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Minerals Yearbook

1971

Volume II

AREA REPORTS: DOMESTIC



Prepared by staff of the

BUREAU OF MINES

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

BUREAU OF MINES • Elburt F. Osborn, Director

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

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

U.S. GOVERNMENT PRINTING OFFICE

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Foreword

This edition of the Minerals Yearbook marks the 90th year in which an annual report on the minerals industry has been published by the Federal Government. This edition provides a statistical record on global mineral industry performance during 1971, and contains sufficient background information to interpret the year's developments. The general content of the individual volumes is as 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 these industries, a statistical summary, and chapters on employment and injuries and on technologic trends.

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, the Commonwealth of Puerto Rico, and the Canal Zone. This volume also has a statistical summary chapter, identical with that in Volume I, and a chapter on employment and injuries.

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

The continuous effort of the Bureau of Mines to improve the value of the Yearbook for its users can be aided by comments and suggestions. Toward that end, the constructive comments and suggestions of readers will be welcomed.

ELBURT F. OSBORN, *Director*

Acknowledgments

The chapters of this volume, except the statistical summary and injury experience and worktime, were prepared by the staffs of the Divisions of Ferrous Metals, Fossil Fuels, Nonferrous Metals, and Nonmetallic Minerals of the Assistant Directorate, Mineral Supply. The injury experience and worktime chapter was prepared in the Health and Safety Activity.

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, and 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: Division of Mines and Geology, California Department of Conservation.
- Connecticut: Connecticut Geological and Natural History Survey.
- Delaware: Delaware Geological Survey.
- Florida: Florida Bureau of Geology.
- Georgia: Earth and Water Division, Georgia Department of Natural Resources.
- 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: Geological Survey of Iowa.
- Kansas: State Geological Survey of Kansas.
- Kentucky: Kentucky Geological Survey.
- Louisiana: Louisiana Geological Survey.
- Maine: Geological Survey of Maine.
- Maryland: Maryland Geological Survey.
- Massachusetts: Department of Public Works, Commonwealth of Massachusetts.
- Michigan: Geological Survey Division, Michigan Department of Natural Resources.
- Minnesota: Minnesota Geological Survey.
- Mississippi: Mississippi Geological, Economic, and Topographical Survey.

ACKNOWLEDGEMENTS

- Missouri: Division of Geological Survey and Water 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.
New Hampshire: New Hampshire Department of Resources and Economic
Development.
New Jersey: Bureau of Geology and Topography, New Jersey Division of
Natural Resources.
New York: New York State Museum and Science Service.
North Carolina: Office of Earth Resources, North Carolina Department of
Natural and Economic Resources.
North Dakota: State Geological Survey of North Dakota.
Oklahoma: Oklahoma Geological Survey.
Pennsylvania: Pennsylvania Bureau of Topographic and Geologic Survey,
Department of Environmental Resources.
Puerto Rico: Mining Commission of Puerto Rico; Economic Development
Administration, Commonwealth of Puerto Rico.
South Carolina: South Carolina Division of Geology, State Development
Board.
South Dakota: South Dakota State Geological Survey.
Tennessee: Division of Geology, Tennessee Department of Conservation.
Texas: Bureau of Economic Geology, University of Texas at Austin.
Utah: Utah Geological and Mineralogical Survey.
Virginia: Virginia Division of Mineral Resources.
Washington: Washington Division of Mines and Geology.
West Virginia: West Virginia Geological and Economic Survey.
Wisconsin: Geological and Natural History Survey of Wisconsin.
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 mineral production in the United States, its island possessions, the Canal Zone, and the Commonwealth of Puerto Rico. Tables showing the principal minerals exported from and imported into the United States, and comparing world and U.S. mineral production also are included. More detailed data are contained in the commodity chapters of volume I and the State chapters of volume II.

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 in the form in which they are first extracted from the ground, but customarily includes for some minerals the product of

auxiliary processing operations at or near mines.

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

The weight or volume units shown are those customarily used in the particular industries producing the commodities. Values shown are in current dollars. No adjustments of the values have been made to compensate for changes in the purchasing power of the dollar.

Table 1.—Value of mineral production ¹ in the United States, by mineral groups
(Millions)

Year	Mineral fuels	Nonmetals (except fuels)	Metals	Total ²
1967	\$16,195	\$5,200	\$2,327	\$23,723
1968	16,820	5,449	2,698	24,966
1969	17,965	5,624	3,333	26,921
1970	20,152	5,711	3,928	29,791
1971	21,258	6,068	3,406	30,732

¹ Revised.

² Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

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

Table 2.—Mineral production in the United States

Mineral	1968		1969		1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
MINERAL FUELS								
Asphalt and related bitumens (native): Bituminous limestone and sandstone and gilsonite.....	1,797,219	\$8,179	1,918,748	\$8,561	1,980,562	\$8,879	1,668,928	\$8,291
Carbon dioxide, natural.....	1,118,027	176	1,194,836	144	1,109,530	191	1,271,996	216
Coal.....	545,245	2,546,340	560,505	2,795,509	602,932	3,772,632	552,192	3,901,496
Bituminous and lignite ²	11,461	97,245	10,473	100,769	9,729	105,341	8,727	103,469
Pennsylvania anthracite.....								
Helium.....	3,788	44,700	3,993	46,843	3,953	46,820	3,988	47,856
Crude.....	1,066	28,355	760	21,599	647	17,405	577	14,559
High purity.....	19,322,493	3,168,698	20,698,240	3,455,615	21,920,642	3,745,680	22,498,012	4,096,550
Natural gas liquids:								
Natural gasoline and cycle products.....	199,049	571,679	201,784	608,084	206,305	608,024	200,181	616,657
thousand 42-gallon barrels.....	351,262	552,335	378,457	498,927	399,611	672,088	417,634	769,397
LP gases.....	619	7,230	566	7,055	526	5,266	417,600	7,011
thousand short tons.....	3,329,042	9,794,826	3,371,751	10,426,680	3,517,450	11,173,726	3,458,914	11,692,938
Petroleum (crude).....								
thousand 42-gallon barrels.....								
Total mineral fuels.....	XX	16,820,000	XX	17,965,000	XX	20,152,000	XX	21,258,000
NONMETALS (EXCEPT FUELS)								
Abrasive stones ¹	3,141	629	3,311	600	3,055	635	2,349	563
Asbestos.....	120,690	10,406	125,936	10,648	125,314	10,806	130,832	12,174
Barite.....	927	18,706	1,077	15,753	894	12,897	895	13,491
Boron minerals.....	963	76,585	1,020	81,261	1,041	86,897	1,047	89,856
Bromine.....	362,452	86,787	391,853	87,990	349,743	86,560	355,946	61,750
Calcium-magnesium chloride.....	W	W	W	W	632,500	15,225	W	W
Cement:								
Portland.....	388,525	1,227,942	400,833	1,284,600	381,001	1,268,718	403,621	1,421,338
Masonry.....	23,167	66,259	23,253	69,106	21,275	67,537	23,860	84,556
Natural and slag.....	86	382	86	382	86	382	86	382
Clays.....	57,348	246,933	58,694	264,415	54,833	267,912	56,666	274,431
Diatomite.....	667,679	8,265	598,482	36,463	597,636	32,649	585,318	34,392
Feldspar.....	252,411	11,656	673,985	8,369	648,276	9,638	663,223	9,969
Fluorspar.....	22,136	182,411	182,587	8,411	268,291	13,923	272,071	17,263
Garnet (abrasive).....	NA	1,922	20,458	1,174	18,337	1,936	18,984	2,589
Gem stones ³	NA	2,487	NA	2,390	9	3,396	NA	2,589
Gypsum.....	10,018	36,775	9,305	38,334	9,436	35,132	10,418	39,057
thousand short tons.....	18,687	249,639	20,209	280,736	19,747	286,155	19,591	308,100
do.....								
Magnesium compounds from sea water and brine (except for metal).....	525,210	49,449	618,762	53,046	707,874	62,434	668,649	62,322

Mica:	125	3,014	133	2,893	119	2,527	127	2,917
Scrap.....	15,000	W	W	3			17,005	7
Sheet.....	427,574	4,221	471,454	5,100	456,134	4,904	432,208	4,941
Perlite.....	41,251	250,692	37,725	208,689	38,739	208,218	38,886	208,828
Phosphate rock.....	2,722	75,664	2,804	73,572	2,729	98,123	2,587	100,527
Potassium salts.....	3,630	5,570	3,609	5,050	r 3,036	r 4,671	3,316	5,064
Pumice.....	872	W	W	W	W	W	7,137	7,137
Pyrites.....	41,274	272,275	44,245	287,680	r 45,896	r 304,759	44,077	308,687
Salt.....	917,468	1,020,107	937,169	1,069,667	948,941	1,115,705	919,593	1,148,969
Sand and gravel.....	2,043	42,104	2,513	50,320	2,688	56,320	2,878	60,774
Sodium carbonate (natural).....	700	12,729	672	12,427	10,982	10,982	688	11,008
Sodium sulfate (natural).....	819,697	1,317,911	862,895	1,454,694	874,512	1,474,917	875,716	1,601,391
Stone 1.....	6,645	268,146	6,551	176,659	6,419	151,779	6,756	118,245
Sulfur:	3	46						
Frash process mines.....	958,262	6,656	1,029,238	7,508	1,027,929	7,773	1,037,287	7,634
Other mines.....	85,634	796	84,673	68,105	68,105	520	75,184	7,198
Talc, soapstone, and pyrophyllite.....	290	5,684	310	6,805	285	6,501	301	
Tripoli.....								
Vermiculite.....								
Value of items that cannot be disclosed: Aplite, brucite, emery, graphite, iodine, kyanite, lithium minerals, magnesite, greensand marl, olivine, staurolite, wollastonite, and values of nonmetal items indicated by symbol W	XX	79,809	XX	46,941	XX	r 33,373	XX	50,289
Total nonmetals.....	XX	r 5,449,000	XX	5,624,000	XX	r 5,711,000	XX	6,068,000

METALS

Antimony ore and concentrate.....	856	W	938	W	1,130	W	1,025	983
Bauxite.....	1,965	23,752	1,843	25,725	2,082	30,070	1,988	28,543
Beryllium.....	168	81	W	W	W	W	W	W
Copper (recoverable content of ores, etc.).....	1,204,621	1,008,195	1,544,579	1,468,400	1,719,657	1,984,484	1,522,183	1,583,071
Gold (recoverable content of ores, etc.).....	1,478,292	58,038	1,783,176	71,944	1,743,322	63,439	1,495,108	61,673
Iron ore, usable (excluding hydroxide iron sinter).....	81,934	836,433	89,854	929,293	87,176	941,739	77,106	891,002
Lead (recoverable content of ores, etc.).....	359,156	94,903	509,013	151,635	571,767	178,609	578,550	159,679
Manganese ore (35 percent or more Mn).....	11,378	W	5,630	157	4,737	W	142	W
Manganiferous ore (5 to 35 percent Mn).....	244,590	W	430,637	W	368,302	W	198,334	W
Mercury.....	28,874	15,464	29,640	14,969	r 27,296	r 11,130	17,627	5,154
Niobium (content of concentrate).....	93,245	151,000	103,009	173,819	110,381	190,077	97,882	164,917
Nickel (content of ore and concentrate).....	17,294	W	17,056	W	15,933	W	17,036	W
Rare-earth metal concentrates.....	W	W	W	W	W	W	17,194	7,538
Silver (recoverable content of ores, etc.).....	32,729	70,191	41,906	75,040	r 45,006	r 79,697	41,564	64,258
Titanium concentrate, ilmenite.....	960,118	19,484	893,034	18,636	920,964	18,626	713,549	15,403
Tungsten ore and concentrate.....	r 9,501	r 20,293	r 8,312	r 18,770	r 9,785	r 23,790	7,173	20,184
Uranium (recoverable content U ₃ O ₈).....	24,139	182,698	23,748	142,161	24,682	149,464	24,520	152,029
Vanadium (recoverable in ore and concentrate).....	6,483	23,143	5,577	26,334	5,319	34,923	5,252	37,690
Zinc (recoverable content of ores, etc.).....	529,446	142,950	563,124	151,512	594,136	163,650	502,543	161,820

See footnotes at end of table.

Table 2.—Mineral production¹ in the United States—Continued.

Mineral	1968		1969		1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS—Continued								
Value of items that cannot be disclosed: Cobalt, columbium-tantalum concentrate (1969), magnesium chloride for magnesium metal, manganese residuum, platinum-group metals (crude), tin (content of concentrates), titanium concentrate (rutile 1968), zircon concentrates, and value of metal items indicated by symbol W.....	XX	51,080	XX	54,180	XX	58,480	XX	51,690
Total metals.....	XX	2,698,000	XX	3,333,000	XX	3,928,000	XX	3,406,000
Grand total mineral production.....	XX	24,966,000	XX	26,921,000	XX	29,791,000	XX	30,782,000

⁰ Estimate. ¹ 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.

² Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

³ Includes a small quantity of anthracite mined in States other than Pennsylvania. In 1971, value excluded that of Arizona, which is withheld to avoid disclosing individual company confidential data; value included with "Nonmetal items that cannot be disclosed."

⁴ Includes abrasives, grinding pebbles, sharpening stones, and tube mill liners.

⁵ Excludes abrasive stones, bituminous limestone, bituminous sandstone, and soapstone, all included elsewhere in table.

⁶ Based on average U.S. Treasury price (\$35.00) Jan. 1, 1968 through March 15, 1968; and Engelhard selling quotations Mar. 20, 1968 through 1971.

Table 3.—Minerals produced in the United States and principal producing States in 1971

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

Table 3.—Minerals produced in the United States and principal producing States in 1971—Continued

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

Table 4.—Value of mineral production in the United States and principal minerals produced in 1971

State	Value (thousands)	Rank	Percent of U.S. total	Principal minerals, in order of value
Alabama	\$291,492	23	.95	Coal, cement, stone, petroleum.
Alaska	333,923	21	1.09	Petroleum, sand and gravel, natural gas, coal.
Arizona	981,020	8	3.19	Copper, molybdenum, cement, sand and gravel.
Arkansas	253,219	27	.82	Petroleum, bromine, stone, natural gas.
California	1,920,648	3	6.25	Petroleum, natural gas, cement, sand and gravel.
Colorado	392,721	18	1.28	Petroleum, molybdenum, coal, sand and gravel.
Connecticut	27,961	46	.09	Stone, sand and gravel, feldspar, lime.
Delaware	2,241	50	.01	Sand and gravel, clays, gem stones.
Florida	343,731	20	1.12	Phosphate rock, stone, cement, sand and gravel.
Georgia	229,397	29	.75	Clays, stone, cement, sand and gravel.
Hawaii	28,107	45	.09	Stone, cement, sand and gravel, pumice.
Idaho	112,280	33	.37	Silver, lead, phosphate rock, zinc, sand and gravel.
Illinois	700,819	11	2.28	Coal, petroleum, stone, sand and gravel.
Indiana	281,565	25	.92	Coal, cement, stone, sand and gravel.
Iowa	127,821	31	.42	Cement, stone, sand and gravel, coal.
Kansas	589,444	15	1.92	Petroleum, natural gas, natural gas liquids, helium.
Kentucky	925,885	9	3.01	Coal, stone, petroleum, natural gas.
Louisiana	5,553,009	2	18.07	Petroleum, natural gas, natural gas liquids, sulfur.
Maine	21,898	47	.07	Cement, sand and gravel, stone, copper.
Maryland	99,429	35	.32	Stone, cement, sand and gravel, coal.
Massachusetts	50,199	43	.16	Stone, sand and gravel, lime, clays.
Michigan	640,636	13	2.08	Iron ore, cement, sand and gravel, copper.
Minnesota	608,776	14	1.98	Iron ore, sand and gravel, stone, cement.
Mississippi	262,393	26	.85	Petroleum, natural gas, sand and gravel, clays.
Missouri	400,089	17	1.30	Lead, cement, stone, iron ore.
Montana	285,073	24	.93	Petroleum, copper, sand and gravel, stone.
Nebraska	74,079	40	.24	Petroleum, cement, sand and gravel, stone.
Nevada	164,774	30	.54	Copper, gold, sand and gravel, diatomite, cement.
New Hampshire	10,284	48	.03	Sand and gravel, stone, gem stones, clays.
New Jersey	98,575	37	.30	Sand and gravel, stone, zinc, magnesium compounds.
New Mexico	1,046,284	7	3.40	Petroleum, natural gas, copper, potassium salts.
New York	298,835	22	.97	Cement, stone, salt, sand and gravel.
North Carolina	112,451	32	.37	Stone, sand and gravel, cement, phosphate rock.
North Dakota	99,901	34	.33	Petroleum, coal, sand and gravel, natural gas.
Ohio	652,151	12	2.12	Coal, stone, lime, cement.
Oklahoma	1,189,516	5	3.87	Petroleum, natural gas, natural gas liquids, stone.
Oregon	77,855	39	.25	Sand and gravel, stone, cement, nickel.
Pennsylvania	1,149,107	6	3.74	Coal, cement, stone, sand and gravel.
Rhode Island	4,299	49	.01	Sand and gravel, stone, gem stones.
South Carolina	66,888	41	.22	Cement, stone, clays, sand and gravel.
South Dakota	62,988	42	.20	Gold, sand and gravel, stone, cement.
Tennessee	239,662	28	.78	Coal, stone, cement, zinc.
Texas	6,807,955	1	22.15	Petroleum, natural gas, natural gas liquids, cement.
Utah	525,700	16	1.71	Copper, petroleum, coal, molybdenum.
Vermont	36,284	44	.12	Stone, asbestos, sand and gravel, talc.
Virginia	385,161	19	1.25	Coal, stone, sand and gravel, cement.
Washington	94,601	36	.31	Sand and gravel, cement, stone, coal.
West Virginia	1,273,960	4	4.15	Coal, natural gas, stone, sand and gravel.
Wisconsin	84,036	38	.27	Sand and gravel, stone, iron ore, cement.
Wyoming	717,937	10	2.34	Petroleum, natural gas, sodium carbonate, uranium.
Total	30,732,000	--	100.00	

Table 5.—Mineral production¹ in the United States, by State

Mineral	1968		1969		1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
ALABAMA								
Cement: ²								
Masonry-----	2,523	\$7,309	2,600	\$8,520	2,402	\$7,601	2,498	\$8,957
Portland-----	15,514	48,147	16,527	51,251	16,053	51,114	12,149	42,251
Clays (bituminous)-----	2,793	6,995	3,097	8,213	2,748	8,213	3,915	10,913
Coal (bituminous)-----	16,440	115,815	17,456	130,405	20,560	166,308	17,944	146,180
Iron ore (taconite)-----	1,151	6,730	1,125	6,435	W	W	415	2,773
Nine-----	773	8,933	747	9,870	749	10,286	761	11,454
Natural gas-----	230	30	180	24	627	87	355	54
Petroleum (crude)-----	7,695	20,985	7,701	20,793	7,263	20,627	7,882	23,496
Sand and gravel-----	8,140	9,130	8,823	9,427	6,725	8,144	6,574	7,513
Stone-----	20,643	33,847	19,854	37,512	4,199,982	37,166	17,773	34,413
Value of items that cannot be disclosed: Asphalt (native), bauxite, cement (slag), natural gas liquids (1969-71), mica (crap), phosphate rock (1969-70), salt, stone (dimension) (1970-71), talc and values indicated by symbol W-----								
Total-----	XX	2,300	XX	3,416	XX	13,699	XX	7,758
	XX	259,621	XX	284,796	XX	323,245	XX	291,482
ALASKA								
Antimony ore and concentrate short tons, antimony content-----	3	W	12	13	63	109	102	1,075
Barite-----	91	W	667	4,366	549	4,059	698	5,717
Coal (bituminous)-----	750	4,502	21,227	881	34,776	1,265	18,012	537
Gold (recoverable content of ores, etc.) ³ -----	21,262	W	2	1	111,576	27,445	121,613	28,945
Lead (recoverable content of ores, etc.)-----	17,343	4,388	50,864	12,665	83,616	251,684	79,494	257,562
Natural gas-----	66,204	186,695	16,205	18,615	25,825	41,082	23,617	32,806
Petroleum (crude)-----	18,013	20,866	16,205	18,615	25,825	41,082	23,617	32,806
Sand and gravel-----								
Silver (recoverable content of ores, etc.)-----	4	8	2	4	2	4	1	1
Stone-----	W	W	1,954	8,902	6,470	10,014	2,655	5,065
Tin-----	W	W	W	W	W	W	17	47
Value of items that cannot be disclosed: Copper (1968), gem stones LP gases (1969-71), platinum-group metals, uranium (1971), and values indicated by symbol W-----								
Total-----	XX	4,923	XX	2,865	XX	1,761	XX	2,174
	XX	221,717	XX	257,776	XX	338,271	XX	333,923

ARIZONA		77	347	120	394	199	454	3 119	3 84
Clays.....	thousand short tons	627,961	525,566	801,963	761,840	917,918	1,069,277	820,171	852,978
Coal (bituminous).....	do.	NA	NA	NA	NA	NA	NA	NA	160
Copper.....	short tons	95,999	3,769	110,878	4,603	109,853	3,998	94,083	3,879
Diatomite.....	do.	65	1,600	83	4,424	98	358	W	W
Gem stones.....	trov ounces	1,704	450	217	1,126	62	1,186	15,859	287
Gold (recoverable content of ores, etc.) ⁵	thousand short tons	192	4,561	263	5,074	309	4,528	296	4,474
Gypsum.....	thousand short tons	12,127	19,207	12,699	20,947	15,672	26,700	22,684	39,872
Helium, high purity.....	thousand cubic feet	8,881	1,136	199	1,101	1,188	868	1,553	153
Iron ore (usable).....	million cubic feet	3,870	9,606	2,483	7,056	1,784	5,281	1,236	3,918
Lead (recoverable content of ores, etc.).....	thousand 42-gallon barrels	1,033	974	910	1,824	949	627	625	625
Lime.....	thousand short tons	13,981	14,423	16,744	18,224	17,822	19,804	19,791	24,391
Mercury.....	76-pound flasks	4,958	10,633	6,141	10,997	7,330	12,981	6,170	9,538
Molybdenum (content of concentrate).....	thousand ounces	3,293	6,239	2,827	5,812	3,511	7,094	2,873	5,848
Natural gas (marketed).....	thousand short tons	1	3	1	2	W	W	W	W
Natural gas (crude).....	thousand short tons	5,441	1,469	9,039	2,639	9,618	2,947	7,761	2,499
Petroleum (crude).....	thousand short tons	XX	16,253	XX	18,957	XX	21,105	XX	32,364
Quartzite.....	thousand short tons	XX	617,541	XX	859,462	XX	1,166,767	XX	981,020
Sand and gravel.....	thousand short tons	XX	198,723	XX	208,126	XX	225,625	XX	263,219
Silver (recoverable content of ores, etc.).....	thousand short tons	XX	24,655	XX	28,465	XX	63,331	XX	79,703
Stone.....	thousand short tons	XX	198,723	XX	208,126	XX	225,625	XX	263,219
Tungsten ore and concentrate.....	thousand short tons	XX	198,723	XX	208,126	XX	225,625	XX	263,219
Uranium (recoverable content U ₃ O ₈).....	thousand short tons	XX	198,723	XX	208,126	XX	225,625	XX	263,219
Zinc (recoverable content of ores, etc.).....	thousand short tons	XX	198,723	XX	208,126	XX	225,625	XX	263,219
Value of items that cannot be disclosed: Asbestos, cement, clays (beaumont, 1971), feldspar, fluorspar (1971), mica (scrap) perlite, pyrites, vanadium (1968-69), vermiculite (1968-69) and values indicated by symbol W.									
Total.....									

ARKANSAS		166	3,839	210	4,616	168	3,721	W	W
Barite.....	thousand short tons	1,582	23,058	1,755	24,706	1,869	26,293	1,781	24,979
Bauxite.....	thousand long tons, dried equivalent	95,499	20,790	145,100	28,287	W	W	W	W
Bromine and bromine in compounds.....	thousand pounds	919	2,134	992	2,426	1,014	2,902	3 936	3 1,499
Clays.....	thousand short tons	211	1,576	238	1,802	268	2,225	276	2,848
Coal (bituminous).....	do.	NA	30	NA	24	NA	25	NA	30
Gem stones.....	thousand short tons	206	3,058	184	2,748	186	2,680	157	2,313
Natural gas.....	thousand short tons	156,627	24,456	169,257	26,743	181,351	29,560	172,154	29,426
Natural gas liquids.....	million cubic feet	758	2,192	692	2,049	643	1,824	517	1,686
Natural gasoline and cycle products.....	thousand 42-gallon barrels	1,435	2,899	1,279	2,098	1,205	2,482	1,035	2,650
LP gases.....	do.	19,464	53,137	18,049	51,079	18,095	51,760	18,263	56,305
Petroleum (crude).....	thousand short tons	12,997	14,643	12,674	14,949	13,801	16,086	11,630	16,508
Sand and gravel.....	thousand short tons	16,322	22,256	16,463	23,134	15,284	22,786	17,116	35,677
Stone.....	thousand short tons	XX	24,655	XX	28,465	XX	63,331	XX	79,703
Value of items that cannot be disclosed: Abrasive stones, cement, clays, gypsum, mercury (1970-71), soapstone, tripoli, vanadium (1971), and values indicated by symbol W.									
Total.....									

See footnotes at end of table.

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

Mineral	1968		1969		1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
CALIFORNIA								
Antimony ore and concentrate								
Asbestos	75,592	\$6,139	75,823	\$5,956	78,966	6,832	87,144	\$7,806
Boron minerals	963	76,535	1,020	81,261	1,041	86,827	1,047	89,856
Cement	47,595	151,961	50,610	170,612	49,499	173,126	48,493	159,921
Clays	2,755	6,630	2,993	7,443	2,824	6,506	3,222	7,103
Copper (recoverable content of ores, etc.)	1,182	989	1,129	1,073	2,803	2,663	515	536
Gem stones	NA	200	NA	200	200	200	NA	NA
Gold (recoverable content of ores, etc.)	15,682	616	7,904	323	4,999	182	2,966	123
Gypsum	1,860	3,603	1,210	3,339	1,132	3,271	1,852	3,884
Lead (recoverable content of ores, etc.)	4,001	1,057	2,518	8,750	1,772	553	2,284	634
Lime	563	9,301	588	9,666	572	9,911	630	10,846
Magnesium compounds from seawater and bitterns (partly estimated)	81,622	7,229	76,220	7,143	73,726	7,489	152,918	16,836
Mercury	21,417	11,470	18,480	9,333	18,598	7,582	13,233	3,869
Natural gas liquids:	714,893	221,077	677,689	207,440	649,117	208,367	612,629	199,717
75-pound flasks								
million cubic feet								
Natural gasoline and cycle products								
thousand 42-gallon barrels	13,403	42,963	12,954	39,944	11,993	38,478	11,045	35,545
LP gases	8,589	18,749	8,233	17,646	7,051	16,006	6,755	16,482
do	W	W	W	W	W	W	W	W
thousand short tons	80	105	11	106	10	12	12	12
Petite	8,806	80	11,419	105	W	W	W	W
Petroleum (crude)	375,496	883,644	375,291	920,060	372,191	945,365	358,484	975,076
Pumice	1,776	1,312	1,866	1,229	1,656	1,832	699	1,179
Salt	1,901	1,901	1,895	1,895	1,656	1,150,053	1,887	21,142
Sand and gravel	124,655	153,860	124,718	155,883	140,259	174,221	115,463	157,683
Silver (recoverable content of ores, etc.)	598	1,282	492	881	451	799	444	686
thousand troy ounces	36,125	52,671	38,083	57,757	46,399	66,950	43,336	86,255
Stone	3,125	46	3,125	46	3,125	46	3,125	46
Tals, soapstone, and pyrophyllite	165,398	2,075	145,158	2,829	184,660	2,545	153,227	2,084
Zinc (recoverable content of ores, etc.)	8,525	952	8,327	971	8,514	1,077	3,003	967
Value of items that cannot be disclosed: Barite, bromine, calcium-magnesium chloride, carbon dioxide, coal (lignite), distamite, feldspar, iron ore, lithium minerals, scrap mica (1968), polybismuth, phosphate rock (1968-70), platinum, group, metals (crude) (1968), potassium salts, rare-earth metal concentrates, sodium carbonates and sulfates, tungsten concentrate, wollastonite, and values indicated by symbol W.								
Total	XX	r 146,009	XX	r 143,208	XX	r 125,337	XX	112,218
	XX	r 1,799,950	XX	r 1,844,663	XX	r 1,899,682	XX	1,920,648

COLORADO		CONNECTICUT	
	W	W	W
Beryllium concentrate.....	200,657	175,787	46
Carbon dioxide, natural.....	34	30	W
Clays.....	1,222	637	W
Coal (bituminous).....	26,785	5,630	625
Coal (recoverable content of ores, etc.).....	2,888	3,745	38,813
Copper (recoverable content of ores, etc.).....	3,451	3,421	5,938
Feldspar.....	W	358	4,096
Gem stones.....	NA	122	NA
Gold (recoverable content of ores, etc.).....	22,688	1,070	125
Gravel.....	98	339	42,031
Iron (recoverable content of ores, etc.).....	19,778	6,484	1,784
Lead (recoverable content of ores, etc.).....	2,275	127	25,746
Lime.....	125	119	7,106
Mica, sheet.....	61,684	62,411	193
Molybdenum (content of concentrate).....	121,424	118,754	8,309
Natural gas.....	16,892	105,804	4
Natural gas liquids.....	1,289	745	16,982
Natural gasoline.....	3,838	2,798	108,537
LP gases.....	1,987	1,642	1,987
Peat.....	28	160	929
Petroleum (crude).....	31,987	88,277	1,653
Pumice.....	28	234	8,190
Pyrites.....	23	50	156
Sand and gravel.....	28,131	22,261	27,391
Silver (recoverable content of ores, etc.).....	1,646	4,658	92,855
Stone.....	2,711	5,079	27,000
Tin (content of concentrate).....	1,638	119	30,155
Tungsten concentrate.....	2,706	1,941	3,390
Uranium (recoverable content U ₃ O ₈).....	3,492	2,735	5,241
Zinc (recoverable content of ores, etc.).....	50,258	16,985	7,983
Value of items that cannot be disclosed: Cement, fluorspar, iron ore, scrap mica (1970-71), perlite, rare-earth metal concentrates (1968-69), salt, and values indicated by symbol W.....	XX	56,694	XX
Total.....	XX	32,745	XX
	XX	368,494	XX
	XX	169,060	XX
	XX	392,721	XX

CONNECTICUT		CONNECTICUT	
	W	W	W
Clays.....	195	197	386
Gem stones.....	NA	8	174
Iron, scrap.....	8	NA	15
Sand and gravel.....	9,821	10,869	3
Stone.....	6,383	8,867	6,921
Value of items that cannot be disclosed: Feldspar, lime, and scrap mica.....	XX	1,784	XX
Total.....	XX	27,767	XX
	XX	28,888	XX
	XX	1,872	XX
	XX	27,961	XX

See footnotes at end of table.

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

Mineral	1968		1969		1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
DELAWARE								
Clays.....	12	\$12	11	\$11	11	\$11	14	\$8
..... thousand short tons.....	NA	1	NA	1	NA	2	NA	2
Gem stones.....	1,596	1,483	2,257	2,074	1,565	1,608	2,205	2,281
Sand and gravel.....	200	500	--	--	--	--	--	--
Stone.....	XX	1,996	XX	2,086	XX	1,615	XX	2,241
Total.....	XX	1,996	XX	2,086	XX	1,615	XX	2,241
FLORIDA								
Cement:								
Masonry.....	W	W	W	W	W	W	W	4,877
..... thousand 280-pound barrels.....	808	11,689	907	13,627	872	12,661	11,581	48,970
Portland.....	125	2,059	182	2,712	167	2,810	159	12,884
..... thousand short tons.....	108	16	8	50	8	50	908	2,270
..... million cubic feet.....	1,474	277	55	359	46	304	57	412
Peat.....	1,474	W	1,731	W	2,999	W	5,347	W
..... thousand 42-gallon barrels.....	7,765	7,967	14,409	13,988	12,482	12,254	23,228	18,886
Sand and gravel.....	36,682	46,563	42,332	56,811	43,089	61,302	42,816	64,332
Stone ¹	XX	236,042	XX	208,071	XX	210,711	XX	190,242
Total.....	XX	304,623	XX	295,376	XX	300,042	XX	343,731
GEORGIA								
Barite.....	140	2,874	124	3,116	W	W	W	W
Cement:								
Masonry.....	W	W	W	W	W	W	W	1,470
..... thousand 280-pound barrels.....	5,111	88,682	5,670	98,462	5,684	110,149	6,458	22,470
Portland.....	1,119	1,119	241	1,388	248	1,467	5,791	119,096
..... thousand long tons, gross weight.....	W	W	W	W	W	W	W	13
Peat.....	3,803	4,814	3,824	4,709	3,667	4,437	3,697	5,810
Sand and gravel.....	26,903	56,177	27,755	59,451	26,635	59,200	30,669	69,897
Stone.....	45,600	288	47,790	301	45,900	289	58,000	334
Talc.....	XX	19,686	XX	23,525	XX	27,683	XX	10,807
Total.....	XX	173,090	XX	190,902	XX	203,225	XX	229,897

Value of items that cannot be disclosed: Kaolin (1971), kyanite, manganese compounds, natural gas liquids, phosphate rock, rare-earth metal concentrates (1968), staurolite, stone (dimension limestone 1968-70), titanium concentrate, zircon concentrate, and values indicated by symbol W.

Value of items that cannot be disclosed: Bauxite, fire clay (1971), feldspar, kyanite, scrap mica, rare-earth metal concentrates, titanium concentrate, zircon concentrates, and values indicated by symbol W.

HAWAII		IDAHO		ILLINOIS	
Cement:					
Portland	9,254	2,075	10,544	77	366
Masonry	4	2	2,105	2	9,968
Clays	3	5	287	9	11
Lime	8	268	388	8	228
Pumice, pumicite, and volcanic ash	408	724	850	289	779
Sand and gravel	546	1,653	1,816	552	836
Stone	5,211	11,273	16,059	4,632	15,588
Value of items that cannot be disclosed: Gem stones, salt, and value of items indicated by symbol W	XX	49	41	XX	132
Total	XX	23,225	29,539	XX	28,965

IDAHO		ILLINOIS	
Anthony ore and concentrate, short tons, antimony content	853	W	993
Clays	12	14	13
Copper (recoverable content of ores, etc.)	3,525	2,950	3,612
Gen stones	NA	200	NA
Gold (recoverable content of ores, etc.)	3,277	127	3,403
Gypsum	3	13	141
Lead (recoverable content of ores, etc.)	54,790	14,478	61,211
Mercury	W	W	1,012
Beats	W	W	423
Phosphate rock	3,879	22,721	19,541
Pumice	185	259	511
Sand and gravel	8,224	9,133	7,588
Silver (recoverable content of ores, etc.)	15,959	34,225	33,897
Tungsten concentrate	2,195	5,209	6,426
Zinc (recoverable content of ores, etc.)	57,248	15,457	63
Value of items that cannot be disclosed: Cement, clays, (fire clay and kaolin), fluorspar (1971), abrasive garnet, iron ore, lime, perlite, stone (dimension 1970), vanadium, and values indicated by symbol W	XX	9,467	30,453
Total	XX	114,253	118,309

ILLINOIS		IDAHO		HAWAII	
Cement:					
Portland	32,475	8,720	29,996	7,946	25,252
Masonry	2,602	608	2,187	508	1,874
Clays	2,327	1,863	4,321	1,676	3,862
Coal (bituminous)	62,441	250,685	64,722	65,119	320,705
Fluorspar	188,325	9,134	88,480	148,208	58,402
Lead (recoverable content of ores, etc.)	1,467	388	4,676	188,051	188,051
Natural gas	4,380	552	8,791	1,582	8,742
Petroleum	62	8,800	4,850	4,850	1,238
Petroleum (crude)	56,391	67	711	72	488
Sand and gravel	45,609	178,120	161,302	43,747	39,084
Stone	55,858	80,188	56,688	48,926	60,155
Value of items that cannot be disclosed: Gem stones, salt, and value of items indicated by symbol W	XX	80,188	81,318	55,776	86,502
Total	XX	114,253	118,309	XX	112,230

See footnotes at end of table.

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

Mineral	1968		1969		1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Zinc (recoverable content of ores, etc.) ⁷.....short tons.	18,182	\$4,909	18,765	\$4,019	16,797	\$5,146	12,706	\$4,091
Value of items that cannot be disclosed: Clay (fuller's earth, 1968-70), gem stones, lime, natural gas liquids, silver (1971), and tripoli.....	XX	35,372	XX	38,916	XX	32,619	XX	38,880
Total.....	XX	647,543	XX	659,815	XX	688,697	XX	700,819
ILLINOIS—Continued								
INDIANA								
Abrasive stones.....short tons	5	16	5	17	W	W	W	W
Cement ².....thousand 376-pound barrels	14,774	48,096	14,497	45,264	12,432	41,810	11,924	32,904
Clay (bituminous).....thousand short tons	1,550	2,355	1,433	2,264	1,389	2,139	1,296	1,904
Coal (bituminous).....do.	18,486	71,680	20,086	82,902	22,263	102,341	21,587	110,796
Natural gas.....million cubic feet	284	55	171	40	169	56	67	587
Petroleum (crude).....thousand short tons	39	557	38	515	W	W	60	60
Sand and gravel.....thousand 42-gallon barrels	8,692	26,511	7,841	25,013	7,437	28,958	6,653	22,770
Stone.....thousand short tons	25,774	26,160	26,218	27,438	23,476	25,796	24,982	29,094
Value of items that cannot be disclosed: Cement (masonry), Gypsum, lime, and values indicated by symbol W.....	26,307	46,790	25,559	45,400	25,813	45,215	26,283	48,213
Total.....	XX	13,166	XX	13,018	XX	14,461	XX	68,251
IOWA								
Total.....	XX	235,386	XX	241,871	XX	255,786	XX	281,565
KANSAS								
Cement: Portland.....thousand 376-pound barrels	13,900	47,275	14,084	47,265	12,744	45,432	12,726	47,925
Masonry.....thousand 280-pound barrels	624	1,986	1,912	1,912	520	1,719	478	1,719
Clays.....thousand short tons	1,264	1,747	1,199	1,660	1,181	1,823	1,028	1,702
Gypsum.....do.	1,351	5,838	1,169	3,392	987	4,293	1,154	4,460
Sand and gravel.....do.	16,332	15,192	18,391	17,867	21,068	20,942	18,273	20,530
Stone.....do.	26,150	40,397	26,233	40,895	25,305	41,119	25,389	44,977
Value of items that cannot be disclosed: Clay (fire, 1971), gem stones, lime, peat, and dimension stone (1971).....	XX	1,573	XX	1,665	XX	1,766	XX	1,899
Total.....	XX	117,297	XX	119,980	XX	120,822	XX	127,821
KANSAS								
Cement: Portland.....thousand 376-pound barrels	9,680	29,898	9,764	29,365	9,197	28,177	9,208	29,961
Masonry.....thousand 280-pound barrels	383	1,177	348	1,023	323	1,029	355	1,232
Clays.....thousand short tons	932	1,433	1,433	1,070	713	1,946	879	1,151
Coal (bituminous).....do.	1,263	6,526	1,313	7,108	1,627	9,102	1,151	6,579

Table 5.—Mineral production¹ in the United States, by State—Continued

Mineral	1968		1969		1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
MAINE								
Clays ²	42	\$65	42	\$56	41	\$55	42	\$56
Copper.....	W	W	W	W	2,703	8,129	2,510	8,129
Gem stones.....	NA	35	NA	35	NA	33	NA	40
Sand and gravel.....	11,866	5,978	11,275	6,026	12,971	6,888	8,262	5,881
Silver.....	W	W	W	W	63	117	117	64
Stone.....	1,187	3,205	1,101	3,798	9,114	2,792	1,188	2,913
Zinc ³	W	W	W	W	W	W	5,880	1,884
Value of items that cannot be disclosed: Beryllium (1969-70), cement, clays, feldspar (1968-70), peat, and values indicated by symbol W.....	XX	8,527	XX	10,273	XX	10,778	XX	8,450
Total.....	XX	17,810	XX	20,188	XX	23,780	XX	21,898
MARYLAND								
Clays ²	⁵ 1,078	⁵ 1,262	⁵ 1,182	⁵ 1,369	⁵ 1,129	⁵ 1,433	⁵ 1,097	⁵ 1,558
Coal (bituminous).....	1,447	5,318	1,368	5,251	1,615	8,068	1,644	10,274
do.....	NA	3	NA	3	NA	8	NA	8
Gem stones.....	864	221	813	202	978	247	214	89
Natural gas.....	6	94	4	78	4	47	3	52
Peat.....	11,719	17,187	14,280	21,226	12,951	20,434	12,842	23,201
Sand and gravel.....	18,344	26,606	15,067	30,504	16,015	32,783	15,912	34,770
do.....	W	W	W	W	W	W	W	W
Stone.....	XX	21,198	XX	24,794	XX	25,231	XX	29,527
Value of items that cannot be disclosed: Cement, selected clays, diatomite (1969), lime, greensand marl, potassium salts (1968-70), and talc and soapstone.....	XX	71,844	XX	83,483	XX	88,216	XX	99,429
Total.....	XX	117,844	XX	131,483	XX	141,216	XX	151,429
MASSACHUSETTS								
Clays.....	257	314	332	624	284	582	186	377
Gem stones.....	NA	2	NA	2	NA	2	NA	W
Lime.....	198	3,850	199	8,718	W	W	W	W
Peat.....	17,799	20,106	19,485	22,950	17,925	22,244	17,343	23,058
Sand and gravel.....	6,917	19,501	7,847	22,521	8,186	24,349	7,816	23,582
do.....	W	W	W	W	W	W	W	W
Stone.....	XX	37	XX	28	XX	3,183	XX	3,150
Value of items that cannot be disclosed: Nonmetals and values indicated by symbol W.....	XX	43,340	XX	49,843	XX	50,360	XX	50,199
Total.....	XX	88,344	XX	100,843	XX	104,360	XX	107,199

MICHIGAN											
Cement:											
Portland.....	31,375	99,158	30,373	98,425	29,813	101,019	32,489	104,665			
Masonry.....	2,006	5,527	1,904	5,473	1,519	5,253	1,704	5,972			
Clays.....	2,599	2,906	2,667	3,067	2,480	2,887	2,458	3,966			
Copper (recoverable content of ores, etc.).....	74,805	62,607	75,226	71,516	67,543	77,945	67,005	58,245			
Gypsum.....	1,405	5,196	1,327	5,384	1,312	5,061	5,493	5,535			
Iron ore (usable).....	12,699	148,890	14,058	169,756	13,100	168,958	11,893	169,394			
Lime.....	1,630	19,870	1,589	20,372	1,588	21,855	1,444	20,849			
Magnesium compounds from sea water and brine (except for metal).....	266,406	25,087	321,191	30,343	411,911	38,050	272,918	27,777			
Natural gas liquids:	40,480	10,160	36,163	9,294	38,851	10,373	25,662	6,776			
Natural gasoline.....	1,066	3,177	921	2,481	1,611	2,764	553	1,513			
LP gases.....	1,384	3,432	1,197	2,561	1,176	2,764	975	2,623			
Peat.....	2,388	2,919	1,866	2,724	1,896	1,896	2,022	2,497			
Petroleum (crude).....	12,974	38,287	12,213	37,494	11,683	36,246	11,893	38,859			
Salt.....	4,893	44,481	4,899	45,961	4,458	49,963	4,458	49,007			
Sand and gravel.....	56,663	54,979	58,092	58,968	53,092	54,646	56,613	62,898			
Silver (recoverable content of ores, etc.).....	473	1,014	1,009	1,807	892	1,579	670	1,036			
Stone.....	37,279	41,092	39,186	43,572	41,887	49,501	40,705	49,240			
Value of items that cannot be disclosed: Bromine, calcium magnesium chloride, gem stones, iodine, and potassium salts (1968-70).....	XX	XX	XX	58,818	XX	41,622	XX	XX			
Total.....	XX	627,075	XX	667,986	XX	670,729	XX	640,636			

MINNESOTA											
Clays.....	² 240	³ 359	² 275	³ 412	227	335	228	335			
Iron ore (usable).....	51,275	508,814	56,957	570,446	54,791	571,488	49,054	547,607			
Manganiferous ore (5 to 35 percent Mn).....	191,846	W	381,491	W	321,436	W	169,732	W			
Peat.....	6	96	12	249	14	335	11	335			
Sand and gravel.....	44,674	36,414	48,121	40,191	46,851	38,802	44,916	37,645			
Stone.....	4,427	13,045	5,035	14,253	4,579	12,311	5,838	14,846			
Value of items that cannot be disclosed: Abrasive stones, cement, fire clay (1968-69), gem stones, lime, and values indicated by symbol W.....	XX	8,699	XX	10,085	XX	9,735	XX	8,843			
Total.....	XX	567,427	XX	635,696	XX	633,006	XX	608,776			

MISSISSIPPI											
Clays.....	1,693	9,075	1,703	8,660	1,553	8,062	2,278	8,501			
Natural gas liquids:	135,051	22,601	131,284	23,097	126,031	23,190	118,805	24,830			
Natural gasoline and cycle products:											
LP gases.....	459	1,277	565	1,572	544	1,465	W	W			
Petroleum (crude).....	518	958	799	799	964	964	W	W			
Sand and gravel.....	58,708	164,396	64,283	187,514	65,119	194,706	64,066	201,808			
Stone.....	11,980	12,669	11,484	12,263	10,859	11,950	11,289	13,526			
Value of items that cannot be disclosed:	747	883	W	W	W	W	848	988			

See footnotes at end of table.

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

Mineral	1968		1969		1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
MISSISSIPPI—Continued								
Value of items that cannot be disclosed: Cement, lime, magnesium compounds, and values indicated by symbol W-----								
Total.....	XX	\$9,146	XX	\$9,279	XX	\$9,636	XX	\$12,790
	XX	220,955	XX	243,184	XX	249,973	XX	262,393
MISSOURI								
Barite.....	284	4,102	304	4,220	280	3,555	282	3,606
Cement:								
Portland.....	20,081	71,206	21,325	74,368	21,224	64,261	24,017	77,568
Masonry.....	4,405	1,312	4,427	1,319	4,022	1,284	4,518	1,629
Clays.....	2,433	6,158	3,251	6,405	3,247	6,480	3,284	7,454
Coal (bituminous).....	5,205	18,480	5,301	14,233	4,447	19,526	4,036	19,670
Copper (recoverable content of ores, etc.).....	5,494	12,684	12,684	12,039	12,134	14,003	8,445	8,788
Iron ore (usable).....	1,648	23,585	2,622	35,826	2,612	38,100	2,727	8,779
Lead (recoverable content of ores, etc.).....	212,107	56,130	355,432	105,839	421,764	131,751	429,622	118,579
Natural gas.....	107	14	126	17	87	21	66	5
Petroleum (crude).....	W	W	67	W	66	W	W	W
Sand and gravel.....	10,649	14,204	10,940	14,574	12,446	15,379	10,827	15,109
Silver (recoverable content of ores, etc.).....	341	731	1,442	2,582	1,817	3,218	1,661	2,568
Stone.....	38,988	58,743	41,977	63,251	39,726	41,099	41,099	464,772
Zinc (recoverable content of ores, etc.).....	12,301	8,321	41,099	12,001	50,721	15,540	48,215	15,525
Value of items that cannot be disclosed: Native asphalt, lime, and values indicated by symbol W-----	XX	18,624	XX	20,458	XX	22,643	XX	64,821
Total.....	XX	276,238	XX	367,232	XX	392,996	XX	400,089
MONTANA								
Antimony.....								
Clays.....	30	34	34	63	341	W	185	81
Coal (bituminous and lignite).....	519	1,214	1,080	2,199	3,447	6,394	3,264	12,817
Copper (recoverable content of ores, etc.).....	69,480	58,151	103,314	98,219	120,412	138,955	7,064	92,125
Gem stones.....	NA	109	NA	109	NA	114	NA	NA
Gold (recoverable content of ores, etc.).....	13,365	525	24,189	1,004	22,456	817	15,613	644
Iron ore (usable).....	W	W	13	14	W	W	W	W
Lead (recoverable content of ores, etc.).....	1,870	494	1,768	522	996	311	615	169
Lime.....	179	2,005	255	2,737	208	W	199	2,416
Manganese ore and concentrate (35 percent or more Mn).....	4,649	213	775	26	512	W	142	W
Manganiferous ore (5 to 35 percent Mn).....	2,063	22	41,229	4,205	42,705	4,899	32,720	3,959
Natural gas.....	19,313	1,757	43,954	118,359	37,879	105,403	34,599	104,123
Petroleum (crude).....	48,460	124,488	43,827	102	---	---	---	---
Fumice.....	98	827	184	102	---	---	---	---

Sand and gravel.....do.....	8,762	7,754	16,595	14,888	19,275	20,249	15,781	25,207
Silver (recoverable content of ores, etc.) thousand troy ounces.....	2,183	4,574	3,429	6,141	4,304	7,622	2,748	4,248
Stone.....do.....	3,314	4,878	7,667	10,579	6,501	46,896	W	W
Tungsten ore and concentrate short tons, 60-percent WO ₃ basis.....do.....	3,778	1,020	6,143	1,794	9	23	W	W
Zinc (recoverable content of ores, etc.) thousand short tons.....do.....	3,778	1,020	6,143	1,794	9	23	W	W
Value of items that cannot be disclosed: Cement, clays (ben-tonite 1968-70 and fire clay 1971), fluorspar, gypsum, natural gas liquids, peat, phosphate rock, stone (dimension, 1970), talc, vermiculite and values indicated by symbol W.....	XX	20,566	XX	22,189	XX	21,321	XX	37,387
Total.....	XX	228,131	XX	282,631	XX	313,016	XX	285,073

NEBRASKA

Clays.....do.....	148	206	149	223	90	147	69	82
Gem stones.....do.....	NA	4	NA	5	NA	5	NA	10
Lime.....do.....	28	W	35	W	27	W	29	W
Natural gas (marketed).....do.....	8,129	1,423	6,989	1,209	5,991	1,024	3,496	612
Natural gas liquids:.....do.....								
Natural gasoline.....do.....	163	456	128	387	W	W	W	W
LP gases.....do.....	451	911	408	738	365	858	W	W
Petroleum (crude).....do.....	18,183	36,781	12,106	36,075	11,451	35,884	10,062	34,010
Sand and gravel.....do.....	12,742	12,946	12,758	13,592	12,232	12,974	13,224	13,626
Stone.....do.....	4,416	7,435	4,665	9,494	4,265	7,878	4,174	7,892
Value of items that cannot be disclosed: Cement, pumice, and values indicated by symbol W.....	XX	14,446	XX	16,307	XX	14,887	XX	17,847
Total.....	XX	74,608	XX	78,080	XX	72,657	XX	74,079

NEVADA

Antimony ore and concentrate short tons, antimony content.....do.....	216	1,511	W	2,275	W	1,455	W	W
Barite.....do.....	216	64,623	320	99,749	192	123,118	192	1,490
Copper (recoverable content of ores, etc.) thousand short tons.....do.....	77,213	100	104,924	100	106,688	100	96,928	100,806
Gem stones.....do.....	317,382	12,460	456,294	18,941	NA	100	NA	105
Gold (recoverable content of ores, etc.) ^s.....do.....	569	1,534	521	1,550	480,144	1,457	374,878	15,464
Gypsum.....do.....	582	2,917	W	575	W	W	W	2,372
Iron ore (usable).....do.....	863	228	1,420	364	114	114	111	30
Lead (recoverable content of ores, etc.) ^s.....do.....	4,780	2,560	8,165	4,124	4,909	2,001	1,589	465
Perlite.....do.....	9,315	79	8,998	77	8,470	73	9,600	114
Pumice.....do.....	271	W	223	W	149	W	113	W
Petroleum (crude).....do.....	62	144	83	188	80	191	112	232
Sand and gravel.....do.....	7,812	10,442	8,447	10,834	8,574	9,819	9,379	12,225
Silver (recoverable content of ores, etc.) thousand short tons.....do.....	645	1,384	884	1,588	718	1,271	601	980
Stone.....do.....	1,325	2,041	1,494	2,433	1,860	2,722	2,531	3,800
Talc and soapstone.....do.....	3,029	38	6,434	81	W	W	W	W
Tungsten ore and concentrate short tons, 60-percent WO ₃ basis.....do.....	2,105	58	34	69	122	306	33	88
Zinc (recoverable content of ores, etc.) ^s.....do.....	2,104	568	941	275	127	39	71	23

See footnotes at end of table.

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

Mineral	1968		1969		1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NEVADA—Continued								
Total.....	XX	\$119,354	XX	\$125,594	XX	\$126,207	XX	\$126,680
	XX	120,041	XX	168,296	XX	186,945	XX	164,774
NEW HAMPSHIRE								
Clays.....	41	41	44	40	40	32	37	84
Gem stones.....	W	W	W	W	W	W	W	W
Sand and gravel.....	7,742	5,698	6,310	5,149	6,529	4,753	8,404	6,777
Stone.....	383	3,377	320	2,888	W	7,845	429	8,433
Value of items that cannot be disclosed: Feldspar (1968-69), mica scrap (1969-70), and values indicated by symbol W.....	XX	50	XX	43	XX	8,100	--	--
Total.....	XX	9,166	XX	8,120	XX	8,730	XX	10,284
NEW JERSEY								
Clays.....	873	1,008	327	1,123	262	990	201	864
Gem stones.....	NA	10	NA	10	NA	10	NA	15
Peat.....	56	621	46	551	45	557	46	526
Sand and gravel.....	20,306	33,570	20,325	33,977	16,732	31,571	18,511	38,279
Stone.....	13,150	30,343	15,162	34,934	15,160	40,567	13,469	486,057
Zinc (recoverable content of ores, etc.).....	25,668	6,930	25,076	7,322	23,683	8,738	29,977	9,653
Value of items that cannot be disclosed: Lime, magnesium compounds, manganese residuum, greensand marl, stone, dimension (1970-71), and titanium concentrate.....	XX	4,984	XX	6,122	XX	6,798	XX	8,181
Total.....	XX	77,466	XX	83,139	XX	89,281	XX	99,575
NEW MEXICO								
Carbon dioxide, natural.....	749,364	52	902,186	69	W	W	W	W
Clays.....	66	89	70	89	67	91	87	114
Coal (bituminous).....	3,429	13,507	4,471	16,376	7,361	21,249	8,175	26,657
Copper (recoverable content of ores, etc.).....	90,769	75,968	119,956	114,040	166,278	191,385	157,419	163,715
Feldspar.....	98	W	W	W	W	W	W	W
Gem stones.....	NA	59	NA	60	NA	60	NA	65
Gold (recoverable content of ores, etc.).....	6,630	260	8,952	372	8,719	317	10,681	441
Gypsum.....	146	649	141	526	W	W	W	W
Helium:								
Crude.....	39	1,355	13	260	1	18	W	W
High purity.....	17	113	W	W	W	6	W	W
Iron ore (usable).....					(⁹)			

Lead (recoverable content of ores, etc.).....	360	2,368	705	3,550	1,109	2,971	820
Lime.....	377	37	W	37	W	35	W
Manganese ore (85 percent or more Mn).....							
Manganiferous ore (5 to 85 percent Mn), gross weight.....	6,729	4,955	131	4,225	W	28,490	W
Natural gas.....	379	49,146	340	46,166	W	1,167,577	W
Natural gas liquids.....	156,000	1,138,133	155,924	1,188,980	162,874	1,167,577	175,137
Natural gasoline and cycle products							
thousand 42-gallon barrels.....	23,104	9,053	24,888	9,606	25,548	9,952	28,465
LP gases.....	34,989	24,920	30,402	25,999	37,179	27,082	43,331
thousand short tons.....	4	(9)	4	(9)	7	1	W
Perlite.....	3,706	397,987	4,493	382,456	4,321	385,746	4,559
Petroleum (crude).....	378,441	129,227	404,441	128,184	410,320	118,412	402,602
Potassium salts.....	68,706	2,327	62,034	2,390	85,877	2,291	86,689
Pumice.....	248	240	415	203	442	287	601
Sand.....	W	W	W	W	W	W	W
Sand and gravel.....	12,262	8,574	10,422	10,666	10,516	146	1,130
Silver (recoverable content of ores, etc.).....	225	465	884	782	1,885	782	1,210
Strone.....	3,226	3,236	3,236	43,000	4,080	42,913	45,337
Uranium (recoverable content U ₃ O ₈).....	12,282	11,341	99,887	11,574	69,970	10,567	65,517
Zinc (recoverable content of ores, etc.) ¹	18,686	5,045	7,098	16,601	5,086	13,959	4,495
Value of items that cannot be disclosed: Beryllium (1968-69), cement, fluorspar, mica scrap, molybdenum, stone (other than cement (1970-71), tin (1969), vanadium, and other values indicated by symbol W.....	XX	XX	XX	XX	XX	XX	XX
Total.....	XX	893,775	985,746	1,060,358	1,060,358	XX	1,046,284

NEW YORK

Clays.....	1,675	1,790	1,623	1,783	1,897	1,598	1,742
Gem stones.....	NA	10	NA	10	NA	NA	NA
Gypsum.....	570	2,925	492	2,945	2,737	415	2,378
Lead (recoverable content of ores, etc.).....	1,396	369	1,686	502	400	877	2,418
Lime.....	1,086	10,154	1,055	10,224	W	242	W
Mercury.....							
76-pound flasks.....		280	141	28	W	W	W
Natural gas.....	4,632	1,390	4,861	1,458	1,017	2,202	661
million cubic feet.....	15	153	14	178	145	186	186
Peat.....	15	7,093	1,256	5,683	1,194	5,397	5,282
Petroleum (crude).....	5,218	42,488	5,582	45,561	47,264	3,303	48,601
Salt.....	43,439	45,812	39,806	42,518	38,539	23,221	28,328
Sand and gravel.....							
thousand short tons.....	28	59	32	57	42	18	28
Stone.....	35,441	63,510	37,561	66,839	68,118	37,778	78,443
Zinc (recoverable content of ores, etc.) ¹	66,194	17,872	58,728	17,149	17,947	63,420	20,421
Value of items that cannot be disclosed: Cement, emery, abrasive garnet, iron ore, talc, titanium concentrate, wollastonite, and values indicated by symbol W.....	XX	XX	XX	XX	XX	XX	XX
Total.....	XX	299,636	302,480	299,564	299,564	XX	298,885

NORTH CAROLINA

Clays.....	3,310	2,148	3,342	3,318	3,102	3,503	3,802
Feldspar.....	316,862	4,340	388,149	945,186	5,173	351,617	4,681
Gem stones.....	NA	20	NA	NA	20	NA	30

See footnotes at end of table.

Table 5.—Mineral production¹ in the United States, by State—Continued

Mineral	1968		1969		1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NORTH CAROLINA—Continued								
Mica:								
Scrap.....	69	\$1,640	67	\$1,513	64	\$1,457	67	\$1,770
Sheet.....	15,000	W	W	W	3	3	8,705	3
Sand and gravel.....	10,771	11,178	10,562	11,437	12,772	13,277	14,240	14,690
Stone.....	24,543	42,429	26,812	47,829	30,363	54,121	30,917	58,026
Talc and pyrophyllite.....	100,030	520	105,728	586	92,639	544	85,289	522
Value of items that cannot be disclosed: Asbestos, barite (1968), cement, clay (kaolin), copper (1971), gold (1971), iron ore (1969-71), lead (1971), lithium minerals, olivine, phosphate rock, silver (1971), tungsten (1970-71), zinc (1971), and values indicated by symbol W								
Total.....	XX	20,544	XX	21,843	XX	20,671	XX	28,327
	XX	82,819	XX	90,456	XX	98,365	XX	112,451
NORTH DAKOTA								
Coal (lignite).....	4,487	7,986	4,704	8,696	5,639	11,009	6,075	11,580
Gem stones.....	NA	1	NA	1	NA	1	NA	2
Natural gas.....	41,023	6,769	33,587	5,441	34,889	5,722	33,864	5,655
Natural gas liquids:								
Natural gasoline.....	558	1,479	508	1,346	504	1,376	W	W
LP gases.....	2,156	3,622	1,951	2,868	1,840	2,944	W	W
Petroleum (crude).....	10,839	66,106	22,703	63,568	21,998	67,107	21,653	70,805
Sand and gravel.....	165	10,159	7,039	7,274	8,090	6,336	8,196	6,210
Stone.....	165	325	72	99	103	126	W	W
Value of items that cannot be disclosed: Clays, lime, peat (1968), 1970-71 salt, uranium (1968), and values indicated by symbol W								
Total.....	XX	1,588	XX	1,755	XX	1,426	XX	5,649
	XX	98,036	XX	91,048	XX	96,047	XX	99,901
OHIO								
Cement:								
Portland.....	15,222	49,814	15,100	50,071	11,752	39,997	15,411	54,338
Masonry.....	1,063	3,155	1,123	3,527	867	3,116	1,016	3,811
Clays (bituminous).....	4,750	15,216	4,587	11,698	3,920	10,100	3,973	11,380
Coal (bituminous).....	48,323	191,427	51,242	210,082	55,351	262,390	51,431	269,161
Gem stones.....	NA	3	NA	3	NA	3	NA	8
Lime.....	3,701	49,367	4,159	60,375	3,951	61,197	4,007	65,258
Natural gas.....	42,673	10,540	49,793	12,837	52,113	14,123	79,903	27,007
Peat.....	7	94	11	116	6	95	6	84
Petroleum (crude).....	11,204	35,722	10,972	36,098	9,864	32,914	8,286	29,801
Salt.....	5,713	43,172	5,844	48,519	5,329	47,498	5,709	46,651
Sand and gravel.....	46,734	57,671	50,029	64,552	42,069	50,206	40,797	54,044
Stone.....	448,054	478,772	51,792	86,570	47,244	81,506	46,891	88,372

Value of items that cannot be disclosed: Abrasive stone, gypsum, and dimension stone (1968)	XX	1,945	XX	1,815	XX	1,721	XX	1,796
Total	XX	586,898	XX	581,858	XX	612,166	XX	652,151
OKLAHOMA								
Clays ¹	726	967	802	1,182	769	1,120	845	1,255
Coal (bituminous).....	1,089	6,401	1,838	10,662	2,427	15,211	2,284	15,004
Gypsum.....	931	2,565	980	3,942	874	2,616	1,022	3,073
Helium:								
High purity.....	309	8,700	221	7,717	149	5,214	123	4,305
Crude.....	133	1,123	245	1,123	245	2,940	270	8,240
Lead (recoverable content of ores, etc.).....	2,387	631	605	180	797	249	1,684	273,945
Natural gas.....	1,390,884	197,506	1,523,715	293,128	1,594,943	248,811	1,684,260	273,945
Natural gas liquids:								
Natural gasoline and cycle products								
LP gases.....	13,905	38,829	14,621	38,981	14,813	39,933	14,197	40,856
Petroleum (crude).....	25,497	39,520	27,304	34,403	28,029	52,975	27,540	56,782
Salt.....	223,623	668,202	224,729	701,155	223,574	712,419	213,313	725,611
Sand and gravel.....	7	44	9	51	13	478	W	W
Stone.....	5,041	6,288	5,262	7,156	5,675	7,258	5,713	8,259
Zinc (recoverable content of ores, etc.) ⁷	17,290	21,950	18,799	23,650	18,177	23,701	19,449	27,125
Value of items that cannot be disclosed: Cement, clay (bentonite), copper, lime, pumice, silver, tripoli, and values indicated by symbol W)	6,921	1,869	2,744	801	2,650	812	W	W
Total	XX	23,360	XX	26,758	XX	24,935	XX	30,111
Total	XX	1,016,832	XX	1,090,809	XX	1,198,272	XX	1,189,516

OREGON								
Clays.....	3 213	3 284	3 215	3 321	3 184	3 180	3 157	255
Copper.....	W	W	W	W	W	W	3	3
Diatomite.....	120	85	70	500	5	750	NA	1
Gem stones.....	NA	750	NA	750	NA	755	NA	755
Gold (recoverable content of ores, etc.) ⁵	23	1	875	36	256	9	244	10
Lead.....	120	2,407	115	2,337	96	1,777	105	1,989
Lime.....	17,294	502	17,056	22	274	112	17,036	W
Mercury.....	(4)	977	875	1,189	989	1,221	868	1,289
Nickel (content of ore and concentrate).....	18,260	21,457	15,740	20,491	17,532	25,978	20,230	28,707
Peat.....	(9)	1	5	9	4	6	4	6
Pumice.....	14,812	21,168	11,662	18,897	13,439	20,948	13,794	26,708
Sand and gravel.....	3	1	W	W	W	W	W	W
Silver (recoverable content of ores, etc.).....	XX	16,890	XX	16,162	XX	17,095	XX	18,212
Stone.....	XX	64,449	XX	60,164	XX	68,081	XX	77,885
Talc and soapstone.....								
Value of items that cannot be disclosed: Bauxite (1970), cement, clay (fire clay (1968-70), copper (1968-70), tungsten (1971), and values indicated by symbol W)								
Total	XX	16,890	XX	16,162	XX	17,095	XX	18,212
Total	XX	64,449	XX	60,164	XX	68,081	XX	77,885

See footnotes at end of table.

feldspar.....	226	1,119	187	1,171	165	946	3,150	3,128
Gold (recoverable content of ores, etc.) ⁵	39,077	264	29,434	194	17,211	114	22,000	539
Gypsum.....	NA	34	NA	36	NA	35	NA	40
Lead (recoverable content of ores, etc.).....	593,052	28,283	593,146	24,621	578,716	21,059	513,427	21,179
Lead (recoverable content of ores, etc.).....	16	65	11	46	1	61	21	83
Mica (scrap).....	W	W	(9)	(9)	(9)	34	W	W
Petroleum (crude).....	187	158	187	362	160	374	233	604
Sand and gravel.....	11,558	11,578	11,158	10,807	16,556	16,556	16,727	18,392
Silver (recoverable content of ores, etc.).....	138	295	124	223	120	212	107	165
Stone.....	1,860	9,687	2,092	10,839	1,979	13,375	2,199	8,874
Zinc (recoverable content of ores, etc.).....	--	--	--	--	1	(9)	--	--
Value of items that cannot be disclosed: Columbium-tantalum concentrates (1969), lime, lithium minerals (1968-69), tin (1969), uranium, vanadium (1970), and values indicated by symbol W.....	XX	917	XX	683	XX	8,709	XX	12,984
Total.....	XX	54,086	XX	54,921	XX	61,576	XX	62,988

TENNESSEE

Barite.....	21	362	16	295	19	286	21	342
Cement:								
Portland.....	8,488	27,691	9,159	29,403	8,878	29,832	9,110	38,733
Masonry.....	1,370	3,836	1,831	3,867	969	2,749	1,135	3,649
Clays ³	1,562	5,772	1,719	7,064	1,401	7,123	1,537	6,595
Coal (bituminous).....	8,148	29,647	8,082	90,682	8,237	40,372	9,271	59,368
Copper (recoverable content of ores, etc.).....	14,196	11,881	16,353	14,596	16,535	17,928	13,916	14,473
Gold (recoverable content of ores, etc.) ⁵	140	5	126	5	124	5	192	8
Natural gas.....	48	9	57	11	64	18	89	20
Petroleum (crude).....	6	W	32	W	309	W	398	W
Phosphate rock.....	3,149	23,628	6	W	9,073	15,005	2,571	12,151
Sand and gravel.....	7,844	11,140	6,175	9,709	6,715	10,639	8,018	11,845
Silver (recoverable content of ores, etc.).....	90	192	79	141	95	168	131	203
Stone.....	32,083	48,854	38,265	46,192	35,374	50,013	32,369	48,665
Zinc (recoverable content of ores, etc.).....	124,039	33,491	124,532	36,363	118,260	36,233	119,295	38,413
Value of items that cannot be disclosed: Clay (fuller's earth), lime, pyrites, stone (crushed sandstone 1968), and values indicated by symbol W.....	XX	9,826	XX	27,402	XX	10,099	XX	10,197
Total.....	XX	201,334	XX	205,450	XX	220,465	XX	239,662

TEXAS

Cement:								
Portland.....	34,499	107,532	36,037	117,989	38,967	122,960	38,287	140,206
Masonry.....	1,089	3,371	3,873	3,873	1,007	3,769	1,209	4,514
Clays.....	4,687	8,860	4,407	8,664	4,148	9,587	4,615	10,432
Gem stones.....	NA	150	NA	150	NA	150	NA	155
Gypsum.....	1,089	3,616	1,314	4,998	1,220	4,252	1,303	4,806
Helium:								
Crude.....	1,039	11,100	1,190	13,053	1,157	13,262	1,208	14,496
High purity.....	362	9,400	82	4,917	50	2,862	141	1,750
Lime.....	1,564	21,154	1,633	22,107	1,673	24,427	1,612	24,533

See footnotes at end of table.

Table 5.—Mineral production¹ in the United States, by State—Continued

Mineral	1968			1969			1970			1971		
	Quantity (thousands)	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Natural gas.....	7,495,414	\$1,011,881	7,858,199	\$1,075,888	8,357,716	\$1,208,511	8,550,705	\$1,376,664				
Natural gas liquids:												
Natural gasoline and cycle products												
LP gases.....	97,075	269,182	96,628	289,042	97,511	284,871	96,286	299,981				
Petroleum (crude).....	189,162	278,068	194,599	237,411	204,177	334,850	210,435	380,887				
Pumice.....	1,133,380	3,450,707	1,151,775	3,696,328	1,249,697	4,104,005	1,222,326	4,261,775				
..... thousand short tons.												
Salt.....	8,584	42,663	9,261	43,012	10,184	45,000	9,217	40,838				
Sand and gravel.....	31,843	41,546	29,972	39,756	31,438	46,862	32,788	51,814				
Stone.....	48,468	58,006	46,688	45,557	41,168	64,422	41,168	62,144				
Sulfur (Frasch process).....	2,571	105,482	2,552	68,360	2,801	62,290	3,075	62,144				
Talc and soapstone.....	125,880	517	163,812	668	171,420	878	193,830	1,024				
Value of items that cannot be disclosed: Native asphalt, bromine (1968-69), coal (lignite), graphite, iron ore, magnesium chloride (for metal), magnesium compounds (except for metal), mercury, sodium sulfate, uranium, vermiculite (1968-69), and values indicated by symbol W.												
Total.....	XX	82,596	XX	79,368	XX	74,541	XX	131,882				
	XX	5,505,831	XX	5,769,970	XX	6,401,999	XX	6,807,955				
UTAH												
Carbon dioxide, natural.....	57,747	4	64,839	5	60,754	4	55,178	4				
Clays ¹	1,160	476	1,179	1,286	1,189	1,237	1,064	1,064				
Coal (bituminous).....	4,316	24,893	4,567	29,996	4,733	34,472	4,626	33,982				
Copper (recoverable content of ores, etc.).....	228,245	191,027	296,689	282,066	295,738	341,282	263,451	270,986				
Fluorspar.....	8,767	213	6,667	207	19,214	341,595	10,947	341				
Gem stones.....	NA	83	NA	85	NA	85	NA	NA				
Gold (recoverable content of ores, etc.) ²	334,419	13,129	433,385	17,990	408,029	14,848	368,996	15,221				
Iron ore (usable).....	1,764	11,281	1,921	12,652	1,990	13,837	1,881	1,886				
Iron ore (recoverable content of ores, etc.).....	45,205	11,945	41,832	12,313	45,377	14,175	38,270	10,562				
Lime.....	174	3,439	1,191	3,947	1,186	3,756	3,569	3,569				
Manganese ore (5 to 35 percent Mn).....					700	112	700	700				
Natural gas.....	46,151	7,292	46,733	7,197	42,781	6,460	42,418	7,084				
Natural gas liquids:												
Natural gasoline and cycle products												
LP gases.....	23,504	62,826	23,295	65,320	23,370	65,603	23,630	71,886				
Petroleum (crude).....	8	19	10	21	6	18	6	10				
Pumice.....	405	3,756	481	4,439	450	4,192	513	513				
Sand and gravel.....	10,293	9,364	19,151	16,042	12,010	10,439	10,505	10,190				
Silver (recoverable content of ores, etc.).....												
Stone.....	5,121	10,982	5,954	10,661	6,030	10,678	5,294	8,185				
Tungsten concentrates.....	1,953	4,312	2,582	4,434	1,650	4,320	2,556	5,335				
Uranium (recoverable content U ₃ O ₈).....	1,712	18,175	1,140	6,824	1,635	10,023	1,445	8,959				
Vanadium (recoverable in ore and concentrate).....	563	2,010	563	2,010	226	2,010	226	226				
Zinc (recoverable content of ores, etc.).....	33,153	8,951	34,902	10,191	34,638	10,628	25,701	8,276				

Value of items that cannot be disclosed: Asphalt (gilsonite), cement, clay (kaolin (1968)), gypsum, magnesium compounds, molybdenum, natural gas liquids, perillite (1969-70), phosphate rock, potassium salts, pyrites (1968), sodium sulfate (1971), and values indicated by symbol W.

XX	44,774	XX	57,507	XX	55,899	XX	49,754
XX	423,951	XX	542,489	XX	602,551	XX	525,700

VERMONT

W	1,500	25					
W	(8)	4					
W	3,386	3,028			\$6		W
W	2,140	19,810			4,322		W
W	2,586	2,151			19,088		W
XX	4,508	XX	4,892	XX	4,627	XX	4,681
XX	28,715	XX	27,759	XX	27,848	XX	36,284

VIRGINIA

1,462	\$1,714	1,677	\$1,504	1,698	\$1,672	1,710	\$1,800
36,966	178,946	35,555	192,802	35,016	246,181	30,628	254,872
NA	7	NA	7	NA	7	NA	7
3,573	944	3,353	1,000	3,355	1,048	3,356	894
11,138	919	1,072	18,653	1,046	14,039	894	11,882
1,013	1,013	2,846	384	2,805	382	2,619	382
3,389	3	3,389	3	3,389	3	3,389	3
10,859	13,644	12,140	15,954	11,126	15,229	12,796	20,201
3,928	10	4,600	12	3,760	9	3,704	8
31,217	53,533	33,461	58,713	35,415	60,477	34,643	63,482
19,257	5,199	18,704	5,462	18,063	5,584	16,829	5,419
XX	29,515	XX	27,575	XX	29,210	XX	26,564
XX	295,668	XX	317,527	XX	374,321	XX	385,161

WASHINGTON

6,928	28,080	6,956	22,724	6,495	24,382	W	W
56	175	58	204	41	188	W	W
255	253	290	484	240	486	265	\$549
1,8	823	98	450	37	470	1,134	7,614
72	13	17	17	11	11	W	W
NA	100	NA	150	NA	150	NA	185
5,655	1,494	8,649	2,577	6,784	2,119	5,117	1,429
40	139	33	134	17	71	17	72
31,432	27,839	34,245	31,046	25,089	27,902	22,702	26,658
14,351	16,690	15,742	21,069	13,701	19,100	12,436	20,489
W	W	4,228	W	W	W	W	W
13,884	3,749	9,738	2,843	11,966	3,663	5,782	1,862
XX	7,095	XX	6,948	XX	12,010	XX	35,773
XX	81,425	XX	88,626	XX	90,922	XX	94,601

See footnotes at end of table.

Petroleum (crude).....do.....	144,250	380,589	154,945	493,846	160,345	469,811	148,114	459,079
Sand and gravel.....do.....	9,350	8,973	7,568	7,288	9,447	9,298	9,820	8,750
Stone.....do.....	1,434	2,754	1,584	3,012	1,266	2,758	2,894	4,789
Uranium (recoverable content U ₃ O ₈).....do.....	5,928	44,343	6,716	40,318	6,346	38,768	6,986	43,311
Value of items that cannot be disclosed: Cement, copper (1969), feldspar (1968, 1970-71), gold (1969), phosphate rock, pumice (1969), sodium carbonate, sodium sulfate (1968-70), and values indicated by symbol W.....	XX	40,691	XX	48,993	XX	76,329	XX	80,544
Total.....	XX	576,190	XX	647,443	XX	705,683	XX	717,987

⁰ Estimate. ^r Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data. XX Not applicable.
¹ Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
² Excludes certain cement, included with "Value of items that cannot be disclosed."
³ Excludes certain clays, included with "Value of items that cannot be disclosed."
⁴ Excludes certain stone, included with "Value of items that cannot be disclosed."
⁵ Value based on average U.S. Treasury price (\$35.00) Jan. 1, 1968 through Mar. 15, 1968; and Engelhard selling quotations Mar. 20, 1968 through 1971.
⁶ Excludes salt in brine, included with "Value of items that cannot be disclosed."
⁷ Recoverable zinc valued at the yearly average price of Prime Western slab, East St. Louis market. Represents value established after transportation, smelting and manufacturing charges have been added to the value of ore at mine.
⁸ Less than 1/2 unit.

Table 6.—Mineral production¹ in the Canal Zone and islands administered by the United States

Area and mineral	1968		1969		1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
American Samoa:								
Pumice.....	21	\$51	2	\$5	2	\$6	10	\$35
Sand and gravel.....	20	19	7	7	26	25	24	25
Stone.....	53	79	54	108	49	69	W	W
Total.....	XX	149	XX	120	XX	100	XX	\$ 60
Canal Zone:								
Sand and gravel.....	55	77	60	97	60	97	--	--
Stone.....	106	290	74	231	85	265	--	--
Total.....	XX	367	XX	328	XX	362	XX	--
Guam: Stone.....	560	998	654	1,399	636	1,289	718	1,705
Virgin Islands: Stone.....	866	1,555	411	1,682	514	2,226	2,236	W
Wake: Stone.....	41	132	9	45	4	18	4	16

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 Total does not include value of items withheld.

Table 7.—Mineral production¹ in the Commonwealth of Puerto Rico

Mineral	1968		1969		1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement.....	8,923	\$27,577	8,943	\$27,920	9,460	\$29,515	10,642	\$38,413
Clays.....	512	481	438	454	429	486	342	358
Lime.....	39	1,187	41	1,505	41	W	44	W
Salt.....	32	895	32	895	32	395	24	570
Sand and gravel.....	16,146	24,723	9,432	23,296	r 11,506	r 28,001	7,292	20,607
Stone.....	7,367	13,580	6,935	13,550	7,296	13,947	12,130	29,847
Total.....	XX	67,943	XX	67,120	XX	r 72,844	XX	r 89,795

r Revised. W Withheld to avoid disclosing individual company confidential data. XX Not applicable.

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

² Total does not include value of items withheld.

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

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals:				
Aluminum:				
Ingots, slabs, crude.....short tons..	408,452	\$214,780	112,295	\$58,040
Scrap.....do....	r 57,087	r 20,923	30,675	9,995
Plates, sheets, bars, etc.....do....	r 137,764	r 106,989	141,061	111,787
Castings and forgings.....do....	3,438	9,068	3,561	8,245
Aluminum sulfate.....do....	17,726	578	16,840	568
Other aluminum compounds.....do....	1,134,707	92,633	1,120,969	95,578
Antimony: Metals and alloys, crude.....do....	544	634	1,023	761
Bauxite, including bauxite concentrates thousand long tons..	3	245	34	1,529
Beryllium.....pounds..	41,353	1,021	41,114	1,051
Bismuth: Metals and alloys.....do....	910,275	2,332	71,187	199
Cadmium.....thousand pounds..	373	997	66	172
Chrome:				
Ore and concentrates:				
Exports.....thousand short tons..	41	2,582	35	2,094
Reexports.....do....	73	2,572	145	6,081
Ferrocchrome.....do....	28	8,259	9	3,620
Cobalt.....thousand pounds..	2,699	5,798	1,212	2,108
Columbium metals, alloys and other forms do....	46	562	21	588
Copper:				
Ore, concentrate, composition metal and unrefined (copper content).....short tons..	69,343	65,869	36,824	30,672
Refined copper and semimanufactures do....	249,717	370,388	215,705	267,303
Other copper manufactures.....do....	6,057	8,568	7,746	9,145
Copper sulfate or blue vitriol.....do....	2,485	1,543	2,815	2,078
Copper base alloys.....do....	127,593	138,327	97,955	106,829
Ferroalloys:				
Ferro silicon.....do....	44,694	11,887	25,506	5,603
Ferrophosphorous.....do....	33,106	1,199	35,111	1,419
Gold:				
Ore and base bullion.....troy ounces..	106,117	3,903	577,502	23,470
Bullion, refined.....do....	968,103	33,887	761,302	27,779
Iron ore.....thousand long tons..	5,492	67,893	3,061	38,147
Iron and steel:				
Pig iron.....short tons..	309,746	18,339	34,164	2,352
Iron and steel products (major):				
Semimanufactures.....do....	r 6,593,540	r 846,767	2,504,263	403,370
Manufactures steel mill products.....do....	r 1,063,399	r 528,074	1,023,871	538,994
Iron and steel scrap: Ferrous scrap, including rerolling materials thousand short tons..	r 10,893	r 458,848	6,653	222,222
Lead:				
Pigs, bars, anodes.....short tons..	7,747	4,757	5,925	3,889
Scrap.....do....	4,214	1,056	9,573	1,410
Magnesium:				
Metal and alloys and semimanufactured forms, n.e.c.....do....	35,732	22,542	24,311	15,692
Manganese:				
Ore and concentrate.....do....	20,294	2,461	55,413	2,683
Ferromanganese.....do....	21,747	4,356	4,526	1,205
Mercury:				
Exports.....76-pound flasks..	4,653	2,133	7,232	2,789
Reexports.....do....	50	19	--	--
Molybdenum:				
Ore and concentrates (molybdenum content) thousand pounds..	55,737	95,246	46,284	79,111
Metals and alloys, crude and scrap.....do....	671	802	222	227
Wire.....do....	107	1,252	140	1,212
Semifabricated forms, n.e.c.....do....	133	643	623	1,195
Powder.....do....	329	523	41	170
Ferromolybdenum.....do....	2,014	3,088	1,355	1,973
Nickel:				
Alloys and scrap (including Monel metal), ingots, bars, sheets, etc.....short tons..	26,007	64,830	18,923	48,503
Catalysts.....do....	2,524	6,451	3,740	10,013
Nickel-chrome electric resistance wire.....do....	870	5,642	643	3,269
Semifabricated forms, n.e.c.....do....	2,055	9,001	2,837	12,780
Platinum:				
Ore, concentrate, metal and alloys in ingots, bars, sheets, anodes, and other forms, including scrap.....troy ounces..	270,584	32,978	320,842	29,432
Palladium, rhodium, iridium, osmiridium, ruthenium, and osmium (metal and alloys including scrap).....do....	143,182	10,034	83,768	4,021
Platinum group manufactures, except jewelry.....do....	NA	5,727	NA	4,769

See footnotes at end of table.

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

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals—Continued				
Rare earths:				
Cerium ore, metal, alloys and lighter flints pounds..	77,523	\$275	60,044	\$164
Silver:				
Ore, concentrates, waste and sweepings thousand troy ounces..	10,375	18,102	3,728	6,164
Bullion, refined.....do.....	17,239	31,037	8,496	13,634
Tantalum:				
Ore, metal, and other forms thousand pounds..	762	3,884	242	2,611
Powder.....do.....	139	4,367	85	2,519
Tin:				
Ingots, pigs, bars, etc:				
Exports.....long tons..	4,009	15,222	1,821	6,648
Reexports.....do.....	443	1,701	441	1,620
Tin scrap and other tin-bearing material except tinplate scrap.....do.....	2,756	2,466	2,605	1,780
Titanium:				
Ore and concentrate.....short tons..	1,058	201	1,760	299
Sponge (including iodide titanium and scrap) do.....	2,902	2,588	1,711	1,139
Intermediate mill shapes and mill products, n.e.c.....do.....	1,740	10,435	430	4,788
Dioxide and pigments.....do.....	26,194	7,950	26,759	9,378
Tungsten: Ore and concentrates:				
Exports.....thousand pounds..	19,470	61,131	2,006	7,323
Reexports.....do.....	188	341	1	1
Vanadium ore and concentrate, pentoxide, etc. (vanadium content).....do.....	1,946	5,808	520	1,834
Zinc:				
Slabs, pigs, or blocks.....short tons..	288	114	13,346	2,337
Sheets, plates, strips, or other forms, n.e.c. do.....	1,412	1,173	1,686	1,486
Scrap (zinc content).....do.....	3,112	1,049	2,000	504
Semifabricated forms, n.e.c.....do.....	25,528	5,635	6,042	2,709
Zirconium:				
Ore and concentrate.....do.....	4,380	591	9,429	802
Metals and alloys and other forms..pounds..	600,035	6,284	1,125,242	13,054
Nonmetals:				
Abrasives:				
Dust and powder of precious or semiprecious stones, including diamond dust and powder.....thousand carats..	7,258	18,711	7,506	18,726
Crushing bort.....do.....	33	154	20	94
Industrial diamonds.....do.....	339	1,838	415	1,831
Diamond grinding wheels.....do.....	614	3,117	526	2,932
Other natural and artificial, metallic abrasives and products.....	NA	40,518	NA	37,102
Asbestos, unmanufactured:				
Exports.....short tons..	38,235	5,340	52,202	7,571
Reexports.....do.....	8,350	1,656	1,476	292
Boron: Boric acid, borates, crude and refined do.....	232,958	25,654	202,496	24,411
Cement.....thousand 376-pound barrels..	847	5,211	663	3,467
Clays:				
Kaolin or china clay.....short tons..	816,284	27,294	673,033	26,125
Fire clay.....do.....	167,308	3,464	161,934	3,566
Other clays.....do.....	1,093,001	35,358	1,137,723	35,638
Fluorspar.....do.....	14,952	1,145	12,491	525
Graphite.....do.....	5,783	701	5,733	680
Gypsum:				
Crude, crushed or calcined thousand short tons..	41	1,915	41	2,318
Manufactures, n.e.c.....	NA	1,560	NA	1,896
Kyanite and allied minerals.....short tons..	24,024	1,622	31,554	2,097
Lime.....do.....	53,876	1,391	65,862	1,971
Mica sheet, waste and scrap and ground pounds..	17,459,607	1,422	14,383,388	1,209
Mica, manufactured.....do.....	1,260,780	3,310	798,956	2,559
Mineral-earth pigments: Iron oxide, natural and manufactured.....short tons..	4,565	1,621	3,984	1,680
Nitrogen compounds (major) thousand short tons..	3,414	150,515	3,126	141,381
Phosphate rock.....do.....	11,738	89,898	12,687	94,816
Phosphatic fertilizers (superphosphates).....do.....	774	28,645	750	30,464
Pigments and compounds (lead and zinc):				
Lead pigments.....short tons..	1,516	649	1,955	833
Zinc pigments.....do.....	7,867	2,866	7,229	2,864

See footnotes at end of table.

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

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Nonmetals—Continued				
Potash:				
Fertilizer..... short tons..	r 956,638	r \$28,473	1,032,948	\$35,323
Chemical..... do.....	80,377	8,450	55,188	8,072
Quartz, natural, quartzite, cryolite and chiolite do.....	671	108	431	54
Salt:				
Crude and refined..... thousand short tons..	423	3,657	670	4,182
Shipments to noncontiguous Territories do.....	16	969	19	1,898
Sodium and sodium compounds:				
Sodium sulfate..... do.....	55	1,668	66	1,825
Sodium carbonate..... do.....	336	12,007	437	15,400
Stone:				
Dolomite, block..... do.....	77	1,454	87	1,639
Limestone, crushed, ground, broken..... do.....	1,755	3,459	1,822	3,751
Marble and other building and monumental thousand cubic feet..	NA	877	NA	905
Stone, crushed, ground, broken thousand short tons..	388	3,288	585	3,871
Manufactures of stone..... do.....	NA	1,318	NA	1,322
Sulfur:				
Crude..... thousand long tons..	1,429	33,096	1,532	27,844
Crushed, ground, flowers of..... do.....	4	955	4	1,019
Talc, crude and ground..... short tons..	104,946	r 5,739	135,881	4,844
Fuels:				
Carbon black..... thousand pounds..	192,636	24,505	163,246	20,425
Coal:				
Anthracite..... thousand short tons..	789	11,215	671	10,104
Bituminous..... do.....	r 70,944	r 950,790	56,633	891,484
Briquets..... do.....	69	3,736	72	4,335
Coke..... do.....	r 2,478	r 78,327	1,509	44,819
Natural gas..... thousand cubic feet..	66,229,687	30,930	84,196,444	38,430
Natural gas liquids, including liquefied petroleum gas, n.e.c..... thousand barrels..	6,134	19,046	6,339	19,417
Petroleum:				
Crude..... thousand barrels..	4,991	17,225	503	1,563
Gasoline..... do.....	1,049	10,362	1,783	15,259
Jet..... do.....	63	228	211	898
Naphtha..... do.....	2,052	19,249	1,593	16,401
Kerosine..... do.....	118	973	172	1,356
Distillate oil..... do.....	1,631	5,555	2,869	12,323
Residual oil..... do.....	19,801	45,734	13,162	40,991
Lubricating oil..... do.....	r 15,717	r 189,555	15,218	183,032
Asphalt..... do.....	399	4,668	304	3,449
Liquefied petroleum gases..... do.....	9,932	31,674	9,379	29,235
Wax..... do.....	1,783	40,862	1,638	36,017
Coke..... do.....	30,515	97,654	26,823	106,594
Petrochemical feedstocks..... do.....	r 3,834	r 20,076	5,243	27,555
Miscellaneous..... do.....	1,061	21,331	1,006	20,132
Total.....	XX	r 5,664,158	XX	4,369,767

r Revised. NA Not available. XX Not applicable.

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

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals:				
Aluminum:				
Metal.....short tons..	350,060	\$164,227	554,208	\$257,473
Scrap.....do.....	36,779	12,979	62,840	21,504
Plates, sheets, bars, etc.....do.....	78,660	53,836	70,944	45,702
Aluminum oxide (alumina).....do.....	2,554,807	152,537	2,390,677	138,841
Antimony:				
Ore (antimony content).....do.....	13,820	12,733	9,619	8,787
Needle or liquated.....do.....	18	54	32	47
Metal.....do.....	1,290	3,493	1,638	1,914
Oxide.....do.....	4,256	10,023	2,791	4,317
Arsenic: White (As ₂ O ₃ content).....do.....	18,763	2,089	16,406	2,187
Bauxite: Crude.....thousand long tons..	12,620	156,362	12,326	153,639
Beryllium ore.....short tons..	4,942	1,912	4,026	1,475
Bismuth.....pounds..	997,924	5,636	848,708	4,050
Boron carbide.....do.....	52,652	166	18,298	56
Cadmium:				
Metal.....thousand pounds..	2,492	7,800	3,499	6,264
Flue dust (cadmium content).....do.....	1,111	2,438	1,112	1,118
Calcium:				
Metal.....pounds..	164,769	141	48,391	30
Chloride.....short tons..	8,280	359	13,019	544
Chromate:				
Ore and concentrates (Cr ₂ O ₃ content).....thousand short tons..	647	31,805	590	32,107
Ferrochrome.....do.....	27	9,620	54	22,697
Metal.....do.....	2	3,052	2	2,966
Cobalt:				
Metal.....thousand pounds..	11,873	26,020	10,381	22,287
Oxide (gross weight).....do.....	710	1,394	726	1,426
Salts and compounds (gross weight).....do.....	157	92	40	27
Columbium ore.....do.....	5,719	4,345	3,054	2,222
Copper: (copper content)				
Ore and concentrates.....short tons..	64,540	77,367	5,547	4,091
Regulus, black, coarse.....do.....	247	346	119	220
Unrefined, black, blister.....do.....	224,289	245,778	153,625	144,395
Refined in ingots, etc.....do.....	132,143	149,169	163,988	165,686
Old and scrap.....do.....	2,308	2,044	7,459	6,679
Ferroalloys: Ferrosilicon (silicon content).....do.....	10,060	4,117	12,684	5,988
Gold:				
Ore and base bullion.....troy ounces..	286,988	9,992	191,470	7,264
Bullion.....do.....	6,365,380	227,472	7,009,241	276,683
Iron ore.....thousand long tons..	44,891	479,518	40,124	450,644
Iron and steel:				
Pig iron.....short tons..	249,241	13,729	306,320	16,964
Iron and steel products (major):				
Iron products.....do.....	44,428	15,332	37,519	13,964
Steel products.....do.....	13,655,762	2,050,668	18,605,589	2,727,879
Scrap.....do.....	279,586	10,609	263,192	10,713
Tinplate.....do.....	21,707	591	20,239	546
Lead:				
Ore, flue dust, matte (lead content).....do.....	42,606	8,360	88,184	19,362
Base bullion (lead content).....do.....	1,177	448	41	16
Pigs and bars (lead content).....do.....	244,623	73,397	192,570	48,021
Reclaimed scrap, etc. (lead content).....do.....	2,981	798	2,518	579
Sheet, pipe and shot.....do.....	513	241	237	86
Magnesium:				
Metallic and scrap.....do.....	2,948	1,566	3,442	1,633
Alloys (magnesium content).....do.....	122	300	99	286
Sheets, tubing, ribbons, wire and other forms (magnesium content).....do.....	225	637	130	397
Manganese:				
Ore (35 percent or more manganese) (manganese content).....do.....	846,706	34,263	928,122	42,184
Ferromanganese (manganese content).....do.....	226,979	31,563	189,260	32,392
Mercury:				
Compounds.....pounds..	196	3	1,220	9
Metal.....76-pound flasks..	21,972	9,068	28,449	8,165
Minor metals: Selenium and salts.....pounds..	461,974	4,329	409,264	4,134
Nickel:				
Pigs, ingots, shot, cathodes.....short tons..	117,334	302,578	100,531	259,931
Scrap.....do.....	2,149	4,485	1,336	1,896
Oxide.....do.....	6,423	12,611	5,769	11,604

See footnotes at end of table.

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

Mineral	1970		1971		
	Quantity	Value (thousands)	Quantity	Value (thousands)	
Metals—Continued					
Platinum group:					
Unwrought:					
Grains and nuggets (platinum)					
Sponge (platinum).....	troy ounces..	r 29,065	r \$3,861	34,958	\$3,170
Sweepings, waste and scrap.....	do.....	8,459	r 1,239	14,293	1,908
Iridium.....	do.....	r 270,034	r 9,877	215,518	7,731
Palladium.....	do.....	38,626	r 7,527	33,764	5,980
Rhodium.....	do.....	20,816	984	28,063	1,222
Ruthenium.....	do.....	9,242	495	15,037	2,067
Other platinum group metals.....					
Semimanufactured:					
Platinum.....	do.....	r 115,073	16,323	105,806	11,475
Palladium.....	do.....	r 503,783	17,532	442,465	15,198
Rhodium.....	do.....	r 2,386	r 417	898	169
Other platinum group metals.....	do.....	3,036	442	1,575	207
Radium: Radioactive substitutes.....	do.....	NA	r 3,471	NA	5,671
Rare earths: Ferrocium and other cerium alloys					
Silver:	pounds..	9,373	54	16,190	82
Ore and base bullion.....	thousand troy ounces..	29,246	45,400	33,452	45,003
Bullion.....	do.....	29,569	52,637	22,388	33,979
Tantalum ore.....	thousand pounds..	1,046	3,231	1,180	3,332
Tin:					
Ore (tin content).....	long tons..	4,667	13,987	3,060	10,564
Blocks, pigs, grains, etc.....	do.....	50,554	187,662	46,940	164,403
Dross, skimmings, scrap, residues and tin alloys, n.s.p.f.....	do.....	776	275	4,125	1,385
Tin foil, powder, flitters, etc.....	do.....	NA	4,311	NA	4,471
Titanium:					
Ilmenite ¹	short tons..	r 261,863	r 6,829	378,049	10,459
Rutile.....	do.....	r 243,089	r 19,796	215,109	23,155
Metal.....	pounds..	r 13,740,209	r 13,520	6,594,448	6,355
Ferrotitanium.....	do.....	146,300	48	173,057	154
Compounds and mixtures.....	do.....	121,000,933	22,566	86,230,153	16,125
Tungsten: (tungsten content)					
Ore and concentrates.....	thousand pounds..	1,284	3,176	418	1,033
Metal.....	do.....	35	173	17	117
Other alloys.....	do.....	190	1,560	129	1,804
Zinc:					
Ore (zinc content).....	short tons..	450,770	67,164	467,368	62,678
Blocks, pigs, and slabs.....	do.....	260,132	73,695	324,751	93,766
Sheets.....	do.....	692	419	509	237
Old, dross, and skimmings.....	do.....	1,915	234	1,967	237
Dust.....	do.....	9,359	3,161	8,184	2,949
Manufactures.....	do.....	NA	1,276	NA	1,347
Zirconium: Ore, including zirconium sand.....	do.....	94,759	3,704	96,387	3,656
Nonmetals:					
Abrasives: Diamonds (industrial)					
Asbestos.....	thousand carats..	13,365	49,037	12,910	46,023
Barite:	short tons..	649,402	75,146	681,367	80,090
Crude and ground.....	do.....	707,028	6,360	484,762	4,490
Witherite.....	do.....	182	35	511	42
Chemicals.....	do.....	7,238	1,173	7,800	1,299
Cement.....	thousand 376-pound barrels..	13,812	34,176	16,422	44,343
Clays:					
Raw.....	short tons..	81,393	1,610	58,965	1,239
Manufactured.....	do.....	5,147	192	5,084	212
Cryolite.....	do.....	r 21,399	r 4,586	23,127	5,056
Feldspar: Crude.....	long tons..	225	23	120	19
Fluorspar.....	short tons..	1,092,318	32,758	1,072,405	34,530
Gem stones:					
Diamond.....	thousand carats..	4,275	424,897	4,667	463,242
Emeralds.....	do.....	326	7,715	351	7,731
Other.....	do.....	NA	53,431	NA	55,010
Graphite.....	short tons..	66,449	3,027	57,755	2,727
Gypsum:					
Crude, ground, calcined.....	thousand short tons..	6,130	r 13,897	6,096	13,552
Manufactures.....	do.....	NA	2,684	NA	2,730
Iodine, crude.....	thousand pounds..	r 6,043	r 6,834	7,275	11,510
Kyanite.....	short tons..	1,179	56	1,343	65
Lime:					
Hydrated.....	do.....	34,158	479	39,807	618
Other.....	do.....	167,432	1,946	202,477	2,690

See footnotes at end of table.

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

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Nonmetals—Continued				
Magnesium compounds:				
Crude magnesite..... short tons..	21	(²)	7	(²)
Lump, ground, caustic calcined magnesite..... do.....	11,476	\$702	11,518	\$736
Refractory magnesite, dead-burned fused magnesite, dead-burned dolomite..... do.....	128,193	9,032	129,025	10,014
Compounds..... do.....	40,700	1,362	49,731	1,257
Mica:				
Uncut sheet and punch..... thousand pounds..	875	966	1,355	1,171
Scrap..... do.....	6,048	136	7,284	171
Manufactures..... do.....	4,530	2,549	4,464	2,476
Mineral-earth pigments, Iron oxide pigments:				
Natural..... short tons..	2,115	155	1,794	171
Synthetic..... do.....	24,138	5,264	28,236	5,592
Ocher, crude and refined..... do.....	62	4	--	--
Siennas, crude and refined..... do.....	1,051	115	1,427	125
Umber, crude and refined..... do.....	4,883	171	4,681	228
Vandyke brown..... do.....	435	50	358	39
Nitrogen compounds (major), including urea				
..... thousand short tons..	2,495	119,176	2,573	118,281
Phosphate, crude..... do.....	136	3,790	84	2,478
Phosphatic fertilizers..... do.....	110	5,679	92	6,972
Pigments and salts:				
Lead pigments and compounds..... short tons..	22,591	5,845	21,669	4,734
Zinc pigments and compounds..... do.....	20,766	4,106	20,920	4,187
Potash..... do.....	4,418,064	101,337	4,687,379	118,481
Pumice:				
Crude or unmanufactured..... do.....	10,639	74	8,833	109
Wholly or partly manufactured..... do.....	354,681	902	390,900	975
Manufactures, n.s.p.f..... do.....	NA	29	NA	18
Quartz crystal (Brazilian pebble)..... pounds..	975,679	421	752,001	368
Salt..... thousand short tons..	3,536	13,329	3,855	14,429
Sand and gravel:				
Glass sand..... do.....	64	262	48	243
Other sand and gravel..... do.....	815	1,338	667	984
Sodium sulfate..... do.....	269	4,753	269	4,667
Stone and whiting..... do.....	NA	35,674	NA	33,643
Strontium: Mineral..... short tons..	37,254	827	45,505	1,115
Sulfur and pyrites:				
Sulfur ore and other forms n.e.s..... thousand long tons..	1,537	34,149	1,297	25,419
Pyrites..... do.....	197	662	285	962
Talc: Unmanufactured..... short tons..	29,988	1,294	17,382	745
Mineral fuels:				
Carbon black:				
Acetylene..... pounds..	5,876,221	1,103	6,125,541	1,405
Gas black and carbon black..... do.....	168,997	39	386,246	41
Coal:				
Bituminous, slack, culm and lignite..... short tons..	36,441	457	111,036	1,772
Briquets..... do.....	3,208	93	4,145	63
Coke..... do.....	152,879	3,531	173,914	5,038
Natural gas, ethane, methane, and mixtures thereof..... thousand cubic feet..	1,004,983,099	257,542	1,115,381,461	312,067
Peat:				
Fertilizer grade..... short tons..	281,429	13,398	293,810	14,988
Poultry and stable grade..... do.....	1,782	104	2,473	154
Petroleum:				
Crude petroleum..... thousand barrels..	535,052	1,260,164	670,972	1,687,279
Distillate..... do.....	19,198	62,203	36,108	103,227
Residual..... do.....	530,602	1,020,970	498,546	1,109,102
Unfinished oils..... do.....	4,636	9,833	4,801	12,292
Gasoline..... do.....	1,941	8,117	353	1,684
Jet fuel..... do.....	53,971	165,425	54,390	175,112
Motor fuels, n.e.s..... do.....	883	2,838	1,127	3,538
Kerosine..... do.....	2,643	8,408	211	779
Lubricants..... do.....	233	3,179	14	593
Wax..... do.....	120	480	96	505
Naphtha..... do.....	63,243	153,588	69,066	169,273
Liquefied petroleum gases..... do.....	18,923	35,246	26,247	57,208
Asphalt..... do.....	6,507	13,371	7,248	16,242
Miscellaneous..... do.....	4,735	15,005	4,241	15,088
Total.....	XX	\$ 9,176,713	XX	10,406,340

^r Revised. NA Not available. XX Not applicable.

¹ Includes titanium slag averaging about 70 percent TiO₂. For detail see Titanium Chapter, table 5.

² Less than ½ unit.

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

Mineral	1970 ^r			1971 ^p		
	World ¹	United States	Percent of world	World ¹	United States	Percent of world
	Thousand short tons (unless otherwise stated)	Thousand short tons (unless otherwise stated)		Thousand short tons (unless otherwise stated)	Thousand short tons (unless otherwise stated)	
MINERAL FUELS						
Carbon black.....thousand pounds..	5,959,667	2,931,153	49	6,170,182	3,017,135	49
Coal:						
Bituminous.....	² 2,231,453	596,969	27	2,226,826	545,790	25
Lignite.....	865,354	5,963	1	883,609	6,402	1
Pennsylvania anthracite.....	198,664	9,729	5	198,508	8,727	4
Coke (excluding breeze):						
Gashouse ³	28,090			24,152		
Oven and beehive.....	386,203	66,525	17	374,098	57,436	15
Natural gas (marketable) million cubic feet..	37,921,317	21,920,642	58	43,846,430	22,493,012	51
Peat.....	215,550	517	(⁴)	215,412	605	(⁴)
Petroleum (crude).....thousand barrels..	16,689,617	3,517,450	21	17,633,033	3,453,914	20
NONMETALS						
Asbestos.....	3,846	125	3	3,948	131	3
Barite.....	4,134	854	21	4,153	825	20
Cement.....thousand 376-pound barrels..	3,353,592	⁵ 404,870	12	3,460,674	427,220	12
China clay.....	14,134	⁶ 4,926	35	13,905	⁶ 4,886	35
Corundum.....	8	--	--	8	--	--
Diamond.....thousand carats..	42,586	--	--	42,189	--	--
Diatomite.....	1,766	598	34	1,697	535	32
Feldspar.....thousand long tons..	2,346	648	28	2,231	663	30
Fluorspar.....	4,597	269	5	5,112	272	5
Graphite.....	426	W	NA	429	W	NA
Gypsum.....	57,244	9,436	16	58,564	10,418	18
Lime (sold or used by producers).....	106,431	⁵ 19,788	19	108,183	19,635	18
Magnesite.....	12,218	W	NA	12,933	W	NA
Mica (including scrap).....thousand pounds..	356,045	237,686	67	367,041	254,185	69
Nitrogen, agricultural ⁷	33,670	⁸ 8,413	25	36,233	⁸ 8,932	25
Phosphate rock.....	94,082	38,739	41	96,468	38,886	40
Potash (K ₂ O equivalent).....	20,416	2,729	13	22,119	2,587	12
Pumice ⁸	16,470	3,038	18	20,790	3,326	16
Pyrites.....thousand long tons..	21,874	W	NA	19,603	808	41
Salt.....	160,416	⁵ 45,928	29	157,299	⁵ 44,106	28
Strontium ⁸	69	--	--	134	--	--
Sulfur, elemental.....thousand long tons..	21,749	9,551	44	22,516	9,572	43
Talc, pyrophyllite, and soapstone.....	5,332	1,023	19	5,388	1,037	19
Vermiculite ⁸	431	285	66	457	301	66
METALS, MINE BASIS						
Antimony (content of ore and concentrate) short tons..	75,618	1,130	1	70,161	1,025	1
Arsenic, white.....	58	W	NA	59	W	NA
Bauxite ⁹.....thousand long tons..	56,260	⁹ 2,082	4	61,981	⁹ 1,988	3
Beryllium concentrate.....short tons..	8,307	W	NA	5,553	W	NA
Bismuth.....thousand pounds..	8,408	W	NA	7,891	W	NA
Cadmium.....do.....	36,641	¹⁰ 9,465	26	34,153	¹⁰ 7,930	23
Chromite.....	6,672	--	--	6,936	--	--
Cobalt (contained).....	26	W	NA	26	W	NA
Columbium-tantalum concentrates ⁸ thousand pounds..	44,934	W	NA	23,261	W	NA
Copper (content of ore and concentrate).....	6,634	¹¹ 1,720	26	6,665	1,522	23
Gold.....thousand troy ounces..	47,531	1,743	4	46,506	1,495	3
Iron ore.....thousand long tons..	754,484	¹² 89,760	12	773,376	80,762	10
Lead (content of ore and concentrate).....	3,726	¹¹ 572	15	3,752	579	15
Manganese ore (35 percent or more Mn).....	20,084	5	(⁴)	22,792	(⁴)	(⁴)
Mercury.....thousand 76-pound flasks..	284	27	10	306	18	6
Molybdenum (content of ore and concentrate) thousand pounds..	177,982	111,352	63	173,024	109,592	63
Nickel (content of ore and concentrate).....	694	16	2	706	16	2
Platinum group (Pt., Pd., etc.) thousand troy ounces..	4,239	17	(⁴)	4,077	18	(⁴)
Silver.....do.....	303,897	45,006	15	294,691	41,564	14
Tin (content of ore and concentrate) long tons..	229,437	W	NA	229,533	W	NA
Titanium concentrates:						
Ilmenite ⁸	3,956	868	22	3,721	683	18
Rutile ⁸	460	--	--	416	--	--
Tungsten concentrate (contained tungsten) pounds..	74,034	9,625	11	80,728	6,900	9
Vanadium (content of ore and concentrate) short tons..	20,805	5,319	26	20,894	5,252	25
Zinc (content of ore and concentrate).....	6,008	534	9	6,126	503	8
METALS, SMELTER BASIS						
Aluminum.....	10,630	3,976	37	11,339	3,925	35
Copper.....	6,731	¹³ 1,641	24	6,736	1,500	22

See footnotes at end of table.

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

Mineral	1970 ^r			1971 ^p		
	World ¹	United States		World ¹	United States	
	Thousand short tons (unless otherwise stated)	Per- cent of world		Thousand short tons (unless otherwise stated)	Per- cent of world	
METALS, SMELTER BASIS—Continued						
Iron, pig	471,066	91,293	19	474,347	81,382	17
Lead	3,622	667	18	3,492	650	19
Magnesium	245,324	112,007	46	256,807	123,485	48
Selenium ⁸	2,849	1,005	35	2,283	657	29
Steel ingots and castings	655,380	¹⁵ 131,514	20	641,673	¹⁵ 120,443	19
Tellurium ⁸	365	158	43	318	164	52
Tin ¹⁶	220,939	W	NA	226,321	W	NA
Uranium oxide (U ₃ O ₈) ⁸	23,858	12,768	54	24,582	12,907	53
Zinc	5,379	878	16	5,083	766	15

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

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

² Includes small quantities of lignite for People's Republic of China, Mongolia, North Korea, and Pakistan, and anthracite for Colombia.

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

⁴ Less than $\frac{1}{2}$ unit.

⁵ Includes Puerto Rico.

⁶ Kaolin sold or used by producers.

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

⁸ World total exclusive of U.S.S.R.

⁹ Dry bauxite equivalent of crude ore.

¹⁰ Includes secondary.

¹¹ Recoverable.

¹² Iron-nickel ore.

¹³ Smelter output from domestic and foreign ores, exclusive of scrap. Production from domestic ores only, exclusive of scrap, was as follows: 1969, 1,547,496; 1970, 1,605,256.

¹⁴ Lead refined from domestic and foreign ores, excludes lead refined from imported base bullion.

¹⁵ Data from American Iron and Steel Institute. Excludes production of castings by companies that do not produce steel ingots.

¹⁶ Includes tin content of alloys made directly from ores.

Injury Experience and Worktime in the Solid Mineral Mining Industries By States

By Forrest T. Moyer¹

The safety record of the solid mineral mining and milling industries in 1971 was 342 fatal and 23,530 non-fatal injuries at respective frequency rates of 0.44 and 30.59 per million man-hours and a severity rate of 4,056 days lost or charged per million man-hours for all injuries. One major disaster (a single accident which results in the death of five or more persons) occurred during 1971 in the solid mineral mining industries, when seven men were killed by hydrogen sulfide gas in the Barnett Complex mine, Ozark-Mahoning Co., a fluorspar mine near Rosiclare, Ill. In 1970, there also was one major disaster, a coal dust explosion which claimed 38 lives in the interconnected Nos. 15 and 16 mines, Finley Coal Co., a bituminous-coal operation near Hyden, Ky.

This total experience covers an aggregate worktime of 769.1 million man-hours accumulated by an average of 379,500 men working on active days at mineral mining and milling operations extracting minerals in solid form, or if in liquid form, with men working below the surface. Data are included on underground, open pit, dredging, hydraulicking and all other operations within the preceding limitations. Milling or cleaning and associated surface shop and yard activities at such operations also are included.

The coverage of the 1971 injury and worktime data, as indicated by the foregoing definitions and the changed title of this chapter, was limited to those mineral fuel and mineral mining and processing

establishments covered by the Federal Coal Mine Health and Safety Act (30 U.S.C. 921) and the Federal Metal and Non-metallic Mine Safety Act (30 U.S.C. 732). The limited coverage was required by the Federal Occupational Safety and Health Act (Public Law 91-596) which became effective April 28, 1971. As a result, the Bureau of Mines ceased collection of injury and worktime data on the oil and natural gas, sulfur, salt and other saline minerals obtained from wells or by evaporation, coke, primary nonferrous metal reduction and refining, and slag industries. These responsibilities were transferred to the Department of Labor, Bureau of Labor Statistics. For 1970 and earlier years, the data on the aforementioned industries had been considered part of and included in the total figures for the mineral industries. Annual injury and worktime statistics on these industries are available in earlier Minerals Yearbooks or in other Bureau of Mines reports; for example, such data on the coke industry started in 1916 and on the oil and gas industries in 1942.

The 1971 data on the mineral industry subgroups by State in this chapter are comparable with those for earlier years except in the nonmetal mining group. In this latter subgroup, coverage was reduced, by the aforementioned transfer of collection responsibilities, for those States in which nonmetallic minerals are produced in liquid form from wells or by solar evaporation. Such operations include those

¹ Statistician (general), Health and Safety.

producing sulfur by the Frasch process, salt by solution mining or solar evaporation, sodium and potassium compounds from dry lake beds, and others. Comparability of the 1971 data on the nonmetal group by State was affected further by the inclusion of the injury and worktime data on the peat industry for the first time. In years prior to 1971, such data had been treated separately. This inclusion resulted from an administrative action which placed peat operations under the Federal Metal and Nonmetallic Mine Safety Act.

Mine Safety Legislation and Regulations.

—Activities under the Federal Coal Mine Health and Safety Act of 1969 (30 U.S.C. 821) continued to accelerate through 1971.² The number of mine inspectors, engineers, specialists and aides in the field totaled 1,055 at the end of 1971 compared with 564 at the close of 1970. During 1971 more than 26,500 health and safety inspections of coal operations were made; 1,847 roof-control and 1,625 ventilation-dust control plans were approved, and more than one-third million coal dust samples were processed. Noise surveys covering nearly 23,000 miners revealed that fewer than 5 percent were subjected to the excessive noise levels established by the standard. Dust control measures by the industry were effective, and at the end of 1971, more than 90 percent of the underground mining sections were in compliance with the standard of not more than 3.0 milligrams of respirable dust per cubic meter of air.

Title IV of the Coal Mine Health and Safety Act of 1969 established coal workers' pneumoconiosis (black lung) as a compensable occupational disease and provided for monthly benefit payments to coal miners totally disabled due to pneumoconiosis and to widows and dependents of miners who died from the disease. From the start of the program up to the end of 1971, a total of 347,700³ claims had been filed and of these 322,500 had been processed. Of the claims completed by December 31, 1971, 159,500 were allowances (88,100 miners and 71,400 widows) and 163,000 were denials (125,000 miners and 38,000 widows). By the end of the year, 9,900 allowances (7,200 miners and 2,700 widows) had been terminated. The total cumulative

Federal disbursements since enactment of the program to the end of 1971 were \$532.6 million and current monthly recurring payments at the end of the year were \$28.0 million.

Activities under the Federal Metal and Nonmetallic Mine Safety Act (30 U.S.C. 732) were increased through 1971. A total of 8,457 inspections, comprising 5,174 regular and 3,283 spot inspections, of metal, nonmetal, stone, and sand and gravel operations were made during the year. In 1970, a total of 2,088 inspections were made. In addition, 74 special surveys, concerned mainly with radiation, dust, and noise problems in mine and mill environments, were conducted in 1971. State plan agreements provide for enforcement of the act by State agencies. Of the four agreements in effect at the end of 1971, those with the States of Arizona and Colorado were effective throughout the year and those with California and New York became effective during July and August.

Scope of Report.—The statistics in this chapter comprise the disabling injury and work experience of all personnel engaged in production, exploration, development, maintenance, repair, and force-account construction work, including supervisory and technical personnel, and working partners at solid mineral producing and processing establishments in the United States. Data concerning officeworkers are excluded.

The coverage of the industries is complete. All injury rates are calculated from unrounded data, and in some instances the rates cannot be reproduced from rounded data shown in the tables. Most of the information was reported by the producer or operator, but to obtain complete coverage it was necessary to estimate some worktime data for nonreporting plants with information from other sources. Injury experience for these nonreporters was not estimated but was projected from the aggregate injury experience of reporters in the same industry.

Detailed statistics on work stoppages and information on the Bureau's annual safety

² Department of the Interior. *Moving Forward in Coal Mine Health and Safety*. 1971 Annual Report of the Secretary of the Interior, 84 pp.

³ Department of Health, Education, and Welfare, Social Security Administration. *Second Annual Report to Congress on the Administration of Part B of Title IV of the Federal Coal Mine Health and Safety Act of 1969*. June 1972, 25 pp.

competitions have been transferred from this chapter to the companion chapter in volume I of the Minerals Yearbook. The companion chapter provides national information on specific component industries within the major mineral-industry subgroups given herein by State.

Injury Experience.—The injury records of the major subgroups of the solid mineral mining industries varied within a relatively wide range in 1971, as measured by the injury-frequency and -severity rates shown in the summary section at the end of table 1.

The safety record of the coal mining industry during 1971 improved in fatality experience but worsened slightly in nonfatal injury experience. Work fatalities in 1971 totaled 180 and occurred at a frequency rate of 0.71 per million man-hours of worktime. Both measures of fatality experience were better than for any other year of statistical history. The previous low annual fatality record was established in 1969 when 203 work deaths occurred at a frequency rate of 0.85. The fatality total in 1971 was 80 less than in 1970, when 260 fatal work injuries had a frequency rate of 1.00. There were no major disasters (a single accident which results in the death of five or more persons) in coal mines during 1971, whereas in 1970 a coal-dust explosion in the underground workings of a bituminous-coal mine at Hyden, Ky., claimed the lives of 38 men. Owing primarily to the better fatality record in 1971, the severity rate for all injuries decreased to 6,407 days lost or charged per million man-hours, 23 percent better than that of 8,308 in 1970.

The estimated total of 11,380 nonfatal work injuries during 1971 occurred at a frequency rate of 45.14 per million man-hours. This total was 172 less than that of 1970, but the rate of occurrence was 2 percent higher than that of 44.40 in 1970, owing to the reduced worktime in the current year. The frequency rate of nonfatal injuries in 1971 was the highest annual rate since 1957, when it was 46.04 per million man-hours. Aggregate worktime of 252 million man-hours in 1971 was 3 percent lower than in 1970, owing largely to the widespread work-stoppage in bituminous-coal mines which greatly reduced mining activity during October and the first half of November 1971. This stoppage involved 80,000 men and resulted in the loss of 257

million man-days of work, according to the Department of Labor.

Overall injury experience at metal mines and mills during 1971 was 56 fatal and 3,815 nonfatal injuries at respective frequency rates of 0.37 and 24.88 per million man-hours and a severity rate of 3,241 days lost or charged per million man-hours. These injuries occurred during a total worktime of 153.3 million man-hours at metal mines and mills during the year. Each of these general measures of safety experience was better than in the preceding year. There were nine fewer fatal and 428 fewer nonfatal injuries than in 1970 and the frequency and severity rates for all injuries were improved, respectively, by 3 and 8 percent.

The safety record at all nonmetal (except stone, and sand and gravel) mining operations producing solid minerals in 1971 was 24 fatal and 2,310 nonfatal injuries at respective frequency rates of 0.28 and 27.39 per million man-hours and a severity rate of 2,989 days lost or charged per million man-hours. A major disaster in April killed seven men in the Barnett Complex mine, a fluorspar operation (miscellaneous nonmetal group) of the Ozark-Mahoning Co., near Rosiclare, Ill. The men died from exposure to hydrogen-sulfide gas which was released from pressurized water entering the underground workings through an exploratory drill hole. The last previous major disaster in nonmetal mining occurred in 1968 when a shaft fire in a Louisiana salt mine killed 21 men.

Fatalities at sand and gravel plants decreased to 25, or four fewer than in 1970, and this decrease was primarily responsible for the better overall injury-severity rate of 2,552 days lost or charged per million man-hours in 1971, 11 percent better than in 1970. However, nonfatal injuries increased to a total of 2,130, 85 more than in 1970. The larger total coupled with the slight decrease in man-hours of worktime resulted in a frequency rate of 22.76 per million man-hours for all injuries in 1971, 4 percent higher than in 1970.

All general measures of injury experience at stone quarries and mills retrogressed in 1971. The totals of 57 fatal and 3,895 nonfatal injuries at all stone operations in 1971 were, respectively, 14 and 229 higher than in 1970. As a result, the combined frequency rate for all injuries in

1971 advanced to 21.40 per million man-hours, 6 percent worse than in 1970. Similarly, the overall injury-severity rate of 2,784 days lost or charged per million

man-hours in 1971 was 21 percent higher than in the preceding year. Total worktime of 184.6 million man-hours in 1971 was only slightly higher than in 1970.

STATE DATA

The solid mineral mining industries of Idaho, in which metal mining was dominant, had the highest injury-frequency rates of any State in 1971. The rate of 61.03 was 2 percent worse than that of 59.85 in 1970. Mineral mines and mills in West Virginia, where coal mining predominates, ranked second highest in injury-frequency with a rate of 55.24 in 1971, virtually the same as that of 55.76 in 1970. In Hawaii, Kentucky, and Connecticut, the mineral industries had respective frequency rates of 49.98, 46.27, and 45.10, the third, fourth, and fifth highest of any State.

Mineral mines and mills in Idaho in 1971 also had the worst injury-severity rate, 8,759 days lost or charged per million man-hours, than these industries had in any other State. The next highest injury-severity rates were for the mineral industries in Washington (7,968), Tennessee (7,888), Kentucky (7,241), and Virginia (6,713).

The mineral industries of Kentucky had the largest number of work fatalities, 45 in 1971. States ranking next in number of mineral industry fatalities in 1971 were West Virginia (42), Pennsylvania (40), Illinois (26), and Virginia (20). States ranked by number of nonfatal work injur-

ies in mines and processing plants during 1971 were West Virginia (4,304), Kentucky (2,268), Pennsylvania (2,022), Virginia (1,222), and Illinois (1,215).

Of the States with major mineral industry activity (more than 10 million man-hours of worktime) in 1971, mines and associated plants had the lowest injury-frequency rates in Minnesota (10.24), Florida (15.74), Alabama (18.27), Wyoming (19.85), and New York (20.80). Similarly, the better injury-severity rates in 1971 were for the mineral industries in Minnesota (697), New York (1,071), Montana (1,298), Texas (1,407), and Louisiana (1,566).

The magnitude of solid mineral mining and milling activity in the ranking States, as gaged by worktime in thousands of man-hours, was as follows for 1971: West Virginia (78,672), Pennsylvania (76,964), Kentucky (49,971), Ohio (36,126), and Arizona (35,831). States with the largest number of man-hours worked (in thousands) within the general groupings of mining and milling industries were as follows: Coal—West Virginia (75,019), metal—Arizona (31,243), nonmetal—Georgia (9,571), sand and gravel—California (12,431), and stone—Pennsylvania (17,132).

ACTIVE OPERATIONS

The number of active mineral extractive and processing establishments in the United States during 1970 is listed in table 1 by States for each of the general subgroups of the mineral industries. For the nonmetal group, these counts include those establishments extracting minerals in liquid form from wells or by solar evaporation. The counts of active operations for 1971 are not yet available.

Producers and processors of minerals reported 25,112 active mines, quarries, pits, dredges, brine, well, and other types of

mineral extractive operations in 1970. The largest numbers of mining establishments, active during all or part of 1970, were in Kentucky (2,015), Pennsylvania (1,751), West Virginia (1,500), California (1,307), and Colorado (1,118). States with the largest number of active mines within the general industry subgroups were as follows: Coal—Kentucky (1,803), metal—Colorado (465), nonmetal—California (176), sand and gravel—California (725), and stone—Wisconsin (392). Active mineral cleaning and processing plants totaled 5,042 in 1970.

WORK STOPPAGES

A total of 656 work stoppages in the solid mineral industries during 1971 resulted in an aggregate time loss of 4.9 million man-days of work, according to the Bureau of Labor Statistics, U.S. Department of Labor. Most of the strikes, 606, were in the bituminous-coal industry and caused an aggregate loss of 4.2 million man-days of work. More than half of this lost work-time occurred in the widespread strike

from October 1 until the middle of November during the industry-labor contract negotiations. The only other sizable time loss (591,100 man-days) at solid mineral operations during 1971 was from the two strikes in copper mining. Detailed statistics on work stoppages can be found in the chapter on injury experience in volume I of the Minerals Yearbook.

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

State and industry group	Average men working daily		Man-days worked (thousands)		Man-hours worked (thousands)		Number of injuries				Injury rates per million man-hours				Count of operations 1970	
	1970	1971	1970	1971	1970	1971	Fatal		Nonfatal		Frequency		Severity		Mines	Mills
							1970	1971	1970	1971	1970	1971	1970	1971		
Alabama:	5,026	4,915	1,211	1,110	9,571	8,886	7	6	173	224	18.81	25.88	5,917	5,309	135	20
Coal.....	895	580	273	180	2,231	1,477	-	-	27	27	12.10	5.43	815	213	11	4
Metal.....	770	755	1,947	1,580	1,647	1,580	1	1	18	98	13.54	21.52	4,004	4,051	43	27
Sand and gravel.....	582	550	1,222	1,25	1,158	1,222	1	1	20	19	18.14	13.91	9,472	5,725	78	57
Stone.....	2,431	2,320	672	656	5,569	5,443	1	-	54	51	9.88	9.36	1,400	1,439	68	57
Total or average.....	9,654	9,070	2,485	2,273	20,177	18,613	10	8	292	332	14.97	18.27	4,154	3,692	335	108
Alaska:	86	95	21	22	171	183	-	-	10	12	58.55	65.45	820	916	4	1
Coal.....	215	220	32	34	292	289	-	-	22	17	76.44	58.88	4,242	1,139	64	3
Metal.....	13	15	3	3	26	27	-	-	38	41	22.48	26.50	556	703	92	1
Nonmetal.....	1,208	1,075	197	198	1,691	1,685	1	-	17	17	25.17	24.80	9,128	516	25	21
Sand and gravel.....	1,391	360	80	86	715	-	-	-	-	-	-	-	-	-	-	-
Stone.....	1,913	1,765	333	343	2,894	2,744	1	-	87	87	30.40	31.71	3,062	710	186	26
Total or average.....	79	100	5	25	42	196	-	-	17	19	407.17	97.01	3,904	970	2	28
Arizona:	12,097	12,210	4,048	3,903	32,436	31,243	8	11	763	807	23.77	26.18	2,487	3,001	159	48
Coal.....	257	285	61	61	460	490	-	-	5	5	10.87	44.94	3,427	1,223	48	15
Metal.....	1,588	1,340	362	326	2,904	2,712	6	1	63	61	35.82	18,316	3,129	177	177	15
Nonmetal.....	487	490	136	148	1,088	1,191	-	-	9	26	8.27	21.83	111	459	93	37
Sand and gravel.....	14,453	14,425	4,605	4,463	36,930	35,831	14	13	857	942	23.59	26.65	3,207	3,055	479	80
Stone.....	140	150	23	23	184	188	-	-	4	4	21.72	21.30	380	833	12	5
Total or average.....	1,500	1,300	376	310	3,006	2,480	-	-	51	42	16.97	16.93	1,244	1,025	10	5
Arkansas:	963	950	236	1,898	1,874	1,874	-	-	56	72	29.51	38.42	743	1,454	65	17
Coal.....	914	960	225	2,093	1,988	1,988	-	-	40	46	20.12	21.98	970	1,385	290	50
Metal.....	1,338	1,430	378	395	3,208	3,320	-	-	77	78	24.00	23.79	1,983	2,489	92	50
Nonmetal.....	4,865	4,790	1,238	1,194	10,284	9,956	-	-	228	242	22.17	24.41	1,314	1,483	409	72
Sand and gravel.....	5	5	1	1	4	4	-	-	156	123	31.17	28.55	5,458	8,643	1	25
Stone.....	2,228	2,160	638	565	5,102	4,518	4	6	269	243	30.33	39.10	1,571	2,383	176	73
Total or average.....	3,868	2,750	1,108	773	8,903	6,214	1	-	300	300	26.08	24.45	4,466	2,828	725	107
California:	6,247	6,545	1,560	1,431	12,226	12,431	6	7	134	170	12.79	17.06	2,291	4,676	211	107
Coal.....	4,331	4,335	1,237	1,075	10,373	10,373	3	4	-	-	-	-	-	-	-	-
Metal.....	4,831	4,835	1,332	1,287	10,715	10,373	6	7	-	-	-	-	-	-	-	-
Nonmetal.....	12	12	1	1	11	11	-	-	-	-	-	-	-	-	-	-
Sand and gravel.....	16,741	15,795	4,580	4,176	36,960	33,541	13	17	859	886	23.59	25.43	3,270	4,100	1,307	203
Stone.....	16,741	15,795	4,580	4,176	36,960	33,541	13	17	859	886	23.59	25.43	3,270	4,100	1,307	203
Total or average.....	16,741	15,795	4,580	4,176	36,960	33,541	13	17	859	886	23.59	25.43	3,270	4,100	1,307	203

Colorado:															
Coal.....	1,292	1,420	380	344	2,596	2,713	--	1	96	114	36.98	42.38	2,736	3,346	53
Metal.....	4,388	4,300	1,192	1,116	9,547	8,926	6	3	458	411	48.08	46.38	6,101	4,608	28
Nonmetal.....	481	550	106	844	928	928	2	--	52	18	64.01	19.39	18,656	8,677	84
Sand and gravel.....	1,451	1,565	292	320	2,423	2,675	1	1	52	68	21.87	23.92	3,021	2,764	340
Stone.....	683	735	168	172	1,335	1,400	--	--	19	28	13.72	20.00	215	1,505	161
Peat.....	22	(¹)	3	(¹)	18	(¹)	--	(¹)	--	(¹)	--	--	--	(¹)	15
Total or average.....	8,317	8,570	2,091	2,069	16,812	16,644	9	5	672	634	40.51	38.39	5,276	3,634	1,118
Connecticut:															
Nonmetal.....	75	75	19	18	145	189	1	--	6	4	48.29	28.69	45,120	717	6
Sand and gravel.....	422	390	90	87	729	693	--	--	11	14	15.09	20.20	226	332	72
Stone.....	408	365	100	89	812	720	--	--	30	52	36.96	72.24	1,112	1,075	26
Total or average.....	905	825	209	194	1,686	1,552	1	--	47	70	28.47	45.10	4,513	711	104
Delaware:															
Nonmetal.....	2	(¹)	1	1	5	5	5	--	--	3	--	36.81	--	810	14
Sand and gravel.....	54	55	10	10	85	81	--	--	--	--	--	--	--	--	--
Total or average.....	56	55	11	11	90	86	--	--	3	--	34.68	--	--	763	15
Florida:															
Metal.....	149	145	53	53	427	422	--	1	43	78	6.05	8.91	862	1,422	40
Nonmetal.....	3,523	3,525	1,090	1,106	8,720	8,862	1	1	37	37	33.59	23.31	518	1,304	74
Sand and gravel.....	466	560	118	140	1,102	1,284	--	6	121	163	19.79	22.43	3,460	5,777	94
Stone.....	2,462	2,840	712	871	6,266	7,533	3	--	1	(¹)	13.66	(¹)	96	(¹)	9
Peat.....	38	(¹)	9	(¹)	73	(¹)	--	(¹)	--	--	--	--	--	--	--
Total or average.....	6,638	7,070	1,982	2,169	16,587	18,102	4	7	202	278	12.42	15.74	1,790	3,193	219
Georgia:															
Metal.....	120	120	37	33	309	318	--	2	2	7	6.48	22.01	55	421	5
Nonmetal and peat.....	3,592	3,875	1,077	1,189	8,684	9,571	--	1	228	251	26.49	26.33	2,496	1,843	78
Sand and gravel.....	227	280	61	61	549	549	1	--	11	15	22.33	27.31	11,496	4,444	23
Stone.....	2,348	2,910	737	769	6,446	6,711	1	2	165	148	25.75	22.35	1,994	2,390	87
Total or average.....	6,787	7,185	1,911	2,056	15,976	17,149	4	3	406	421	25.66	24.72	2,549	1,989	198
Hawaii:															
Nonmetal.....	79	80	11	9	86	75	--	--	5	3	53.32	39.84	1,225	385	22
Sand and gravel.....	48	65	7	9	60	67	--	--	3	2	50.20	29.78	954	596	16
Stone.....	542	540	155	146	1,273	1,158	--	--	57	60	44.76	51.81	1,552	724	40
Total or average.....	669	690	173	164	1,419	1,301	--	--	65	65	45.81	49.93	1,507	693	78
Idaho:															
Metal.....	2,252	2,255	578	565	4,617	4,510	1	6	365	352	79.27	79.33	3,891	10,881	103
Nonmetal and peat.....	418	455	91	99	740	818	1	1	12	11	17.57	14.76	8,302	7,509	23
Sand and gravel.....	693	685	116	108	685	837	--	--	21	24	21.36	27.05	477	8,574	154
Stone.....	329	300	61	63	489	476	--	--	9	7	14.42	29.42	475	466	29
Total or average.....	3,692	3,695	845	890	6,884	6,686	2	7	407	401	59.35	61.03	3,681	8,763	309

See footnotes at end of table.

Louisiana:														
Metal.....	1,236	1,160	451	424	3,609	8,391	1	--	17	22	4.99	6.49	1,908	408
Nonmetal.....	2,010	1,190	576	339	4,657	2,700	6	--	97	87	22.12	32.23	8,224	1,117
Sand and gravel.....	1,155	1,220	277	289	2,534	2,741	1	1	54	55	21.70	20.43	3,079	3,925
Stone.....	565	525	180	182	1,663	1,624	--	--	49	56	29.47	34.48	1,132	746
Total or average.....	4,966	4,095	1,485	1,245	12,463	10,456	8	1	217	220	18.05	21.14	4,403	1,566
Maine:														
Metal and peat.....	101	75	26	21	206	167	1	--	15	6	77.52	35.90	32,189	1,322
Nonmetal.....	56	75	10	13	82	106	--	--	3	8	36.61	75.57	708	2,645
Sand and gravel.....	695	780	134	147	1,201	1,267	--	--	21	13	17.49	10.26	329	2,449
Stone.....	195	320	60	93	495	750	--	2	5	24	10.11	34.66	75	16,501
Total or average.....	1,047	1,250	231	274	1,984	2,290	1	2	44	51	22.69	23.14	3,597	5,761
Maryland and District of Columbia:														
Coal and peat.....	342	315	67	59	541	481	1	--	5	4	11.10	8.32	11,529	391
Nonmetal.....	166	125	40	29	321	235	--	--	16	6	49.89	25.55	7,761	319
Sand and gravel.....	749	730	193	189	1,748	1,699	--	--	34	50	19.46	29.43	2,360	553
Stone.....	1,457	1,255	405	343	3,356	2,873	--	--	97	41	28.90	14.27	651	612
Total or average.....	2,714	2,425	706	621	5,965	5,287	1	--	152	101	25.65	19.10	2,144	560
Massachusetts:														
Nonmetal and peat.....	68	75	18	20	148	158	--	--	7	16	47.17	101.07	2,406	6,967
Sand and gravel.....	972	915	227	229	1,972	1,952	--	--	32	31	16.22	15.88	423	469
Stone.....	718	870	171	218	1,404	1,779	1	--	46	45	33.47	25.29	4,936	683
Total or average.....	1,753	1,855	417	467	3,525	3,889	1	--	85	92	24.40	23.65	2,304	831
Michigan:														
Metal.....	4,640	4,015	1,406	1,247	11,251	9,376	3	--	314	251	28.18	25.16	2,565	1,517
Nonmetal.....	1,719	910	508	224	4,147	1,855	2	--	87	52	21.46	28.04	3,409	561
Sand and gravel.....	2,651	2,470	571	555	4,835	4,786	1	1	117	125	24.41	26.33	1,988	3,178
Stone.....	2,976	3,090	876	850	7,122	7,001	--	1	57	82	8.00	11.86	251	1,238
Peat.....	173	(^b)	34	(^b)	311	(^b)	--	(^b)	5	(^b)	16.10	(^b)	230	(^b)
Total or average.....	12,159	10,485	3,396	2,877	27,665	23,617	6	2	580	510	21.18	21.68	1,969	1,696
Minnesota:														
Metal.....	8,397	8,095	2,755	2,585	22,042	20,683	8	--	86	92	4.26	4.45	2,432	423
Nonmetal.....	151	205	37	41	293	328	--	1	11	11	37.50	36.58	211	18,396
Sand and gravel.....	2,854	2,735	466	442	4,164	3,536	1	--	79	73	19.21	20.65	1,934	438
Stone.....	1,292	1,220	307	278	2,693	2,414	--	--	73	99	27.11	41.01	1,051	1,014
Peat.....	35	(^b)	3	(^b)	20	(^b)	--	(^b)	1	(^b)	49.52	(^b)	446	(^b)
Total or average.....	12,669	12,255	3,568	3,347	29,212	26,961	9	1	250	275	8.87	10.24	2,210	697
Mississippi:														
Nonmetal.....	718	530	178	127	1,435	1,028	--	--	33	23	22.99	22.38	968	287
Sand and gravel.....	686	690	155	180	1,429	1,642	--	--	33	33	27.29	20.09	702	649
Stone.....	135	120	28	28	214	230	--	--	1	--	4.67	--	135	4
Total or average.....	1,474	1,340	360	336	3,078	2,900	--	--	73	56	23.71	19.81	507	469

See footnotes at end of table.

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

State and industry group	Average men working daily		Man-days worked (thousands)		Man-hours worked (thousands)		Number of injuries		Injury rates per million man-hours						Count of operations 1970
	1970	1971	1970	1971	1970	1971	Fatal		Nonfatal		Frequency		Severity		
							1970	1971	1970	1971	1970	1971	1970	1971	
Missouri:															
Coal.....	490	525	155	156	1,155	1,178	1	1	41	89	36.96	33.94	6.097	5.942	11
Metal.....	8,047	2,950	892	815	7,154	6,821	4	6	866	260	54.16	40.79	4,767	6,448	19
Nonmetal.....	702	710	167	172	1,364	1,352	--	1	62	19	45.46	31.84	4,650	5,256	107
Sand and gravel.....	572	525	125	125	1,079	1,080	--	--	19	22	17.61	21.90	8,873	6,420	86
Stone.....	4,181	4,185	1,139	1,134	9,317	9,278	1	4	191	219	20.61	24.04	2,027	8,455	251
Total or average.....	8,992	8,890	2,478	2,401	20,069	19,439	6	13	699	588	35.13	30.66	3,328	4,908	474
Montana:															
Coal and peat.....	111	120	28	29	220	231	--	--	3	3	13.66	12.97	41	39	15
Metal.....	3,430	8,645	1,029	865	8,234	6,899	2	1	171	192	21.01	19.28	3,029	1,684	112
Nonmetal.....	416	455	110	124	892	990	--	--	28	38	31.38	38.37	5,740	945	20
Sand and gravel.....	1,016	940	152	142	1,313	1,177	--	--	31	31	23.61	26.34	704	637	166
Stone.....	459	465	117	113	942	901	--	--	21	13	22.28	14.43	632	308	44
Total or average.....	5,432	5,625	1,436	1,273	11,601	10,198	2	1	254	217	22.07	21.38	2,723	1,298	367
Nebraska:															
Metal.....	2	(¹)	(¹)	(¹)	(²)	(²)	--	--	--	--	--	--	--	--	2
Nonmetal.....	14	15	3	3	23	(³)	23	--	17	81	10.36	18.08	187	996	5
Sand and gravel.....	880	880	176	184	1,641	1,715	--	--	31	84	21.01	25.80	338	2,631	300
Stone.....	600	530	172	167	1,476	1,344	--	--	43	65	15.29	21.09	231	1,701	86
Total or average.....	1,446	1,430	352	344	3,140	3,082	--	--	43	65	15.29	21.09	231	1,701	343
Nevada:															
Metal.....	2,027	1,840	606	556	4,898	4,462	4	2	108	72	22.87	16.58	5,955	3,314	142
Nonmetal.....	739	765	185	191	1,492	1,534	--	--	51	42	34.17	27.37	2,343	1,143	46
Sand and gravel.....	418	450	87	719	750	--	--	1	12	10	16.69	14.67	452	3,190	15
Stone.....	294	300	82	86	681	712	--	--	21	16	30.85	22.48	835	770	21
Total or average.....	3,478	3,350	959	919	7,790	7,458	4	3	192	140	25.16	19.17	4,308	3,115	324
New Hampshire:															
Nonmetal.....	84	85	8	9	60	72	--	--	--	1	13.87	13.87	250	5	2
Sand and gravel.....	976	305	68	54	606	452	--	--	9	13	14.84	28.74	322	615	74
Stone.....	172	190	41	47	330	384	--	--	13	15	39.43	39.09	437	704	6
Total or average.....	582	535	117	110	997	908	--	--	22	29	22.07	31.94	340	623	85

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

State and industry group	Average men working daily		Man-days worked (thousands)		Man-hours worked (thousands)		Number of injuries		Injury rates per million man-hours				Count of operations 1970	Mines	Mills
	1970	1971	1970	1971	1970	1971	Fatal	Nonfatal	1970	1971	1970	1971				1970	1971
									Frequency	Severity	Frequency	Severity			
Oklahoma:															
Coal.....	561	600	144	145	1,120	1,143	2	3	52	50	48.21	46.38	18,970	17,372	4
Metal.....	176	170	49	41	398	325	--	--	18	14	45.74	43.07	1,987	1,864	4
Nonmetal.....	468	480	119	125	938	1,000	1	--	25	39	27.86	39.00	7,657	1,426	26
Sand and gravel.....	364	375	89	91	762	807	--	--	16	16	23.62	19.84	934	216	108
Stone.....	1,291	1,395	345	378	2,849	3,113	--	1	76	90	26.68	29.23	673	4,622	102
Total or average.....	2,860	3,025	747	779	6,058	6,387	3	4	189	209	31.69	33.35	4,322	5,706	249
Oregon:															
Coal.....	4	5	(²)	20	2	166	2	--	6	--	42.15	6.10	42,206	1,831	1
Metal.....	112	120	21	14	201	111	1	--	4	4	19.89	9.01	268	1,62	35
Nonmetal.....	1,271	1,360	277	277	2,321	2,321	2	1	51	59	24.07	25.85	6,285	3,386	205
Sand and gravel.....	1,425	1,395	309	319	2,475	2,605	1	--	83	84	33.94	32.24	4,934	613	287
Stone.....															187
Total or average.....	2,927	2,965	632	630	5,046	5,202	4	1	144	145	29.33	28.06	6,587	1,879	560
Pennsylvania:															
Bituminous coal.....	22,369	21,100	5,544	5,280	44,661	42,074	31	32	1,208	1,085	27.74	26.60	5,813	5,873	815
Anthracite.....	5,933	5,800	1,392	1,355	10,224	10,099	5	4	503	480	49.69	44.95	4,598	3,891	462
Metal.....	1,351	1,195	409	377	3,273	3,014	1	2	20	33	6.42	11.61	2,172	4,896	4
Nonmetal.....	1,065	1,170	274	297	2,213	2,401	--	--	77	91	34.80	37.90	1,880	845	75
Sand and gravel.....	1,181	1,075	273	252	2,873	2,243	2	--	80	83	34.55	37.00	8,337	934	105
Stone.....	7,901	7,495	2,176	2,073	13,066	17,132	5	2	273	280	15.39	16.46	2,720	1,449	280
Feat.....	55	(⁵)	13	(⁵)	90	(⁵)	--	(⁵)	4	(⁵)	44.34	(⁵)	3,303	(⁵)	10
Total or average.....	39,830	37,810	10,081	9,644	80,899	76,964	44	40	2,165	2,022	27.31	26.82	4,785	4,289	1,761
Rhode Island:															
Sand and gravel.....	165	160	31	30	258	242	--	--	6	7	23.26	23.89	988	351	13
Stone.....	43	50	11	12	90	92	--	--	2	4	22.10	43.44	199	3,312	4
Total or average.....	208	210	42	42	348	334	--	--	8	11	22.96	32.90	783	1,166	22
South Carolina:															
Nonmetal and peat.....	1,030	1,005	272	263	2,202	2,126	--	--	63	78	28.61	36.68	657	698	59
Sand and gravel.....	387	425	97	103	890	989	2	--	7	6	7.78	6.07	153	270	83
Stone.....	824	816	238	229	2,032	1,964	2	2	23	24	12.30	13.24	6,286	8,139	21
Total or average.....	2,241	2,245	607	594	5,133	5,079	2	2	93	108	18.51	21.66	2,797	3,492	113

INJURY EXPERIENCE AND WORKTIME IN THE MINERAL INDUSTRIES BY STATES 51

South Dakota:	1,621	1,680	506	520	4,058	4,167	3	1	98	91	24.89	22.08	5,805	2,712	31
Metal.....	1,194	1,155	42	26	340	215	--	1	14	11	41.19	55.71	1,539	28,362	58
Nonmetal.....	825	820	151	137	1,366	1,340	--	1	29	34	21.22	26.12	768	5,058	318
Sand and gravel.....	524	540	126	140	1,071	1,160	--	1	31	32	29.87	27.58	6,138	804	38
Stone.....															
Total or average.....	3,164	3,200	826	824	6,836	6,883	4	3	172	168	25.75	24.85	4,637	3,650	445
Tennessee:	1,910	1,870	367	336	3,015	2,799	1	8	98	120	31.18	45.74	3,508	19,252	168
Coal.....	1,721	1,740	467	451	3,740	3,610	2	5	103	97	28.08	28.26	6,019	12,085	15
Metal.....	661	815	171	206	1,435	1,697	--	--	39	38	27.18	19.45	761	668	62
Nonmetal.....	560	615	144	154	1,249	1,361	1	--	33	36	27.22	26.45	5,918	918	80
Sand and gravel.....	2,681	2,755	686	726	5,885	6,151	4	3	135	123	23.62	20.49	6,181	3,787	137
Stone.....															
Total or average.....	7,523	7,790	1,835	1,874	15,323	15,617	8	16	403	409	26.82	27.21	5,087	7,888	462
Texas:	120	130	36	37	290	296	--	--	5	5	17.24	16.90	228	220	2
Coal.....	1,732	1,685	561	453	4,507	3,646	2	--	50	40	11.54	10.97	3,700	452	21
Metal.....	2,954	1,980	856	530	6,914	4,358	5	--	147	139	21.99	31.90	5,286	681	134
Nonmetal.....	1,914	1,930	494	500	4,575	4,736	5	--	126	120	27.54	25.34	1,724	758	275
Sand and gravel.....	4,266	4,310	1,291	1,294	11,074	11,104	2	2	247	233	22.48	21.16	2,198	2,314	230
Stone.....															
Total or average.....	10,936	9,990	3,239	2,813	27,360	24,140	9	2	575	537	21.35	22.33	3,126	1,407	662
Utah:	1,440	1,585	323	336	2,531	2,544	5	2	186	222	75.45	84.72	15,999	9,806	23
Coal.....	5,210	5,155	1,645	1,581	13,159	12,545	3	4	241	210	18.54	16.92	2,336	2,473	179
Metal.....	1,042	585	267	133	2,133	1,068	1	1	77	34	36.57	32.76	4,820	6,544	71
Nonmetal.....	1,505	385	103	76	834	667	1	1	14	18	17.99	28.50	7,560	18,967	165
Sand and gravel.....	338	345	101	93	810	743	--	--	11	11	13.57	14.80	590	851	38
Stone.....															
Total or average.....	8,535	8,055	2,440	2,219	19,467	17,768	10	8	529	495	27.69	28.31	4,536	4,264	466
Vermont:	333	335	92	92	743	743	--	--	22	24	29.63	32.32	315	8,694	6
Nonmetal and peat.....	1,291	1,265	323	309	2,681	2,502	--	1	79	60	29.46	24.38	1,043	8,178	41
Sand and gravel.....															
Stone.....															
Total or average.....	1,854	1,890	451	449	3,755	3,701	--	1	109	91	29.03	24.85	924	8,925	101
Virginia:	10,715	10,080	2,349	2,113	18,757	16,951	27	16	1,143	928	62.38	55.69	12,709	8,479	797
Coal.....	288	280	75	69	598	551	--	1	37	40	61.90	74.43	1,476	11,332	2
Metal.....	563	735	156	200	1,255	1,606	--	--	34	20	27.09	12.45	3,232	4,126	31
Nonmetal.....	553	530	131	132	1,200	1,165	1	--	24	21	20.83	18.08	6,911	7,466	83
Sand and gravel.....	3,538	3,540	924	929	7,656	7,782	3	8	148	213	18.72	27.76	8,497	8,991	141
Stone.....															
Total or average.....	15,657	15,165	3,635	3,442	23,466	23,055	81	20	1,386	1,222	48.09	44.27	9,448	6,713	1,054

See footnotes at end of table.

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

State and industry group	Average men working daily		Man-days worked (thousands)		Man-hours worked (thousands)		Number of injuries		Injury rates per million man-hours				Count of operations 1970	
	1970		1971		1970		1971		Frequency		Severity			
	1970	1971	1970	1971	1970	1971	Fatal	Nonfatal	1970	1971	1970	1971	1970	1971
Washington:														
Coal.....	69	75	16	17	130	139	--	10	12	77.14	86.23	1,651	1,811	4
Metal.....	277	265	74	70	589	561	3	42	35	76.34	62.42	32,229	2,490	16
Nonmetal.....	57	95	9	16	74	125	--	3	3	28.94	23.94	7,734	314	2
Sand and gravel.....	1,176	1,100	231	217	1,852	1,753	1	44	50	24.29	29.66	4,163	7,767	814
Stone.....	991	1,155	203	211	1,625	1,689	3	36	27	22.15	17.77	1,164	11,040	274
Feat.....	15	(¹)	2	(¹)	11	(¹)	--	--	(¹)	--	(¹)	--	(¹)	10
Total or average.....	2,585	2,695	535	531	4,282	4,267	4	132	127	31.76	30.94	6,730	7,968	639
West Virginia:														
Coal.....	46,171	45,700	9,943	9,457	78,825	75,019	66	40	4,445	4,220	57.23	56.79	8,119	6,142
Nonmetal.....	184	160	42	37	338	293	--	7	4	20.70	13.64	121	317	11
Sand and gravel.....	307	285	68	64	625	698	--	15	22	24.01	31.51	360	1,431	14
Stone.....	1,182	1,315	303	326	2,455	2,661	1	2	52	21.69	22.55	3,221	6,282	54
Total or average.....	47,844	47,470	10,357	9,883	82,243	78,672	67	42	4,519	4,304	55.76	55.24	7,881	6,083
Wisconsin:														
Metal.....	329	245	92	66	740	527	--	37	12	49.99	22.75	1,952	595	10
Nonmetal.....	21	30	2	4	17	35	--	1	1	58.43	25.89	2,454	473	2
Sand and gravel.....	1,977	1,725	370	327	3,274	2,820	1	2	68	71	21.07	25.89	2,947	4,974
Stone.....	1,711	1,805	373	386	3,133	3,301	2	--	97	95	31.59	28.78	4,622	607
Feat.....	9	(¹)	2	(¹)	15	(¹)	--	(¹)	(¹)	--	(¹)	--	(¹)	2
Total or average.....	4,047	3,805	838	783	7,181	6,683	3	2	203	178	23.69	26.93	3,568	2,445
Wyoming:														
Coal.....	526	575	123	130	936	1,001	--	1	26	31	27.78	31.97	1,528	7,723
Metal.....	1,922	1,985	511	565	4,491	5,065	1	3	118	112	26.50	22.71	2,118	4,168
Nonmetal.....	1,432	1,535	441	450	3,572	3,670	--	34	36	9.52	9.81	331	116	37
Sand and gravel.....	1,752	1,660	151	118	1,211	977	--	24	27	19.82	27.64	541	1,039	
Stone.....	215	275	50	57	410	474	1	--	5	12	14.63	25.33	14,929	445
Total or average.....	4,895	5,030	1,276	1,320	10,620	11,187	2	4	207	218	19.68	19.85	1,780	2,731
United States totals: ⁵														
Coal.....	144,480	142,400	32,814	31,527	260,169	252,062	260	180	11,552	11,380	45.40	45.86	8,308	6,407
Feat.....	542	542	91	91	763	763	--	14	14	18.36	18.36	587	123	
Metal.....	67,643	65,400	20,553	19,084	165,091	153,345	65	56	4,243	3,815	26.09	25.24	3,536	3,241
Nonmetal.....	42,461	38,400	11,083	10,453	94,707	84,278	23	24	2,894	2,310	25.57	27.67	2,917	2,989
Sand and gravel.....	50,674	50,500	10,034	10,977	95,067	94,766	29	25	2,045	2,180	21.82	22.76	2,853	2,552
Stone.....	82,010	82,800	22,082	22,126	134,225	134,615	43	57	3,666	3,895	20.13	21.40	2,292	2,784
Total or average.....	387,810	379,500	98,339	94,167	800,021	769,088	425	342	23,914	23,530	30.42	31.04	4,644	4,056

Oil and natural gas ¹	462,468	(?)	NA	(?)	972,278	(?)	134	(?)	9,989	(?)	10.41	(?)	1,281	(?)	NA
Coke.....	13,997	(?)	4,937	(?)	39,554	(?)	8	(?)	260	(?)	6.78	(?)	1,562	(?)	71
Blast-furnace slag.....	1,647	(?)	441	(?)	3,602	(?)	1	(?)	72	(?)	20.27	(?)	2,072	(?)	61
Primary nonferrous smelting and refining.....	44,674	(?)	15,587	(?)	124,692	(?)	8	(?)	1,525	(?)	12.29	(?)	1,056	(?)	92
Grand total or average ² ...	910,596	379,500	NA	94,167	1,940,146	769,088	576	342	35,760	23,530	18.73	31.04	2,660	4,056	NA

NA Not available.
¹ Data for 1970 are final; those for 1971 are preliminary. As explained in the text, State data for 1971 are comparable in coverage with 1970 for all industry groups except "Nonmetal," for which coverage may have been reduced in 1971 if any nonmetals, such as potash, salt, sulfur, or saline minerals, were produced from wells or by evaporation.
² Less than 500.
³ Beginning with 1971, data on peat are included in the nonmetal industry.
⁴ Less than 3.
⁵ Data may not add to totals shown because of independent rounding.
⁶ Includes data on officeworkers.
⁷ Data not collected by the Bureau of Mines. Under the Federal Occupational Safety and Health Act of 1970 (P.L. 91-596), responsibilities for data subsequent to 1970 on these industries was transferred to the Departments of Labor and Health, Education, and Welfare. See text.

Table 2.—Worktime and injury experience in the mineral industries ¹

Year	Average men working daily	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours		
			Fatal	Nonfatal	Frequency		Severity
					Fatal	Nonfatal	All injuries
1967-----	900,240	1,863,349	512	31,360	0.27	16.83	2,468
1968-----	904,436	1,901,322	607	31,254	.32	16.44	2,741
1969-----	891,068	1,884,890	510	32,240	.27	17.10	2,431
1970-----	910,596	1,940,146	576	35,760	.30	18.43	2,660
1971 ^p -----	379,500	769,088	342	23,530	.44	30.59	4,056

^p Preliminary.

¹ Data for 1971 cover only the solid mineral mining industries as detailed in the text. These data are not comparable with those for 1967-70 which in addition covered the oil and natural gas, sulfur, salt and other saline minerals obtained from wells or by evaporation, coke, primary nonferrous metal reduction and refining, and slag industries.

The Mineral Industry of Alabama

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

By H. L. Riley ¹ and W. Everett Smith ²

Alabama's index of industrial production remained about the same as in 1970. Bituminous coal production decreased, partly as a result of the coal miners' strike, the sharp reduction in the number of underground mines, and reduced productivity. Coke, pig iron, and steel manufacture were less than in 1970. Reported shipments of portland cement from Alabama plants declined.

Mineral production values decreased to \$291,492,000 from \$323,245,000 in 1970. Coal, cement, petroleum, and stone accounted for 87.5 percent of the total value of mineral production, with coal alone accounting for 50.1 percent.

Alabama ranked second in the Nation in the production of bauxite, and scrap and flake mica, and fifth in kaolin.

The number of persons employed in the nonagricultural sector in 1971 averaged 1,010,000 per month, compared with 1,006,000 per month in 1970.

The value of exports from the Mobile Customs District declined 18.0 percent to \$383.2 million; imports were valued at \$271.1 million or 6.6 percent higher than in 1970.

¹ Mining engineer, Division of Fossil Fuels.

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

Table 1.—Mineral production in Alabama ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement: ²				
Masonry..... thousand 280-pound barrels..	2,402	\$7,601	2,493	\$8,657
Portland..... thousand 376-pound barrels..	16,053	51,114	12,149	42,281
Clays..... thousand short tons	2,748	8,213	³ 2,915	6,913
Coal (bituminous)..... do	20,560	166,308	17,945	146,180
Iron ore..... long tons	W	W	415,384	2,773
Lime..... thousand short tons	749	10,286	761	11,454
Natural gas..... million cubic feet	627	87	355	54
Petroleum (crude)..... thousand 42-gallon barrels	7,263	20,627	7,832	23,496
Sand and gravel..... thousand short tons	6,725	8,144	6,674	7,513
Stone..... do	19,982	37,166	17,773	34,413
Value of items that cannot be disclosed:				
Asphalt (native), bauxite, cement (slag), natural gas liquids, mica (scrap), phosphate rock (1970), salt, stone (dimension, 1970), talc, and values indicated by symbol W.....	XX	13,699	XX	7,758
Total.....	XX	323,245	XX	291,492
Total 1967 constant dollars.....	XX	289,143	XX	^p 253,248

^p Preliminary. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

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

² Excludes slag cement; included with "Value of items that cannot be disclosed."

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

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

County	1970	1971	Minerals produced in 1971 in order of value
Autauga	\$171	\$178	Sand and gravel.
Baldwin	W	W	Clays.
Barbour	1,725	2,488	Bauxite, clays, sand and gravel.
Bibb	7,057	5,732	Coal, stone, clays, sand and gravel.
Blount	2,253	3,107	Coal, slag cement, masonry cement.
Calhoun	2,942	2,891	Clays, stone, sand and gravel.
Chilton	W	W	Sand and gravel.
Choctaw	2,501	--	
Clarke	W	W	Do.
Cleburne	--	47	Do.
Coffee	40	56	Do.
Colbert	W	W	Stone, native asphalt.
Covington	W	--	
Crenshaw	W	W	Iron ore, sand and gravel.
Cullman	W	1,453	Coal.
Dale	W	W	Sand and gravel.
Dallas	W	W	Sand and gravel, stone.
De Kalb	W	W	Coal, stone.
Elmore	W	W	Sand and gravel, clays.
Escambia	W	W	Do.
Etowah	W	W	Stone, coal.
Fayette	W	210	Sand and gravel.
Franklin	4,157	3,546	Iron ore, stone, sand and gravel, coal, clays.
Geneva	W	W	Sand and gravel.
Hale	W	W	Do.
Henry	W	W	Bauxite, clays.
Houston	W	W	Sand and gravel.
Jackson	W	W	Coal, stone.
Jefferson	133,878	104,846	Coal, cement, stone, clays, iron ore.
Lee	W	W	Stone.
Limestone	W	82	Do.
Lowndes	W	W	Clays, sand and gravel.
Macon	W	313	Sand and gravel.
Madison	W	W	Stone, clays.
Marengo	W	W	Cement, stone.
Marion	W	W	Coal, clays.
Marshall	W	W	Stone, sand and gravel, clays.
Mobile	29,838	13,475	Cement, stone, sand and gravel, clays.
Monroe	84	W	Natural gas liquids, sand and gravel.
Montgomery	1,634	W	Sand and gravel, clays.
Morgan	2,140	W	Stone.
Pike	W	--	
Randolph	W	W	Mica (scrap).
Russell	W	W	Clays, sand and gravel.
St. Clair	W	7,522	Cement, stone, clays.
Shelby	32,425	33,378	Lime, cement, stone, coal, clays.
Sumter	W	W	Clays, sand and gravel.
Talladega	11,997	8,786	Stone, talc, iron ore.
Tuscaloosa	12,339	W	Coal, sand and gravel.
Walker	38,744	30,706	Coal, clays.
Washington	W	W	Salt, stone.
Winston	W	1,799	Coal.
Undistributed ²	39,319	70,878	
Total ³	323,245	291,492	

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

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

² Includes value of natural gas, petroleum, some sand and gravel, and values indicated by symbol W.

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

Table 3.—Indicators of Alabama Business activity

	1970	1971 ^P	Change, percent
Monthly average employment:			
Total nonagricultural..... thousands..	1,006.0	1,010.0	+0.4
Manufacturing..... do.....	317.9	324.4	+2.0
Nonmanufacturing..... do.....	682.6	692.1	+1.4
Personal income:			
Total..... millions..	\$9,832	\$10,610	+7.9
Per capita..... do.....	\$2,849	\$3,050	+7.1
Construction activity:			
Total building contracts.....	1,036	1,189	+14.8
Value of residential construction..... millions..	\$423	\$570	+34.8
Value of nonresidential construction..... do.....	\$305	\$303	-.7
Farm marketing, cash receipts..... do.....	\$741.6	\$803.0	+8.3
Mineral production value..... do.....	\$523.2	\$291.5	-9.8
Utility consumption:			
Total consumption of electrical energy..... billion kilowatt hours..	34.0	34.6	+1.8
Consumption for industrial purposes..... do.....	19.0	19.1	+.5
Foreign trade, Mobile Customs District: ¹			
Value of exports..... millions..	\$473.1	\$433.2	-8.4
Value of imports..... do.....	\$266.0	\$276.8	+4.1

^P Preliminary.¹ Includes period from October 1969 through September 1970 and from October 1970 through September 1971.

Sources: Alabama Business, Center for Business and Economic Research, University of Alabama; Survey of Current Business.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Coal.....	5,026	241	1,211	9,571	7	173	18.81	5,917
Metal.....	895	305	273	2,231	--	27	12.10	815
Nonmetal.....	770	265	204	1,647	1	13	11.54	4,004
Sand and gravel.....	532	236	125	1,158	1	20	18.14	9,472
Stone.....	2,431	276	672	5,569	1	54	9.88	1,400
Total ¹	9,654	257	2,485	20,177	10	292	14.97	4,154
1971: ^P								
Coal.....	4,915	226	1,110	8,886	6	224	25.88	5,309
Metal.....	530	340	180	1,477	--	8	5.41	213
Nonmetal.....	755	255	193	1,530	1	33	21.52	4,051
Sand and gravel.....	550	246	135	1,222	1	16	13.91	5,725
Stone.....	2,320	283	656	5,448	--	51	9.36	1,439
Total ¹	9,070	251	2,273	18,613	8	332	18.27	3,692

^P Preliminary.¹ Data may not add to totals shown because of independent rounding.

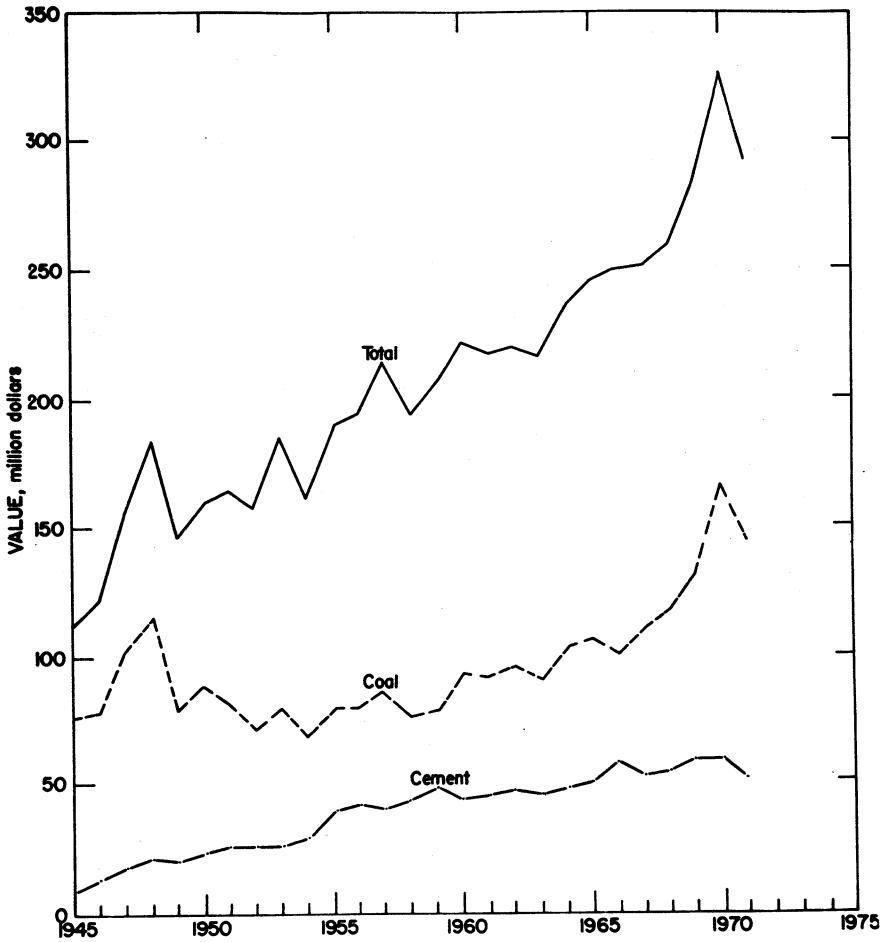


Figure 1.—Value of coal, and cement, and total value of mineral production in Alabama.

Trends and Developments.—The Alabama State Legislature gave final approval to a bill authorizing \$15 million in revenue bonds for construction of a new bulk handling facility on an island in Mobile Harbor. A severance tax of 13.5 cents per ton

on all coal mined in Alabama was enacted to pay the debt service on the bonds.

The oil and gas severance tax was increased from 6 to 7 percent. One percent will be paid to the county where the oil and gas were produced.

The Bureau of Mines published one report on heavy mineral resources in the Southeastern United States.³

During the year the Geological Survey of Alabama was engaged in 227 projects directed toward energy resources, minerals evaluation, paleontology, stratigraphy, geologic mapping, water resources evaluation, geophysics, geochemistry, environmental problems, and urban planning. During the year the Geological Survey released 19 reports dealing with geology, mineral, and water resources, and six maps describing geology, and mineral and water resources in specific counties.

United States Steel Corp. (USS) announced plans to build two bottom-blow oxygen steel converters which USS refers to as Q-BOP units. These converters are the largest of their kind in the world and have a design capacity of 200 tons of steel per unit per heat, which is estimated to require about 30 minutes.

Revere Copper and Brass, Inc., activated their 336-cell aluminum reduction plant on Goose Pond Island, in Jackson County. The initial annual production was 112,000 tons of aluminum. Alumina to supply the reduction plant will be shipped from this company's plant in Jamaica, West Indies. The alumina will be barged via the Ten-

nessee River to new unloading facilities on Goose Pond Island.

Republic Steel Corp. announced the opening of an underground coal mine in the Pratt coalbed in Fayette and Tuscaloosa Counties. The mine was designed to supply 50 million tons of coal over a 25-year period to the Alabama Power Co. The output will be used to fuel an 850,000-kilowatt steam-electric generating plant near Wilsonville, in Shelby County. Plans are to transport the coal by unit train from the mine to the plant.

As the result of construction delays at the Brown's Ferry nuclear plant in north-west Alabama, the Tennessee Valley Authority (TVA) began installing gas turbine electric generating units to increase the reserve margin of their system. Eight of these gas turbines with a capacity of 476,000 kilowatts are planned to be installed at the Colbert steam-electric generating plant in Colbert County. The TVA constructed a pilot scrubber using alkali slurries to test removal of sulfur oxides from the stack gases at the Colbert steam plant.

Design work began on a full-scale wet-scrubber-type sulfur dioxide removal facility for a 550,000-kilowatt generating unit at the Widows Creek steam plant in Jackson County.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Mineral fuels accounted for 58.6 percent of the total value of mineral production, and the bituminous coal value alone was 50 percent of the total.

Coal (Bituminous).—Coal production in 1971 was 17,945,000 tons, a 12.8 percent decrease from the 20,560,000 tons produced in 1970. The 1971 value was \$146,180,000 compared with \$166,308,000 in 1970, a decrease of 12.2 percent.

Strip mine production was 62.0 percent of the total coal tonnage produced during 1971, compared with 55.1 percent in 1970. Strip mines produced 11,121,000 tons in 1971, compared with 11,339,000 tons in 1970. There were 95 strip mines in 1971, compared with 91 in 1970.

Sixteen underground mines operated at yearend 1971, compared with 35 in 1970. In Jefferson County, 10 underground mines operated in 1971, compared with 20 at

yearend 1970. Production from underground mines decreased from 9,078,000 tons in 1970 to 6,750,000 tons in 1971, or 25.7 percent.

Table 5 presents bituminous coal production and value, by county.

Coke.—Production of oven coke in 1971 totaled 5,363,000 tons, compared with 6,116,000 tons in 1970. A major reason for the decline in coke production was the decline in pig-iron production. Seven plants produced coke in Alabama; five were in Jefferson County, and both Etowah and Tuscaloosa Counties had one coke plant each in operation.

Natural Gas.—The marketed production of natural gas in 1971 was 355 million cubic feet, compared with 627 million cubic feet in 1970, a decline of 43.4 percent. The value decreased from \$87,000 to \$54,000.

³ Davis, E.G., and G. V. Sullivan. Recovery of Heavy Minerals From Sand and Gravel Operations in the Southeastern United States. BuMines RI 7517, 1971, 25 pp.

Table 5.—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	
Bibb.....	--	7	--	7	--	807	--	807	\$4,720
Blount.....	--	4	--	4	--	253	--	253	2,587
Cullman.....	--	3	--	3	--	243	--	243	1,453
De Kalb.....	--	2	--	2	--	W	--	W	W
Etowah.....	--	1	--	1	--	W	--	W	W
Franklin.....	--	1	--	1	--	W	--	W	W
Jackson.....	--	2	--	2	--	1,045	--	1,045	5,215
Jefferson.....	10	27	2	39	4,856	3,498	67	8,421	75,100
Marion.....	1	5	--	6	24	349	--	373	2,263
Shelby.....	1	3	--	4	338	173	--	516	5,447
Tuscaloosa.....	--	10	--	10	--	2,366	--	2,366	16,751
Walker.....	4	27	2	33	1,532	2,062	6	3,600	29,993
Winston.....	--	3	--	3	--	170	--	170	1,799
Undistributed ¹	--	--	--	--	--	145	--	145	852
Total.....	16	95	4	115	6,750	11,121	73	17,944	146,180

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

¹ Includes production and value indicated by symbol W.

Table 6.—Oil and gas well drilling completions, by county

County	Proved field wells ¹			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Baldwin.....	--	--	--	--	--	1	1	16,762
Choctaw.....	1	--	1	1	--	9	12	136,166
Clarke.....	--	--	--	--	--	2	2	27,307
Concehuh.....	--	--	--	--	--	1	1	12,328
Escambia.....	--	--	1	--	--	4	5	67,156
Lamar.....	2	4	2	1	1	12	22	48,138
Madison.....	--	--	--	--	--	2	2	1,755
Marengo.....	--	--	--	--	--	1	1	7,622
Marion.....	--	--	--	--	--	4	4	6,396
Mobile.....	2	--	--	--	--	--	2	22,333
Monroe.....	--	--	1	1	--	5	7	93,307
Washington.....	--	--	--	--	1	2	3	27,320
Total.....	5	4	5	3	2	43	62	466,590

¹ Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

Table 7.—Crude oil production, by county
(Thousand 42-gallon barrels and thousand dollars)

County	Production		Principal fields in 1971, in order of production
	1970	1971	
Baldwin.....	19	16	Tensaw Lake.
Choctaw.....	880	922	Choctaw Ridge, Womack Hill, Turkey Creek, Toxey, Gilbertown.
Clarke and Baldwin.....	150	131	South Carlton.
Escambia.....	196	220	Pollard, Little Escambia Creek.
Lamar.....	--	7	East Detroit.
Mobile.....	r 5,993	6,455	Citronelle.
Monroe.....	7	43	Uriah, Vocation.
Washington.....	18	38	Chatom.
Total.....	7,263	7,832	
Value.....	\$20,627	\$23,496	

r Revised.

Source: State Oil and Gas Board of Alabama, except for value in 1970 for which the U.S. Bureau of Mines is the source.

The average well head value per thousand cubic feet increased from 13.9 to 15.1 cents.

Oil and gas exploration set new highs during 1971. Data on oil and gas well drilling are presented in table 6.

Seismic exploration activities set a record as these tests were extended farther across southern Alabama. During 1971, the estimated cost of seismic exploration was \$16 million. Drilling operations cost an estimated \$10 million and approximately \$5 million was paid for leasing of mineral rights.

Natural Gas Liquids.—Production of natural gasoline and cycle products increased 26.5 percent, and that of liquefied petroleum gases and ethane increased 14.6 percent.

Petroleum.—Crude petroleum production in the State increased 7.8 percent in 1971 to 7,832,000 barrels from 7,263,000 barrels in 1970. The value increased 13.9 percent, from \$20,627,000 to \$23,496,000.

Petroleum production is shown in table 7. Production in the State's major field, Citronelle, in Mobile County, increased 463,000 barrels above the 1970 level.

The discovery well for the Vocation field in Monroe County was reported to have 98 feet of oil saturation in the Smackover Formation at a depth of approximately 14,000 feet below the surface.

A record new depth for an oil test well was set by deepening the Tyler-Odom well in Washington County to 20,434 feet. This depth penetrated the Smackover and Norphlet Formations; however, the well was abandoned as a dry hole.

NONMETALS

Nonmetals, excluding fuels, accounted for 39.3 percent of the State's total value of mineral production in 1971, compared with 39 percent in 1970.

Cement.—Cement was produced in seven plants in Jefferson, Shelby, Mobile, St. Clair, Marengo, and Blount Counties. Reported portland cement shipments declined from 16,053,000 376-pound barrels in 1970 to 12,149,000 barrels in 1971, a decrease of 24 percent. The 1970 shipments included distribution of foreign cement by domestic producers. Portland cement shipments in 1971 were valued at \$42,281,000, compared with \$51,114,000 in 1970, a decline of 17 percent. Portland cement production was 12,223,000 376-pound barrels, compared with 12,795,000 barrels in 1970. Stocks of

portland cement at mills at yearend 1971 were 625,000 barrels, compared with 704,000 barrels in 1970.

Shipments of masonry cement during 1971 were 2,493,000 280-pound barrels, valued at \$8,657,000. In 1970 shipments of masonry cement were 2,402,000 barrels valued at \$7,601,000. Production of masonry cement in 1971 was 2,478,000 280-pound barrels, compared with 2,090,000 barrels in 1970, an increase of 19 percent.

Portland and masonry cement used in the State was 6,158,000 376-pound barrels and 714,000 280-pound barrels, respectively.

The end uses for portland cement were as follows: ready-mix concrete, 62 percent; concrete products, 13 percent; building materials, 9 percent; other uses, 16 percent.

Raw materials used in making portland cement included 3,422,000 tons of limestone, oystershells, and cement rock, 491,000 tons of clay and shale, 139,000 tons of sand, and 176,000 tons of slag, gypsum, and iron-bearing materials.

Two companies produced slag cement. Production of slag cement increased 9 percent in 1971. However, Cheney Lime & Cement Co. ceased production late in 1971, reportedly due to the lack of supply of granular slag.

Clays.—Common clay and shale was mined by 21 companies at 29 mines in 20 counties. Total production was 2.6 million tons. Leading counties in terms of production were Jefferson, Russell, and Shelby. Major uses are in the manufacture of building brick, other heavy clay products, lightweight aggregates, and cement.

Fire clay was mined by five companies at six open pits in Calhoun, Henry, Walker, and Franklin Counties. Production was 0.3 million tons.

Alabama ranked fifth among the States in the production of kaolin. Four companies mined 64,000 tons of kaolin from eight open pits in five counties. Leading producing counties were Barbour, Marion, Henry, and Calhoun. The kaolin was used in refractories, as a catalyst in oil refineries, and as mineral fillers.

Lime.—Southern Cement Co., United States Gypsum Co., Longview Lime Co., Cheney Lime & Cement Co., and Alabaster Lime Co. produced lime in Shelby County for paper and pulp, steel manufacture, water purification, and other uses. The end use and value are shown in table 9. Out-

Table 8.—Portland cement salient statistics
(Thousand 376-pound barrels and thousand dollars)

	1970	1971
Number of active plants.....	18	7
Rated clinker capacity, Dec. 31.....	12,373	12,881
Production.....	12,795	12,223
Shipments from mills:		
Quantity.....	¹ 16,053	12,149
Value.....	² \$51,114	\$42,281
Stocks at mills, Dec. 31.....	^r 704	625

^r Revised.

¹ One producing plant ceased production October 1970.

² Includes distribution of foreign cement by domestic producers.

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

Use	1970		1971	
	Short tons	Value (thousands)	Short tons	Value (thousands)
Paper and pulp.....	242,394	\$3,232	215,566	\$2,437
Basic oxygen furnaces.....	122,372	1,601	110,592	1,562
Water purification.....	82,515	1,182	87,081	1,152
Sewage treatment.....	W	W	45,187	668
Miscellaneous chemicals.....	29,554	419	43,910	691
Electric furnaces.....	33,370	507	28,544	413
Aluminum and bauxite.....	W	W	11,898	170
Food.....	1,815	25	W	W
Coke ovens.....	294	4	W	W
Other ¹	236,830	3,316	218,392	4,361
Total.....	749,144	10,286	761,170	11,454

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

¹ Includes construction, magnesia, manganese (1971), other metallurgy, alkalies, insecticides, chrome (1971), tanning, brick (1970), calcium carbide, petrochemicals, paint, petroleum refining, oil well drilling, other steel furnaces (1970), refractory dolomite (1970), whiting (1970), wire drawing (1970), agriculture, and uses indicated by symbol W.

Table 10.—Sand and gravel sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Autauga.....	1	256	\$171	1	266	\$178
Calhoun.....	--	--	--	1	3	2
Cleburne.....	--	--	--	1	19	47
Coffee.....	1	50	40	2	50	56
Fayette.....	1	W	W	2	284	210
Macon.....	3	W	W	3	153	313
Marshall.....	1	W	W	1	80	160
Monroe.....	1	51	65	1	W	W
Montgomery.....	5	1,626	1,487	5	1,521	1,073
Undistributed ¹	^r 43	4,742	6,381	41	4,300	5,476
Total ²	56	6,725	8,144	58	6,674	7,513

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

¹ Includes Baldwin (1970), Barbour, Bibb, Chilton, Clarke, Crenshaw, Dale, Dallas, Elmore, Escambia, Franklin, Geneva, Hale, Houston, Lowndes, Mobile, Morgan (1970), Russell, Sumter, and Tuscaloosa, and some sand and gravel that cannot be assigned to specific counties.

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

put increased 2 percent but was 1 percent below the 1968 record. The lime was consumed in Alabama, Florida, Georgia, and other States. Total lime consumption in Alabama was 414,000 tons.

Mica.—Scrap mica was produced by one company which operated one mine in Randolph County; production increased 4.8 percent. Among the States, Alabama ranked second in the Nation in the production of scrap mica.

Salt.—Salt was produced from brine by one company for use in chemical manufacture; production in 1971 decreased 4 percent and value decreased 29 percent.

Sand and Gravel.—Forty-eight operators reported production of sand and gravel at 58 operations in 27 counties. Production was 6,674,000 tons valued at \$7,513,000, a decrease of 1 percent in tonnage and 8 percent in value, respectively, from 1970. Leading producing counties were Montgomery, Elmore, Clarke, and Mobile. Table 10 lists sand and gravel production and value by county. During 1971, 33 stationary plants, five portable plants, and 19 dredges were in operation. Nearly all the sand and gravel was processed. The major uses of the sand and gravel were for building, paving, and other uses. Table 11 presents major end uses for sand and gravel.

Stone.—Limestone and dolomite were quarried and crushed at 51 quarries in six counties. Production of crushed limestone and dolomite in 1971 was 15,473,000 tons compared with 17,616,000 tons in 1970, a decrease of 12 percent. The 1971 production was valued at \$21,824,000, a 5-percent decrease from the 1970 value of \$23,026,000. Leading producing counties were Shelby and Jefferson. Production of crushed lime-

stone by county is shown in table 12. End use of the stone is listed in table 13.

One company produced asphaltic limestone in Colbert County.

Dimension limestone was quarried by one company at an underground operation in Franklin County. Production decreased 29 percent, and value decreased 25 percent.

Three companies produced crushed and ground marble in Talladega County. Output increased 1 percent. The ground marble was used primarily for extenders and fillers.

Oystershell, from ancient oysterbeds, was dredged from Mobile Bay by one company at two operations.

Talc.—American Talc Co. mined and ground talc in Talladega County for toilet preparations and other uses. Mine production increased substantially.

METALS

Aluminum.—Aluminum production decreased 10 percent; the value was 14 percent below 1970.

Bauxite.—Alabama ranks second among the States in bauxite production. Four companies mined crude bauxite in Barbour and Henry Counties. Production increased 23 percent, and total value increased 16 percent over 1970.

Iron Ore.—Usable iron ore shipments of concentrates and sinter from Alabama declined to 415,000 tons in 1971.

Three brown iron ore mines were operated in 1971. One mine in Franklin County suspended operations in December.

Pig Iron.—Production of pig iron was 3,862,000 tons valued at \$263,696,000 compared with 4,709,000 thousand tons valued at \$300,544,000 in 1970.

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

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,675	\$1,998	1,969	\$2,213
Fill	104	47	W	W
Paving	875	896	553	666
Other uses ¹	810	672	1,163	851
Total ²	3,465	3,613	3,686	3,730
Gravel:				
Building	1,854	2,852	1,427	2,193
Paving	1,154	1,375	1,158	1,243
Other uses ³	233	235	384	299
Total ²	3,241	4,462	2,969	3,736
Government-and-contractor operations:				
Sand:				
Building	--	--	8	21
Paving	9	31	--	--
Total	9	31	8	21
Gravel:				
Building	--	--	11	27
Paving	11	37	--	--
Total	11	37	11	27
Total sand and gravel ²	6,725	8,144	6,674	7,513

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

¹ Includes railroad ballast, fire-furnace (1970), engine, filtration (1970), molding and other sands.

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

³ Includes fill and other gravel and miscellaneous gravel.

Table 12.—Crushed limestone and dolomite sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Colbert	3	1,040	\$1,430	4	1,140	\$1,919
Covington	1	W	20	--	--	--
Jefferson	8	4,244	5,562	9	3,622	5,105
Limestone	1	W	W	1	55	82
Marshall	1	300	W	1	W	W
Shelby	9	4,420	6,757	10	4,458	7,068
Undistributed ¹	18	7,611	9,256	26	6,198	7,650
Total ²	41	17,616	23,026	51	15,473	21,824

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

¹ Includes Bibb, Calhoun, De Kalb, Etowah, Franklin, Jackson, Lee, Madison, Marengo, Morgan, St. Clair, Talladega, and Washington counties.

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

Table 13.—Crushed limestone and dolomite sold or used by producers, by use
(Thousand short tons and thousand dollars)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Bituminous aggregate.....	1,319	\$1,854	1,607	\$2,315
Concrete aggregate.....	1,669	2,098	3,152	4,066
Dense graded roadbase stone.....	2,675	3,269	1,078	1,313
Macadam aggregate.....	200	300	698	838
Surface treatment aggregate.....	83	114	195	287
Unspecified aggregate and roadstone.....	1,732	2,212	1,698	2,542
Agricultural limestone.....	2,251	2,753	679	1,162
Cement.....	3,755	3,473	3,389	3,370
Flux.....	931	1,602	451	1,112
Lime.....	1,472	2,753	1,347	2,576
Other uses ¹	1,529	2,594	1,178	2,244
Total ²	17,616	23,026	15,473	21,824

¹ Includes stone used in refractories, chemicals, acid neutralizers, dam construction, other metallurgical purposes (1970), asphalt and other fillers (1970), filter stone, railroad ballast, riprap and jetty stone, mine dusting (1970), poultry grit and soil conditioners (1970), and other unspecified uses in smaller quantities.

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

Table 14.—Principal producers

Commodity and company	Address	Type of activity	County
Alumina:			
Aluminum Company of America.....	1501 Alcoa Bldg. Pittsburgh, Pa. 15219	Plant.....	Mobile.
Aluminum smelters:			
Revere Copper and Brass, Inc.....	Box 191 Rome, N.Y. 13440	...do.....	Jackson.
Reynolds Metals Co.....	Reynolds Metals Bldg. Richmond, Va. 23218	...do.....	Colbert.
Bauxite:			
Eufaula Bauxite Mining Co.....	Box 556 Eufaula, Ala. 36027	Open pit mine and plant.	Barbour.
General Refractories Co.....	Abbeville, Ala. 36310	Open pit mine.....	Henry.
United States Gypsum Co.: A. P. Green Refractories Co.....	Mexico, Mo. 65265	5 open pit mine and plant.	Barbour.
Dresser Industries:			
Harbison-Walker Refractories Co.....	2 Gateway Center Pittsburgh, Pa. 15222	Open pit mine and plant.	Henry.
Wilson-Snead Mining Co.....	Box 568 Eufaula, Ala. 36027	...do.....	Barbour.
Cement:			
Alpha Portland Cement Co. ¹	15 S. Third St. Easton, Pa. 18043	Plant.....	Jefferson.
Ideal Basic Industries:			
Ideal Cement Co.....	Ideal Cement Bldg. Denver, Colo. 80202	...do.....	Mobile.
Lone Star Industries.....	Box 6237 West End Branch Richmond, Va. 23230	2 plants.....	Jefferson and Marengo.
Martin Marietta Corp. ²	18th Floor Daniel Bldg. Birmingham, Ala. 35233	...do.....	Jefferson and Shelby.
Mead Corp.....	Box 3353 Birmingham, Ala. 35205	Plant.....	St. Clair.
United States Steel Corp.....	600 Grant Street Pittsburgh, Pa. 15230	...do.....	Jefferson.
Clays:			
Fire:			
R. T. Vanderbilt Co.; Dixie Clay Co.....	Box 361 Anniston, Ala. 36202	Open pit mine and plant.	Calhoun.
Donoho Clay Co.....	Box 343 Anniston, Ala. 36202	...do.....	Do.
Dresser Industries:			
Harbison-Walker Refrac- tories Co.....	2 Gateway Center Pittsburgh, Pa. 15222	2 open pit mines ..	Henry and Walker.
Marigold Coal, Inc.....	Box 420 Jasper, Ala. 35501	Open pit mine.....	Walker.
Common clay and shale:			
Bickerstaff Clay Products Co., Inc.....	Box 1178 Columbus, Ga. 31902	4 open pit mines and plants.	Jefferson and Russell.
Glen-Gery Corp.....	Box 1656 East Canton, Ohio 44730	Open pit mine and plant.	Jefferson.

See footnotes at end of table.

Table 14.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clays—Continued			
Common clay and shale—Continued			
Ideal Basic Industries:			
Ideal Cement Company	Ideal Cement Bldg. Denver, Colo. 80202	Open pit mine	Mobile.
Jenkins Brick Co.	Box 91 Montgomery, Ala. 36101	2 open pit mines and plants.	Elmore and Montgomery.
Marigold Coal, Inc.	Box 420 Jasper, Ala. 35501	Open pit mine	Walker.
Martin Marietta Corp.	18th Floor Daniel Bldg. Birmingham, Ala. 35233	do	Shelby.
Mead Corp.	Box 3358 Birmingham, Ala. 35205	Open pit mine and plant.	St. Clair.
Ragland Brick Co.	3507 Rainbow Dr. Gadsden, Ala. 35901	do	Do.
Tombigbee Lightweight Aggregate Co.	Box 1247 Nashville, Tenn. 37202	do	Sumter.
United States Steel Corp.	600 Grant Street Pittsburgh, Pa. 15230	do	Jefferson.
Vulcan Materials Co.	Box 7324-A Birmingham, Ala. 35223	do	Do.
Kaolin:			
Dresser Industries:			
Harbison-Walker Refractories Co.	2 Gateway Center Pittsburgh, Pa. 15222	do	Henry.
Thomas Alabama Kaolin Co.	15 Charles Plaza Baltimore, Md. 21201	Open pit mine	Marion.
United States Gypsum Co.:			
A. P. Green Refractories Co.	Mexico, Mo. 65265	5 open pit mines and plants.	Barbour and Henry.
Marigold Coal, Inc.	Box 420 Jasper, Ala. 35501	Open pit mine and plant.	Walker.
Coal:			
Alabama By-Products Corp.	Box 354 Birmingham, Ala. 35210	3 underground and 1 strip mine and 2 plants.	Jefferson.
Arch Minerals Corp.	400 Mansion House Center St. Louis, Mo. 63100	Strip mine	Jackson.
Peabody Coal Co.	301 N. Memorial Dr. St. Louis, Mo. 63102	2 strip mines and plants.	Jefferson, Tuscaloosa, and Walker.
Southern Electric Generating Co.	600 North 18th St. Birmingham, Ala. 35203	Underground mine and plant.	Walker.
United States Steel Corp.	Box 599 Fairfield, Ala. 35064	do	Jefferson.
Woodward Co.	Woodward, Ala. 35189	2 underground mines and plants.	Do.
Coke:			
Alabama By-Products Corp.	Box 354 Birmingham, Ala. 35210	Plant	Do.
Empire Coke Co.	2201 First Ave., N. Birmingham, Ala. 35203	do	Tuscaloosa.
Republic Steel Corp.	Box 6778 Cleveland, Ohio 44101	2 plants	Etowah and Jefferson.
U.S. Pipe & Foundry Co.	Box 2651 Birmingham, Ala. 35212	Plant	Jefferson.
United States Steel Corp.	Box 599 Fairfield, Ala. 35064	do	Do.
Woodward Co.	Woodward, Ala. 35189	do	Do.
Ferroalloys:			
Calumet & Hecla Corp.	Calumet Ave. Calumet, Mich. 49913	do	Selma.
Tennessee Alloys Corp.	Bridgeport, Ala. 35740	do	Jackson.
Tennessee Valley Authority	Muscle Shoals, Ala. 35660	do	Colbert.
Union Carbide Corp.	270 Park Ave. New York, N.Y. 10017	2 plants	Colbert and Jefferson.
Woodward Co.	Woodward, Ala. 35189	Plant	Jefferson.
Iron ore:			
Limonite:			
Shook & Fletcher Supply Co.	Box 2686 Birmingham, Ala. 35202	do	Franklin.
U.S. Pipe & Foundry Co.	3300 First Ave., N. Birmingham, Ala. 35202	do	Do.
Lime:			
Alabaster Lime Co.	Siluria, Ala. 35144	Limekiln and plant.	Shelby.
Cheney Lime & Cement Co.	Algood, Ala. 35013	do	Do.
Longview Lime Co.	Woodward, Ala. 35189	do	Do.
Southern Cement Co.	18th Floor Daniel Bldg. Birmingham, Ala. 35233	do	Do.

See footnotes at end of table.

Table 14.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Lime—Continued			
United States Gypsum Co.....	101 S. Wacker Dr. Chicago, Ill. 60606	Limekiln and plant.	Shelby.
Mica, flake:			
United States Gypsum Co.....	101 S. Wacker Dr. Chicago, Ill. 60606	Open pit mine and plant.	Randolph.
Natural gas:			
Black Warrior Petroleum Co., Inc..	Box 1642 Mobile, Ala. 36601	Gasfield.....	Escambia.
Natural gas liquids, including LP-gases and natural gasoline:			
Cities Service Oil Co.....	Box 300 Tulsa, Okla. 74102	Plant.....	Mobile.
Petroleum:			
Crude:			
Ancora Corp.....	1 Jackson Pl., Suite 620 San Francisco, Calif. 94111	Citronelle field ...	Do.
E. L. Erickson.....	1235 Petroleum Bldg. Jackson, Miss. 39201	Toxey field.....	Choctaw.
Mobil Oil Corp.....	Box 900 Dallas, Tex. 75221	Citronelle field ...	Mobile.
Pruett & Hughes Co.....	390 Petroleum Bldg. Jackson, Miss. 39201	Choctaw Ridge field.	Choctaw.
Sun Oil Co.....	Box 2880 Dallas, Tex. 75221	Citronelle field ...	Mobile.
Refineries:			
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.
Pig iron:			
Republic Steel Corp.....	1629 Republic Bldg. Cleveland, Ohio 44115	Blast furnaces and mills.	Etowah and Jefferson.
U.S. Pipe & Foundry Co.....	Box 2651 Birmingham, Ala. 35202	.....do.....	Jefferson.
United States Steel Corp.....	Box 599 Fairfield, Ala. 35064	.....do.....	Do.
Woodward Co.....	Woodward, Ala. 35189.....	.....do.....	Do.
Salt:			
Olin Mathison Chemical Corp.....	Box 28 McIntosh, Ala. 36553	Brine wells.....	Washington.
Sand and gravel:			
Dixie Sand & Gravel.....	P.O. Box 1128 Montgomery, Ala. 36102	4 dredges and 1 plant.	Montgomery.
Radcliff Materials, Inc.....	Mobile, Ala. 36601.....	Dredge.....	Mobile.
W. T. Ratliff Co., Inc.....	Box 1111 Knoxville, Tennessee 37901	Open pit mine and plant.	Clarke.
C. T. Thackston Sand and Gravel Co.....	Box 3211 Montgomery, Ala. 36101	.....do.....	Montgomery.
Vulcan Materials Co.....	Box 7324-A Birmingham, Ala. 35223	2 open pit mines and plants.	Elmore and Montgomery.
Stone:			
Dolomite:			
Southern Stone Co., Inc.....	2111 8th Ave., S. Birmingham, Ala. 35233	Quarry and plant.	Shelby.
U.S. Pipe & Foundry Co.....	3300 First Ave., N. Birmingham, Ala. 35202	.....do.....	Jefferson.
United States Steel Corp.....	Box 599 Fairfield, Ala. 35064	3 quarries and plants.	Do.
Limestone, crushed:			
Lone Star Industries.....	Box 6237 West End Branch Richmond, Va. 23230	4 quarries and plants.	Jefferson, Marengo, and Wash- ington.
Madison Limestone Co., Inc....	Box 46 Huntsville, Ala. 35804	.....do.....	Madison.
Martin Marietta Corp.....	18th Floor Daniel Bldg. Birmingham, Ala. 35223	2 quarries and plants.	Shelby.
Vulcan Materials Co.....	Box 7324-A Birmingham, Ala. 35223	6 quarries and plants.	Colbert, Etowah, Franklin, Jackson, Shelby, and Talladega.
Limestone, dimension:			
Georgia Marble Co.....	Russellville, Ala. 35653.....	.....do.....	Franklin.
Marble, crushed:			
Georgia Marble Co.....	Gants Quarry, Ala. 35069.....	2 quarries and plant.	Talladega.
Moretti-Harrah Marble Co.....	Box 330 Sylacauga, Ala. 35150	Quarry and plant.	Do.
Thompson-Weinman & Co.....	Cartersville, Ga. 30120.....	2 quarries and plants.	Do.

See footnotes at end of table.

Table 14.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Oystershell:			
Radcliff Materials, Inc.-----	Box 1288 Mobile, Ala. 36601	2 dredges and plants.	Mobile.
Sandstone, crushed:			
Dallas Sand & Gravel Co.-----	2196 Water St. Selma, Ala. 36701	Quarry and plant.	Dallas.
Enos Vann-----	Box 246 Trussville, Ala. 35173	-----do-----	Jefferson.
United States Steel Corp-----	Box 2969 Pittsburgh, Pa. 15230	2 quarries and plants.	Do.
Talc:			
American Talc Co-----	Alpine, Ala. 35014-----	Open pit mine and plant.	Talladega.

¹ Portland and masonry cement.² Portland, masonry, and slag cement.

The Mineral Industry of Alaska

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

By Richard B. Smith¹ and William C. Fackler²

Passage of the Alaska Native Claims Settlement Act and the continuing delays in issuance of a permit for the construction of a trans-Alaska pipeline dominated the news of the mineral industry in 1971. A favorable outlook for the development of a fluorite deposit in the vicinity of Lost River near Nome and the take-over of mining leases on an iron ore deposit near Klukwan by a Japanese company highlighted the activities in the hard rock mining sector. The value of mineral production in Alaska declined slightly from the alltime high level reached in 1970, owing principally to uncertainties occasioned by forthcoming land withdrawals under the Native Claims Settlement Act and the Wilderness Act and delays in approval of a pipeline for North Slope crude oil. The

total value of mineral production in 1971 was \$333.9 million, a decrease of 1.3 percent below the 1970 figure, despite a \$5.9 million increase in the value of crude petroleum. Metals production dropped in value by \$0.7 million, and nonmetals declined \$13.0 million below the 1970 level. Crude oil and natural gas, \$257.6 million and \$28.9 million, respectively, made up 86 percent of the total value of mineral production. Sand and gravel maintained its position as second most valuable mineral commodity produced in the State, followed by natural gas, coal, stone, barite, uranium platinum-group metals, gold, and mercury.

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² Deputy Commissioner for Minerals, Department of Natural Resources, State of Alaska, Anchorage, Alaska.

Table 1.—Mineral production in Alaska¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony ore and concentrate... short tons, antimony content...	63	\$109	(?)	(?)
Barite..... thousand short tons	134	835	102	\$1,075
Coal (bituminous)..... do	549	4,059	698	5,710
Gold (recoverable content of ores, etc.)..... troy ounces	34,776	1,265	13,012	537
Natural gas..... million cubic feet	111,576	27,448	121,618	28,945
Petroleum (crude)..... thousand 42-gallon barrels	83,616	251,684	79,494	257,562
Sand and gravel..... thousand short tons	25,825	41,092	23,617	32,806
Silver (recoverable content of ores, etc.)..... thousand troy ounces	2	4	1	1
Stone..... thousand short tons	6,470	10,014	2,658	5,066
Tin..... long tons	W	W	17	47
Value of items that cannot be disclosed:				
Gem stones, LP gases (1971), mercury, platinum-group metals, uranium (1971) and values indicated by symbol W	XX	1,761	XX	2,174
Total.....	XX	338,271	XX	333,923
Total 1967 constant dollars.....	XX	302,583	XX	*290,112

¹ Preliminary. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

² Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

³ No production of antimony was reported to the Bureau of Mines. However, the Alaska Department of Natural Resources reported production of 34 tons of ore valued at approximately \$34,000.

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

Region	1970	1971	Minerals produced in 1971 in order of value
Aleutian Islands.....	W	\$36	Sand and gravel.
Bristol Bay.....	W	141	Do.
Cook Inlet-Susitna.....	\$241,534	254,668	Petroleum, natural gas, sand and gravel, stone, coal, gold.
Copper River.....	W	W	Sand and gravel, stone, gold.
Kenai Peninsula.....	51,380	38,469	Petroleum, sand and gravel, natural gas liquids, stone.
Kodiak.....	W	W	Stone, sand and gravel.
Kuskokwim.....	W	W	Platinum-group metals, mercury, gold.
Northern Alaska.....	1,240	3,789	Petroleum, sand and gravel.
Northwestern Alaska.....	W	W	Sand and gravel, stone.
Seward Peninsula.....	646	W	Sand and gravel, tin, stone, gold.
Southeastern Alaska.....	W	W	Uranium, stone, barite, sand and gravel.
Yukon River.....	30,040	22,158	Sand and gravel, coal, stone, gold, silver.
Undistributed ²	13,430	14,662	
Total	\$338,271	333,923	

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

¹ No production was reported in the Alaska Peninsula and Bering Sea regions.

² Includes gem stones and some sand and gravel and stone that cannot be assigned to specific regions.

³ Data does not add to total shown because of independent rounding.

Table 3.—Indicators of Alaska business activity

	1970 ^r	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force.....	thousands..... 114.8	122.3	+6.5
Unemployment.....	do..... 9.9	12.2	+23.2
Employment:			
Construction.....	do..... 6.9	6.4	-7.2
Mining.....	do..... 2.9	2.4	-17.2
Transportation and public utilities.....	do..... 9.1	9.8	+7.7
Wholesale and retail trade.....	do..... 15.3	15.8	+3.3
Manufacturing.....	do..... 8.6	7.7	-10.5
Services.....	do..... 11.6	12.6	+8.6
Government.....	do..... 35.6	37.3	+4.8
Finance, insurance, and real estate.....	do..... 3.1	3.3	+6.5
Personal income:			
Total.....	millions..... \$1,400	\$1,486	+6.1
Per capita.....	do..... \$4,592	\$4,749	+3.4
Construction activity:			
Value of authorized nonresidential construction.....	millions..... \$15.0	\$21.6	+44.0
Number of authorized new housing units.....	do..... 1,673	1,848	+10.5
Highway construction contracts awarded.....	millions..... \$57.7	\$31.1	-46.1
Mineral production value.....	do..... \$338.3	\$333.9	-1.3
Foreign trade:			
Exports.....	do..... \$134.8	\$128.5	-4.7
Imports.....	do..... \$106.9	\$53.5	-50.0

^p Preliminary. ^r Revised.

Sources: Area Trends in Employment and Unemployment; Employment and Earnings; Survey of Current Business; Construction Review; Streets and Roads; Highlights of United States Import and Export Trade; and U.S. Bureau of Mines.

Legislation and Government Programs.—On December 14, 1971, President Nixon signed into law the Alaska Native Claims Settlement Act, which granted the Natives of Alaska a cash settlement of \$962.5 million and a land package of 40 million acres.

The Act established 13 regional corporations, which may merge to not less than seven regional corporations. Twelve of the corporations represent the Native residents of 12 geographic areas of the State, and one corporation is for the enrollment of Natives

who are not permanent residents of any of the 12 geographic areas. All Alaska Natives will be stockholders in the corporations, the stock of which cannot be alienated for a period of 20 years. The cash settlement, which is tax exempt, consists of two parts: \$462.5 million will be paid to the regional corporations by the Federal Government over an 11-year period and allocated among the individual corporations on the basis of population distribution. The second portion is a 2-percent royalty on minerals, subject to the Mineral Leasing Act,

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Coal.....	86	243	21	171	--	10	58.55	820
Metal.....	215	151	32	292	--	22	75.44	4,242
Nonmetal.....	13	252	3	26	--	--	--	--
Sand and gravel.....	1,208	163	197	1,691	--	38	22.48	566
Stone.....	391	204	80	715	1	17	25.17	9,128
Total.....	1,913	174	333	12,894	1	87	30.40	3,062
1971: ^P								
Coal.....	95	235	22	183	--	12	65.45	916
Metal.....	220	152	34	289	--	17	58.88	1,139
Nonmetal.....	15	260	3	27	--	--	--	--
Sand and gravel.....	1,075	184	198	1,559	--	41	26.30	708
Stone.....	360	239	86	685	--	17	24.80	516
Total.....	1,765	194	343	12,744	--	87	31.71	710

^P Preliminary.¹ Data does not add to total shown because of independent rounding.Table 5.—Expenditures by major companies for exploration, prospecting, and development, excluding petroleum
(Thousands)

Region	1968	1969	1970	1971
Arctic Alaska.....	\$710	NA	\$775	\$850
Interior Alaska.....	120	NA	1,325	1,100
Western Alaska.....	1,240	NA	1,225	1,500
Southwestern Alaska.....	50	NA	150	150
South-central Alaska.....	850	NA	1,100	1,400
Southeastern Alaska.....	1,540	NA	2,275	4,000
Total.....	4,510	\$6,900	6,850	9,000

NA Not available.

Source: State of Alaska Department of Natural Resources, Division of Geological Survey.

which are produced under leases on both Federal and State lands. These payments will continue until a total of \$500 million is paid to the Natives.

The land settlement provides for 40 million acres of surface estate and mineral rights to be distributed partly on the basis of population and partly on the basis of relative land areas of the regions. This land will be exempt from any form of taxation for a period of 20 years. Essentially, 22 million acres will be allocated to the villages, 16 million acres to regional corporations on a checkerboard pattern, and two million acres for cemetery sites, historical places, Natives not living on village lands, and other "hardship" purposes.

The Act protects existing mining rights and existing timber management and sales practices for 5 years. It also excludes from selection any utility transportation corridors (e.g., the trans-Alaska pipeline) and

up to 80 million acres of public lands as selected by the Secretary of the Interior. The Act provides for a Joint Federal and State Land Use Planning Commission to assist in land selection and management practices.

At least two of the bills passed by the Alaska Legislature could have an impact on the mineral industry of Alaska. A bill creating the Department of Environmental Conservation concentrated all existing anti-pollution statutes under one agency and assigned to the new agency the primary responsibility for prevention or abatement of pollution in the State. Another bill created the Joint State-Federal Natural Resources and Land Use Planning Commission. The establishment of this body was recommended by the Federal Land Law Planning Commission. The State Commission will, among other things, prepare a state-wide natural resources and land use plan;

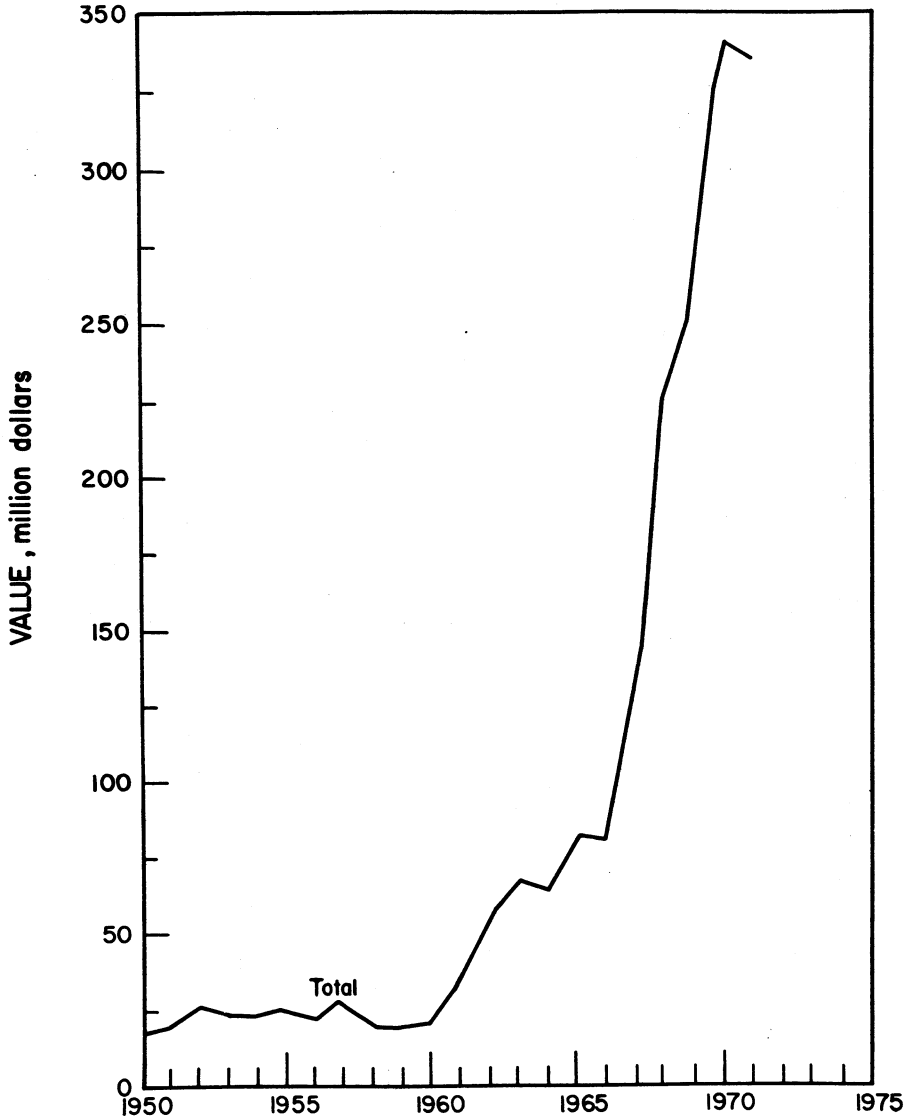


Figure 1.—Total value of mineral production in Alaska.

review existing Federal land withdrawals; establish a committee comprised of representatives of commercial, residential, industrial, recreational, wilderness, and other land users to advise it on land use; and make recommendations to the President and Congress and to the Governor and

State Legislature as to changes in laws, policies, and programs affecting natural resources and land use.

The Oil and Gas Conservation Committee, Department of Natural Resources, ordered a halt to the flaring of oil-associated natural gas from all producing oilfields in

Cook Inlet by July 1972. At yearend 1971, operators had filed applications and were making plans for construction of two pipelines for delivery of the gas to locations where it can be beneficially used.

The State of Alaska, following the lead of the Federal Government, passed a geothermal leasing bill for State lands to stimulate the development of geothermal resources as a source of energy for electric power generation. The U.S. Geological Survey lists Umnak Island in the Aleutians and Pilgrim Hot Springs near Nome on Seward Peninsula as the two most favorable areas in the State for geothermal development.

The Alaska Department of Natural Resources, Division of Geological Survey, in its Annual Report for 1971 published a comprehensive list of geological and mining reports that were released during 1971 by the Alaska Division of Geological Survey, the U.S. Bureau of Mines, and the U.S. Geological Survey. As a stimulant to the development of Alaska's natural resources, including minerals, the Alaska Department of Economic Development, Industrial Development Division, released a 44-page publication titled Pacific Rim Trade Opportunities, A Trade Aid for Alaska's Businessmen.

Transportation.—The long-awaited Anchorage to Fairbanks highway, completed in 1971, reduced the previous driving distance between the two cities by more than 100 miles. At the end of 1971, work was under way on the Copper River Road, which will, within the next 5 years, connect Cordova with the Richardson Highway. A multimillion dollar bridge connecting Chitina with the old road to McCarthy was completed during 1971. Sitka was connected with Japonski Island by bridge spans, although the bridge will not be completed until midyear 1972.

Owing to the low level of drilling activity on the North Slope, the quantity of airfreight handled at the Fairbanks airport decreased in 1971 to below that of 1970. The State Division of Aviation, however, reported that the number of aircraft operations (take-offs and landings) for 1971 totaled 109,109, an increase of 16,000 over that of 1970.

Total freight handled at Anchorage International Airport increased 10.7 percent from 87.3 million pounds through Novem-

ber 1970 to 96.6 million pounds through November 1971.

The Civil Aeronautics Board (CAB) handed down a decision during 1971 that changed Alaska air route patterns. Alaska Airlines, Inc., received exclusive rights to southeastern routes it formerly shared with Western Air Lines, Inc. (Western). Pan American World Airways, Inc., retained its nonstop flight from Seattle to Fairbanks. Western was permitted to continue its Seattle to Kodiak flights on a seasonal basis. CAB approved the acquisition by Wien Consolidated Airlines, Inc., (Wien) of routes formerly served by Western, between Anchorage, Kenai, Homer, and Kodiak. Wien was granted exclusive rights to serve Prudhoe Bay.

The State received Federal grants totaling \$3.6 million for airport improvement projects in Nome, Cold Bay, King Salmon, and the upper Cook Inlet area.

The Alaska State Ferry System carried 170,000 passengers during fiscal 1971, representing a 6-percent increase over the 1970 level. A major portion of this increase was attributed to the M/V Bartlett on the Valdez to Whittier route. This segment of the system experienced traffic increases of more than 50 percent. During 1971, contracts were let for expansion of the State ferry system. One small ferry will be built for service to outlying southeastern ports, and the Malaspina will be lengthened to 408 feet increasing her capacity by 28 percent.

Substantially reduced activity by oil companies in 1971, owing to delays in approval of a pipeline, caused a decrease below 1970 levels in waterborne freight through the Bering and Beaufort Seas to the North Slope. Three tugs and six barges carried 10,000 tons of freight to the North Slope in 1971, compared with 185,000 tons in 70 vessels during 1970. Four of the tugs passed through the Panama Canal on their 10,000 mile trip from Houston, Tex., to Prudhoe Bay.

The Alaska Steamship Co., which had served Alaska for more than 70 years, made its last freight haul in 1971. As a result, the contract for freight service to Adak Naval Station was awarded to SeaLand Service, Inc. Also during 1971, Foss Launch & Tug Co. started construction of a \$2.3 million terminal in Seattle and announced plans for improved service to southeastern Alaska. During fiscal 1971, the Division of Waters and Harbors completed

over \$1.3 million of capital improvement projects at Homer, Kodiak, Old Harbor, Petersburg, Seward, Seldovia, Soldotna, Ninilchik, Cordova, Anchorage, Sitka, Ketchikan, and Wrangell.

In 1971, the U.S. Department of Transportation completed a study of three po-

tential routes and selected the one best suited for surface transportation corridors from Fairbanks to the North Slope. The study also included an examination of the feasibility of building a railroad or a highway through the proposed corridor.

According to its Annual Report, the

Table 6.—Coastwise receipts and foreign mineral trade
(Short tons)

Commodity	1969			1970		
	Coastwise receipts	Imports	Exports	Coastwise receipts	Imports	Exports
Bituminous coal and lignite.....	45	--	--	21	--	--
Gasoline, including natural gasoline.....	388,509	66,710	--	364,796	45,605	2,613
Kerosine, distillate, residual fuel oil.....	1,222,850	471,955	--	955,712	414,000	--
Asphalt, tar, pitches.....	15,979	--	--	25,375	--	--
Lubricating oil and greases.....	6,223	--	--	8,916	--	--
Petroleum and coal products, not elsewhere classified.....	1,662	120,833	--	15,678	140,028	--
Building cement.....	57,098	18,222	--	31,776	45,686	--
Building stone, unworked.....	64	--	--	--	--	--
Clay, ceramic and refractory materials.....	10,691	--	--	7,141	--	--
Structural clay products including refractories.....	2,137	63	--	3,893	6	--
Sulfur, dry and liquid.....	13,053	7,745	--	12,429	7,136	--
Sand, gravel and crushed rock.....	1,011	9,287	--	169,455	23,243	--
Iron ore and concentrates.....	--	--	--	--	--	--
Iron and steel scrap.....	155	--	--	125	--	--
Primary iron and steel products.....	42,112	56,897	--	29,080	276,352	--
Aluminum and aluminum alloys, unworked.....	204	--	--	447	--	--
Lead and zinc including alloys, unworked.....	--	--	--	--	--	--
Nonferrous metal ores and concentrates.....	7	--	53,046	1	--	585,875
Nonferrous metals, primary smelter products, basic shapes, wire, casting and forgings, except copper, lead, zinc and aluminum.....	995	--	--	2,843	1	--
Chemical fertilizer and fertilizer materials.....	594	--	--	113	--	--

* Revised.

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

Table 7.—Freight rates, Seattle to selected Alaskan cities in 1971 Hydro-Train service¹
(Cents per hundred pounds)

Commodity	Minimum shipment (pounds)	From Seattle to—		
		Anchorage via Whittier	Fairbanks via Whittier	Seward via Whittier
Groceries.....	60,000	238	302	--
Do.....	80,000	189	253	--
Do.....	100,000	113	178	--
Iron or steel articles.....	50,000	283	382	253
Do.....	80,000	194	272	194
Do.....	100,000	183	261	183
Machinery.....	60,000	269	316	254
Do.....	80,000	231	273	216
Do.....	100,000	220	267	205
Lumber.....	80,000	186	255	187
Do.....	100,000	175	244	177
Do.....	120,000	150	--	--
Ores and concentrates (southbound only) ²	60,000	119	158	--
Do.....	80,000	100	140	--
Do.....	100,000	95	134	--
Petroleum and products.....	60,000	229	336	229
Do.....	80,000	191	298	191
Do.....	100,000	180	287	180

¹ Rates include all-risk insurance.

² Excess over 80,000-pound minimum when loaded in or on same car.

³ Value not to exceed \$60 per ton. Rate increases 25 percent for each additional \$60 (or fraction) per ton valuation.

Source: Alaska Hydro-Train, Division of Puget Sound Tug & Barge Co.

Alaska Railroad, operated by the Federal Railroad Administration, Department of Transportation, experienced a net operating loss of \$3.1 million in fiscal 1971, compared with a net loss of \$158,902 in 1970. The number of revenue passenger miles increased 20 percent in 1971 over the 1970 level, but the quantities of freight decreased from 270.0 million to 214.4-million-ton miles over the same period.

Employment.—Total insured wages in the mineral industries in the calendar year 1971, as reported by the Alaska Department of Labor, were \$43.7 million (\$52.0 million in 1970), down 22.4 percent from the alltime high of \$56.3 million in 1969. Average monthly employment was 2,430

(2,994 in 1970). In the mineral industries covered by the Employment Securities Act (operators with hired labor) monthly earnings averaged \$1,498, compared with \$1,447 in 1970. Monthly earnings in metal mining were reported to be \$1,522; in coal and nonmetal mining \$1,014; the figures for 1970 were \$997, \$1,487, and \$1,442, respectively.

The Alaska Oil and Gas Association reported that employment in the petroleum industry decreased by 20 percent in 1971. Including personnel employed by oil and gas companies, drilling, geophysical, service and supply companies, total employment was 2,707 in 1971, compared with 3,385 in 1970.

Table 8.—Leases and acreage under Federal supervision, at yearend

Year	Oil and gas leases		Mining leases	
	Number of leases	Acres (thousands)	Number of leases	Acres (thousands)
1967	3,912	7,135	18	21
1968	4,147	6,841	16	20
1969	4,290	6,936	13	16
1970	3,638	6,168	14	16
1971	2,926	5,344	13	16

Source: U.S. Geological Survey.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—Tonnage of coal produced was up 27 percent from that reported in 1970. Value increased 41 percent as unit value rose from \$7.39 to \$8.18. Most of the coal was produced by Usibelli Coal Mine, Inc., and B & R Coal Co. in the Nenana field of south-central Alaska. The last mine to operate in the Matanuska valley, Alaska Matanuska Coal Co., ceased operations at its Premier mine in August 1971 as a result of loss of equipment during a flood. A new mine operated by Delta Coal Co. was opened in the fall of 1971 in the eastern part of the Nenana field about 38 miles south of Delta Junction.

Exploration of coal beds to outline areas for strip mining continued in both the Nenana and Susitna fields. Most of the exploration money was spent in the Beluga section of the Susitna field.

A proposal to study the feasibility of developing the lignite-subbituminous coal reserves in the Beluga River coal field west

and north of Cook Inlet has been dropped, at least temporarily. Representatives of the Bureau of Mines, the University of Alaska, and American Exploration and Mining Co. discussed possible contributions to the study by each group, but a final agreement was not concluded.

The Bureau of Mines initiated an investigation of coal in Arctic Alaska as a part of a nationwide coal study to determine reserves, potential rates of production, and costs. The Geological Survey, the Bureau of Land Management, and the University of Alaska are cooperating in the Arctic study. The initial area of investigation is northwest Alaska near the Kukpowruk River, inland from Cape Beaufort. Equipment for drilling and collecting samples was assembled by the Bureau of Mines at Fairbanks and prepared for an air-lift to Cape Beaufort. The drilling equipment, modified to accept drill pipe employing the center sample return system, was mounted on a Nodwell tracked vehicle. A Rolligon vehicle, using very large low-pressure tires, was selected to transport person-

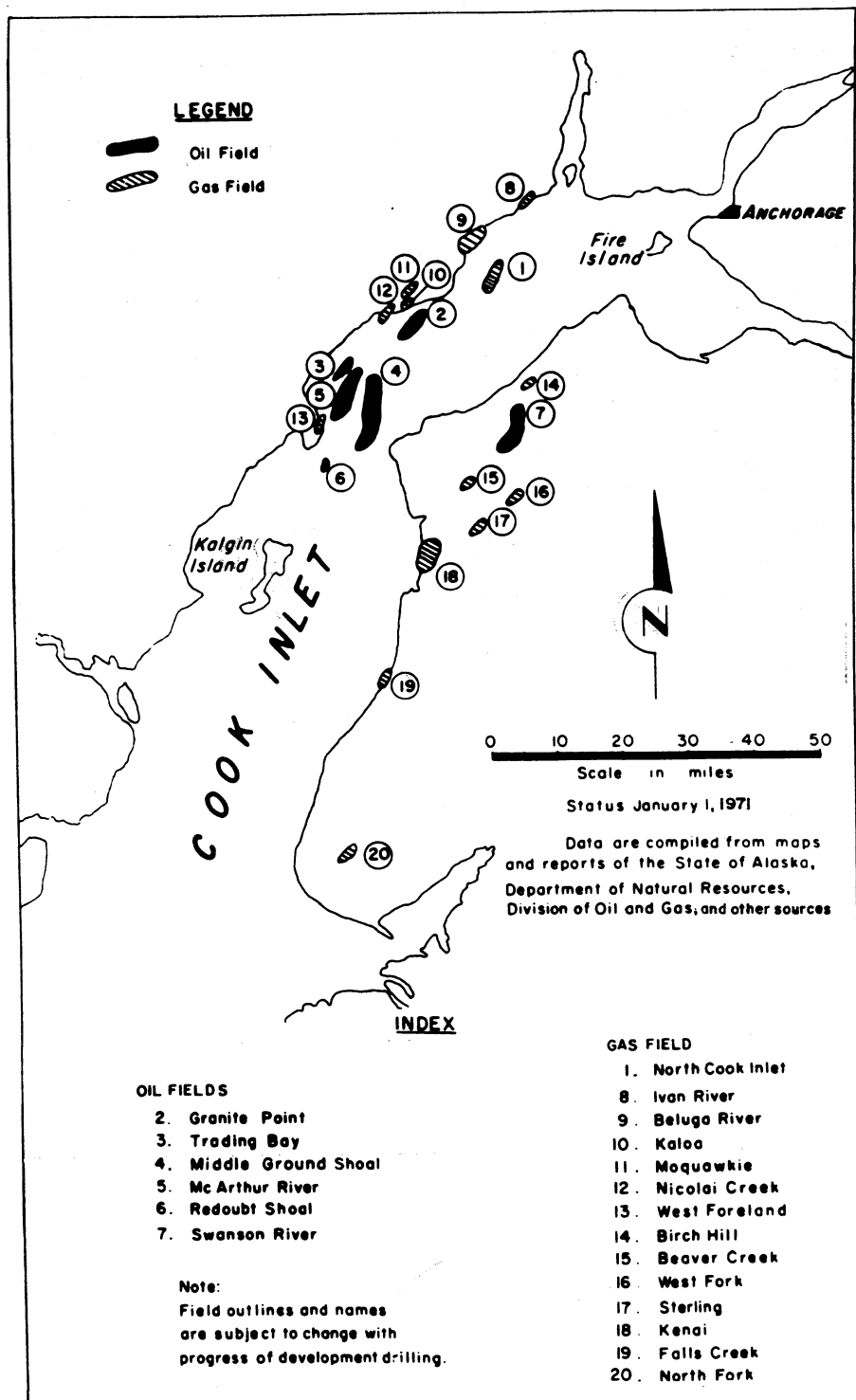


Figure 2.—Cook Inlet Oilfields and Gasfields.

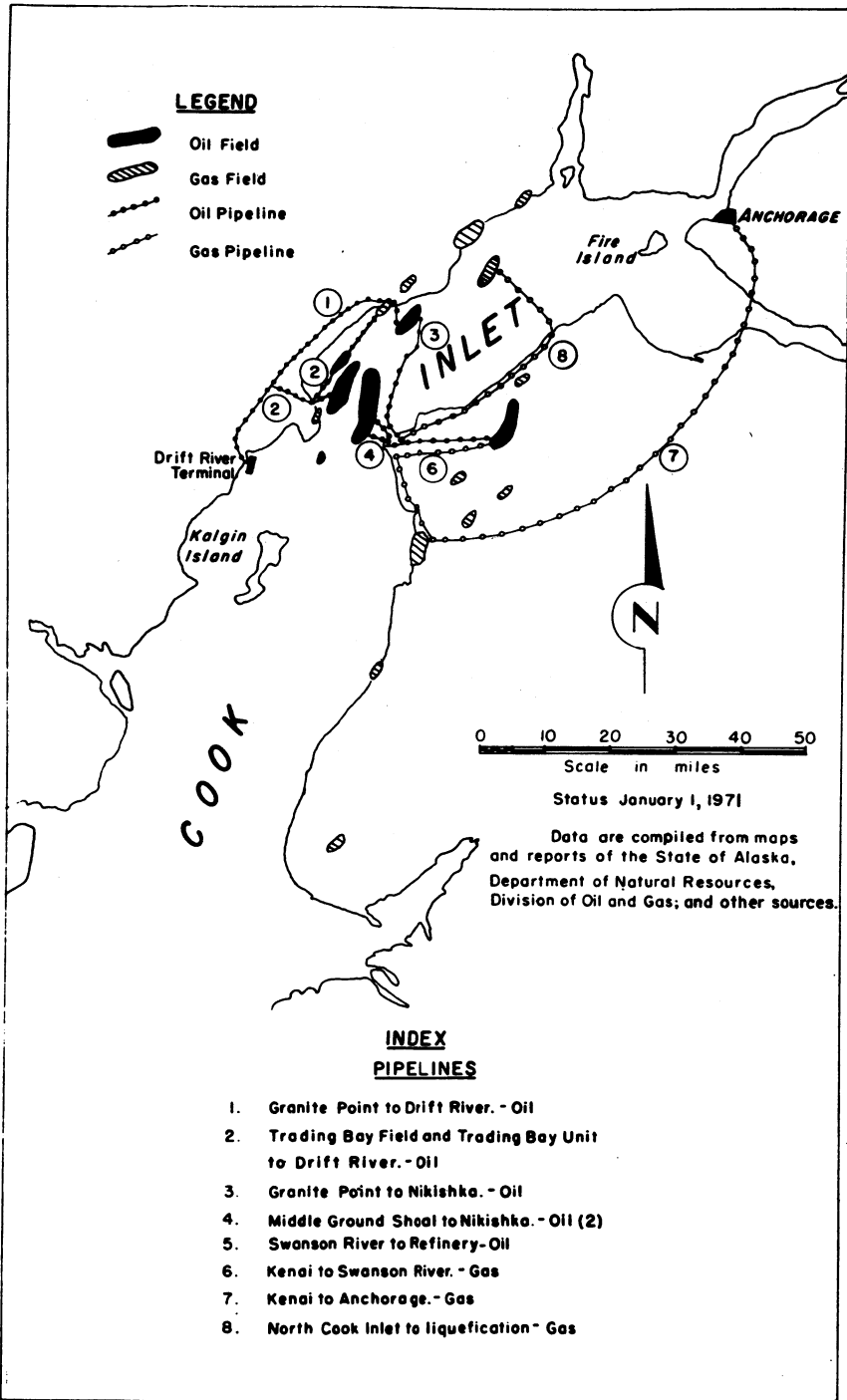


Figure 3.—Cook Inlet oil and gas pipelines.

nel and supplies. Sample drilling was scheduled to begin in June 1972.

Petroleum and Natural Gas.—Crude oil remained the leading revenue producer among minerals in Alaska. The value of crude oil produced in 1971 increased to \$257.6 million from the 1970 level of \$251.7 million although production declined about 4.9 percent. Crude oil production was 79.5 million barrels in 1971, compared with 83.6 million barrels in 1970.

All oilfields showed decreases in output except the McArthur River field, which gained slightly during 1971. The Swanson River field, until recently the State's most productive, was surpassed by the McArthur River field. By September, 1971, total cumulative production from the McArthur River field had reached 123.7 million barrels and that of the Swanson River field stood at 122.8 million barrels.

Production of natural gas increased 9.0 percent over that of 1970 reflecting a slight decline in nonassociated gas from gas wells but a compensating increase in associated gas from oil wells. The statewide average ratio of associated gas to oil production has exhibited a normal growth rate for depletion type reservoirs, increasing from 204 cubic feet per barrel in 1961 to 1,314 cubic feet per barrel in 1971.

According to the American Petroleum Institute (API)³ the total number of wells in Alaska classified⁴ as "drilled" during 1971 decreased 71 percent from an all-time high of 112 wells in 1970 to 32 wells

³ American Petroleum Institute. Quarterly Review of Drilling Statistics for the United States, Annual Summary, 1970 and 1971, pp. 14-15.

⁴ For definitions of API well counts see American Petroleum Institute, Technical Report No. 1, Standard Definitions for Petroleum Statistics, 1969, pp. 22-30.

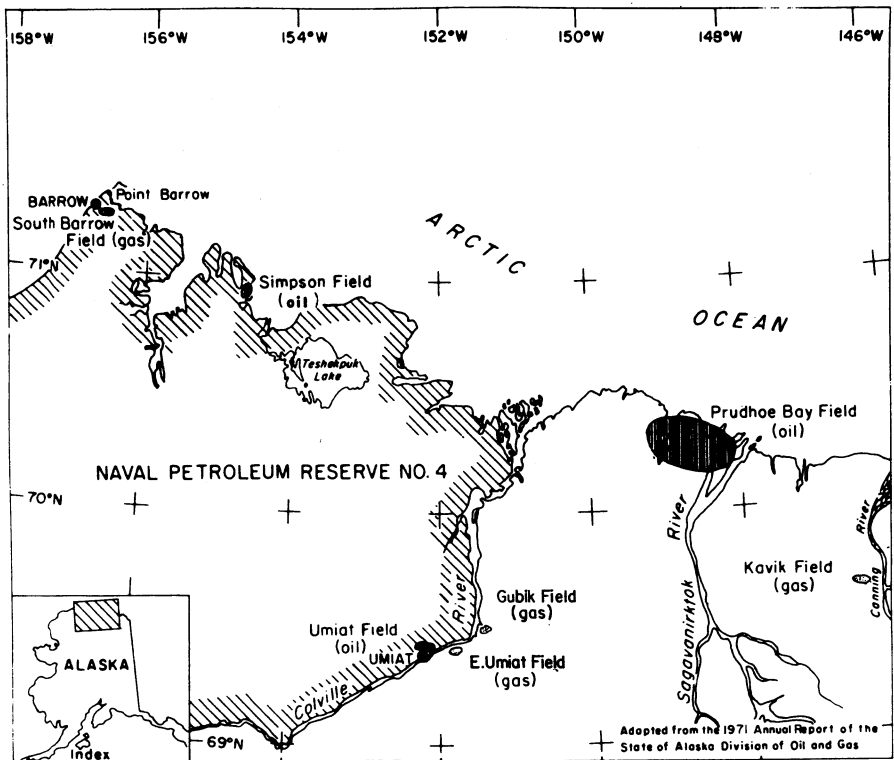


Figure 4.—Oilfields and Gasfields of the Arctic North Slope.

in 1971, the lowest level since 1965. Three of the five exploratory wells were located on the North Slope, an area that had 49 new exploratory wells drilled in 1970. The average footage drilled per well has changed very little during the 5 years ending in 1971, each year remaining within 1 percent of the 5-year average of 10,433 feet per well.

The Alaska Division of Oil and Gas reported 16 exploratory wells active in 1971; 11 on the Arctic North Slope and five in the Cook Inlet Basin. The activity on the North Slope resulted in one suspended well, three dry holes, five locations, and two drilling wells. The five active wells in the Cook Inlet Basin resulted in two dry holes, one location, and two drilling wells. One of the dry holes, Union Oil Co. of California No. 1 Kenai Unit Hemlock was plugged back and completed as a gas well in the Kenai gasfield. There were no new oil or gas discoveries during 1971.

At yearend the Alyeska Pipeline Service Co. was marking time awaiting the issuance by the Secretary of Interior of permits for the construction of a crude oil pipeline from Prudhoe Bay on the North Slope to Valdez on the Gulf of Alaska.

The Standard Oil Co. (Ohio) announced

the first contracts for the sale of crude oil and natural gas from leases in the Prudhoe Bay area of Alaska's North Slope. The Standard Oil Co. (Ohio) reportedly agreed to sell to the Columbia Gas System, Inc., \$200 million in crude oil, with the first \$60 million payment to be made initially and the balance due after a permit is issued for construction of the proposed trans-Alaska pipeline.

Tesoro-Alaskan Petroleum Corp. (Tesoro) contracted to supply San Diego Gas & Electric Co. with three million barrels of low-sulfur fuel oil annually over a 3-year period commencing in April 1972. Prior to the agreement date Tesoro shipped its residual fuel oil to Japan.

The Alaska Oil and Gas Conservation Committee issued orders effective July 1972 prohibiting the flaring of casinghead (oil-associated) gas from wells in Cook Inlet fields. At yearend Marathon Oil Co. and Union Oil Co. of California had requested permission from the U.S. Corps of Engineers to build a 16-inch gas pipeline to collect the gas from the Trading Bay production facility and transport it northward 20 miles to a shoreline location near Granite Point. Final plans for making an Inlet crossing had not been completed, but the

Table 9.—Oil well drilling in Alaska

Province and area	Wells				Footage
	Oil	Gas	Dry	Total	
Exploratory drilling:					
Cook Inlet Basin: West Tyonek.....	--	--	1	1	6,646
Kenai Peninsula: Seward.....	--	--	1	1	3,254
North Slope:					
Beechey Point.....	--	--	1	1	11,922
Mikkelsen Bay.....	--	--	1	1	15,205
West Sagavanirktok.....	1	--	--	1	10,290
Total.....	1	--	2	3	37,417
Total exploratory.....	1	--	4	5	47,317
Development drilling:					
Cook Inlet Basin:					
Kenai.....	--	1	--	1	14,721
Swanson River.....	1	--	--	1	11,209
Trading Bay.....	1	--	--	1	4,960
Total.....	2	1	--	3	30,890
North Slope:					
Prudhoe Bay.....	6	--	--	6	65,348
Putuligayuk River.....	18	--	--	18	192,128
Total.....	24	--	--	24	257,476
Total development.....	26	1	--	27	288,366
Grand total.....	27	1	4	32	335,683

Source: American Petroleum Institute.

operators were considering a submarine line from Granite Point to processing plants at Nikiski where the gas can be beneficially used.

METALS

Antimony.—No production of antimony was reported to the Bureau of Mines in 1971. The Earl Pilgram & Co. Stampede mine in the Kantishna River district of Central Alaska, leased to Charles R. Butler, was the only producer of antimony in 1970. The mine was inactive in 1971. Tillicum Mining Co. reported that its Klemm mine had been leased to El Paso Natural Gas Co. and that there was no production from the mine in 1971. However, the State of Alaska Department of Natural Resources, Division of Geological Survey, in its Annual Report for 1971, reported the production of 34 short tons of antimony valued at \$34,000. Output was attributed to the metal produced as a by-product of mercury mining. The decrease in production from 63 short tons in 1970 was attributed to the sharp drop in the price of antimony. Unit value decreased about 42 percent.

Copper.—Alaska had no copper production in 1971, but the State has a long history of producing the mineral. Copper is second to gold in value of past production in Alaska. Almost 700,000 tons of copper have been produced since 1906 when the Kennecott Mines Co. (now Kennecott Copper Corp.) established a mining camp at Kennicott Glacier in the Wrangell Mountains. The company took its name from the glacier but misspelled it with a second "e". They mined what is considered to be the largest mass of almost pure copper ore that had ever been discovered. The mines were shutdown in 1938, but the company

and others have continued to explore. The search has extended to all parts of the State except, possibly, the North Slope.

Under a contract with the U.S. Bureau of Mines, the University of Alaska Mineral Industry Research Laboratory compiled information on copper occurrences in eight quadrangles covering an area generally known as the Copper River, White River, and Prince William Sound copper provinces. A publication⁵ based on records of the Bureau of Mines, the U.S. Geological Survey, the State Division of Geological Survey, and the University of Alaska was released during 1971.

American Metal Climax, Inc., did some exploratory drilling at a copper deposit at Orange Hill in the Chisana district. An investigation by the U.S. Geological Survey indicates the presence of a copper prospect in a quartz diorite at Orange Hill containing 200 million tons of material averaging 0.4 percent copper, 0.02 percent molybdenum, 0.02 ounce gold and 0.08 ounce of silver per ton. On a copper equivalent basis this ore compares favorably with Duval Corp. Sahuarita mine in southern Arizona.

The Slana, Nabesna, and Chisana areas of the eastern Alaska Range were the scene of airborne geophysical, surface geological, and core drilling activities by crews working on prospective deposits of copper and related minerals. Companies have been exploring the area for several years, but activity in 1971 was unusually heavy.

Gold.—The production of gold in Alaska decreased, according to reports filed with the Bureau of Mines, from 1970 to 1971 in

⁵ Heiner, Lawrence E., Ernest N. Wolff, and Donald G. Grybeck. Copper Mineral Occurrences in the Wrangell Mountain-Prince William Sound Area, Alaska. Univ. of Alaska Min. Ind. Res. Lab. Rept. No. 27, 1971, 179 pp.

Table 10.—Placer production of gold

Year	Mines producing ²	Material ¹ treated (thousand cubic yards)	Gold recovered		
			Troy ounces	Value (thousands)	Average value per cubic yard
1967.....	50	1,888	22,948	\$803	\$0.425
1968.....	37	1,208	21,124	829	.687
1969.....	30	1,081	21,146	878	.812
1970.....	23	999	34,776	1,265	1.266
1971.....	27	1,060	12,327	508	.480

¹ Excludes material treated primarily for the recovery of platinum.

² Excludes itinerant prospectors, "snipers," "highgraders," and others who gave no evidence of legal right to property.

both quantity and total value despite an increase in the number of mines, a twofold increase in the quantity of material washed, and a 13-percent increase in the unit price of gold. The area of major decrease was the Yukon River where the quantity of placer gold production dropped more than 60 percent from 33,962 ounces valued at \$1,235,877 in 1970 to 11,589 ounces valued at \$478,049 in 1971. Bucketline dredging operations in the State washed 185 percent more material in 1971 than in 1970 but produced only about one-fourth as much gold. Lode production continued during 1971 at the Little Squaw mine in the Brooks Range near Chandalar Lake by Little Squaw Gold Mining Co., successor to Chandalar Gold Mining and Milling Co.

Iron Ore.—Alaska's iron ore resources continued to receive attention from major mining organizations. Iron Ore Co. of Alaska, a Japanese company wholly owned by Mitsubishi International Corp., took over from United States Steel Corp. the exclusive rights to some iron ore mining leases at Klukwan. The low-grade iron ore deposit, discovered 60 years ago, is located in an alluvial fan in the Chilkat River about 25 miles north of Haines. Iron Ore Co. of Alaska engaged H. J. Kaiser Co. to conduct a feasibility study for developing the property. Engineers envision a plant that would produce 600,000 tons per year of pellets averaging 68 percent iron. The development was estimated to cost \$123 million and would employ 900 men. It was estimated that the alluvial fan contains at least 800 million tons of ore and would provide 20 years of operation. A decision by Iron Ore Co. of Alaska will await additional studies.

Mercury.—Soft demand for mercury led to continuously lower prices during the year. By yearend, the price had fallen to \$216–\$218 per 76-pound flask from \$350–\$360 in January. The low price made mining uneconomical for most producers. Announcements by the Environmental Protection Agency in March listing mercury as a hazardous air pollutant, and in December establishing an emission standard on mercury-producing plants, depressed prices. The average 1971 price of mercury at New York was \$292.41 per flask.

The Red Devil mine in the Aniak district, operated by Alaska Mines & Minerals, Inc., closed in June. Clayton R. Rasmus-

sen's Alaska Red Top mine was inactive all year. The Alice & Bessie mine, operated by George H. Willis, closed in October. T. A. Hubbard's Schaefer (Cinnabar Creek) mine closed in September. At yearend there were no reported mercury retorts operating in the State. Mercury ores were concentrated by hand sorting, gravity, and flotation. Concentrates were shipped to Japan, Oregon, and California for retorting.

Platinum.—Goodnews Bay Mining Co. continued to operate a floating dredge and a sluice box on the Salmon River near Goodnews Bay to recover platinum. According to the annual report of the Alaska Division of Geological Survey, the volume of material processed was about the same as that of 1970, but the price of platinum and platinum-group metals was lower in 1971 than in 1970. As a result the value of the produced metals declined in 1971.

Tin.—The only tin production in Alaska during 1971 came from the Lee Bros. Dredging Co., Inc., operation on the Seward Peninsula. The Lost River mine, operated in 1970 by L. Grothe and C. Pearson, reported no tin production in 1971.

Uranium.—Uranium mining operations at the Bokan Mountain property, Kendrick Bay, during the 1971 season resulted in the production of approximately 55,000 tons of high-grade uranium-bearing ore according to the Western Miner. The mine is located above Kendrick Bay near the southern tip of Prince of Wales Island, Alaska, and about 40 miles southwest of Ketchikan. The ore was mined for Newmont Mining Corp. by CM Inc., a mining contractor, and shipped by barge to Dawn Mining Co.'s uranium concentrating facility at Ford, Wash.

NONMETALS

Barite.—Alaska Barite Co., a subsidiary of Inlet Oil Corp., continued offshore mining at its underwater mine off Castle Island. Production in 1971 from the State's only producer was 101,888 short tons, a decrease of 31,697 tons, or 23.7 percent, below that of 1970. However, a gain in unit price resulted in an increase in the total value of barite produced to almost \$1.1 million. Alaska ranked fifth among States in the production of barite.

Fluorite.—The Lost River mine was discovered in 1903 and developed as a tin mine.⁶ The mine has experienced several periods of activity and intermittent production including a mill built in 1951. Several companies, agencies, and individuals have conducted exploratory or development work since discovery of the mine. The partnership of L. Grothe and C. Pearson reported tin production from the mine in 1970. In 1971 the Lost River Mining Corp., Ltd. (Lost River), a subsidiary of Pan Central Exploration, Ltd., conducted the second year of an extensive diamond drilling program. As a result, fluorite replaced tin as the predominant mineral resource on the property. As a consequence of core drilling during the 1970 and 1971 field seasons and earlier explorations by other investigators, Lost River estimated fluorite reserves in the two zones that have been investigated at 39 million tons of ore, up from 10 million tons estimated in 1970. There reportedly are seven separate fluor-

ite ore zones in the area. Lost River shipped composite ore samples to Battelle Memorial Institute for metallurgical testing and 100 tons of bulk ore samples to the Colorado School of Mines for milling tests. Feasibility studies for mining, milling, construction, and shipping were completed or in progress at the end of 1971.

Sand and Gravel.—Sand and gravel output in 1971 declined 8.5 percent in quantity and 20.2 percent in value from 1970 totals. The decline resulted from a reduction in Government-and-contractor operations; commercial operations increased 48.2 percent over the 1970 level. Production of sand and gravel by commercial operators gained in importance over Government-and-contractor operators from 9.5 percent of the State total in 1970 to 15.3 percent in 1971. Sand

⁶ Lorain, S. H., R. R. Wells, Miro Mihelich, J. J. Mulligan, R. L. Thorne, and J. A. Herdlick. Lode-Tin Mining at Lost River, Seward Peninsula, Alaska. BuMines Inf. Circ. 7871, 1958, 76 pp.

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

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	119	\$222	W	\$321
Fill.....	2	5	W	W
Paving.....	47	139	83	233
Blast.....	17	54	--	--
Other uses ¹	310	775	494	877
Total².....	494	1,195	578	1,431
Gravel:				
Building.....	317	168	147	299
Fill.....	1,063	973	1,791	722
Paving.....	224	532	575	996
Miscellaneous.....	9	29	W	W
Other uses ³	334	858	528	874
Total².....	1,947	2,560	3,040	2,891
Government-and-contractor operations:				
Sand:				
Building.....	15	37	20	58
Fill.....	26	29	31	40
Paving.....	6,781	12,102	5,749	8,561
Other uses.....	10	71	10	77
Total².....	6,832	12,289	5,810	8,735
Gravel:				
Building.....	5	2	7	7
Fill.....	705	417	533	486
Paving.....	15,838	24,610	13,543	19,216
Other uses.....	4	20	106	41
Total².....	16,552	25,049	14,188	19,750
Total sand and gravel².....	25,825	41,092	23,617	32,806

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

¹ Includes building, fill, and other sands (1971).

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

³ Includes miscellaneous gravel (1971).

and gravel used for paving by commercial operators rose from 271,000 short tons in 1970 to 658,000 in 1971.

Stone.—In 1971 the production of stone decreased 58.9 percent below that of 1970 to 2,657,793 short tons. An increase in average unit value from \$1.55 to \$1.91 per ton held the drop in overall value to 49.4

percent. The Alaska State Department of Highways was the leading producer of stone in both tonnage and value. Other major producers included Manson Osberg Co., Moore Construction Co. Inc., U.S. Army Corps of Engineers, Burgess Construction Co., and Central Construction Co., Inc.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	Region
Barite: Alaska Barite Co.	Anchorage, Alaska 99500	Open pit	Southeastern Alaska.
Coal:			
B. & B. Coal Co.	Healy, Alaska 99749	Strip mine	Yukon River.
Delta Coal Co.	North Pole, Alaska 99705	do	Do.
Premier Coal Co.	Palmer, Alaska 99645	do	Cook Inlet-Sustitna.
Usibelli Coal Mine, Inc.	Usibelli, Alaska 99787	do	Yukon River.
Gold:			
U.S. Smelting Refining and Mining Co.	Fairbanks, Alaska 99701	Dredge	Do.
L. McCree	Manley Hot Springs, Alaska 99756	Nonfloat plant	Do.
Ruby Mining Co.	Ruby, Alaska 99768	do	Do.
Prince Creek Mining Co.	Flat, Alaska 99584	do	Do.
Natural gas:			
Amoco Production Co.	Anchorage, Alaska 99500	Gas production	Offshore Cook Inlet.
Mobil Oil Corp.	do	do	Westside Cook Inlet.
Phillips Petroleum Co.	do	do	Kenai Peninsula, Offshore Cook Inlet.
Standard Oil Co. of California	do	do	Kenai Peninsula, Westside Cook Inlet.
Texaco Inc.	do	do	Offshore Cook Inlet, Westside Cook Inlet.
Union Oil Co. of California	do	do	Offshore Cook Inlet, Kenai Peninsula.
Holmes & Narver, Inc.	Point Barrow, Alaska	do	North Slope.
Petroleum-crude:			
Amoco Production Co.	Anchorage, Alaska 99500	Oil production	Offshore Cook Inlet.
Atlantic Richfield Co.	do	do	Kenai Peninsula, Offshore Cook Inlet, North Slope.
BP Alaska, Inc.	do	do	North Slope.
Mobil Oil Corp.	do	do	Offshore Cook Inlet.
Shell Oil Co.	do	do	Kenai Peninsula, Offshore Cook Inlet.
Texaco Inc.	do	do	Offshore Cook Inlet.
Standard Oil Co. of California	do	do	Kenai Peninsula.
Union Oil Co. of California	do	do	Offshore Cook Inlet.
Petroleum refining:			
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.
Platinum-group metals: Goodnews Bay Mining Co.	Fairbanks, Alaska 99701	Dredge	Salmon River.
Sand and gravel:			
Alaska Department of Highways	Juneau, Alaska 99801	Open pit	Various.
Alaska Department of Public Works	do	do	Do.
Burgess Construction Co.	Fairbanks, Alaska 99701	do	Yukon River.
Stone:			
Alaska Department of Highways	Juneau, Alaska 99801	Open quarry	Various.
Manson Osberg Co.	Seattle, Wash. 98100	do	Southeastern Alaska.
Moore Construction Co., Inc.	Ketchikan, Alaska 99901	do	Do.
U.S. Army Corps of Engineers	Anchorage, Alaska 99500	do	Copper River, Kenai Peninsula, Southeastern Alaska.
Burgess Construction Co.	Fairbanks, Alaska 99701	do	Various.
Central Construction Co., Inc.	Seattle, Wash. 98100	do	Northwestern Alaska.

The Mineral Industry of Arizona

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

By Lyman Moore ¹

The value of mineral production in Arizona was \$981 million, 16 percent below the \$1,167 million of 1970. Income from the mineral industry ranked second to manufacturing among sources of income.

Copper accounted for \$853 million, 87 percent of the total value of minerals produced. The State continued to lead the nation in copper output, which was 820,171 tons; was second in silver, 6.2 million troy ounces; second in molybdenum,

22.7 million pounds; and fourth in gold 94,038 troy ounces.

The value of metals decreased 18 percent, mainly because of lower output of copper due to lower demand, a prolonged strike, and reduced smelting capacity. Molybdenum output increased because of the effect of the first full years production from the Sierrita mine of Duval Corp. The

¹ Mining engineer, Division of Nonferrous Metals.

Table 1.—Mineral production in Arizona ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays..... thousand short tons..	199	\$454	² 119	² \$84
Coal (bituminous)..... do.....	132	W	1,146	W
Copper..... short tons.....	917,918	1,059,277	820,171	852,978
Gem stones.....	NA	155	NA	160
Gold (recoverable content of ores, etc.).. troy ounces..	109,853	3,998	94,038	3,879
Gypsum..... thousand short tons..	98	358	W	W
Helium, grade A..... million cubic feet..	62	1,186	W	W
Iron ore (usable) thousand long tons, gross weight..	W	W	15,859	W
Lead (recoverable content of ores, etc.).. short tons..	285	89	859	237
Lime..... thousand short tons..	309	4,523	296	4,474
Molybdenum (content of concentrate)				
..... thousand pounds..	15,672	26,700	22,684	39,872
Natural gas (marketed)..... million cubic feet..	1,101	188	868	153
Petroleum (crude)..... thousand 42-gallon barrels..	1,784	5,281	1,236	3,918
Pumice..... thousand short tons..	824	627	949	625
Sand and gravel..... do.....	17,822	19,804	19,791	24,891
Silver (recoverable content of ores, etc.)				
..... thousand troy ounces..	7,330	12,981	6,170	9,538
Stone..... thousand short tons..	3,511	7,094	2,873	5,848
Zinc (recoverable content of ores, etc.).. short tons..	9,618	2,947	7,761	2,499
Value of items that cannot be disclosed: Asbestos, cement, clays (bentonite, 1971), diatomite, feldspar, fluorspar, mica (scrap), perlite, pyrites, tungsten concentrate, and values indicated by symbol W.....	XX	21,105	XX	32,364
Total.....	XX	1,166,767	XX	981,020
Total 1967 constant dollars.....	XX	1,043,673	XX	^p 852,310

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

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

² Excludes bentonite; included with "Value of items that cannot be disclosed."

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

County	1970	1971	Minerals produced in 1971 in order of value
Apache	\$7,231	\$5,913	Petroleum, helium, clays, natural gas, pumice, iron ore, sand and gravel, stone.
Cochise	78,297	62,799	Copper, stone, lime, silver, gold, sand and gravel, fluorspar.
Coconino	2,250	666	Pumice, sand and gravel, stone.
Gila	124,653	101,614	Copper, molybdenum, asbestos, lime, stone, silver, sand and gravel, gold, fluorspar, clays.
Graham	W	W	Sand and gravel, stone, lead, zinc, copper, pumice, silver, gold.
Greenlee	151,043	119,492	Copper, silver, lime, stone, gold, sand and gravel.
Maricopa	7,258	14,420	Sand and gravel, lime, stone, clays, mica, copper, silver, gold.
Mohave	40,762	34,017	Copper, molybdenum, sand and gravel, silver, stone, feldspar, gold, tungsten, clays.
Navajo	W	W	Coal, sand and gravel, pumice, stone.
Pima	422,298	378,219	Copper, molybdenum, cement, silver, sand and gravel, gold, lime, stone, lead, clays, zinc, mica.
Pinal	285,166	211,772	Copper, molybdenum, silver, gold, sand and gravel, gypsum, lime, stone, perlite, diatomite, pyrites, lead.
Santa Cruz	W	W	Sand and gravel, stone, tungsten, copper, lead, silver, zinc.
Yavapai	41,698	46,284	Copper, cement, zinc, sand and gravel, stone, lime, molybdenum, gypsum, silver, clays, lead, gold, pumice, iron ore.
Yuma	W	W	Sand and gravel, stone, copper, silver, gold.
Undistributed ¹	6,071	5,819	
Total	1,166,767	² 981,020	

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

¹ Includes gem stones, sand and gravel, and stone that cannot be assigned to specific counties, and values indicated by symbol W.

² Data does not add to total shown because of independent rounding.

Table 3.—Indicators of Arizona business activity

	1970	1971	Change, percent	
Employment and labor force, annual average:				
Total labor force.....	thousands..	662.5	695.1	+4.9
Total unemployment.....	do.....	62.6	70.6	+12.8
Total nonagricultural employment.....	do.....	547.4	576.6	+5.3
Mining.....	do.....	20.6	20.7	+0.5
Construction.....	do.....	37.1	43.5	+17.3
Manufacturing.....	do.....	91.2	88.5	-3.0
Transportation and public utilities.....	do.....	30.0	31.0	+3.3
Wholesale and retail trade.....	do.....	127.0	133.3	+5.0
Finance, insurance, and real estate.....	do.....	30.5	32.8	+7.5
Services.....	do.....	91.5	97.5	+6.6
Government.....	do.....	119.5	129.3	+8.2
Personal income:				
Total.....	millions..	\$6,418	\$7,157	+11.5
Per capita.....	do.....	\$3,581	\$3,871	+8.1
Construction activity:				
Number of new housing units authorized.....		29,853	51,265	+71.7
Valuation of nonresidential construction.....	millions..	\$170.5	\$193.9	+13.7
Cement shipments to and within the state.....	thousand 376-pound barrels..	5,638	7,255	+28.7
Mineral production value.....	millions..	\$1,166.8	\$981.0	-15.9

Sources: Survey of Current Business; Area Trends in Employment and Unemployment; Construction Review; Employment and Earnings; and the U.S. Bureau of Mines.

Table 4.—Major source of income in Arizona ¹

(Thousands)

Source of income	1970	1971	Change, percent
Manufacturing..	\$1,310,000	\$1,330,000	+2
Mining ²	1,166,767	981,020	-16
Tourism.....	565,000	600,000	+6
Crops.....	r 274,117	304,268	+11
Livestock.....	r 373,227	395,197	+6

¹ Revised.

² Valley National Bank Research Department, Phoenix, Ariz., August 1972.

³ U.S. Bureau of Mines.

Table 5.—Valuation on centrally assessed groups of property in Arizona ¹

(Thousands)

Group	1970	1971	Change, percent
Utilities.....	\$1,271,670	\$1,401,257	+10.2
Mines.....	649,473	793,622	+22.2
Pipelines.....	337,380	352,420	+4.5
Railroads.....	165,301	151,156	-8.6
Airlines.....	20,321	30,880	+52.0
Oil and gas....	5,898	4,470	-24.2

¹ Pay Dirt. No. 384, June 28, 1971, p. 3.

Table 6.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Coal.....	79	66	5	42	--	17	407.17	3,904
Metal.....	12,097	335	4,048	32,436	8	763	23.77	2,443
Nonmetal.....	257	213	55	460	--	5	10.87	87
Sand and gravel.....	1,538	235	362	2,904	6	63	23.76	13,376
Stone.....	487	279	136	1,088	--	9	8.27	111
Total ¹	14,458	319	4,605	36,930	14	857	23.59	3,207
1971 ^p :								
Coal.....	100	249	25	196	--	19	97.01	970
Metal.....	12,210	320	3,903	31,243	11	807	26.18	3,001
Nonmetal.....	285	214	61	490	1	21	44.94	13,220
Sand and gravel.....	1,340	243	326	2,712	1	69	25.82	3,123
Stone.....	490	304	148	1,191	--	26	21.83	459
Total ¹	14,425	309	4,463	35,831	13	942	26.65	3,055

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

value of nonmetals increased 18 percent, and the value of fuels increased 19 percent.

Employment and Injuries.—Final Bureau of Mines statistics for 1970 and preliminary data for 1971 on employment and injuries in the mineral industries, excluding petroleum and natural gas, are given in table 6.

Legislation and Government Programs.—The Arizona State Department of Property Valuation reported that the cash value of Arizona's producing mines was \$794 million, a 22-percent increase over the 1970 valuation. The increase reflects both the first year on the tax roll for Duval Corp.'s Sierrita mine, which is valued at \$106 million, and the \$31 million value placed on improvements completed in 1971 at Magma Copper Co.'s, San Manuel Division. The Morenci Branch of Phelps Dodge Corp. remained the State's most valuable property; cash value was assessed at \$171.5 million, an increase of 1.6 percent from the previous year. The State tax rate was increased to \$1.90 per \$100 valuation in 1971, from \$1.65 in 1970. The average total tax rate throughout the State for State, county, school district, city, and other taxing units increased to \$11.58 in 1971 from \$10.69 in 1970. Mining properties are taxed at 60 percent of the cash value determined by the State Department of Property Valuation.

Air-quality standards were established by the Arizona Department of Health on May 18, 1970. They provided that smelter emis-

sions could not contain more than 10 percent of the sulfur in the feed and a maximum of 6,500 pounds per hour. The maximum allowable ground level concentration of sulfur dioxide in the air outside the boundary of the operation was limited to the following standards in micrograms per cubic meter:

Annual average	50
Any 3-consecutive-day average	120
24-hour average	250
1-hour average	850

Guideline standards were issued by the Federal Environmental Protection Agency on January 25, 1971, suggesting higher allowable sulfur dioxide concentrations and not limiting the total sulfur discharged to a proportion of sulfur in the original smelter feed. An earlier Federal report stated that a total sulfur discharge limit of 10 percent was attainable with existing technology and this limit was placed in regulations adopted by Arizona and other States. However, the 1971 Federal report recommended standards only for actual air quality outside the smelter. Two maximum allowable ground level concentrations were suggested: The higher was considered adequate to protect public health and the lower adequate to safeguard general public welfare. The standards in micrograms per cubic meter were as follows:

Annual average	60-80
24-hour average	260-365
3-hour average	1,300

The State standards provided that smelters must be in compliance by May 18, 1973, and that until then temporary operating permits could be granted to smelters emitting more than the allowable quantities of sulfur dioxide, provided the operators were diligently pursuing a program that would reduce emission to the allowable standards by 1973. Smelter operators submitted plans for sulfur control installations to the State Air Pollution Control Board late in 1970 and by March all had received permits for operating during 1971. As smelter operators continued their studies of sulfur control methods and costs, it became apparent that capital and operating costs to attain State standards were so high that they could not be economically justified for older smelters. Therefore, on

October 20, 1971, Phelps Dodge Corp. petitioned the State Board of Health to lower State standards to those suggested by the Federal Environmental Protection Agency. Phelps Dodge stated in their petition that bringing their Ajo, Douglas, and Morenci smelters into compliance with Federal suggested standards would cost \$112 million and with State standards \$400 million. If State standards were enforced the Douglas smelter would have to be closed. A meeting was held on the petition December 30 and a decision was announced in January. The Board's decision continued the existing State air quality standards pending further study and indicated that more time than previously allowed would be given the smelters to solve the sulfur discharge problem.

REVIEW BY MINERAL COMMODITIES ²

METALS

Copper ore was produced at 45 mines, gold ore at one, silver ore at two, copper-zinc ore at one, lead-zinc ore at one, lead ore at three, iron ore at one, and tungsten ore at four. No production of mercury, uranium, and vanadium was reported.

Copper.—Mines producing copper in Arizona yielded 820,171 tons, about 54 percent of domestic primary mine production. Output was 10.6 percent less than in 1970 due to decreased copper demand, a strike that lasted from 1 to 2 months at many plants, and reduction of smelter capacity due to regulations requiring lower discharges of sulfur to the atmosphere. Of the 45 mines reporting production, 19 mined principally concentrating ore, eight leaching ore, 11 direct smelting ore, and seven low-grade silicious copper ore used for smelter flux. Tailings containing copper were also shipped from one prop-

erty for flux. Of the total copper production of 820,171 tons, 705,564 tons was recovered from 134.91 million tons of ore treated by concentration; 54,646 tons was from 14.28 million tons of ore treated by vat or heap leaching; 51,894 tons was recovered from dump leaching; and 8,066 tons was from direct smelting ore and fluxes. The average yield of copper from concentrating ore was 10.5 pounds per ton and from leaching ore it was 7.7 pounds per ton. About 18 percent of the total metal production was from underground mines.

The Morenci plant of the Phelps Dodge Corp. mined 16,590,000 tons of ore in 1971 and recovered 113,598 tons of copper ³ including 7,090 tons from leach dumps,

² Portions of the information in this section were obtained from Arizona Department of Mineral Resources publications, engineering and trade journals, company annual reports, and other related sources.

³ Phelps Dodge Corp. Annual Report, 1971, p. 10.

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

Year	Arizona			United States		Arizona	
	Total value mineral production (thousands)	Copper production		Copper production		Percent of U.S. copper production	Percent of world copper production
		Short tons	Value (thousands)	Short tons	Value (thousands)		
1967.....	\$465,255	501,741	\$383,591	954,064	\$729,401	52.6	* 9.0
1968.....	617,541	627,961	525,566	1,204,621	1,008,195	52.1	* 11.1
1969.....	859,462	801,363	761,840	1,544,579	1,468,400	51.9	* 12.9
1970.....	1,166,767	917,918	1,059,277	1,719,657	1,984,484	53.4	* 13.8
1971.....	981,020	820,171	852,978	1,522,183	1,583,071	53.9	12.3

* Revised.

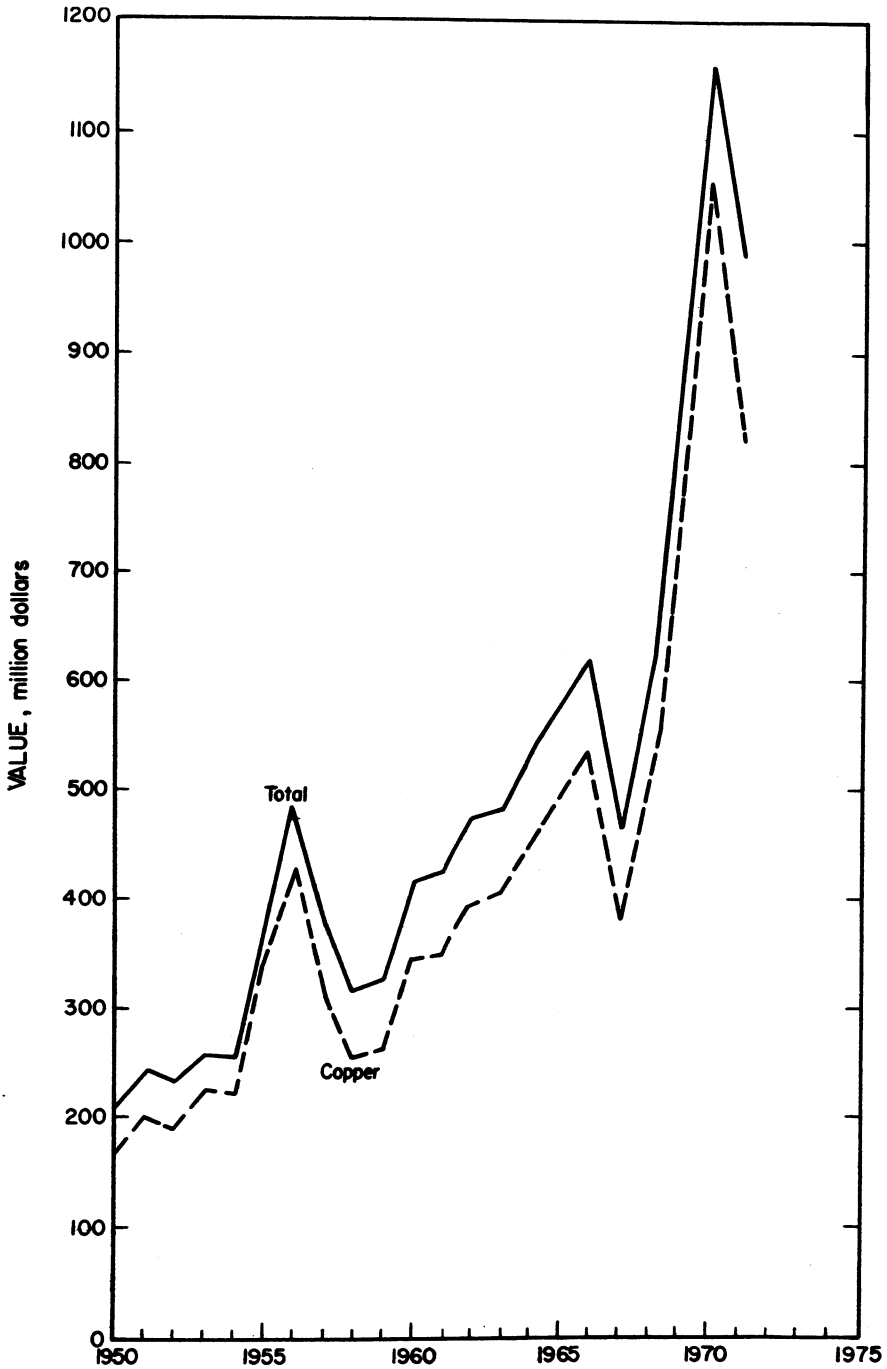


Figure 1.—Value of mine production of copper and total value of mineral production in Arizona.

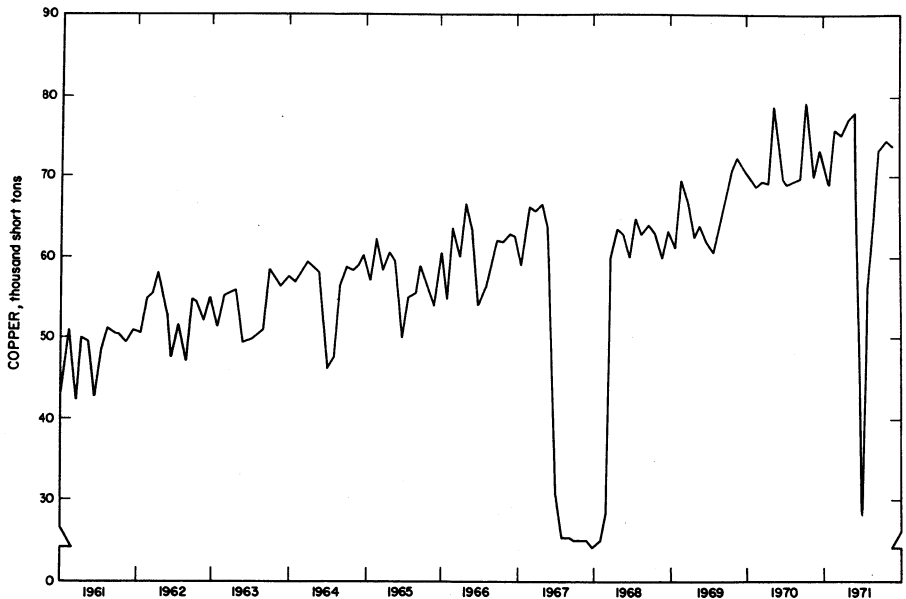


Figure 2.—Mine production of copper in Arizona, by month, in terms of recoverable metal.

compared with 19,173,000 tons of ore produced the previous year, and 129,438 tons of copper recovered including 8,474 tons from leach dumps. Waste stripping increased to 36,347,000 tons from 34,516,000 tons. Most of the reduction in metal output occurred in July during which all Phelps Dodge plants were closed by a strike, and during interruptions of smelting operations incidental to installing new

pollution control equipment. The work week at the mine and concentrator was reduced from 6-½ to 6 days in December 1970 to allow excessively large concentrate inventories at the smelter to be worked down. Improved electrostatic precipitators were installed at the smelter to reduce dust emission and construction began on a new reverberatory furnace having improved emission control equipment.

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

Rank in 1971	Rank in 1970	Mine	District	County	Operator	Source of copper in 1971
1	1	Morenci.....	Copper Mountain..	Greenlee..	Phelps Dodge Corp..	Copper ore, copper precipitates.
2	3	San Manuel.....	Old Hat.....	Pinal.....	Magma Copper Co..	Copper ore.
3	2	Ray.....	Mineral Creek.....	do.....	Kennecott Copper Corp.	Copper ore, copper precipitates.
4	5	Pima.....	Pima.....	Pima.....	Pima Mining Co..	Copper ore.
5	10	Sierrita.....	do.....	do.....	Duval Sierrita Corp..	Do.
6	7	Copper Queen, Lavender Pit.	Warren.....	Cochise.....	Phelps Dodge Corp..	Copper ore, copper precipitates.
7	6	New Cornelia.....	Ajo.....	Pima.....	do.....	Copper ore.
8	4	Twin Buttes.....	Pima.....	do.....	The Anaconda Co..	Do.
9	8	Inspiration.....	Globe-Miami.....	Gila.....	Inspiration Consolidated Copper Co.	Copper ore, copper precipitates.
10	9	Mission.....	Pima.....	Pima.....	American Smelting and Refining Co.	Copper ore.
11	12	Copper Cities.....	Globe-Miami.....	Gila.....	Cities Service Co..	Copper ore, copper precipitates.
12	11	Mineral Park.....	Wallapai.....	Mohave.....	Duval Corp.....	Do.
13	14	Silver Bell.....	Silver Bell.....	Pima.....	American Smelting and Refining Co.	Do.
14	13	Esperanza.....	Pima.....	do.....	Duval Corp.....	Do.
15	16	Bagdad.....	Eureka.....	Yavapai.....	Bagdad Copper Corp.	Copper ore.

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

Mine	Ore mined (thousand short tons)		Waste material removed (thousand short tons)		Leach material placed in dumps (thousand short tons)		Total copper produced from all sources ¹ (short tons)	
	1970	1971	1970	1971	1970	1971	1970	1971
	OPEN PIT							
Morenci.....	19,173	16,590	18,657	24,782	15,860	11,565	133,197	116,833
Ray Pit.....	12,432	13,396	--	--	26,421	23,243	122,679	89,388
Pima.....	14,598	14,617	² 17,327	² 15,288	--	--	66,247	68,073
Sierrita.....	14,384	25,727	47,945	46,568	--	--	32,832	63,049
New Cornelia.....	10,562	9,244	15,875	18,198	--	--	63,849	53,616
Twin Buttes.....	8,763	7,666	--	78,416	--	--	87,876	53,331
Inspiration.....	9,377	6,856	9,541	6,569	4,457	5,245	³ 50,611	³ 45,273
Mission.....	8,039	6,725	18,549	20,029	--	--	47,678	40,618
Lavender Pit.....	4,850	4,575	1,108	742	12,117	6,645	32,017	26,590
Copper Cities.....	5,143	4,450	4,924	2,208	10,992	6,819	26,764	25,459
Mineral Park.....	5,952	5,645	--	2,944	8,432	4,713	27,164	25,405
Silver Bell.....	3,783	3,796	9,099	8,093	993	1,880	22,531	23,046
Esperanza.....	5,514	5,280	--	3,074	8,513	4,299	22,787	20,706
Bagdad.....	2,028	2,001	4,286	5,590	3,813	3,139	17,437	20,035
UNDERGROUND								
San Manuel.....	15,446	14,909	--	184	--	--	98,130	94,217
Copper Queen.....	829	768	--	--	--	--	33,934	30,935

¹ Gross metal content.² 1,000 cubic yards.³ Recoverable content.**Table 10.—Mine production (recoverable) of gold, silver, copper, lead and zinc, by county**

County	Mines producing		Material sold or treated ² (short tons)	Gold		Silver		Total value
	Lode	Placer ¹		Troy ounces	Value	Troy ounces	Value	
1970 total.....	82	--	150,548,405	109,853	3,997,547	7,330,417	12,980,850	
1971:								
Cochise.....	2	--	5,342,998	27,941	1,152,566	819,860	1,267,503	
Gila.....	8	--	19,011,989	3,647	150,439	219,860	339,904	
Graham, Maricopa, Santa Cruz, and Yuma ³	6	--	3,286	14	578	2,132	3,297	
Greenlee.....	1	--	16,589,305	12,467	514,264	554,094	856,629	
Mohave.....	3	--	5,727,025	216	8,910	332,742	514,419	
Pima.....	9	--	73,054,833	23,002	948,833	3,256,690	5,034,342	
Pinal.....	11	--	25,816,258	26,627	1,098,364	895,256	1,384,066	
Yavapai.....	10	--	3,933,306	124	5,116	88,989	137,578	
Total ⁴	50	--	149,479,500	94,038	3,879,070	6,169,623	9,538,238	
Copper								
Lead								
Zinc								
	Short tons	Value	Short tons	Value	Short tons	Value		
1969 total.....	801,363	\$761,839,777	217	\$64,644	9,039	\$2,639,388	\$780,142,898	
1970 total.....	917,918	1,059,276,805	285	88,950	9,618	2,946,762	1,079,290,914	
1971:								
Cochise.....	54,120	56,285,268	--	--	--	--	58,705,337	
Gila.....	94,289	98,060,352	--	--	--	--	98,550,695	
Graham, Maricopa, Santa Cruz, and Yuma ³	9	9,724	124	34,127	70	22,605	70,331	
Greenlee.....	112,160	116,646,132	--	--	--	--	118,017,085	
Mohave.....	26,516	27,576,900	--	--	--	--	28,100,229	
Pima.....	313,292	325,823,732	632	174,391	20	6,279	331,988,077	
Pinal.....	194,152	201,917,612	1	290	--	--	204,400,332	
Yavapai.....	25,633	26,657,800	102	28,166	7,672	2,470,255	29,298,915	
Total ⁴	820,171	852,977,580	859	236,974	7,761	2,499,139	869,131,001	

¹ Operations at miscellaneous cleanups not counted as mines.² Does not include tonnage of precipitates.³ Combined to avoid disclosure of individual company confidential data.⁴ Data may not add to totals shown because of independent rounding.

Table 11.—Mine production of gold, silver, copper, lead, and zinc in 1971, by class of ore or other source materials, in terms of recoverable metals

Source	Number of mines ¹	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode ore:							
Dry gold and dry silver ² -----	3	10,158	10	5,539	(³)	--	--
Copper-----	45	149,293,874	93,617	6,106,204	764,890	623	20
Copper-zinc, lead, and lead-zinc ² -----	5	98,289	25	30,518	3,219	227	7,742
Total⁴-----	50	149,392,163	93,642	6,136,722	768,109	859	7,761
Other lode material:							
Gold-silver tailings-----	1	76,999	385	27,037	128	--	--
Copper cleanup-----	(⁵)	180	1	325	38	--	--
Copper precipitates-----	10	71,085	--	--	51,894	--	--
Total⁴-----	11	148,264	386	27,362	52,061	--	--
Grand total⁴---	50	149,550,585	94,038	6,169,623	820,171	859	7,761

¹ Detail will not necessarily add to totals because some mines produce more than one class of material.

² Combined to avoid disclosing individual company confidential data.

³ Less than ½ unit.

⁴ Data may not add to totals shown because of independent rounding.

⁵ From properties not classed as mines.

Table 12.—Mine production of gold, silver, copper, lead, and zinc in 1971, by type of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode:					
Acid leaching: (vat, tank, and heap): ¹					
Ore-----	--	--	54,646	--	--
Smelting of concentrates from:					
Ore-----	90,980	6,003,940	705,564	850	7,757
Direct smelting of:					
Ore-----	2,672	138,321	7,900	9	4
Cleanup-----	1	325	38	--	--
Precipitates-----	--	--	51,894	--	--
Tailings-----	385	27,037	128	--	--
Total-----	3,058	165,683	59,960	9	4
Grand total-----	94,038	6,169,623	820,171	859	7,761

¹ Includes copper recovered by electrowinning process.

² Data does not add to total shown because of independent rounding.

Production of the New Cornelia plant was 53,000 tons of copper, a reduction of 16 percent from the previous year. Ore production was 9,244,000 tons, a decrease of 12 percent and waste stripping 18,198,000 tons, an increase of 15 percent. As at Morenci, 1971 production was reduced from that in 1970 by a strike and a shorter workweek at the mine and concentrator. Equipment costing more than \$28.0 million is being installed at the Ajo smelter to remove SO₂ and particulates from the atmospheric discharge. Included

are new converter flues with waste heat boilers, improved electrostatic precipitators, a very large absorption plant to concentrate SO₂, and a sulfuric acid plant.

The Lavender pit at Bisbee produced 26,590 tons of copper during 1971, a decrease of 17 percent from the previous year. Ore production was 4,575,000 tons, a decrease of 6 percent, and waste stripping including leach material was 7,387,000 tons, a decrease of 44 percent. About 16 percent of the copper was produced by dump leaching. Production was reduced as at

Morenci and Ajo by a strike and shortening of the workweek. A further workweek reduction was made at the Lavender plant, in November 1971, to 5 days at the mine and to 5-½ days at the concentrator. The Lavender ore body is approaching depletion with exhaustion expected in 1973.

The Copper Queen underground mine at Bisbee yielded 30,985 tons of copper, a decrease of 9 percent from 1970 production. Ore production was 768,000 tons, a decrease of 7 percent. Production was reduced by the same strike loss and workweek reductions as occurred at the Lavender open pit and concentrator. Underground mining at the Copper Queen may become uneconomic when the Lavender pit ceases production because of higher unit milling and overhead costs for the reduced area output. Economic production from the Copper Queen could also be jeopardized by large increases in smelting costs which could result if the nearby Douglas smelter were closed because of the adoption of higher air quality standards. New electrostatic precipitators were installed during the year to reduce particulate discharges from Douglas.

Development of the Metcalf mine proceeded on a slowed schedule with production now planned for 1974 at an annual rate of 50,000 tons of copper. Smelting capacity for the concentrates at the nearby Morenci smelter will not be available until a new smelter has been constructed to treat concentrates from Tyrone, N. Mex., that are now being smelted at Morenci. The Metcalf ore body will be mined by both surface and underground methods.

Magma Copper Co. (wholly owned by Newmont Mining Corp.) produced 14,909,000 tons of ore and 83,328 tons of copper from the San Manuel Division and 428,000 tons of ore and 17,804 tons of copper from the Superior Division.⁴ A strike of 25-day duration caused a 10-percent decrease from the previous years' output. The expansion of San Manuel mining and concentrating capacity to 60,000 tons per day from the previous 40,000 tons was completed on schedule late in 1971 and production was at a 65,000 tons per day rate in early 1972.

A second electrostatic precipitator and additional gas-collecting flues were installed at the San Manuel smelter to reduce pollution. Construction will start in 1972 on a sulfuric acid plant utilizing exhaust from

the converters and at a later date on a limestone scrubbing plant to remove sulfur from reverberatory gases. A new electrolytic refinery of 200,000 tons per year capacity was completed in December 1971. The refinery contains continuous casting rod mill equipment with an annual capacity of 100,000 tons per year.

Work continued on expansion of the Superior mine and concentrator to a 3,300-ton-per-day capacity, doubling its present size. Completion is scheduled for 1974. New facilities include a 4,800-foot-deep, 22-foot-diameter shaft and a 6,300-ton refrigeration system. The Superior smelter was not reopened after the strike because the 57-year-old facilities could not economically be rebuilt to meet new air quality standards. Concentrates have subsequently been smelted at San Manuel.

Newmont continued engineering studies on the Vekol Hills copper project in the Papago Indian Reservation. Reserves are estimated at 103 million tons averaging 0.56 percent copper. Development of the deposit has been deferred until smelting facilities become available.

Newmont Exploration Limited and Humble Oil & Refining Co. drilled the Copper Creek prospect across the San Pedro Valley from San Manuel. Extensions of known but deep seated ore have been indicated.

The Ray Mines Division of Kennecott Copper Corp. produced 83,431 tons of copper during 1971 and mined 10,278,000 tons of ore which was treated by concentration and by vat leaching.⁵ Production was 15 percent below that of 1970. Output was lost during a 1-month strike and a further reduction was effected by reducing mining, and concentrating work schedules to 6 days per week from their previous 7 days per week during the second half of the year.

Construction continued on the Mineral Creek flood control project with completion expected in 1973. When finished the 155-foot-high dam and a 3.6-mile diversion tunnel of 16-foot diameter will protect the mine from flash floods. Effective smelting capacity was increased at the Hayden smelter by shipping converter slag to the concentrator for flotation separation of

⁴ Arizona Department of Mineral Resources. The Copper Industry. Phoenix, Ariz., 1971. Annual issues.

⁵ Kennecott Copper Corp. Annual Report, 1971, p. 24.

contained copper rather than recycling the slag as had previously been done.

Pima Mining Co. produced 14,617,000 tons of ore and 64,500 tons of copper,⁶ about 1 percent more than in 1970. Construction began on an expansion of mining and concentrating capacity from 40,000 tons per day to 54,000 tons at an estimated cost of \$17 million. Completion is expected early in 1972. The expanded section of the plant will use autogenous grinding and large-cell flotation units.

The Bruce mine division of Cyprus Mines Corp. produced 95,034 tons of ore and 3,013 tons of copper⁷ plus about 7,000 tons of zinc, approximately the same as in 1970. Ore grades averaged 3.75 percent copper and 12.4 percent zinc. Decline haulage-ways were driven from the 2,150 level and development of the 2,300 and 2,450 levels began. New regrinding and flotation equipment was added to the mill with a significant improvement in copper recovery. Proven ore reserves are adequate for a 5-year operation and development below the 2,150 level is expected to prove at least an additional 1-year supply of ore.

Arizona mines of The American Smelting and Refining Company (Asarco) produced 64,200 tons of copper compared with 70,600 tons in the previous year. The production loss occurred in July and August when the Hayden smelter and the Mission mine were closed by strikes. The Silver Bell mine remained open and concentrates from it were stockpiled while the smelter was closed. However, limited smelter capacity prevented treating this stockpile. Production at Mission was 6,725,000 tons of ore and 40,600 tons of copper compared with 8,039,000 tons of ore and 47,700 tons of copper in 1970.⁸ Production at Silver Bell was 3,796,000 tons of ore and 23,100 tons of copper compared with 3,788,000 tons of ore and 22,500 tons of copper the previous year. About 500 tons of copper were recovered from 68,200 tons of fluxing ore produced at the San Xavier mine on Papago Indian land, compared with 400 tons of copper in 1970 from 63,800 tons of fluxing ore. At the Hayden smelter a sulfuric acid plant was completed late in 1971 that will utilize the SO₂ content of converter fumes. The daily output of 1,000 to 1,200 tons of acid recovers over one-half of the sulfur content of the ore smelted. Cost of the facility was \$17.1 million.

In December plans were announced to build vat-leaching facilities at the nearby Mission plant to treat 4,000 tons of ore per day from the San Xavier deposit. Oxide ore reserves are adequate for 8 years of operation. Underlying the oxide are large reserves of sulfide ore containing about 0.50 percent copper. Engineering studies for the development of the Sacaton deposit near Casa Grande were completed and detailed studies of plant design are being made to estimate capital and production costs. A decision on placing the deposit in production may be made in 1972. Reserves are reported to be over 47 million tons of ore containing an average of 0.76 percent copper.

Duval Corp., a subsidiary of Pennzoil United Inc., operated three open-pit mines in Arizona during 1971—Mineral Park, Esperanza, and Sierrita. Mineral Park produced 5,645,000 tons of ore and 25,405 tons of copper in concentrates including 3,658 tons from dump leaching, a decrease of about 7 percent from 1970 production. Esperanza produced 5,280,000 tons of ore and 20,706 tons of copper, in concentrates including 2,227 tons from dump leaching, a decrease of about 9 percent from the previous year. The large new Sierrita mine and concentrator operated for its first full year and produced 25,727,000 tons of ore and 63,049 tons of copper in concentrates.⁹ At the end of 1971 mining and concentrating were at an 82,000-ton-per-day rate. The original plant capacity of 72,000 tons per day is being gradually increased to 84,000 tons.

In late December, production was suspended at Esperanza because of the buildup of excessive inventories of concentrate at Duval plants. Production at Duval mines was not halted by strikes which closed custom smelters during July and August but concentrate had to be stockpiled. The smelters after reopening were unable to treat these concentrates because smelting capacity was only equal to current mine production. Consequently mine production was reduced to free working capital tied up in stockpiles. An estimated 9 to 12 months will be needed to smelt these concentrates.

⁶ Cyprus Mines Corp. Annual Report, 1971, p. 9.

⁷ Cited in footnote 4.

⁸ American Smelting and Refining Co. Annual Report, 1971, p. 4.

⁹ Cited in footnote 4.

Inspiration Consolidated Copper Co. plants in the Inspiration, Christmas, and Ox Hide areas produced 58,840 tons of copper, a decrease of 16 percent from the previous year. The Inspiration mine and plant produced 46,254 tons of copper, the Christmas open-pit mine and concentrator 7,712 tons, and the Ox Hide mine and heap leaching plant 4,874 tons.¹⁰ Most of the production decrease occurred during July and August when plants were closed by a strike. An additional cutback of 7 percent was made in ore treated during 1971 to an average of 22,950 tons per operating day because of reduced demand for metal.

Overburden removal was completed for the Red Hill ore body which will provide additional ore for existing metallurgical plants. Exploration of the Barney area near Red Hill indicated the presence of a medium-sized body of acid soluble ore which could support a heap-leaching plant. A mineralized area 3,000 feet long and 1,000 feet wide was discovered between the Live Oak and Ox Hide mines by geophysical prospecting methods. Additional mineralized land was obtained west of the Christmas mine. Development and test work continued on the Sanchez deposit near Safford. The proven ore reserve at Sanchez was increased to 79,362,000 tons of oxide ore containing 0.36 percent copper and with a stripping ratio of 1.49 to 1. A much larger tonnage of low-grade oxide, mixed oxide and sulfide, and sulfide ore is indicated. Ore was mined for metallurgical testing and satisfactory recoveries were made by acid leaching. New primary and tertiary crushing plants for the Inspiration area mines were nearly completed. A pilot liquid ion-exchange plant using electrolytic deposition of copper was placed in operation to develop operating methods and determine production costs.

Site preparation was begun in September for an electric smelting furnace and for siphon converters, which will replace the existing reverberatory furnace and Pierce-Smith converters, and also for a large gas-cleaning installation and a double absorption sulfuric acid plant. These improvements will allow the efficient recovery, as sulfuric acid, of the sulfur in the ore smelted. The new furnace and converters will have much higher concentrations of SO₂ in their effluents than did the older equipment because the furnace exhausts

will no longer contain products of fuel consumption and the converter exhausts large quantities of surplus air. Particulate discharges will also be greatly reduced. Completion of the improvements is scheduled for the end of 1973 at an estimated cost of \$45 million. The rebuilt smelter will have a capacity of 500 tons per day of metal.

The Twin Buttes mine of The Anaconda Company produced 50,745 tons of copper compared with 81,281 tons during 1970.¹¹ The reduction was caused by a major slide in the open pit that diluted considerable ore; a strike of 1-month duration at the mine and concentrator; and a strike at custom smelters which caused shortage of smelter capacity and necessitated a 5-week shutdown of the concentrator to liquidate concentrate inventories.

Miami Copper operations of Cities Service Co. produced 6,403 tons of copper from precipitates, a 14-percent reduction from 1970 figures. Production was lost for 25 days in July because of a strike. A longer strike at custom smelters caused additional disruptions in deliveries. The Copper Cities open pit mine produced 4,630,000 tons of ore and 24,618 tons of copper including 2,188 tons from dump leaching,¹² a decrease of 5 percent from the previous year. Copper leaching at Castle Dome was terminated during 1970. Work continued on evaluation of a downfaulted segment of the Miami-Inspiration ore body. The No. 5 shaft is being deepened to 3,520 feet to permit underground exploration and mining tests. Planning continued for development of the Pinto Valley deposit 8 miles west of Miami, at a production rate of 40,000 tons per day. Arrangements have been made for smelting Pinto Valley concentrates.

Hecla Mining Co. continued exploration, mine development, metallurgical testing, and plant engineering at the Lakeshore deposit near Casa Grande. Metal production is expected to start late in 1974. About 59,000 feet of hole was drilled to develop extensions of the deposit. Two parallel declines, on a minus 15-degree slope were continued to a vertical depth of 1,400 feet. Planned depth is 1,800 feet. Haulage levels for ore production are being advanced at

¹⁰ Inspiration Consolidated Copper Co. Annual Report, 1971, p. 3.

¹¹ The Anaconda Company. Annual Report, 1971, p. 10.

¹² Cited in footnote 4.

900 and 1,300 foot depths. The old segregation plant was closed at the end of 1970 and the facilities were converted to a pilot sulfide concentrator of 900-ton-per-day capacity that began treating development ore in September. A pilot roast-leach-electrowin plant was also constructed and sulfide concentrates were treated to recover cathode copper and byproducts. Construction of a pilot oxide copper leaching and cementation plant was begun with completion expected in the spring of 1973.

The Bagdad Copper Corp. produced 12,520 tons of copper in concentrates and 7,341 tons of cathode copper.¹³ Purchased feed was used in the copper powder refinery which produced 2,600 tons of copper powder. Production increased 15 percent from that of 1970, reflecting the first full year of cathode refinery operation, and ore grade also increased from 0.75 to 0.87 percent in 1971. The copper industry strike did not affect Bagdad directly but concentrates had to be stockpiled during a 2-month period when the custom smelter was idle. Arrangements have been made with White Pine Copper Co. in Michigan to smelt the stockpiled concentrates during 1972. Drill-hole sampling of the area surrounding and underlying the present mine proved 215 million tons of sulfide ore containing 0.51 percent copper with a stripping ratio of 1.25 to 1 and an underlying 50 million tons of 0.40 percent copper ore that would not require waste stripping beyond that needed to expose the higher grade ore. Expansion of the mine and concentrator from the present 6,000 to 30,000 tons per day is planned with completion tentatively scheduled for 1975. Cost is estimated at \$60 million. A smelter to treat the concentrates is also planned.

The Bluebird operation of Ranchers Exploration and Development Corp. produced 6,228 tons of cathodes,¹⁴ about 8 percent more than in the previous year. Cathode production in the last quarter increased to 1,750 tons. Drill exploration during the year increased proven ore reserves to over 75 million tons with an average grade of 0.52 percent copper from a previous 13.5 million tons of similar grade. The stripping ratio for the larger ore body is 1.50 to 1. The management is evaluating a shift from heap leaching to vat leaching. The change would increase the proportion of metal recovered and provide a higher grade feed for the solvent extraction and

electrowinning circuits. In June an 80-percent interest in mining rights to the Old Reliable mine near San Manuel was purchased from Occidental Minerals Corp. and Siskon Corp. The deposit occurs in a steeply plunging pipe-shaped zone and contains about 4 million tons of oxidized ore with a copper content of 0.74 percent. A decision was made to fracture the ore body with high explosives and extract the copper by in situ leaching. Two existing adits below the oxidized ore were rehabilitated and a third new adit was driven to provide access to the ore body and to collect the leaching solutions that would be percolated through the deposit.

McAllister Fuel Co. produced 2,385 tons of copper from the Zonia open pit mine and leaching plant near Kirkland.¹⁵ Little Hill Mines Inc., shipped 55,000 tons of fluxing ore from the Gold Hill mine near Oracle. Big Hole Mining Co. shipped 7,000 tons of ore and 120 tons of precipitates from workings in the United Verde open pit near Jerome. McFarland and Hullinger shipped 77,000 tons of tailings from the Tiger dump near Mammoth. Ore shipments were reported from 23 other Arizona properties.

Exploration drilling by Occidental Minerals Corp. on 7,000 acres of claimed and leased land near Miami was reported to have encountered copper values in 10 of the 18 holes drilled. Mineralized drill intersections contained from 0.56 to 1.26 percent copper over widths ranging from 103 to 368 feet and at depths of 1,100 to 2,000 feet.

Gold.—Gold production was 94,038 troy ounces of which all was a byproduct of copper mining, except a few ounces recovered from lead and zinc ores and from gold prospects. About 96.7 percent of the gold associated with copper ores was contained in concentrates with the remainder being in fluxing or direct smelting copper ore. Output decreased 14 percent from that of 1970, reflecting the reduction in copper output.

Iron Ore.—CF&I Steel Corp. shipped 15,859 long tons of iron ore from the Apache pit in Navajo County to their steel plant in Pueblo, Colo.

Lead.—Lead output was 859 tons compared with 285 tons in the previous year.

¹³ Bagdad Copper Corp. Annual Report, 1971, p. 1.

¹⁴ Cited in footnote 4.

¹⁵ Cited in footnote 4.

The increase resulted from improved dust precipitating equipment installed in smelter exhaust conduits to recover lead contained in copper concentrates. Eighty percent of total lead production was a by-product from copper ores, 20 percent was from lead concentrates, and less than 1 percent was from direct smelting ores.

Mercury.—No mercury production was reported during 1971. Exploration and development took place at the Tonto and Sunflower mines in Maricopa County and the Cypress mine in Gila County.

Molybdenum.—Molybdenum output was 22.7 million pounds compared with 15.7 million pounds in 1970. Most of the increase was made by the Sierrita and Twin Butte mines which reported their first full year of production in 1971. All of the metal produced in the State was recovered as a byproduct of copper mining with 12 concentrators having molybdenum circuits. Production at most mines in 1971 was reduced because of the decline in copper concentrate production.

Silver.—Silver production was 6,170,000 ounces, a decrease of 16 percent from 1970. The reduction reflects lower copper production of which almost all Arizona silver production is a byproduct. About 99.2 percent of the silver output was recovered from copper concentrates; 0.6 percent from copper fluxing and direct smelting ores; and the remaining 0.2 percent from lead and zinc concentrates, smelting ores, and fluxing ores.

Tungsten.—Intermittent production of scheelite ore was reported from four mines. Shipments of concentrates were nearly the same as those in 1970.

Zinc.—Zinc production of 7,761 tons was 19 percent below that of 1970. The Bruce mine of Cyprus Mines Corp. in Yavapai County produced most of the zinc as well as considerable copper. Activities were described under "Copper." Improved dust precipitators were installed in copper smelter exhaust streams, and byproduct zinc is now being recovered from copper concentrates.

NONMETALS

Asbestos.—Chrysotile asbestos was produced by Jaquays Mining Corp. from underground mines 33 miles north of Globe and processed in a mill on the east side of Globe. Shipments of fiber decreased

11 percent in quantity compared with 1970 figures but increased 1 percent in value.

Cement.—Shipments of portland cement increased 37 percent and shipments of masonry cement increased 36 percent compared with the previous year. Ninety-nine percent of the portland cement shipped was of general use and moderate heat types, and the remainder was mainly high early-strength type. Cement was produced by Arizona Portland Cement Co. at its Rillito plant in Pima County and by the Phoenix Division of American Cement Corp. at its Clarkdale plant in Yavapai County. Portland cement consumption was 7,255,000 376-pound barrels. The largest use was for ready-mix concrete. Other markets were concrete-product manufacturing plants, building supply firms, highway, construction, and miscellaneous uses. Arizona Portland Cement Co. expected completion of the expansion and modernization of its Rillito plant by mid-1972. Annual capacity will be increased from 3.0 million to 4.2 million barrels. New equipment includes a conveyor belt 3.5 miles long with a capacity of 900 tons per hour for transporting limestone from the quarry to the plant, a grinding mill, and a 10,000 barrel-per-day suspension preheater. Improvement to the dust collecting system are also planned. At the Clarkdale plant installation of bag house type dust collecting equipment was begun with completion expected in 1972.

Clays.—Production of common clay and shale was 119,000 tons, valued at \$84,000. Producers of clay for brickmaking were Phoenix Brick Yard and Wallapai Brick and Clay Products, Inc., in Maricopa County; and Phoenix Brick Yard and Tucson Pressed Brick Corp. in Pima County. Clay for cement manufacture was mined by American Cement Corp. in Yavapai County. Bentonite was mined by the Filtritol Corp. and McCarrell & Gurley in Apache County and by Arizona Gypsum Corp. in Yavapai County. Kaolin was mined by McKusick Mosaic Co. in Gila County and by Motus Chemical Co. in Mohave County.

Diatomite.—Superior Company formerly Arizona Gypsum Corp. mined crude diatomite from the White Cliffs mine near Mammoth in Pinal County. The quantity of material shipped decreased 59 percent and its value decreased 54 percent.

Feldspar.—International Minerals and

Chemical Corp., Industrial Minerals Division, mined and ground feldspar from the Taylor mine in Mohave County for use in pottery and enamel. The quantity shipped increased 33 percent and the value 36 percent over that of 1970.

Fluorspar.—Small shipments of fluorspar were made from mines in Cochise and Gila Counties. Tonto Mining and Milling Co. is developing two mines and opening a mill near Punkin Center.

Gem Stones.—The estimated value of collected gem stones was \$160,000, about the same as for 1970. Gem stones collected include agate, petrified wood, turquoise, chrysocolla, and obsidian.

Gypsum.—Four open pit mines, three in Pinal County and one in Yavapai County, shipped crude gypsum for agricultural use, for portland cement retarder, and after calcining for manufacturing building materials. National Gypsum Co. and Superior Co. produced gypsum from mines near Winkelman and Pinal Mammoth Gypsum Co. from a mine near Coolidge. Superior Co. also mined a deposit near Camp Verde. Output from the National Gypsum Co. mine was calcined at a plant near Phoenix.

Lime.—Lime production decreased slightly from the 1970 output because of lower copper concentrate production. Limestone was calcined at eight plants, two in Gila County and one each in Cochise, Greenlee, Maricopa, Pima, Pinal, and Yavapai Counties. Lime was used mainly for acidity control in copper flotation. Other uses were sugar refining, metallurgical flux, soil stabilization, paper manufacture, and masons lime. The Paul Lime Plant, Inc., about 10 miles west of Douglas was granted a 1-year permit to continue operations pending the installation of equipment to reduce particulate emissions. The Santa Rita Mining Co. began producing lime from its mine and calcining plant, near Sahuarita, in July.

Mica.—Scrap and flake mica was produced from the Buckeye mine in Maricopa County and the San Antonio mine in Pima County for use in roofing and well drilling.

Perlite.—Crude perlite was produced at the Harborlite, Adams, and Guzman open pit mines near Superior. Output fell 62 percent in quantity and 68 percent in value. Production curtailments were necessary to allow installation of dust control

equipment. Supreme Perlite, Inc., operated a plant near Phoenix to expand perlite for use as lightweight plaster aggregate, insulation, and horticultural aggregate.

Pumice and Pumicite.—A total of 949,000 tons of volcanic cinders valued at \$624,000 and 460 tons of pumice valued at \$800 was produced by seven companies, five regional divisions of the State Highway Department, and the County Highway Departments of Apache and Coconino Counties. Output increased 15 percent in quantity and decreased slightly in value from that of 1970. Arizona ranked first among the States in quantity of pumicite produced and fourth in value of product. Plants at seven of the deposits mined, crushed, and screened 396,000 tons of material. The cinders were used in about equal quantities for railroad ballast, highway construction, and concrete aggregate.

Pyrite.—A small quantity of pyrite produced as a byproduct at the Magma Copper Co. mill at Superior was sold to the Ray Mines Division as a supplement feed for their sulfuric acid plant.

Sand and Gravel.—Sand and gravel sold or used increased 11 percent in quantity and 23 percent in value to 19.8 million tons valued at \$24.4 million. Output was reported from 109 operations. Of the total quantity 9.8 million tons was classed as sand valued at \$11.4 million and 10.0 million tons as gravel valued at \$13.0 million.

Sales from commercial pits were 9.2 million tons valued at \$10.6 million classified as sand and 8.0 million tons valued at \$11.1 million classified as gravel. Government and contractor output consisted of 0.5 million tons classified as sand valued at \$0.7 million and 2.0 million tons of gravel valued at \$1.9 million.

Overall consumption by quantity was as follows: Building, 56 percent; fill, 12 percent; paving, 30 percent; and other, which includes railroad ballast and blast, filtration, and hydrafracturing sand, 2 percent. Consumption by value was as follows: Building, 61 percent; fill, 5 percent; paving, 30 percent; and other, 4 percent. Sand and gravel for local construction and industrial use was produced in all 14 counties. Maricopa County produced 65 percent of the State's output and Pima County produced 19 percent.

Stone.—The quantity of stone produced in 1971 was 2.9 million short tons, a de-

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

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Apache.....	--	W	W	2	10	\$102
Cochise.....	4	168	\$218	5	W	W
Coconino.....	6	1,853	1,582	3	W	W
Gila.....	5	141	258	4	96	283
Graham.....	2	W	W	4	120	176
Maricopa.....	28	6,363	6,366	22	12,912	14,022
Mohave.....	6	477	391	6	373	697
Navajo.....	9	358	357	8	295	340
Pima.....	21	2,923	3,074	22	3,749	4,951
Pinal.....	9	1,736	1,850	8	364	941
Santa Cruz.....	4	287	355	5	117	228
Yavapai.....	11	756	759	8	676	1,262
Yuma.....	13	2,546	3,783	6	633	813
Undistributed ¹	6	214	312	6	444	575
Total².....	124	17,822	19,804	109	19,791	24,391

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

¹ Includes Greenlee County.

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

Table 14.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	3,873	\$4,840	6,769	\$8,438
Fill.....	570	208	766	434
Paving.....	598	434	1,512	1,281
Other uses ¹	86	254	201	466
Total².....	5,126	5,736	9,248	10,619
Gravel:				
Building.....	2,913	4,112	4,319	6,450
Fill.....	749	541	729	610
Paving.....	2,414	3,617	2,770	3,737
Other uses ³	69	134	145	352
Total².....	6,146	8,403	7,963	11,147
Government-and-contractor operations:				
Sand:				
Fill.....	31	31	16	9
Paving.....	1,218	1,098	527	737
Total².....	1,250	1,129	543	746
Gravel:				
Building.....	48	40	37	36
Fill.....	101	97	791	278
Paving.....	4,997	4,222	1,102	1,441
Other uses.....	153	176	108	124
Total.....	5,299	4,535	2,038	1,879
Total sand and gravel².....	17,822	19,804	19,791	24,391

¹ Includes blast, filtration (1970), oil (hydrafrac), railroad ballast, and other sand.

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

³ Includes miscellaneous, railroad ballast, and other gravel.

crease of 18 percent from that of 1970; the value also decreased 18 percent, to \$5.8 million. Limestone, quartz, quartzite, traprock, marble, sandstone, and other stone were mined and marketed as crushed and broken stone. Sandstone, marble, quartzite,

and other stone were sold as dimension stone. Uses of crushed and broken stone included cement, flux, lime, road base, terrazzo, acid neutralizer, whiting, concrete aggregate, bituminous roadmix aggregate, and roofing granules. Dimension stone was

principally used for rough blocks, dressed architectural stone, and flagging.

Vermiculite.—Ari-Zonolite Co. exfoliated vermiculite, received from out of State, at its mill in Phoenix. The product was mainly used for block insulation and concrete aggregate.

Zeolite.—The Mining and Metals Division of Union Carbide Corp. mined zeolite for experimental purposes from the E-Z claims in Graham County.

MINERAL FUELS

Coal (Bituminous).—The Peabody Coal Co., division of Kennecott Copper Corp., produced 1,146,000 tons of coal from the Black Mesa No. 1 mine on Navajo and Hopi Indian Lands near Kayenta. A 6-

week strike, which started October 4, interrupted production. The coal was delivered through a 275-mile slurry pipeline operated by Black Mesa, Inc., to the Mohave Generating Station, located near Davis Dam. Coal deliveries to the Mohave plant, owned by four public utilities, are scheduled to be 5,000,000 tons per year when its full generating capacity of 1,500 megawatts is reached. Now under construction at Page, Ariz., is the Navajo Generating Station by six public utilities. This plant will contain three units of 770 megawatts each that are scheduled for completion in 1974, 1975, and 1976. Coal for the plant will be supplied by a second mining unit on Black Mesa. Consumption will be 8 million tons

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

(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Apache.....	3	6	\$23	1	W	W
Cochise.....	3	602	1,661	16	823	\$2,151
Coconino.....	15	139	261	9	W	W
Gila.....	3	155	607	3	W	W
Graham.....	—	—	—	3	W	39
Greenlee.....	5	387	700	5	W	W
Navajo.....	1	1	10	1	W	10
Pima.....	W	W	316	10	554	884
Pinal.....	4	140	316	2	W	W
Santa Cruz.....	2	91	193	1	31	W
Undistributed ¹	54	1,990	3,322	41	1,460	2,764
Total.....	90	3,511	7,094	92	2,873	5,848

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

¹ Includes Maricopa, Mohave, Yavapai, and Yuma Counties.

² Data does not add to total shown because of independent rounding.

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

(Thousand short tons and thousand dollars)

Kind of stone	1970		1971	
	Quantity	Value	Quantity	Value
Dimension ¹	15	\$280	14	\$292
Crushed and broken:				
Limestone.....	2,308	3,941	1,548	2,884
Sandstone, quartz and quartzite.....	W	W	447	1,077
Traprock.....	418	W	435	W
Other stone.....	218	321	² 428	² 1,595
Undistributed ³	552	2,551	--	--
Total ⁴	3,496	6,813	2,859	5,556
Grand total ⁴	3,511	7,094	2,873	5,848

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

¹ Includes data for marble, sandstone, quartz, and other stone.

² To avoid disclosing individual confidential data, figure includes data for marble and any data represented by the symbol W in 1971.

³ Includes data for granite and marble.

⁴ Data may not add to totals shown because of independent rounding.

Table 17.—Stone sold or used by producers, by use
(Thousand short tons and thousand dollars unless otherwise specified)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Dimension:				
Rough blocks.....	W	W	6	\$148
Irregular shaped stone.....	1	W	W	W
Rubble.....	2	\$14	W	W
Other rough stone.....	7	198	4	79
Dressed architectural..... thousand cubic feet.....	61	65	63	65
Other dressed..... do.....	3	4	W	W
Total (approximate in short tons).....	15	280	14	292
Crushed and broken:				
Bituminous aggregate ¹	323	503	240	370
Concrete aggregate.....	221	502	163	307
Dense graded road base stone.....	215	342	463	875
Surface treatment aggregate.....	8	25	17	35
Lime.....	559	1,419	553	1,233
Metallurgical.....	596	1,567	613	1,416
Riprap and jetty stone.....	9	18	2	3
Stone sand.....	W	W	108	W
Other ²	1,566	2,438	700	1,318
Total ³	3,496	6,813	2,859	5,556
Grand total.....	3,511	7,094	2,873	5,848

W Withheld to avoid disclosing individual company data; included in "Other rough" for dimension stone, and in "Other" for crushed and broken.

¹ Data includes macadam and unspecified aggregates.

² Includes agricultural limestone (1971), poultry grit, railroad ballast (1970), stone sand (1970), terrazzo, cement, refractory stone, acid neutralizers, roofing aggregates (1970), mine dusting (1970), and other uses not specified.

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

per year when full generating capacity is attained. Rail laying was commenced in September on the railroad from Black Mesa to Page.

Helium.—The Kerr-McGee Corp. plant in Apache County operated throughout the year. The plant of the Arizona Helium Co. east of Holbrook was purchased by Western Helium Corp., former lessees of the plant, subject to approval by a U.S. Bankruptcy Court. Western announced plans to double capacity of the plant and is continuing drill exploration on 15,000 acres of leased land in the area. Ten holes were drilled during 1971 and reserves were significantly increased. One development hole was completed to recover gas containing 8 to 10 percent helium.

Natural Gas.—Natural gas marketed was 868 million cubic feet valued at \$153,000, a decrease of 21 percent in quantity and 19 percent in value, compared with 1970 figures. All production was from wells in Apache County. Natural gas was reported from one exploratory hole also in Apache County. All gas marketed was distributed

to utilities in Arizona and California by El Paso Natural Gas Co.

Petroleum.—Petroleum production was 1,236,000 barrels valued at \$3,918,000, a decline of 31 percent in quantity and 26 percent in value from 1970 production.

Eight holes were completed during the year compared with 12 completed in 1970. Table 18 shows 1970 and 1971 drill hole completions and drill footages by county and type of hole. Although no holes were completed for oil production during 1971, it was reported that Cities Service Oil Co. found good oil showing in an exploration hole drilled late in the year near Black Rock Point in the northeast corner of Arizona. Much petroleum exploration interest developed during the year in sedimentary rocks which extend across southern Arizona. About three million acres in this area was leased for petroleum exploration including about 1 million acres between Yuma and Phoenix assigned to Humble Oil & Refining Co. Apparent salt domes were encountered in holes drilled south of Florence and in holes drilled north of Redlake.

Table 18.—Oil and gas well drilling, by county

County	Oil	Gas	Dry	Total	Footage	County	Oil	Gas	Dry	Total	Footage
1970:						1971:					
Exploratory completions:						Exploratory completions:					
Apache	8			8	26,936	Apache	1	2	3	6	16,283
Mohave	1			1	5,984	Graham		1	1	2	3,500
						Navajo		1	1	2	1,006
Total	9			9	32,920	Total	1	4	5	10	20,789
Development completions:						Development completions:					
Apache	1		2	3	11,360	Apache	1	2	3	3	3,760
Total all drilling	1	11	12	12	44,280	Total all drilling	2	6	8	8	24,549

Source: Petroleum Information Corp., 1970 and 1971 Résumés, Oil and Gas Operations in the Rocky Mountain Region. American Petroleum Institute, 1971.

Table 19.—Principal producers

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

Table 19.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Copper—Continued			
Phelps Dodge Corp.: Copper Queen Branch.....	Drawer K Bisbee, Ariz. 85603	Open pit mine, under-ground mine, mill, leach dumps and in place leaching, and precipitation plant.	Cochise.
Morenci Branch.....	Douglas, Ariz. 85607 Morenci, Ariz. 85540.....	Custom smelter.....	Do.
New Cornelia Branch.....	Drawer 9 Ajo, Ariz. 85321	Open pit mine, mill, leach dumps, precipitation plant, and smelter.	Greenlee.
Phelps Dodge Corp., (Big Hole Mining Co., lessee).	Box 125 Jerome, Ariz. 86331	Open pit mine, mill, and smelter.	Pima.
Pima Mining Co.....	Box 7187 Tucson, Ariz. 85713	Open pit mine, leach dumps, and precipitation plant.	Yavapai.
Ranchers Exploration and Development Corp.	Box 6217 Albuquerque, N. Mex. 87107	Open pit mine and mill..	Pima.
Cities Service Co., Miami Copper Co. Division.	Box 100 Miami, Ariz. 85539	Open pit mine, heap leaching, and electrowinning plant.	Gila.
Diatomite: Arizona Gypsum Corp.	Box 6495 Phoenix, Ariz. 85005	Open pit mine, mill, leach dumps and in place leaching, and 3 precipitation plants.	Do.
Feldspar: International Minerals & Chemical Corp., Industrial Minerals Division.	Administration Center Old Orchard Road Skokie, Ill. 60079	Open pit mine and plant..	Pinal.
Gold:		---do-----	Mohave.
Inspiration Consolidated Copper Co.	Inspiration, Ariz. 85537.....	See Copper.....	Gila.
Kennecott Copper Corp., Ray Mines Division.	Hayden, Ariz. 85235.....	---do-----	Pinal.
Magma Copper Co.:			
San Manuel Division.....	Box M San Manuel, Ariz. 85631	---do-----	Do.
Superior Division.....	Box 37 Superior, Ariz. 85273	---do-----	Do.
Phelps Dodge Corp.:			
Copper Queen Branch.....	Drawer K Bisbee, Ariz. 85603	---do-----	Cochise.
Morenci Branch.....	Morenci, Ariz. 85540.....	---do-----	Greenlee.
New Cornelia Branch.....	Drawer 9 Ajo, Ariz. 85321	---do-----	Pima.
Cities Service Co., Miami Copper Co. Division.	Box 100 Miami, Ariz. 85539	---do-----	Gila.
Gypsum:			
Arizona Gypsum Corp.:			
Verde Division.....	Box 6675 Phoenix, Ariz. 85005	Open pit mine and plant..	Yavapai.
Winkelman Division.....	---do-----	---do-----	Pinal.
National Gypsum Co.....	325 Delaware Ave. Buffalo, N.Y. 14202	---do-----	Do.
Helium:			
Kerr-McGee Corp., Gas Processing Department.	Kerr-McGee Bldg. Oklahoma City, Okla. 73102	6 wells and plant; Pinta Dome field.	Apache.
Iron ore: CF&I Steel Corp.....	Box 316 Pueblo, Colo. 81002	Open pit mine.....	Navajo.
Lime:			
Paul Lime Plant, Inc.....	Drawer T Douglas, Ariz. 85607	5 rotary-kiln plant.....	Cochise.
Phelps Dodge Corp., Morenci Branch.	Morenci, Ariz. 85540.....	1 rotary-kiln, 1 fluidized-bed-kiln plant.	Greenlee.
Mica:			
Buckeye Mica Company.....	Box 416 Buckeye, Ariz. 85326	Open pit mine.....	Maricopa.
San Antonio Mica Co.....	Box 397 Ajo, Ariz. 85321	---do-----	Pima.
Molybdenum:			
American Smelting and Refining Co.	120 Broadway New York, N.Y. 10005	See Copper.....	Do.
The Anaconda Company.....	Box 127 Sahuarita, Ariz. 85629	---do-----	Do.
Bagdad Copper Corp.....	Box 245 Bagdad, Ariz. 86321	---do-----	Yavapai.
Duval Corp.....	Box 1271 Kingman, Ariz. 86401	---do-----	Mohave, Pima.
Duval Sierra Corp.....	Box 125 Sahuarite, Ariz. 85629	Open pit mine, mill, and and roaster.	Pima.

Table 19.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Molybdenum—Continued			
Inspiration Consolidated Copper Co.	Inspiration, Ariz. 85537	Open pit mine, mill, and roaster.	Gila.
Kennecott Copper Corp., Ray Mines Division.	Hayden, Ariz. 85235	do	Pinal.
Magma Copper Co., San Manuel Division.	Box M San Manuel, Ariz. 85631	do	Do
Pima Mining Co.	Box 7187 Tucson, Ariz. 85713	do	Pima.
Cities Service Co., Miami Copper Co. Division.	Box 100 Miami, Ariz. 85539	do	Gila.
Natural gas and petroleum:			
Humble Oil & Refining Co.	2000 Classen Center-North Oklahoma City, Okla. 73106	Crude oil and natural gas wells; East Boundary Butte field.	Apache.
Kerr-McGee Corp.	Kerr-McGee Bldg. Oklahoma City, Okla. 73102	Crude oil and natural gas wells; Dineh bi Keyah field.	Do.
Perlite:			
Supreme Perlite, Inc.	321 So. 27th Ave. Phoenix, Ariz. 85009	Open pit mine	Maricopa.
Pumice:			
Apache County Highway Department.	Box 428 St. Johns, Ariz. 85936	do	Apache.
Achison Topeka & Santa Fe Railway Co.	Winslow, Ariz. 86047	Open pit mine and plant	Cocconino.
Superlite Bldrs. Supply, Inc.	5201 North 7th St. Phoenix, Ariz. 85014	Open pit mine	Do.
Pyrites: Magma Copper Co., Superior Division.	Box 37 Superior, Ariz. 85273	See Copper	Pinal.
Sand and gravel (commercial):			
Arizona Sand & Rock Co.	Box 20067 Phoenix, Ariz. 85036	2 pit and plants	Maricopa.
Tucson Sand & Soil, Inc.	2430 West Curtis St. Tucson, Ariz. 85705	Pit and plant	Pima.
Union Rock & Materials Corp., Bentson Contracting Co.	2800 South Central Ave. Phoenix, Ariz. 85040	3 pits and plants	Maricopa.
United Metro Materials & Concrete Co., Inc.	Box 13309 Phoenix, Ariz. 85002	5 pits and plants	Do.
		2 pits and plants	Pinal.
		Pit and plant	Yuma.
Silver:			
American Smelting and Refining Co.	120 Broadway New York, N.Y. 10005	See Copper	Pima.
The Anaconda Company	Box 127 Sahuarita, Ariz. 85629	do	Do.
Bagdad Copper Corp.	Box 245 Bagdad, Ariz. 86321	do	Yavapai.
Cyprus Mines Corp., Bruce Mine Division.	Box 457 Bagdad, Ariz. 86321	do	Gila.
Duval Corp.	Box 1271 Kingman, Ariz. 86401	do	Mohave.
	Box 38 Sahuarita, Ariz. 85629	do	Pima.
Inspiration Consolidated Copper Co.	Inspiration, Ariz. 85537	do	Gila.
Kennecott Copper Corp., Ray Mines Division.	Hayden, Ariz. 85235	do	Pinal.
Magma Copper Co.:			
San Manuel Division	Box M San Manuel, Ariz. 85631	do	Do.
Superior Division	Box 37 Superior, Ariz. 85273	do	Do.
Magma Copper Co., (McFarland & Hullinger, lessee).	Box 238 Tooele, Utah 84074	Dump	Do.
Phelps Dodge Corp.:			
Copper Queen Branch	Drawer K Bisbee, Ariz. 85603	See Copper	Cochise.
Morenci Branch	Morenci, Ariz. 85540	do	Greenlee.
New Cornelia Branch	Drawer 9 Ajo, Ariz. 85321	do	Pima.
Pima Mining Co.	Box 7187 Tucson, Ariz. 85713	do	Do.
Cities Service Co., Miami Copper Co. Division.	Box 100 Miami, Ariz. 85539	do	Gila.
Stone:			
American Cement Corp., Phoenix Division.	2404 Wilshire Blvd. Los Angeles, Calif. 90057	Quarry and plant	Yavapai.
New Pueblo Constructors	4115 E. Illinois St. Tucson, Ariz. 85714	Quarry	Pima.
Paul Lime Plant, Inc.	Drawer T Douglas, Ariz. 85607	Quarry and plant	Cochise.
Zinc: Cyprus Mines Corp., Bruce Mine Division.	Box 457 Bagdad, Ariz. 86321	See Copper	Yavapai.

The Mineral Industry of Arkansas

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

By Grace N. Broderick ¹

Value of Arkansas mineral production in 1971 was \$253.2 million, an increase of over 12 percent from the previous record high of \$225.6 million set in 1970. Arkansas continued to rank first among the States in recovery of bauxite and bromine, second in vanadium output, and third in barite production. Combined value of mineral fuels (coal, natural gas, natural gas liquids, and petroleum) represented 37 percent of the State's total mineral production value. Petroleum remained the leading commodity in mineral value accounting for \$56.8 million. Marketed natural gas production declined 5 percent from the record high of 181.4 million cubic feet es-

tablished in 1970. Coal output increased to 276,000 tons as a result of increased market improvements for coking and smelter coals.

Nonmetals value in 1971 accounted for a large part of the State's total mineral production value. Production of abrasive stone, barite, kaolin, lime, sand and gravel, and tripoli declined in quantity and value. Increases in both quantity and value were reported for bromine, cement, common clay, gypsum, stone, and soapstone.

Of the metallic minerals produced in 1971, bauxite output and value decreased

¹ Physical scientist, Division of Ferrous Metals.

Table 1.—Mineral production in Arkansas ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite.....thousand short tons..	168	\$3,721	W	W
Bauxite.....thousand long tons, dried equivalent..	1,869	26,293	1,781	\$24,979
Clays.....thousand short tons..	1,014	2,902	² 936	² 1,499
Coal (bituminous).....do.....	268	2,225	276	2,848
Gem stones.....	NA	25	NA	30
Lime.....thousand short tons..	186	2,680	157	2,313
Natural gas.....million cubic feet..	181,351	29,560	172,154	29,426
Natural gas liquids:				
Natural gasoline and cycle products				
thousand 42-gallon barrels..	643	1,824	517	1,686
LP gases.....do.....	1,205	2,482	1,035	2,650
Petroleum (crude).....do.....	13,035	51,760	13,263	56,805
Sand and gravel.....thousand short tons..	13,301	16,036	11,630	15,603
Stone.....do.....	15,284	22,786	17,116	35,677
Value of items that cannot be disclosed:				
Abrasive stone, bromine, cement, clays (kaolin), gypsum, mercury, soapstone, tripoli, vanadium, and values indicated by symbol W.....	XX	63,331	XX	79,703
Total.....	XX	225,625	XX	253,219
Total 1967 constant dollars.....	XX	201,822	XX	^p 219,997

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

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

² Excludes kaolin; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Arkansas, by county ¹
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Arkansas.....	\$3	--	
Ashley.....	W	W	Sand and gravel.
Baxter.....	W	W	Sand and gravel, stone.
Benton.....	W	W	Stone, sand and gravel.
Boone.....	W	W	Do.
Bradley.....	285	W	Petroleum, sand and gravel.
Calhoun.....	989	\$1,198	Sand and gravel, petroleum.
Carroll.....	327	W	Sand and gravel, stone.
Chicot.....	W	--	
Clark.....	W	W	Sand and gravel, stone.
Clay.....	245	170	Sand and gravel.
Cleburne.....	W	142	Stone.
Cleveland.....	W	W	Sand and gravel.
Columbia.....	40,179	41,507	Bromine, petroleum, natural gas, natural gas liquids, sand and gravel.
Conway.....	262	W	Stone, natural gas.
Craighead.....	W	W	Sand and gravel, clays.
Crawford.....	W	4,742	Natural gas, stone, sand and gravel.
Crittenden.....	W	W	Clays, sand and gravel.
Cross.....	716	W	Sand and gravel.
Dallas.....	W	W	Do.
Desha.....	W	W	Do.
Drew.....	W	W	Do.
Faulkner.....	569	W	Stone, sand and gravel.
Franklin.....	10,065	8,904	Natural gas, coal, stone, sand and gravel.
Fulton.....	208	W	Sand and gravel, stone.
Garland.....	W	W	Vanadium, abrasives, sand and gravel, tripoli, stone.
Grant.....	102	W	Sand and gravel.
Greene.....	194	W	Do.
Hempstead.....	W	W	Sand and gravel, clays.
Hot Spring.....	4,509	W	Barite, clays, stone, sand and gravel.
Howard.....	W	W	Cement, gypsum, stone, clays, petroleum.
Independence.....	W	3,064	Stone, lime, sand and gravel.
Izard.....	2,202	W	Sand and gravel, stone.
Jackson.....	41	W	Sand and gravel.
Jefferson.....	317	W	Do.
Johnson.....	4,931	5,355	Natural gas, coal, stone, clays.
Lafayette.....	16,368	15,308	Petroleum, natural gas, natural gas liquids, sand and gravel.
Lawrence.....	859	W	Stone, sand and gravel.
Lincoln.....	159	W	Sand and gravel.
Little River.....	W	W	Cement, stone, sand and gravel, clays.
Logan.....	1,721	W	Natural gas, stone, coal.
Lonoke.....	W	W	Clays, sand and gravel.
Madison.....	1	1	Sand and gravel.
Marion.....	115	W	Do.
Miller.....	W	13,927	Petroleum, sand and gravel, natural gas, clays.
Mississippi.....	6	7	Sand and gravel.
Monroe.....	(2)	W	Stone.
Montgomery.....	W	W	Petroleum, sand and gravel.
Nevada.....	W	2	Sand and gravel.
Newton.....	8,323	8,580	Petroleum, sand and gravel, natural gas, clays.
Ouachita.....	147	20	Stone.
Perry.....	75	W	Sand and gravel.
Phillips.....	W	W	Gypsum, sand and gravel, stone, tripoli, mercury.
Pike.....	449	341	Sand and gravel.
Poinsett.....	W	W	Sand and gravel, stone.
Polk.....	W	2,089	Stone, natural gas, sand and gravel.
Pope.....	27	--	
Prairie.....	9,047	18,588	Stone, bauxite, clays, sand and gravel.
Pulaski.....	W	32	Stone, sand and gravel.
Randolph.....	W	W	Sand and gravel.
St. Francis.....	27,869	26,202	Bauxite, lime, stone, sand and gravel, clays, talc.
Saline.....	83	W	Natural gas.
Scott.....	3	55	Stone, sand and gravel.
Searcy.....	4,923	5,328	Natural gas, stone, coal, sand and gravel, clays.
Sebastian.....	W	61	Sand and gravel.
Sevier.....	10	11	Do.
Sharp.....	1	17	Stone, sand and gravel.
Stone.....	29,476	30,597	Bromine, petroleum, sand and gravel, natural gas, clays.
Union.....	W	W	Stone.
Van Buren.....	W	W	Stone, sand and gravel, natural gas.
Washington.....	1,046	W	Stone, sand and gravel.
White.....	W	3	Sand and gravel.
Woodruff.....	28	11	Natural gas.
Yell.....	58,743	66,954	
Undistributed ³			
Total ⁴	225,625	253,219	

W Withheld to avoid disclosing individual company confidential data.

¹ Lee County is not listed because no production was reported in 1970 or 1971.

² Less than 1/2 unit.

³ Includes mineral production that cannot be assigned to specific counties and values indicated by symbol W.

⁴ Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Arkansas business activity

	1970	1971 ^p	Change, percent
Annual average labor force and employment:			
Total labor force.....thousands..	733.0	745.8	+1.7
Unemployment.....do.....	86.6	40.1	+9.6
Employment:			
Food and kindred products.....do....	25.2	24.9	-1.2
Lumber and wood products.....do....	20.5	21.0	+2.4
Chemicals and allied products.....do....	5.2	4.8	-7.7
Petroleum refining and related industries.....do....	1.8	1.8	--
Stone, clay, and glass products.....do....	4.4	4.5	+2.3
Primary metal industries.....do....	4.5	4.7	+4.4
Mining.....do.....	4.5	4.4	-2.2
Contract construction.....do.....	25.8	26.2	+1.6
Personal income:			
Total.....millions..	\$5,376.0	\$5,902.0	+9.8
Per capita.....do.....	\$2,791.0	\$3,036.0	+8.8
Construction activity:			
Nonresidential construction contracts.....millions..	\$95.8	\$143.2	+49.5
Residential construction contracts.....do....	\$354.2	\$351.2	-0.8
Cement shipments to and within Arkansas thousand 376-pound barrels..	3,270.0	4,165.0	+27.4
Farm marketing receipts.....millions..	\$1,124.0	\$1,157.2	+3.0
Mineral production value.....do....	\$225.6	\$253.2	+12.2

^p Preliminary. ^r Revised.

Sources: U.S. Department of Commerce, Survey of Current Business; University of Kansas, Bureau of Business and Economic Research; Department of Labor, State Employment Security Division, Arkansas; U.S. Bureau of Mines.

from that of 1970, but output and value of vanadium increased. A small amount of mercury production was reported in Pike County.

The only steelmaking mill in Arkansas was opened in midyear at Newport by the Tennessee Forging Steel Corporation. Scrap metal is melted in a 25-ton furnace and then transferred to a casting machine and converted to billets or steel bars. A rolling mill is incorporated into the operation which permits shaping of products to a customer's requirements.

Arkansas Power and Light Company, the largest electric utility in Arkansas, has under construction two units at its Arkansas Nuclear One Steam Electric Station near Russellville. Unit 1, scheduled for completion in 1973, will have a rated generating capability of 850,000 kilowatts. Unit 2, scheduled for completion in 1976, will have a rated capability of 950,000 kilowatts. The nuclear units combined electric-energy output will nearly equal the present generating capacity of the five company plants that are gas-fired.

The Arkansas Geological Commission continued its cooperative work with the U.S. Geological Survey on a revision of the State geological map; the revised map will be published on a scale of 1:500,000.

The Arkansas Open Cut Land Reclamation Act (Act 236 of 1971) went into effect

July 1, 1971. The Act declared it to be the policy of the State to provide, after open cut mining operations are completed, for the reclamation and restoration of affected lands to productive use. Mining operators must apply to the State Pollution Control and Ecology Department for a permit to engage in open pit mining. Such application must be accompanied by the operator's preliminary plan for reclamation of land affected. Companies also must post a reclamation performance bond of \$25 for up to 2 acres of land to be mined; \$200 for 2 to 10 acres; \$500 for 10 to 50 acres; and \$500 for each 50 acres above the original 50 acres. Exempted from the new law were companies that mine sand and gravel, and stone. Two cities, Little Rock and Benton, made plans to utilize abandoned bauxite open pits for sanitary landfills.

A growing number of mining company processing operations were adding facilities to control air and water pollution in conformance with State regulations.

According to preliminary data for 1971, released by the Corps of Engineers in Little Rock, shipments aggregating more than 4.2 million tons were transported on the McClellan-Kerr Arkansas River Navigation System. Eight mineral commodities or mineral products made up the bulk of the

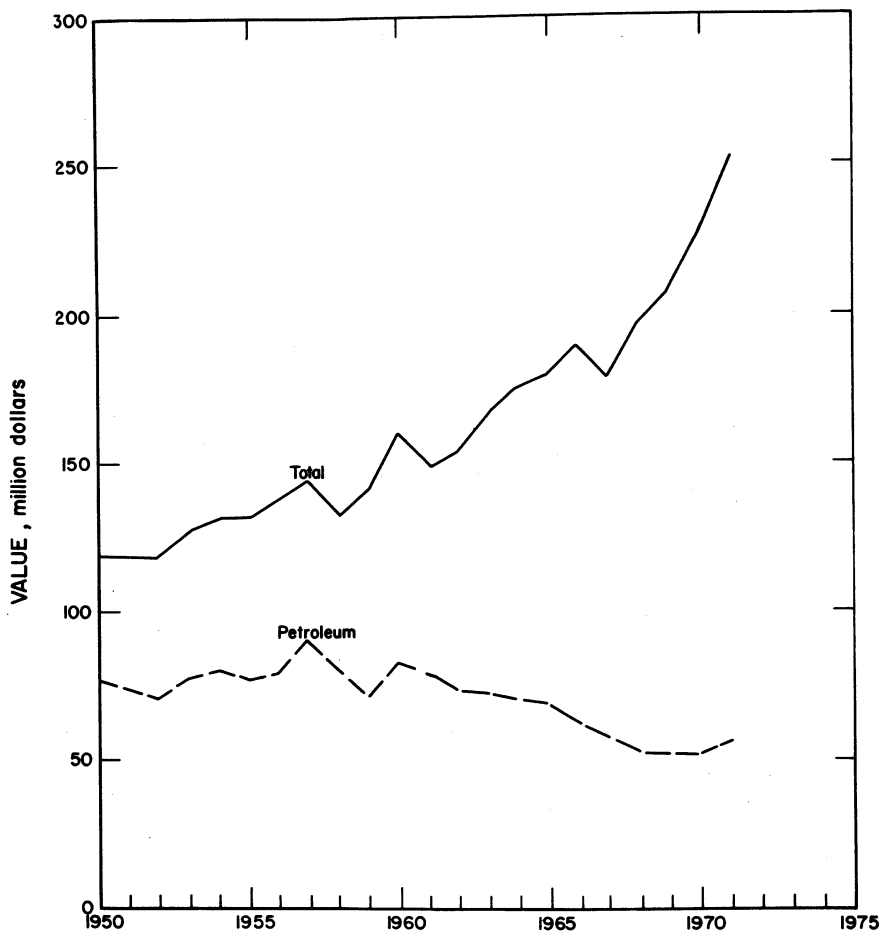


Figure 1.—Value of petroleum and total value of mineral production in Arkansas.

shipments. Of special interest were 294,950 tons of foreign bauxite imported for use at the Hurricane Creek alumina facility of Reynolds Metals Co. to supplement domestic ore and outbound shipments of 38,110 tons of coal. Rock and sand and gravel shipments amounted to 2.7 million tons. Petroleum shipments, which started in July, totaled 25,272 tons; iron and steel

shipments totaled 302,186 tons; caustic soda shipments amounted to 68,700 tons; and fertilizer shipments were 131,371 tons.

Employment.—Preliminary data for 1971 and final data for 1970 compiled by the Federal Bureau of Mines for employment and injuries in the mineral industries, excluding the petroleum industry, are shown in table 4.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Coal.....	140	166	23	184	--	4	21.72	380
Metal.....	1,500	250	376	3,006	--	51	16.97	1,244
Nonmetal.....	963	245	236	1,898	--	56	29.51	743
Sand and gravel.....	914	246	225	1,988	--	40	20.12	970
Stone.....	1,338	283	378	3,208	--	77	24.00	1,983
Total.....	4,855	255	1,238	10,284	--	228	22.17	1,814
1971: ^p								
Coal.....	150	156	23	188	--	4	21.30	383
Metal.....	1,300	239	310	2,480	--	42	16.93	1,025
Nonmetal.....	950	245	233	1,874	--	72	38.42	1,454
Sand and gravel.....	960	242	232	2,093	--	46	21.98	395
Stone.....	1,430	276	395	3,320	1	78	23.79	2,439
Total ¹	4,790	249	1,194	9,956	1	242	24.41	1,433

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

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Value of mineral fuels was \$93.4 million, 37 percent of the total mineral production value. Petroleum remained the most important single contributor to the State's total mineral value. Marketed production of natural gas in 1971 was 172,154 million cubic feet, a decrease of 5 percent from the previous year's record high of 181,351 million cubic feet. Output of bituminous coal increased to 275,528 short tons from 268,152 short tons produced in 1970.

Carbon Black.—Cities Service Co.'s Columbian Carbon Division El Dorado plant in Union County, the only carbon black plant in the State, continued production for the 20th consecutive year. Output declined 3.7 percent from that of 1970, while value rose about 2.5 percent. The plant manufactures carbon black by the furnace process using hydrocarbon liquids and natural gas as feedstock.

Coal (Bituminous).—Output of coal increased about 3 percent in quantity and 28 percent in value compared with 1970. Seven bituminous coal mines with outputs greater than 1,000 tons annually were operated. Of these, one was underground and six were strip mines, with the strip mines accounting for 85 percent of the production. Four counties contributed to the State's total output. These were, in order of tonnage and value, Franklin, Johnson, Sebastian, and Logan.

The Gordon Miles Mining Company of Beverly Hills, Calif., acquired the only active underground mine in Arkansas in 1971, which was Prairie Coal Co., Inc.'s Mine No. 2 near Clarksville. An extensive modernization program is expected to increase output of this mine, which produces a semianthracite coal.

Preliminary tonnage of coal reported by the Corps of Engineers as having been

Table 5.—Bituminous coal production, by type of mine and county, in 1971

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

County	Number of mines			Production (thousand short tons)			Value (\$1,000)
	Underground	Strip	Total	Underground	Strip	Total	
Franklin.....	1	1	2	41	89	130	1,232
Johnson.....	--	3	3	--	116	116	1,349
Logan.....	--	1	1	--	13	13	128
Sebastian.....	--	1	1	--	17	17	189
Total.....	1	6	7	41	235	276	2,848

transported on the McClellan-Kerr Arkansas River navigation system was 38,430 tons in 1971 as compared with only 13,100 tons in 1970.

Natural Gas.—Marketed production of natural gas decreased 5 percent from the record high of 181,351 million cubic feet established in 1970. Value in 1971 was \$29.4 million, a 0.5 percent decrease from the previous year. Gas production from the North Arkansas dry gasfields, according to the Arkansas Oil and Gas Commission, was 121,112,145 thousand cubic feet. Reserves

declined for the fourth year, and were 2,430,115 million cubic feet, 5.8 percent below the 1970 reserve, according to the American Gas Association, Inc.

Petroleum.—Petroleum continued to be the most significant commodity in the overall mineral value in the State, contributing 22.4 percent of the total. Production of 18.3 million barrels represented an increase of 1.3 percent over the 1970 level. There were 7,120 wells producing from 150 reservoirs in South Arkansas. Reserves of recoverable crude oil, according to the

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

Year	Gross withdrawals ¹			Disposition			Vented and wasted ³
	From gas wells	From oil wells	Total	Marketed production ²		Repressuring	
				Quantity	Value (thousands)		
1967	81,491	46,038	127,529	116,522	\$17,828	10,010	997
1968	110,898	51,257	162,155	156,627	24,456	4,633	895
1969	119,230	56,105	175,335	169,257	26,743	4,752	1,326
1970	128,241	55,409	183,650	181,351	29,560	2,073	226
1971	120,454	54,429	174,883	172,154	29,426	995	1,734

¹ Marketed production plus quantities used in repressuring, vented, and wasted.

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

³ Includes direct waste on producing properties and residue blown to air.

American Petroleum Institute, were 117,648,000 barrels on December 31, 1971, a decrease of 11,929,000 barrels from the previous year. Smackover field, in Union and Ouachita Counties, for the fourth successive year, was the State's leading oilfield.

Table 7.—Crude petroleum production, indicated demand, and stocks in 1971, by month
(Thousand 42-gallon barrels)

Month	Production	Indicated demand	End of month stocks originating within Arkansas
January	1,568	1,562	693
February	1,395	1,460	628
March	1,586	1,566	648
April	1,551	1,545	654
May	1,561	1,401	814
June	1,511	1,566	759
July	1,513	1,546	726
August	1,528	1,538	716
September	1,423	1,473	666
October	1,551	1,247	970
November	1,511	1,586	895
December	1,565	1,601	859
Total:			
1971	18,263	18,091	XX
1970	18,035	18,104	XX

XX Not applicable.

Secondary recovery operations continued to play an important role in oil production in Arkansas. Sixty-six projects were in operation at yearend. They produced 5,955,517 barrels of oil, accounting for nearly one-third of the total State oil production. During the year, the Commission approved three secondary recovery projects, of which two were unitized and one was a pilot project. Besides water injection projects, there were six steam injection, three combination gas and water injection, two gas injection, one carbon dioxide injection, and one in-situ combustion projects. A number of additional reservoirs were being studied for either secondary or tertiary recovery.

There were 430 salt water disposal wells in operation during 1971 that disposed of almost 282 million barrels of salt water. An additional 49.3 million barrels of water (including 13.1 million barrels of water from sources other than the zones being flooded) were injected for secondary recovery purposes. Of the 215.5 million barrels of salt water produced with oil or gas, 88 percent was injected into underground res-

ervoirs and 12 percent was disposed of by surface facilities.

Petroleum Refineries.—Arkansas had six petroleum refineries in operation in 1971. One of these, the American Oil refinery, with a capacity of 43,600 barrels per day, was scheduled to close in March 1972. It was the State's first oil refinery, established in El Dorado, Union County in 1922, under the name of Root Petroleum Co. The plant in the mid-1940's became associated with Pan Am Southern which merged with American Oil in 1957. Dwindling supplies of crude oil in the area and the plant's relatively small size and outdated facilities were factors contributing to its closure.

Other refineries were the Lion Oil Co. refinery, a division of Monsanto Co., which began operation at El Dorado, Union County, a few months after the American plant opened in 1922; Macmillan Ring-Free Oil Co., Inc.'s, refinery at Norphlet, Union County; the refinery of Cross Oil & Refining Co. of Arkansas at Smackover, Union County; and Berry Petroleum Co.'s plants at Waterloo, Nevada County, and Stephens, Ouachita County.

Petroleum and Natural Gas Exploration and Development.—Total number of well completions in Arkansas increased from 307 wells in 1970 to 342 wells in 1971. Of the 342 wells drilled, 127 were completed as oil wells, 29 as gas wells, and 186 as dry

holes. Overall success ratio was about 46 percent; about 12 percent of the exploratory wells were completed as oil and gas producers.

According to the 1971 Annual Oil and Gas Report of the Arkansas Oil and Gas Commission, five new fields, two rediscoversies, and eight new reservoirs resulted from drilling during the year. Four of the new fields, the two rediscoversies, and seven of the new reservoirs were oil producers located in South Arkansas; only one new field and one new reservoir were discovered in the dry gas-producing area of North Arkansas.

The four new oilfields were the Chalybeat Springs field in Columbia County, the Enyart Lake field in Lafayette County, the Seminary Church field in Ouachita County, and the Richland Creek field in Union County. The two rediscoversies of oil were the Atlanta East field in Columbia County and the Wegsum field in Ouachita County. Three new pool discoveries were established in Columbia County, two in Lafayette County, and one each in Ouachita and Union Counties. All of the South Arkansas fields produced from either the Cretaceous or Jurassic sedimentary formations.

The new gasfield, Slaytonville, and the new gas pool, Bonanza, were located in Sebastian County. Both produced from the Atoka strata.

Table 8.—Oil and gas well drilling completions, by county, in 1971

County	Proved field wells ¹			Exploratory wells			Total	Footage
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	
Ashley	--	--	4	--	--	4	4	27,922
Bradley	2	--	4	--	--	6	12	42,680
Columbia	18	1	4	2	--	10	35	327,887
Crawford	--	3	2	--	--	--	5	32,733
Desha	--	--	--	--	--	1	1	5,013
Drew	--	--	--	--	--	3	3	18,791
Franklin	--	3	1	--	--	--	4	21,119
Hempstead	--	1	1	--	--	--	1	2,312
Johnson	--	7	7	--	--	--	14	78,964
Lafayette	18	--	17	3	--	15	53	352,222
Little River	--	--	--	--	--	1	1	9,017
Logan	--	--	2	--	--	--	2	17,777
Miller	4	--	1	1	--	9	15	107,353
Nevada	2	--	2	--	--	10	14	58,995
Ouachita	13	--	8	2	--	4	27	102,048
Pope	--	1	2	--	--	--	3	14,617
Prairie	--	--	--	--	--	1	1	1,590
St. Francis	--	--	--	--	--	1	1	14,773
Sebastian	--	12	16	--	2	--	30	212,407
Union	61	--	38	1	--	16	116	481,099
Total	118	27	105	9	2	81	342	1,929,319

¹ Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

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

Commodity	Proved reserves Dec. 31, 1970	Changes in proved reserves, due to extensions, and discoveries in 1971	Proved reserves Dec. 31, 1971 (Production deducted)	Changes from 1970 (percent)
Crude oil.....thousand barrels..	129,577	5,487	117,648	-9.2
Natural gas liquids.....do....	12,272	(242)	9,619	-21.6
Natural gas.....million cubic feet..	2,580,674	23,304	2,430,115	-5.8

Source: American Petroleum Institute and American Gas Association.

NONMETALS

A major part of the total Arkansas mineral value in 1971 was contributed by a wide variety of nonmetallic minerals.

Abrasive Stone.—Seven operators mined novaculite in Garland County for manufacture into oilstones used to sharpen various types of cutlery. Both volume and value decreased more than 13 percent from those of 1970. Arkansas Oilstone Co., Inc., processed crude novaculite at its plant in Hot Springs, and Norton Co. shipped novaculite out of Arkansas for finishing into whetstones.

Barite.—Barite production and value decreased over 10 percent from 1970. Baroid Division, N L Industries, Inc., and Dresser Minerals mined and processed ore in Hot Spring County. Barite mined in Missouri was processed by The Milwhite Co., Inc. at Bryant, Saline County. All of the barite was used in making drilling muds. For the fourth consecutive year, the State ranked third in the United States in barite output.

The Baroid Division, N L Industries, Inc., announced plans to expand underground workings to reach additional reserves of barite ore at greater depths than present mine workings. A first objective would be to drive an incline from the floor of the open pit for a distance of several hundred feet.

Bromine.—Five plants, two in Columbia County and three in Union County, extracted bromine from brine found in the Smackover limestone of Jurassic age. Output and value increased 8 percent and 11 percent, respectively, over that of 1970, and the State continued to rank first in production of bromine in the United States. For the third consecutive year, bromine was the second most important mineral commodity in value to the State. According to the Arkansas Oil and Gas Commis-

sion, 126,622,379 barrels of salt water were produced in 1971 for the processing of bromine. The plants disposed of 139,200,004 barrels of effluent, which is approximately 10 percent more liquids than they take in.

Michigan Chemical Corp. closed its East Lake plant at Manistee, Mich., and transferred production to its El Dorado, Ark., plant where a more concentrated raw material brine results in lower operating costs. Capacity at the Arkansas plant was further increased and an additional brine supply well was completed.

Table 10.—Bromine compounds sold or used by primary producers

(Thousand pounds and thousand dollars)

Year	Quantity		Value
	Gross weight	Bromine content	
1969.....	145,100	129,550	\$28,287
1970.....	186,113	157,006	32,375
1971.....	199,429	168,198	34,426

Cement.—Portland and masonry cement shipped by the State's two producers increased 18 percent in quantity and nearly 24 percent in value. Over 94 percent of the cement shipped was portland cement. The portland cement shipped was used by ready-mix concrete companies (58 percent), contractors (26 percent), concrete products (9 percent), building materials (3 percent), and for other uses. Raw materials used in making portland cement included limestone, clay, sand, gypsum, and iron-bearing materials. Most of the cement shipments were by truck in bulk form.

Arkansas Cement Corp. planned to install three electrostatic precipitators at its plant in Foreman with completion in 1972. Ideal Cement Co., a division of Ideal Basic Industries, Inc., installed two electrostatic

precipitators at the Okay plant. Expenditures at the plants for dust control systems will exceed \$3 million.

Clays.—Clay production was reported from 14 counties. Total clay output increased in quantity but decreased in value from that of 1970. Quantity and value of common clay increased, but kaolin decreased considerably in quantity and value. The five leading clay producing counties (Hot Spring, Lonoke, Pulaski, Crittenden, and Little River) accounted for nearly 73 percent of the total production. Common clay was utilized for manufacture of building brick, drain tile, sewer pipe, and cement; one company produced lightweight aggregate at two plants (England and West Memphis). Kaolin was used for chemicals and refractory products.

Gem Stones.—Small quantities of gem stones and mineral specimens continued to be collected in Arkansas, and estimated value of material found in 1971 increased 20 percent over that of the previous year.

Early in 1971, a 3-carat 30-point, blue-white diamond was reported⁴ to have been found at the Crater of Diamonds mine near Murfreesboro. An even larger 3-carat, 82-point diamond was reported to have been found in August.⁵ At the end of the year, the Arkansas State Department of Parks and Tourism was seeking to purchase the diamond mine, the only such mine in North America, from its owner (GF Industries, Inc.) for development as a State park. The property would continue to operate as a tourist attraction for those who wish the thrill of hunting for their own diamonds.

Gypsum.—The quantity of crude gypsum produced was 2 percent more and the total value 20 percent more than in 1970. The State's two producing companies—Gypsum Division, Dulin Bauxite Co., Inc., in Pike County and Weyerhaeuser Co. in Howard County—mined and processed gypsum for use in cement and wallboard manufacturing, respectively.

A new \$4.5 million gypsum wallboard manufacturing plant, scheduled to start operations in the spring of 1972, was under construction at West Memphis, Crittenden County. The new facilities will be known as Temple Gypsum, a subsidiary of Temple Industries of Diboll, Tex. The plant will use crude gypsum mined in Oklahoma and is to produce 180 million square feet of gypsum wallboard annually.

Lime.—Rangaire Corp. produced lime in Independence County for paper and pulp, soil stabilization, and other uses. Reynolds Metals Corp., a subsidiary of Reynolds Metals Co., and Aluminum Co. of America (Alcoa) produced lime in Saline County for processing bauxite to alumina. Output decreased 16 percent and was 24 percent below the 1966 record. The lime was consumed in Arkansas, Louisiana, Tennessee, and other States. Total consumption of lime in Arkansas was 149,069 tons.

Sand and Gravel.—Output decreased 12.6 percent to 11.6 million short tons, while value decreased 2.7 percent to \$15.6 million. Miller County led the State in production, followed by Crawford, Pulaski, Calhoun, and Lafayette Counties. Collectively, these five counties accounted for about 31 percent of the total tonnage. Most of the production was used for highway construction and building.

Soapstone.—Arkansas' only producer of soapstone, The Milwhite Co., Inc., increased output 12.6 percent in 1971. This was the 19th consecutive year of production from Saline County, where the soapstone is mined and processed.

Stone.—Outputs of limestone, granite (syenite), and sandstone provided most of the volume of stone produced. Crushed and broken limestone, accounting for 41 percent of the stone production, rose from 6.3 million tons in 1970 to 7.1 million tons in 1971, an increase of 13 percent; its value increased from \$9.4 million to \$11.3 million, a rise of 20.5 percent. Limestone quarries were operated mostly in the northern part of the State. Leading limestone producing counties were Little River, Washington, Izard, and Lawrence. Chief uses, in order of importance, were cement, roadbase stone, flux, concrete aggregate, and bituminous aggregate.

Output of granite (syenite), nearly 5 million tons in 1971, accounted for 29 percent of the State's stone production. All of the syenite was from Pulaski County. Among its uses were riprap, railroad ballast, concrete aggregate, roofing aggregate, and road base stone.

Crushed and broken sandstone output, with 4.9 million tons valued at \$8.5 million, accounted for 29 percent of the stone production. Sixty-five percent of the sandstone production was from six counties

⁴ Daily Oklahoman. Feb. 19, 1971.

⁵ Arkansas Gazette. Aug. 15, 1971, p. 20A.

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

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,398	\$1,766	1,947	\$2,752
Fill	W	W	164	122
Paving	1,785	1,823	2,050	2,122
Other uses ¹	604	1,269	457	1,168
Total	3,787	4,858	4,618	6,164
Gravel:				
Building	1,530	2,734	1,862	3,809
Fill	W	W	22	27
Paving	4,618	5,299	2,837	3,254
Miscellaneous	W	W	332	371
Other uses ²	704	661	179	367
Total ³	6,852	8,695	5,232	7,828
Government-and-contractor operations:				
Sand:				
Building	30	21	3	2
Paving	1,094	1,051	713	697
Total	1,124	1,072	716	699
Gravel:				
Paving	1,538	1,413	1,058	911
Other uses	--	--	5	1
Total	1,538	1,413	1,063	912
Total sand and gravel ³	13,301	16,036	11,630	15,603

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

¹ Includes fill and ground and unground sands.

² Includes railroad ballast and other gravel.

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

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

Year	Commercial		Government-and-contractor		Total ¹	
	Quantity	Value	Quantity	Value	Quantity	Value
1967	10,202	\$13,113	4,037	\$2,414	14,239	\$15,531
1968	10,682	12,795	2,315	1,848	12,997	14,643
1969	10,067	12,919	2,608	2,030	12,674	14,949
1970	10,639	13,553	2,662	2,454	13,301	16,036
1971	9,850	13,993	1,779	1,611	11,630	15,603

¹ Data may not add to totals shown because of independent rounding.

(Sebastian, Crawford, Pope, White, Johnson, and Hot Spring). Its uses included road base stone, concrete aggregate, bituminous aggregate, and railroad ballast. Dimension sandstone was produced by four companies in Logan County.

Slate was produced in Montgomery and Saline Counties, and was used for roofing aggregate and flour. Dimension marble was produced in Independence County.

One hundred and three quarries supplied the various stone types.

Sulfur (Recovered Elemental).—As a pollution control measure, Bromet Co. at

its Columbia County bromine extraction plant continued to recover sulfur from hydrogen sulfide during the processing of brines. Three other plants operated by Arkla Chemical Corp., Olin Corp., and Monsanto Chemical Co. in Columbia, Lafayette, and Union Counties, respectively, treated sour gas for sulfur recovery. Total gross shipments from the four plants was 31,127 long tons valued at \$578,937. Olin Corp., was the leading producer.

Tripoli.—Output and value of tripoli decreased in 1971. Two producers, Malvern Minerals Co. and Hercules Minerals Corp.,

operated open pit mines in Garland and Pike Counties, respectively. Principal use was for abrasives.

METALS

Aluminum.—Reynolds Metals Co. continued to be the only producer of aluminum from alumina in Arkansas with operation of its reduction plants in Malvern and Arkadelphia. Aluminum metal was rolled, extruded, and drawn into various semifabricated shapes at several plants in Arkansas. The Dow Chemical operated its Russellville extrusion plant on a full-time basis. New facilities at Alcoa's bauxite refining complex near Benton began producing high-purity reactive aluminas for the man-

ufacture of miniature electronic components by U.S. and foreign firms.

Bauxite.—Output and value of bauxite decreased nearly 5 percent from that of 1970. There were four crude bauxite producers during 1971 as follows: Reynolds Mining Corp., Alcoa, American Cyanamid Co., and A. P. Green Refractories Co. Most of the bauxite was mined in Saline County, but there also was production from Pulaski County. Reynolds Mining Corp. operated both underground and strip mines; the other companies produced from open pit operations. Arkansas continued to rank first among the States in bauxite production with 90 percent of the U.S. total.

Table 13.—Bauxite mine production and shipments from mines and processing plants to consumers

(Thousand long tons and thousand dollars)

Year	Mine production			Shipments from mines and processing plants to consumers		
	Crude	Dry equivalent	Value ¹	As shipped	Dry equivalent	Value ¹
1967	1,943	1,571	\$18,269	2,022	1,742	\$21,343
1968	1,961	1,582	23,058	1,962	1,680	25,349
1969	2,116	1,755	24,706	2,044	1,765	26,304
1970	2,251	1,869	26,293	2,194	1,917	29,049
1971	2,157	1,781	24,979	2,161	1,892	28,296

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

Gallium.—Gallium metal was produced as a byproduct of alumina production by Alcoa at its Bauxite, Ark. plant.

Mercury.—For the second year, Pike County reported a very small amount of mercury production.

Vanadium.—Union Carbide Corp. was the only producer of vanadium oxide in the State. Production of both ore and

oxide from its Wilson Springs plant near Hot Springs, Garland Co., increased over that of 1970. The vanadium oxide was shipped to Union Carbide's Marietta, Ohio, plant for conversion to a vanadium ferroalloy prior to marketing. Arkansas ranked second to Colorado in domestic vanadium production.

Table 14.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Arkansas Oilstone Co., Inc.-----	P.O. Box 1426 Hot Springs, Ark. 71901	Mine and plant...	Garland.
Norton Pike Division, Norton Co.-----	Littleton, N. H. 03561-----	Mine.....	Do.
Hiram A. Smith Whetstone Co.-----	11 Snider St. Hot Springs, Ark. 71901	...do.....	Do.
Barite:			
Dresser Minerals.....	P.O. Box 6504 Houston, Tex. 77005	Mine and plant...	Hot Spring.
N L Industries, Inc.-----	P.O. Box 1675 Houston, Tex. 77001	...do.....	Do.
Bauxite:			
Aluminum Co. of America.....	1036 Alcoa Bldg. Pittsburgh, Pa. 15219	Mine.....	Saline.
American Cyanamid Co.-----	Berdan Avenue Wayne, N.J. 07470	Mine and plant...	Pulaski and Saline.
A.P. Green Refractories Co.-----	Mexico, Mo. 65265-----	Mine.....	Saline.
Reynolds Mining Corp.-----	P.O. Box 398 Bauxite, Ark. 72011	...do.....	Do.
Bromine:			
Arkansas Chemicals, Inc.-----	Route 6, Box 98 El Dorado, Ark. 71730	Brine wells and plant.	Union.
Bromet Co.-----	P.O. Box B Magnolia, Ark. 71753	...do.....	Columbia.
The Dow Chemical Co.-----	Midland, Mich. 48640-----	...do.....	Do.
Great Lakes Chemical Corp.-----	P.O. Box 2200, West Lafayette, Ind. 47901	...do.....	Union.
Michigan Chemical Corp.-----	351 East Ohio St. Chicago, Ill. 60611	...do.....	Do.
Carbon black:			
Cities Service Co., Columbian Division.	60 Wall St. New York, N.Y. 10005	Furnace.....	Do.
Cement:			
Arkansas Cement Corp.-----	P.O. Box 398 Foreman, Ark. 71836	Plant and quarry..	Little River.
Ideal Cement Co., Div. of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	...do.....	Howard.
Clays:			
Acme Brick Co.-----	P.O. Box 425 Fort Worth, Tex. 76101	Mine and plant...	Hot Spring and Sebastian.
Arkansas Cement Corp.-----	P.O. Box 398 Foreman, Ark. 71836	...do.....	Little River.
Arkansas Lightweight Aggregate Corp.	P.O. Box 99 England, Ark. 72046	...do.....	Crittenden and Lonoke.
W.S. Dickey Clay Manufacturing Co.	P.O. Box 13125 Kansas City, Mo. 64199	...do.....	Miller and Polk.
Eureka Brick & Tile Co.-----	Clarksville, Ark. 72830	...do.....	Johnson.
A. P. Green Refractories Co.-----	Mexico, Mo. 65265-----	...do.....	Pulaski and Saline.
Coal:			
Dixie Construction Co.-----	P.O. Box 477 Fort Smith, Ark. 72901	Strip mine.....	Johnson.
Excelsior Valley Coal Co.-----	Midland, Ark. 72945-----	...do.....	Sebastian.
Garland Coal & Mining Co.-----	P.O. Box 186 Fort Smith, Ark. 72901	...do.....	Franklin and Johnson.
Johnson Coal Co., Inc.-----	P.O. Box 508 Clarksville, Ark. 72830	Underground mine.	Johnson.
Prairie Coal Co., Inc.-----	415 Grandview Clarksville, Ark. 72830	...do.....	Do.
Gypsum:			
Dulin Bauxite Co., Inc.-----	835 Valley Hot Springs, Ark. 71901	Mine and plant...	Pike.
Weyerhaeuser Co.-----	810 Whittington Avenue Hot Springs, Ark. 71901	...do.....	Howard.
Lime:			
Aluminum Co. of America.....	1501 Alcoa Bldg. Pittsburgh, Pa. 15219	Plant.....	Saline.
Rangaire Corp., Batesville White Lime Division.	P.O. Box 1311 Batesville, Ark. 72501	...do.....	Independence.
Reynolds Metals Co.-----	6603 W. Broad Street Richmond, Va. 23226	...do.....	Saline.
Roofing granules:			
Bird and Son, Inc.-----	East Walpole, Mass. 02032--	...do.....	Montgomery.
Minnesota Mng & Mfg Co.-----	3 M Center (220-13W) St. Paul, Minn. 55101	...do.....	Pulaski.
Sand and gravel:			
Arkansas Rock & Gravel Co.-----	P.O. Box "I" Murfreesboro, Ark. 71958	Stationary.....	Pike.
Arkholia Sand & Gravel Co.-----	323 Merchants Bank Bldg. Fort Smith, Ark. 72901	...do.....	Crawford.
Belvedere Sand & Gravel Co.-----	P.O. Box 243 Benton, Ark. 72015	...do.....	Saline.

Table 14.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
Braswell Sand and Gravel Co., Inc.	P. O. Box 798 Minden, La. 71055	Stationary	Little River.
Gifford-Hill & Co., Inc.	P. O. Box 47127 Dallas, Tex. 75247	do	Lafayette and Miller
Jeffrey Sand Co.	P. O. Box 5054, North Little Rock, Ark. 72114	do	Pulaski.
Malvern Gravel Co.	P. O. Box 337 Malvern, Ark. 72104	do	Hot Spring.
Mobley Construction Co., Inc.	P. O. Box 109 Morrilton, Ark. 72110	Portable	Jackson and Pope.
St. Francis Material Co.	P. O. Box 999 Forrest City, Ark. 72335	Stationary	Ashley, Calhoun, Craighead, Poinsett, St. Francis.
Silica Products Co., Inc.	P. O. Box 248 Guion, Ark. 72540	do	Izard.
Stone:			
Arkansas Cement Corp.	P. O. Box 398 Foreman, Ark. 71836	Quarry	Little River.
Arkholia Sand & Gravel Co.	323 Merchants Bank Bldg. Fort Smith, Ark. 72901	do	Crawford.
Ben M. Hogan Co., Inc.	P. O. Box 2860 Little Rock, Ark. 72203	do	Franklin, Law- rence, Lonoke, Pope, White.
Ideal Cement Co., Div. of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	do	Howard.
Jeffrey Stone Co., Inc.	P. O. Box 185, North Little Rock, Ark. 72114	do	Pulaski.
McClinton Brothers Co.	P. O. Box 790 Fayetteville, Ark. 72701	do	Madison and Washington.
McGeorge Contracting Co.	P. O. Box 7008 Pine Bluff, Ark. 71601	do	Pulaski and Van Buren.
Minnesota Mng & Mfg Co.	3 M Center 220 13W St. Paul, Minn. 55101	do	Pulaski.
Missouri City Stone Co.	1961 N. Industrial Blvd. Dallas, Tex. 75207	do	Perry.
Rangaire Corp.	P. O. Box 1311 Batesville, Ark. 72501	do	Independence and Izard.
Talc and soapstone:			
The Milwhite Co., Inc.	P. O. Box 15038 Houston, Tex. 77020	Mine and plant	Saline.
Tripoli:			
Hercules Minerals Corp.	114 National Old Line Bldg. Little Rock, Ark. 72201	Mine	Pike.
Malvern Minerals Co.	P. O. Box 1246 Hot Springs, Ark. 71901	do	Garland.
Vermiculite:			
W. R. Grace and Co.	62 Whittemore Avenue Cambridge, Mass. 02140	Exfoliating	Pulaski.
Natural gas liquids:			
Arkla Chemical Corp.	Magnolia, Ark. 71753	Plant	Columbia.
Austral Oil Co., Inc.	Stamps, Ark. 71860	do	Lafayette.
Phillips Petroleum Co.	do	do	Do.
Sun Oil Co., DX Division	do	do	Do.
Petroleum:			
American Oil Co.	El Dorado, Ark. 71730	Refinery	Union.
Berry Petroleum Co., Div. Crystal Oil Co.	Magnolia, Ark. 71753	2 Refineries	Nevada and Ouachita.
Cross Oil & Refinery Co. of Arkan- sas, Div. C. J. Wood Petroleum Co.	Smackover, Ark. 71762	Refinery	Union.
Lion Oil, Div. Monsanto Co.	El Dorado, Ark. 71730	do	Do.
Macmillan Ring-Free Oil Co., Inc.	Norphlet, Ark. 71759	do	Do.
Vanadium:			
Union Carbide Corp.	Route 2, Box 563 Hot Springs, Ark. 71901	Mine	Garland.

The Mineral Industry of California

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

By Walter C. Woodmansee¹

Another record high in total value of mineral production was attained for the fourth consecutive year. Value of mineral output reached \$1,921 million, a 1-percent increase over that of 1970. The petroleum industry continued to be the leading con-

tributor, accounting for 64 percent of the total; 33 percent was from nonmetallic minerals; and only 3 percent from metallic minerals.

¹ Physical scientist, Division of Nonferrous Metals.

Table 1.—Mineral production in California¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony..... short tons	4	\$10		
Asbestos..... do	78,966	6,332	87,144	\$7,806
Boron minerals..... do	1,041,039	86,827	1,047,443	89,856
Cement:				
Portland..... thousand 376-pound barrels	49,499	173,126	48,493	169,921
Masonry..... thousand 280-pound barrels			(?)	(?)
Clays..... thousand short tons	2,824	6,505	2,822	7,103
Copper (recoverable content of ores, etc.) short tons	2,303	2,663	515	536
Gem stones..... NA	200	NA	205	205
Gold (recoverable content of ores, etc.) troy ounces	4,999	182	2,966	122
Gypsum..... thousand short tons	1,132	3,271	1,352	3,884
Lead (recoverable content of ores, etc.) short tons	1,772	553	2,234	630
Lime..... thousand short tons	572	9,911	630	10,846
Magnesium compounds from sea-water bitterns (partly estimated) short tons MgO equivalent	73,726	7,439	152,918	16,836
Mercury..... 76-pound flasks	18,593	7,582	13,233	3,869
Natural gas..... million cubic feet	649,117	208,367	612,629	199,717
Natural gas liquids:				
Natural gasoline and cycle products				
LP gases..... thousand 42-gallon barrels	11,993	38,478	11,045	35,545
LP gases..... do	7,051	16,006	6,755	16,482
Peat..... thousand short tons	10	W	12	W
Petroleum (crude)..... thousand 42-gallon barrels	372,191	945,365	358,484	975,076
Pumice, pumicite, and volcanic cinder				
..... thousand short tons	r 499	r 832	699	1,179
Salt (common)..... do	1,656	r 15,053	1,887	21,142
Sand and gravel..... do	140,259	174,221	115,468	157,683
Silver (recoverable content of ores, etc.)				
..... thousand troy ounces	451	799	444	686
..... thousand short tons	46,399	66,950	43,336	86,255
Talc, pyrophyllite, and soapstone..... short tons	184,660	2,545	153,227	2,084
Zinc (recoverable content of ores, etc.)..... do	3,514	1,077	3,003	967
Value of items that cannot be disclosed: Barite, bromine, calcium-magnesium chloride, carbon dioxide, clays (fuller's earth and ball), coal (lignite), diatomite, feldspar, iron ore, lithium minerals, molybdenum, perlite, phosphate rock, potassium salts, rare-earth metals, sodium carbonate, sodium sulfate, tungsten concentrates and value indicated by symbol W.....	XX	r 125,337	XX	112,218
Total.....	XX	r 1,899,682	XX	1,920,648
Total 1967 constant dollars.....	XX	1,699,266	XX	p 1,668,659

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

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

² Less than 1/2 unit.

³ Excludes ball clay and fuller's earth; included with "Value of items that cannot be disclosed."

Although employment in the mining sector was small compared with the total labor force, the mineral industry made a significant contribution to the State's economy. California ranked third in crude oil production, sixth in output of natural gas, and first in consumption of petroleum refinery products in the United States. Total value of crude oil production increased 3 percent, reaching \$975 million, because of higher prices per barrel, although quantitative output continued a downward trend. Marketed natural gas from State sources also continued to decline. Activity in exploration and development showed a marked decrease, and oil and gas discoveries were of minor significance, contributing little to the resource

position. As a result, oil and gas reserves at yearend were lower than at the first of the year. However, reserves have been maintained in reasonable balance because of successful secondary recovery projects involving steam, water, and gas. A continuing moratorium on offshore exploration in State waters and restrictions on operations in Federal waters, where potential for discovery was considered more favorable than land exploration in the State, was a detriment to the industry. Expansion of capacity was underway at some of California's 13 refineries. Despite the extensive petroleum production operations within the State, large supplies of refinery products and natural gas were received from out-of-State sources.

Table 2.—Value of mineral production in California, by county
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Alameda	\$23,796	\$27,232	Sand and gravel, salt, stone, clays, petroleum.
Alpine	W	W	Silver, gold, stone, copper, lead, zinc, sand and gravel.
Amador	3,741	2,665	Sand and gravel, stone, clays, coal.
Butte	2,507	3,014	Natural gas, sand and gravel.
Calaveras	16,115	17,807	Cement, asbestos, stone, sand and gravel, clays.
Colusa	W	3,578	Natural gas, sand and gravel, stone, mercury.
Contra Costa	12,975	14,330	Stone, natural gas, petroleum, lime, sand and gravel, clays, peat, mercury.
Del Norte	201	319	Sand and gravel, clays, stone.
El Dorado	2,628	2,672	Stone, lime, sand and gravel, talc.
Fresno	55,114	52,525	Petroleum, sand and gravel, natural gas, asbestos, natural gas liquids, stone, gold, tungsten, clays, silver.
Glenn	5,124	5,610	Natural gas, sand and gravel, lime, stone.
Humboldt	2,054	2,078	Sand and gravel, natural gas, stone.
Imperial	W	6,048	Sand and gravel, gypsum, lime, clays, stone.
Inyo	25,621	20,217	Tungsten, talc, zinc, molybdenum, silver, stone, lead, sand and gravel, copper, boron compounds, perlite, clays, gold.
Kern	472,573	480,790	Petroleum, boron compounds, natural gas, cement, natural gas liquids, sand and gravel, stone, gypsum, sodium sulfate, clays, salt, carbon dioxide, pumice, tungsten.
Kings	W	8,423	Natural gas, natural gas liquids, petroleum, sand and gravel.
Lake	1,259	865	Sand and gravel, pumice, mercury, stone.
Lassen	W	W	Pumice, sand and gravel, stone.
Los Angeles	402,746	369,019	Petroleum, sand and gravel, natural gas, natural gas liquids, stone, clays, lime, zinc, copper.
Madera	1,468	1,381	Natural gas, sand and gravel, stone, clays, pumice.
Marin	2,638	2,757	Stone, clays, mercury.
Mariposa	W	411	Sand and gravel, stone.
Mendocino	316	W	Stone, sand and gravel.
Merced	W	3,146	Sand and gravel, stone, mercury, gold.
Modoc	W	W	Sand and gravel, stone, pumice.
Mono	511	221	Sand and gravel, pumice, clays, talc, gold.
Monterey	44,022	52,122	Petroleum, magnesium compounds, stone, lime, sand and gravel, feldspar, natural gas.
Napa	3,135	4,220	Salt, stone, mercury, clays, diatomite, sand and gravel, pumice.
Nevada	W	1,146	Sand and gravel, stone.
Orange	109,544	110,720	Petroleum, sand and gravel, natural gas, natural gas liquids, clays, lime, peat.
Placer	1,170	1,195	Sand and gravel, clays, stone, gold.
Plumas	105	W	Sand and gravel, stone, gold.
Riverside	74,549	61,024	Iron ore, cement, sand and gravel, stone, clays, petroleum, natural gas.
Sacramento	W	20,990	Natural gas, sand and gravel, petroleum, stone, gold, clays, silver.
San Benito	9,824	11,143	Cement, stone, asbestos, mercury, sand and gravel, petroleum, clays, natural gas.
San Bernardino	152,989	146,932	Cement, boron compounds, stone, sand and gravel, potassium salts, sodium carbonate, sodium sulfate, rare-earth minerals, salt, petroleum, clays, lime, calcium-magnesium chloride, talc, iron ore, bromine, lithium minerals, natural gas, tungsten, pumice, gypsum, silver, gold, copper.

See footnotes at end of table.

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

(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
San Diego.....	\$22,723	\$26,901	Sand and gravel, stone, salt, magnesium compounds, clays, lead, gold, silver, copper, zinc.
San Francisco.....	W	W	Sand and gravel.
San Joaquin.....	W	19,453	Natural gas, sand and gravel, lime, stone, gold, silver.
San Luis Obispo.....	7,039	7,898	Petroleum, stone, natural gas, sand and gravel, mercury, gypsum, clays.
San Mateo.....	12,873	18,937	Salt, magnesium compounds, cement, stone, sand and gravel, petroleum, natural gas.
Santa Barbara.....	104,857	103,284	Petroleum, diatomite, natural gas, natural gas liquids, sand and gravel, lime, mercury, stone.
Santa Clara.....	31,700	44,973	Cement, stone, sand and gravel, mercury.
Santa Cruz.....	W	W	Cement, stone, sand and gravel, clays.
Shasta.....	6,217	6,993	Cement, sand and gravel, stone, pumice, clays, barite, gold, silver.
Sierra.....	66	38	Sand and gravel, gold.
Siskiyou.....	W	W	Pumice, sand and gravel, stone.
Solano.....	23,700	29,608	Natural gas, petroleum, stone, sand and gravel.
Sonoma.....	5,275	5,947	Sand and gravel, mercury, stone, clays, natural gas.
Stanislaus.....	2,426	2,224	Sand and gravel, clays, gold, silver, stone.
Sutter.....	12,865	12,977	Natural gas, sand and gravel, clays.
Tehama.....	W	1,830	Natural gas, sand and gravel, stone, pumice.
Trinity.....	723	729	Stone, sand and gravel, mercury, gold.
Tulare.....	3,422	3,456	Sand and gravel, lime, natural gas, stone, petroleum, clays.
Tuolumne.....	1,082	W	Stone, sand and gravel.
Ventura.....	85,461	89,318	Petroleum, natural gas, natural gas liquids, sand and gravel, stone, clays.
Yolo.....	W	5,255	Sand and gravel, natural gas, lime, petroleum.
Yuba.....	808	890	Sand and gravel, stone, clays.
Undistributed ¹	\$151,719	105,335	
Total ²	\$1,899,682	1,920,648	

¹ Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

² Includes Federal offshore petroleum and natural gas, copper, gem stones, mercury, sand and gravel, and tungsten that cannot be assigned to specific counties, and values indicated by symbol W.

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

Table 3.—Indicators of California business activity

	1970 ^r	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force.....	8,545	8,603	+0.7
Unemployment.....	519	599	+15.4
Employment:			
Mining.....	31	30	-3.2
Contract construction.....	295	287	-2.7
Manufacturing.....	1,558	1,470	-5.6
Government.....	1,425	1,456	+2.2
Wholesale and retail trade.....	1,531	1,553	+1.4
Services.....	1,266	1,272	+0.5
Transportation and public utilities.....	459	452	-1.5
Finance, insurance, and real estate.....	382	394	+3.1
Personal income:			
Total.....	\$88,825	\$94,573	+6.5
Per capita.....	\$4,443	\$4,677	+5.3
Construction activity:			
Total private nonresidential construction.....	\$1,973.6	\$2,414.8	+22.4
Number of new housing units authorized.....	195,604	258,903	+32.4
Portland cement shipments to and within California.....	45	45	--
Mineral production value.....	\$1,900	\$1,921	+1.1
Exports through California ports.....	\$4,245	\$3,690	-13.1
Imports through California ports.....	\$4,408	\$4,898	+11.1

^p Preliminary. ^r Revised.

Sources: Area Trends in Employment and Unemployment; Construction Review; Survey of Current Business; Employment and Earnings; Highlights of U.S. Export and Import Trade; and Federal Bureau of Mines.

Table 4.—Worktime and injury experience in the mineral industry

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Coal.....	5	94	(1)	4	--	--	--	--
Peat.....	12	114	1	11	--	--	--	--
Metal.....	2,228	286	638	5,102	3	156	31.17	5,438
Nonmetal.....	3,868	286	1,108	8,903	1	269	30.33	1,571
Sand and gravel.....	6,247	240	1,500	12,226	6	300	25.03	4,466
Stone.....	4,381	304	1,332	10,715	3	134	12.79	2,291
Total ²	16,741	274	4,580	36,960	13	859	23.59	3,270
1971:^p								
Coal.....	5	84	1	4	--	--	--	--
Metal.....	2,160	262	565	4,518	6	123	28.55	8,648
Nonmetal ³	2,750	281	773	6,214	--	243	39.10	2,383
Sand and gravel.....	6,545	237	1,550	12,431	4	300	24.45	2,826
Stone.....	4,335	297	1,287	10,373	7	170	17.06	4,676
Total ²	15,795	264	4,176	33,541	17	836	25.43	4,100

^p Preliminary.¹ Less than 500.² Data may not add to totals shown because of independent rounding.³ Beginning in 1971, data concerning peat operations are included in the nonmetals industry.

A large diversity of nonmetallic minerals was mined and processed during the year. Production was reported for about 22 nonmetals, including 17 for which value of output exceeded \$1 million during the year. California was the leading U.S. producer of asbestos, boron minerals, cement, diatomite, and sand and gravel. Leading nonmetallic commodities in the State, in terms of value of output, were as follows (in order of decreasing value): Cement, sand and gravel, boron, stone, diatomite, salt, magnesium compounds, natural sodium compounds, lime, potassium salts, and asbestos. Production and sales of most nonmetals increased significantly, but cement,

sand and gravel, and talc showed declines. Exploration was underway for asbestos, barite, clay, and fluorspar.

Production returned to normal, after a major labor strike in 1970 at Searles Lake, San Bernardino County, where borax and several other chemical products were recovered from subsurface brines. A Searles Lake project of Hooker Chemical Co., a subsidiary of Occidental Petroleum Co., was in progress for borax and other brine derivatives. A new borate operation of Tenneco Inc. went into production and made its first shipment of colemanite from an open pit near Ryan, Inyo County.

Table 5.—Principal custom mills, commercial grinding plants, and primary smelters in 1971

Company	County	Nearest city or town	Minerals processed	Remarks
Wilbur Ellis Co.....	Fresno.....	Fresno.....	Nonmetals...	Commercial grinding.
Standard Industrial Minerals, Inc.	Inyo.....	Bishop.....	...do.....	Do.
Calcite Corp.....	Kern.....	Rosamond.....	...do.....	Do.
American Minerals Co.....	Los Angeles.....	Los Angeles.....	...do.....	Do.
Industrial Minerals Co.....	Sacramento.....	Florin.....	...do.....	Do.
Kaiser Steel Corp.....	San Bernardino.....	Fontana.....	Iron ore.....	Blast furnaces, steel plants, and fabricating plants.
Pfizer Inc.....	...do.....	Victorville.....	Nonmetals...	Commercial grinding.
Western Talc Co.....	...do.....	Dunn.....	...do.....	Do.

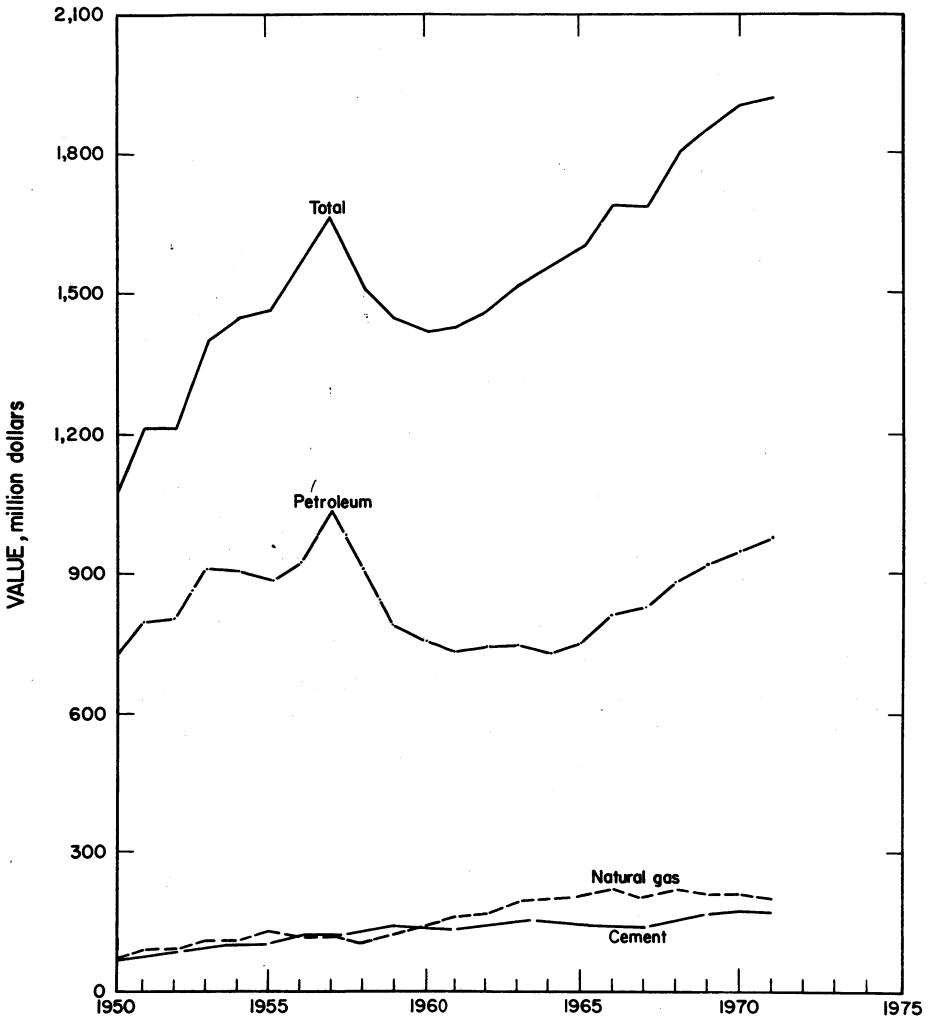


Figure 1.—Value of petroleum, natural gas, cement, and total value of mineral production in California.

Demand continued high for materials in the construction industry, including cement, clay and shale, dolomite, limestone, sand and gravel, and stone (crushed, broken, and dimension). Expansion was underway at several of the State's 14 cement plants. New equipment was installed at sand and gravel pits and stone quarries. New draglines permitted mining of sand and gravel below the water table. High-capacity, automated processing plants were under construction for sand and gravel, particularly in Los Angeles and Alameda Counties,

where demand for these materials was high. Gold mine dump and tailings materials were used increasingly for aggregate and road fill in localities where natural deposits were in short supply. Modernization and expansion were underway at several salt works, and desalination studies for water supply will lead to recovery of various salts.

Pit and quarry activity was extensive throughout the State. There were 81 clay-shale operations recorded in 30 counties; 424 active sand and gravel pits in all of

the 58 counties; and 320 stone quarries in all but a few counties.

Among the metals, principal mine production in terms of value of output was for ores and concentrates of iron, tungsten, rare-earth metals, and mercury. Iron ore and pellet shipments by Kaiser Steel Corp. were reduced substantially, owing to rail and dock strikes that adversely affected the export market. Late in the year, exports were discontinued. A new open pit and milling operation by Standard Slag Co. in San Bernardino County went into production; the concentrate will be shipped to Japan. Production at Kaiser's iron and steel works at Fontana, San Bernardino County, was the lowest since 1963. Tungsten production was at a reduced level at Union Carbide Corp.'s Pine Creek mine, Inyo County, owing to an extended labor strike during the year. Molybdenum Corp. of America reported increased sales of rare-earth concentrates from its operation at Mountain Pass, San Bernardino County. Mercury mining operations were further curtailed; a number of mines were closed, and others were worked at partial capacity. Declining prices and unfavorable environmental publicity were significant factors in the poor market for mercury. Output of several byproducts—copper, lead, molybdenum, zinc, gold and silver—was lower for the most part. The lead smelter of American Smelting and Refining Co. at Selby, Contra Costa County, was closed down at the first of the year, after 85 years of operation.

In the nuclear field, Gulf General Atomic Inc., San Diego, announced sales of its high-temperature, gas-cooled reactor (HTGR), which uses a thorium-uranium fuel and indicates a future demand for thorium. Several uranium-fueled nuclear power reactors were in various stages of planning and construction.

Operations with reduced impact on the environment were a major concern in the mineral industry, particularly for petroleum, asbestos, borax, cement, stone, sand and gravel, mercury, lead, and uranium (siting of nuclear power reactors). A phosphate rock project by United States Gypsum Co. in Los Padres National Forest, Ventura County, was delayed by environmental opposition, and a public hearing was pending.

Significant progress was made in geothermal power development during the year. A number of successful wells were completed. Development continued for large-scale power at The Geysers, Sonoma and Lake Counties, the only commercial geothermal power project in the United States. Other areas of California were under investigation for geothermal resources.

Legislation and Government Programs.²—A large number of bills and resolutions, affecting or related to the mineral industry, were passed by the California Legislature and became chapters of the California Statutes of 1971. In addition, numerous Government and private programs, also related to the mineral industry, were planned or underway. Major emphasis was on environmental activities. Principal legislation enacted and of concern to the mineral industry during the year is summarized as follows:

Assembly Bill (AB) 265.—Made changes in organization of State Air Resources Board; reduced number of members from 14 to five; fixed salary and working hours; required minimum of two regular meetings per month; authorized board to contract for technical advisory services or to appoint advisory groups and committees.

Senate Bill (SB) 658 (Chap. 1403).—Required hearing board of county or regional district to hold hearing on variances, allow public testimony, and consider such testimony in decisions; also allowed State Air Resources Board to revoke variance granted.

Assembly Joint Resolution (AJR) 10 (Res. Chap. 33).—Memorialized the Environmental Protection Agency to adopt the Ringelmann No. 2 test as standard for emissions from aircraft operated in California and for engines for which smoke control devices have been developed.

SB 578 (Chap. 1507).—Required Air Resources Board to establish standards for exhaust emissions and equipping automobiles, 1966–70 models, upon registration, with accredited exhaust emission control devices which have a useful life of 50,000 miles.

² Prepared largely from data provided by William H. Kerns, Bureau of Mines Assistant State Liaison Officer, Sacramento, Calif. Legislation and programs concerning a specific commodity are cited in the appropriate subsection of the Commodity Review section of this chapter.

SB 622.—Required Air Resources Board to set exhaust emission standards for older automobiles (1955–65 models).

AB 1315 (Chap. 1288).—Required offending party to take remedial action to correct a pollution or nuisance condition, upon order of regional board of State Water Resources Control Board; compliance may be enforced by injunction; of noncompliance, cleanup, abatement, or remedial work may be performed at liability of offender.

Senate Concurrent Resolution (SCR) 120 (Res. Chap. 223).—Requested State Water Resources Control Board study of effects of assessments for affluents or a water quality protection fee on waste water dischargers, or effect of permitting an effluent bonus.

SB 255 (Chap. 668).—Established liability, not to exceed \$6,000 per day, for violation of waste discharge requirement of State Water Resources Control Board.

SB 1285.—Directed Resources Agency to propose management plans for waterways along the State's northern coast.

AB 1860 (Chap. 1639).—Ruled a misdemeanor to place fill, extract materials, or make any substantial change in use of water, land or structure within area of jurisdiction of San Francisco Bay Conservation and Development Commission without securing permit from Commission.

SB 678 (Chap. 1518).—Extended authority and specified procedures, rights, remedies, and defenses of Attorney General for intervention or action on damages or threatened damages to environment or natural resources.

SB 1374 (Chap. 1152).—Established strong-motion instrumentation program and directed California Division of Mines and Geology to organize and monitor program with advice of appointed advisory board.

SB 1308 (Chap. 1624).—Added \$1 to automobile license fee for 1 year for funds in Statewide disposal of abandoned automobiles.

SCR 89 (Res. Chap. 189).—Requested California Division of Mines and Geology (CDMG), in concert with State Mining and Geology Board, to submit proposed legislation regarding State mined-lands reclamation and use plan.

Senate Joint Resolution (SJR) 33 (Res. Chap. 127).—Memorialized President and

Congress to support and enact legislation regarding mining claims, abandoned mine shafts, and other mining excavations on Federal lands.

SR 144.—Requested California Department of Conservation study and provide, on or before December 1, 1971, summary of current laws and regulations pertaining to hazardous abandoned or inactive mine workings and septic tanks, cesspools, wells, and other excavations.

Assembly Concurrent Resolution (ACR) 34 (Res. Chap. 71).—Created Joint Legislative Committee on Public Domain and prescribed its membership and powers regarding study of current and projected use of State lands and development of system of automatic inventory of these lands.

In the first actions seeking fines for air pollution violations, the State cited 12 separate charges—six in December 1970, five in January 1971, and one in February 1971—and asked damages of \$6,000 per violation. In January, the Bay Area Air Pollution Control District filed suit in Superior Court to close a roofing plant in San Leandro, Alameda County, until adjustments were made to curb smoke and oil emissions and sought civil penalties under a law allowing fines of \$500 per day for each alleged violation.

For the third consecutive year, the California Senate Transportation Committee endorsed legislation to outlaw the internal-combustion engine or other pollution-emitting engine, beginning in 1975.

A controversial "pollution initiative," titled Clean Environment Initiative Act, will appear on the State ballot in November 1972. It would (1) restrict use of pesticides, (2) limit lead content of gasoline, (3) authorize closing operations that violate air pollution standards, (4) place a 5-year moratorium on nuclear powerplant construction, (5) restrict tidelands oil and gas operations, (6) prohibit conflicting interests among enforcement officials, and (7) provide fines and sentences for violations.

In a report to the Governor and leading legislators in February, the State Environmental Study Council called for creation of an Environmental Quality Board to enforce compulsory annual inspection of automobiles and establish regulations on composition of gasolines. The Council called for

emphasized the need for immediate action on wide-ranging legislation concerning rising smog levels and other pollution problems in the State.

The Attorney General established a unit within his office to act on environmental violations in areas not covered by existing regulations, areas where these regulations were considered inadequate, and areas where assistance was requested.

Further evidence of the expansion of solid-waste recycling efforts in the San Francisco Bay Area was the announcement that the Nation's first recycling information center was scheduled to open on March 1 in San Francisco. The center was sponsored by four can manufacturers (American Can Co., Continental Can Co. Inc., National Can Corp., and Heekin Can Co.) and operated by the executive director of the California Anti-Litter League.

Early in the year, Kaiser Aluminum & Chemical Corp. announced extension of its aluminum can salvage, initiated as a Bay Area pilot program in 1970, to 26 cities from Kern County to Del Norte County. Fourteen million aluminum cans were recovered during the pilot program.

Strong pressures were developing that threatened existing regional quasi-governmental agencies concerned with environmental matters in the Bay Area. In April, the State Air Resources Board approved a plan to permit portions of Sonoma and Solano Counties to remain outside the six-county San Francisco Bay Area Pollution Control District, which by law they would be forced to join on July 1. At the same time, Sonoma County residents voted to withdraw from the Association of Bay Area Governments, a nine-county regional agency, owing mainly to different viewpoints from those of the four large, more populous counties (San Francisco, Alameda, San Mateo, and Santa Clara) on environmental problems.

In May, CDMG announced completion of its 28-sheet Geologic Atlas of California, at a scale of 1:250,000 (or 1 inch equal to 4 miles). This series, the fourth geologic map of the State published by CDMG and its predecessors, was a 20-year program; work on the first sheets began in 1952. The CDMG also was preparing a new multipurpose State geologic map at 1:750,000 as part of a joint Department of Housing and Urban Development (HUD)

—State planning study. This map emphasizes faults and volcanic phenomena. An accompanying Bouguer gravity map, at the same scale, also was in preparation.³

The HUD-State project, scheduled for completion by yearend 1971, was part of a State Development Planning Program of the State Office of Planning and Research. Early in the year, CDMG sought contractors to assist its own staff in preparation of a Statewide urban geological plan. It was pointed out that California is the fastest urbanizing State. Rural areas, such as farmlands, reclaimed lands, desert lands, and grazing and forest lands, are continually being transformed into urban areas. Because the State is subject to diverse geological hazards, including earthquakes, landslides, volcanic eruptions, subsidence, seismic sea waves, and accelerated erosion, all of which should be taken into consideration before construction begins, studies identifying existing or potential geologic problems in urbanizing areas, and investigations on these problems, were considered essential.⁴

Nearly \$500,000 was authorized under the Environmental Protection Program Fund for expansion of the Air Resources Board air quality monitoring equipment, a study of anticipated power demands over the next 20 years, and studies on agricultural burning.

The Board of Directors, Bay Area Pollution Control District, adopted a plan, effective September 1, which called for voluntary corrective actions when air pollutant concentrations exceed established standards.

In October, the Department of Parks and Recreation released the California Preservation and Recreation Plan. This Plan identified natural, historic, and recreational values along the coastline; recommended Federal, State, and local actions necessary for preserving coastline areas and enhancing recreational opportunities; outlined possible means of financing; and recommended preparation and administration of a comprehensive plan by a single coastal zone authority, incorporating local, regional, State, and Federal views.

A report of the Environmental Quality Study Council, published in February,

³ Bacon, F. California's Geologic Atlas Complete. Calif. Geol., v. 24, No. 6, June 1971, pp. 99-103.

⁴ New HUD-State Study. Calif. Geol., v. 24, No. 3, March 1971, p. 42.

a 2-year ban on coastline development to provide time for the preparation of planning and zoning regulations on future coastal development. The report also recommended creation of a State agency with authority to reject any State or local project that would degrade the environment.

Stringent new air pollution control laws that went into effect on November 5 caused more than 50 petitions to the Bay Area Air Pollution Control District for variances; only 27 such requests were submitted during the previous year. Among the companies seeking variances were Judson Steel Corp., Emeryville; Hein Brothers Rock Co., Petaluma; and Basalt Rock Co. for five plants in Napa, Santa Rosa, and San Rafael.

The State Water Resources Control Board amended the policy for controlling temperatures in California waters. It revised temperature standards for coastal and interstate waters, enclosed bays, and estuaries. The Board approved new regulations banning new discharges more than 20°F higher than the river, lake, bay, and coastal waters into which the effluent is discharged. The regulation did not require lower discharge temperatures from existing facilities.

The California Mining and Geology Board continued work on a State Mining Plan that would meet the requirements of the proposed Federal Mined Area Protection Act of 1971. If enacted into law, this plan would require the States to establish State plans within 2 years.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Carbon Black.—Output at four plants (three in Kern County and one on Contra Costa County) was nearly 3 percent lower in quantity, compared with that of 1970, but the value was 4 percent higher. Operators in Kern County were Ashland Chemical Co., Continental Carbon Co., and Cities Service Co. Shell Chemical Co. recovered a byproduct thermal-grade carbon black at Pittsburg, Contra Costa County, from a storage pond at a former ammonia plant.

Continental Energy Corp., Beverly Hills, Los Angeles County, reportedly received rights for use of a process to make carbon black and related chemicals from industrial and agricultural wastes. The company planned to build a new plant at Sacramento, scheduled for operation in 1972.⁷

Carbon Dioxide.—Standard Oil Co. of California produced carbon dioxide from natural gas at a slightly increased rate at the natural gasoline plant near Taft, Kern County. The carbon dioxide was used in the manufacture of dry ice.

Coal (Lignite).—Shipments of lignite by Interpace Corp., Alpo Div., increased more than 60 percent from the McGuire pit, Amador County. The lignite was used in the manufacture of montan wax.

Coke.—Kaiser Steel Corp. produced coke for use in company blast furnaces and coke breeze for use in the agglomerating plant at the Fontana steel works, San Ber-

nardino County. Consumption of these materials decreased substantially because of curtailed iron and steel production operations during the year.

Coking coal for Fontana was shipped largely from the York Canyon mine, New Mexico, and the Sunnyside mine, Utah.

A new cupola coke made from oil byproducts was developed by Republic Carbon Products Inc., Bakersfield, a subsidiary of American Metal Climax Inc. A pilot operation indicated a 12-percent increase in carbon content of iron and a reduction up to 15 percent in coke charge. Metallurgical coke production was scheduled to begin later in the year.

Geothermal Resources.—According to the California Division of Oil and Gas (CDOG), notices were filed for 14 development geothermal wells (13 in The Geysers field, Sonoma County, and one in the Salton Sea field, Imperial County) and five exploration wells (one in Imperial County, two in Lake County, and two in Mono County).

Geothermal development continued on schedule at The Geysers, which is operated jointly by Union Oil Co. of California, Magma Power Co., and Thermal Power Co. Ten wells were completed to production, one production well was abandoned, and four dry wells were drilled. Plans called for a new 110,000-kilowatt gener-

⁷ Wall Street Journal, V. 177, No. 116, June 16, 1971, p. 10.

ating plant each year during 1971-75. In 1975, capacity would be 600,000 kilowatts, sufficient to serve a city the size of San Francisco.

In August, Union Oil completed the world's largest known geothermal steam well in The Geysers field. The well produced 386,000 pounds of superheated steam per hour, equivalent to 20,000 kilowatts, from a depth of 3,036 to 4,438 feet. In August, the deepest geothermal well—more than 9,000 feet—was completed, producing 190,000 pounds of steam per hour.

Signal Oil and Gas Co. completed its seventh and most productive geothermal well in the Lake County portion of The Geysers field. The well tested at a rate of 210,000 pounds of steam per hour.

Pacific Energy Corp. completed two steam wells on its lease, also in The Geysers area. At yearend, this operator had five steam wells. The last well drilled flowed dry steam at a rate of 226,800 pounds per hour. The production interval was 5,925 to 7,150 feet.

Pacific Gas & Electric Co. (PG&E) completed powerplant No. 3, which contains geothermal turbine-generating units Nos. 5 and 6, each with a rated capacity of 55,000 kilowatts. This completion raised the generating capacity of The Geysers field to 192,000 kilowatts. Construction proceeded on powerplant No. 4 and generating units Nos. 7 and 8.

Condensate from the turbogenerators was disposed of by reinjection into nonproductive steam-bearing horizons of the field. Early in the year, about 700 gallons per minute was injected back into the field. The quantity was expected to increase as generating units were added by PG&E.

PG&E applied to the State Public Utilities Commission for permission to install an additional 220,000 kilowatts of generating capacity at The Geysers. A hearing was scheduled as a result of a California Supreme Court decision, which instructed the Commission to consider an antitrust challenge to the application by the Northern California Power Agency (NCPA), a group comprising 11 cities operating city-owned electrical systems. NCPA claimed that PG&E's contract with Union Oil Co. of California, Thermal Power Co., and Magma Power Co. (the three joint operators at The Geysers) was illegal because it barred the municipal power group from

tapping the geothermal plant for electricity.

In the Salton Sea field, Imperial County, Magma Power Co. filed notice for drilling a well, scheduled for early 1972. This company, in a joint venture with San Diego Gas & Electric Co., planned to drill several wells for the first closed-system, binary-cycle powerplant based on geothermal energy in the State. Preliminary exploration indicated a large resource, with hot brines and 25 percent solids. Studies were made on recovery of these salts, combined with a small-capacity geothermal powerplant.

A status report, entitled "Geothermal Resources Investigations, Imperial Valley, California," dated April 1971, was prepared by the U.S. Bureau of Reclamation. It outlines a program for exploration drilling at known anomaly sites on lands withdrawn by the Bureau, a steam production well, a pilot disposal well, and a long-range program for development of a geothermal field. Cooperation was planned with the Office of Saline Water, U.S. Department of the Interior, and with the University of California at Riverside. Late in the year, plans were finalized for a deep geothermal well on East Mesa, Imperial County. The project will test the feasibility of using geothermal heat for water desalination.

In Lake County, the Board of Supervisors granted approval for Eureka Magma Explorers to drill three wells on any of five proposed sites near Mount Konociti, an extinct volcano. The company drilled a dry well, 3,828 feet deep, on the southeast flank of the mountain. In December, the project was transferred to Getty Oil Co., which planned to extend drilling to 8,000 feet.⁵

Geothermal Resources Inc. (GRI) sold its holdings at The Geysers to Pacific Energy Corp. during the year. The sale included six producing wells.

In June, the Bureau of Land Management issued a first use permit for possible geothermal development to GRI for exploration drilling at a site near the south shore of Mono Lake, Mono County. GRI held leases from the State on several tracts in the lake bed and planned to slant-drill

⁵ California Department of Conservation, Division of Oil and Gas. Oil, Gas and Geothermal Production Statistics, 1971. 57th Annual Report of the State Oil and Gas Supervisor, v. 57, No. 2, 1971, pp. 8-13.

beneath the lake from the shore site. Under terms of the permit, GRI could not cause chemical or thermal pollution of the lake and environs, and the noise level could not exceed specified limits. The well was spudded in September, completed at 4,110 feet (vertical depth 4,056 feet), and abandoned as unsuccessful late in the year. The well log indicated a low temperature and thermal gradient.

Another well, drilled by Getty Oil Co. and Mono Power Co., a subsidiary of Southern California Edison Co., on State land on the northwest shore of the lake, was started in November and completed at 2,437 feet, with similar unsuccessful results. Despite these unfavorable results, the Mono Basin was considered a good prospect area for geothermal resources, owing to the presence of abundant water-saturated sediments, evidence of recent volcanism, thermal springs and steam vents, and ground-water temperatures above the mean ambient temperature.⁶

At the request of CDOG, Magma Power Co. abandoned a well, Mammoth 2, in the Casa Diablo field, Mono County. The well was drilled early in 1960's adjacent to a natural geyser, which had been inactive since the well was completed. Prior to abandonment, the well was erupting periodically through leaks in the casing, creating a safety hazard.

A number of programs and legislative bills concerning geothermal development were of interest during the year. SB 716, introduced on March 25, would amend Section 6908 of the California Public Resources Code relating to geothermal resources. It prohibited any person, association, or corporation from owning or controlling a direct or indirect interest in State geothermal permits exceeding 25,600 acres. The bill would allow pooling of acreage of two or more lessees, pursuant to a cooperative development plan approved by the State Lands Commission. On May 20, the bill was amended to require the unitization of acreage of two or more lessees, pursuant to a cooperative or unit development plan approved by the State Lands Commission. Such action would not be deemed to directly or indirectly increase the acreage of any lessee, pursuant to specific limitations. The amended bill passed the Senate Finance Committee with a do-

pass recommendation and was cleared for the third reading.

SB 834, introduced on March 31, would authorize the Geothermal Resources Board to conduct jointly with the Office of Saline Water, U.S. Department of the Interior, a design study for a pilot program to determine the most efficient and economic methods of producing electric power, mineral byproducts, and demineralized water from geothermal resources. It would appropriate \$100,000 (half from the General Fund and half from the Petroleum and Gas Fund) for the study.

AB 2162 (Chap. 1213) changed several sections of the California Public Resources Code concerned with the regulation of geothermal operations. It required the filing of geothermal well-drilling logs, tests, and surveys; authorized changing the specified districts for geothermal resource development; required approval of the State Oil and Gas Supervisor for geothermal well drilling; and authorized a program to drill shallow wells for geothermal observation purposes.

The CDOG established a Geothermal Unit to work with county authorities and planning commissions and provide them with information on geothermal resources, development, and regulations. County Governments played an increasingly important role in geothermal development. The CDOG also organized a short training course, entitled "Introduction to the Study of Geothermal Resources," held in the Sacramento area in December. The course included studies on known and probable geothermal resource areas throughout the world; geological, geochemical, and geophysical methods in mapping geothermal areas; and case histories of various exploration techniques in evaluating, developing, and utilizing geothermal resources.

A Geothermal Resources Council, involving also other Western States, was formed to encourage research, exploration, and development of geothermal resources, compatible with the natural environment.

On May 18, the Board of Supervisors of Imperial County passed what it described as the "most extensive and comprehensive set of county geothermal regulations to be adopted in California," setting forth terms,

⁶ Axtell, L. H. Mono Lake Geothermal Wells Abandoned. Calif. Geol., v. 25, No. 3, March 1972, pp. 66-67.

conditions, standards, and application procedures on initial geothermal development in the county.

On May 26, the Board of Supervisors of Lake County adopted minimum operating standards for geothermal developers. These standards were keyed to the county zoning ordinance and covered distance of a well from a populated area and dust, noise, and odor controls. It also specified safety and regulatory standards adopted by the State.

In response to the Geothermal Act of 1970, which was signed into law on December 24, 1970, the U.S. Department of the Interior designated 15 areas in California, totaling nearly 1.9 million acres, including 553,671 acres of Federal land, as "known geothermal resource areas" (KGRA). A detailed list of these lands was published in the Federal Register. Only Federal lands within a KGRA would be subject to lease by competitive bidding, when offered. In preparation for the first sale, draft environmental impact statements

for the leasing program were prepared, and public hearings were held in November. The first Federal lease sales were expected in 1972.

Natural Gas.—The net (gross withdrawals less quantities used for repressuring, vented, or flared) marketed production of natural gas declined 5.6 percent in 1971, compared with that of 1970. The State accounted for 2.7 percent of U.S. marketed output and ranked sixth in the Nation. According to CDOG, State onshore and offshore output of dry gas exceeded that of oilfield gas for the first time in the State's history, mainly because of increased output from the northern gasfields. Offshore, in State waters, more gas was derived from oilfields than from dry gasfields, of which there were only five fields or zones active in 1971. State offshore gas production was 22 percent below the 1970 rate. In the Federal Outer Continental Shelf (OCS), output more than doubled, compared with the estimated output for 1970.

Table 6.—Oil and gas salient statistics

	1970	1971	
Production:			
Crude oil:			
Quantity.....	thousand 42-gallon barrels...	372,191	358,484
Value.....	thousands.....	\$945,365	\$975,076
Daily rate.....	thousand 42-gallon barrels.....	1,020	982
Price, average.....	per barrel.....	\$2.54	\$2.72
Natural gas, marketed:			
Quantity, net.....	million cubic feet.....	649,117	612,629
Value.....	thousands.....	\$208,367	\$199,717
Price at wellhead, average.....	per thousand cubic feet.....	\$.321	\$.326
Natural gas liquids:			
Quantity.....	thousand 42-gallon barrels.....	19,044	17,800
Value.....	thousands.....	\$54,484	\$52,027
Price, average.....	per barrel.....	\$2.86	\$2.92
Operating companies.....		842	806
Producing wells:			
Oilfield (average).....		40,811	40,406
Gasfield (maximum).....		1,089	1,068
Total.....		41,900	41,474
At yearend.....		40,437	39,668
Exploration and development:			
Well completions:			
Exploration:			
Oil.....		34	21
Gas.....		8	5
Dry.....		220	194
Development: ¹			
Oil.....		1,731	1,438
Gas.....		48	55
Dry.....		120	92
Total.....		2,161	1,805
Footage.....	thousands.....	6,672	4,997
Refineries:			
Operating (yearend).....		35	35
Crude oil throughput capacity (operating).....	thousand 42-gallon barrels per day.....	1,702	1,733
Gasoline output capacity (operating).....	do.....	966	1,018

¹ Includes service wells.

Sources: California Department of Conservation, Division of Oil and Gas; Conservation Committee of California Oil Producers; American Petroleum Institute; and Federal Bureau of Mines.

Exploration and development drilling for natural gas showed a slight increase in 1971. No new gasfields were discovered, but there were five successful exploration wells in new zones and in extensions to existing fields.

The CDOG reported an increase in gas storage from 125.2 billion cubic feet at yearend 1970 to 136.3 billion cubic feet at yearend 1971. Total storage capacity was 290 billion cubic feet in six reservoirs.

The State Public Utilities Commission projected natural gas annual consumption in excess of 2,600 billion cubic feet in 1977. The 1971 consumption rate was estimated at 1,947 billion cubic feet. In a report to the State Legislature, the Commission indicated that projected demand for Southern California cannot be met from existing sources and that supply for electricity generation and other nonresidential uses would have to be reduced. During the past 10 years, three-fourths of the supply for the gas utility companies was provided from out-of-State sources, which, however, were in increasingly tight supply. The utility companies were seeking new sources of supply in Canada and imported liquefied natural gas.⁸

According to the American Gas Association, reserves of natural gas were reduced more than 9 percent, compared with those at the first of the year. Estimated reserves at yearend, in billion cubic feet, were distributed as follows: Associated gas, 3,175; dry gas, 2,342; and underground storage, 212.

Natural Gas Liquids.—Output of natural gas liquids, including condensate and liquefied petroleum gas (LPG), were lower by 6.5 percent in quantity and 4.5 percent in value, compared with 1970 output. These natural gas liquids were produced in seven counties, the leading of which was Kern County. According to CDOG, condensate production from dry gasfields, onshore and in State waters, was 380,401 barrels.

Peat.—Production of peat by three companies—two in Contra Costa County and one in Orange County—increased 19 percent in quantity and 23 percent in value, compared with that of 1970. Eighty percent of the quantity shipped was unprepared peat; 20 percent was shredded peat. The materials were used for soil improvement.

Petroleum.—*Production.*—In 1971 Cali-

fornia accounted for 10.4 percent of total U.S. output of crude oil and ranked third, following Texas and Louisiana. Continuing a downward trend that started in 1969, output in 1971 decreased 3.7 percent in quantity compared with that of 1970, although value was increased because of a higher average price per barrel. The average daily rate was 982,000 barrels, below 1 million barrels for the first time since 1967, and had decreased to 949,000 barrels at yearend. The declining rate of production was attributed to the continuing attrition of wells reaching their economic limit and the lack of success in locating new oil pools, both onshore and offshore. Many small, marginal wells were shut-in. According to the Conservation Committee of California Oil Producers (CCCOP), there were 1,197 abandonments, compared with 946 in 1970, and 549 wells shut-in as uneconomic during 1971.

The principal producing onshore fields were the Wilmington, Midway Sunset, Kern River, and Huntington Beach, which together accounted for 41 percent of the total output of crude oil. Approximately 73 million barrels was produced at Wilmington, an 11 percent decrease from that of 1970, owing to a temporary production curtailment in high water-bearing wells. Water disposal in the harbor was no longer permitted by the Los Angeles Regional Water Quality Control Board, and there were insufficient water disposal wells.

Of total 1971 output, 71.6 percent was from onshore oilfields; 19.8 percent was from State offshore properties; and 8.6 percent was from OCS. The CCCOP reported that offshore output (State and OCS) averaged 278,700 barrels per day, including 193,500 barrels per day from 17 oilfields in State leases and grants, and 85,200 barrels per day from three Federal leases in the OCS. According to CDOG, curtailment of drilling continued in the State tidelands areas. This curtailment was ordered by the State Lands Commission in early 1969 when a well of Union Oil Co. of California blew out in Federal waters of the Santa Barbara Channel.

The largest offshore oilfield was the Wilmington, East Area, operated as the Long Beach Unit (State, 85 percent; City of Long Beach, 15 percent). The CDOG re-

⁸ Oil and Gas Journal. V. 69, No. 25, June 21, 1971, p. 96.

Table 7.—Production of crude petroleum and natural gas (marketed) in 1971, by county

County	Number of producing wells		Production		
	Oil (average)	Dry gas (maximum)	Petroleum (thousand barrels)	Natural gas (marketed)	
				Oil zones (Million cubic feet)	Dry gas zones (Million cubic feet)
Alameda	6	--	113	--	--
Butte	--	25	--	--	5,173
Colusa	--	93	--	--	10,340
Contra Costa	44	59	¹ 363	2,546	14,171
Fresno	2,688	2	14,804	13,088	609
Glenn	--	104	--	--	13,331
Humboldt	--	23	--	--	2,595
Kern	21,362	66	113,900	107,640	3,435
Kings	157	14	467	11,591	1,301
Los Angeles	6,822	4	109,018	79,575	266
Madera	--	21	--	--	3,108
Monterey	963	--	10,068	1,229	--
Orange	3,490	--	33,416	12,546	--
Riverside	13	5	70	12	382
Sacramento	--	118	¹ 23	--	43,169
San Benito	26	--	67	46	--
San Bernardino	37	--	470	260	--
San Joaquin	--	97	--	--	42,322
San Luis Obispo	193	--	2,051	1,375	--
San Mateo	10	--	18	1	--
Santa Barbara	1,605	13	19,221	30,135	18,237
Solano	--	178	¹ 134	--	85,291
Sonoma	--	7	--	--	19
Sutter	--	143	--	--	37,566
Tehama	--	41	--	--	4,467
Tulare	24	17	43	--	1,366
Ventura	2,758	3	23,579	31,198	316
Yolo	--	35	--	--	5,741
Other: Federal offshore	208	--	31,101	17,856	(?)
Total	40,406	1,068	¹ 358,926	309,098	293,255

¹ Includes field condensate.

² Included in estimate for Federal offshore oil zones.

Source: California Department of Conservation, Division of Oil and Gas.

ported offshore Wilmington production at about 140,000 barrels per day from 984 active wells. The contractor in the east area was THUMS Long Beach Co. (THUMS), a consortium of Texaco Inc., Humble Oil & Refining Co., Union Oil Co., Mobil Oil Corp., and Shell Oil Co. In October, the city of Long Beach received more than \$3 million, representing the first monthly payment under a contract to develop the city's offshore oil. The consortium had recovered a \$350 million investment in development of the offshore extension of the Wilmington oilfield and \$75 million paid in advanced royalties to the City and the State. Thereafter, 95.56 percent of net profits, estimated at \$4 million monthly, would be paid to the City (8.56 percent) and State (87 percent).

Exploration and Development.—Compared with the 1970 rate, total exploration and development drilling was lower by nearly 16.5 percent in number of wells and by 25 percent in footage drilled, according to data provided by the American Petro-

leum Institute. The number of new producing oil wells was 1,459, compared with 1,765 in 1970. In wildcat drilling, CCCOP reported discovery of three new fields, none of which was considered major, and the drilling of 86 dry holes. Reductions in drilling activities were attributed to the continuing moratorium on drilling in the Santa Barbara Channel, political and economic uncertainties in the industry, and the shift of company efforts to other States and overseas, where prospects were considered more favorable. New development drilling was insufficient to offset normal decline in yield of some wells. The CDOG reported 2,166 notices to drill new wells in 1971 (2,033 in 1970), filed with the State Oil and Gas Supervisor, including 168 notices for State offshore drilling (exclusive of OCS).

In April, Santa Fe Minerals Inc., a subsidiary of Santa Fe International Corp., announced a fault-block oil discovery at 2,568 to 2,638 feet in a wildcat well in Riverside County. In late August, McCulloch Oil

Table 8.—Offshore oil and gas production in 1971, by field ¹

Field or area	Number of producing wells	Production	
		Oil (thousand barrels)	Gas (million cubic feet)
State:			
Alegria.....	1	60	180
Belmont: Oil zone.....	82	2,821	716
Caliente: Gas zone.....	1	--	2,115
Carpinteria.....	56	1,934	1,498
Coal Oil Point.....	3	51	121
Conception.....	20	347	274
Cuarta:			
Oil zone.....	2	* 3	14
Gas zone.....	2	--	102
Elwood.....	14	94	369
Elwood, South.....	11	662	765
Gaviota: Gas zone.....	3	--	2,080
Huntington Beach.....	372	11,589	2,995
Molino: Gas zone.....	7	--	13,939
Montalvo, West.....	5	112	--
Newport.....	15	149	36
Point Conception.....	3	96	49
Rincon.....	90	689	476
Summerland.....	22	651	3,363
Torrance.....	10	72	74
Venice Beach.....	4	194	83
Wilmington.....	984	51,099	16,528
Total.....	1,707	70,623	45,777
Federal:			
Carpinteria.....	52	3,348	2,369
Dos Cuadras.....	156	27,753	15,487
Total.....	208	31,101	17,856
Grand total.....	1,915	101,724	63,633

¹ Includes production from offshore portions of onshore fields.

² Includes condensate from dry gas zone.

Source: California Dept. of Conservation, Division of Oil and Gas.

Corp. struck oil in a wildcat well, 5 miles northeast of the prolific Kettleman North Dome field, Kings County. The well was completed at 14,338 feet. A high-pressure flow of oil was reported. The discovery started a vigorous lease play, and 143,000 acres were taken up by both major and independent oil companies. Late in the year, the well flowed 1,000 barrels in a 6-hour test.⁹

In November, a new oil area was discovered by Argo Petroleum Corp. in a deep zone of the Silverthread field, Ventura County, the oldest oilfield in the State. The discovery, at 5,400 feet, called attention to potential for deep drilling in the area.¹⁰

The CDOG reported the drilling of an exploration well in San Joaquin County, which established a depth record for northern California. The well, completed at 16,350 feet, was unsuccessful and was abandoned.

In offshore OCS operations, CCCOP reported development drilling on several parcels in the Santa Barbara Channel. A

total of 37 new wells were completed. However, failure to secure permits for additional platforms resulted in reduced drilling by yearend, and production started a decline. There was also a resumption of exploration drilling on 14 leases in the Channel, following a Department of the Interior environmental impact statement filed with the Council on Environmental Quality. These Federal leases were not included in 35 leases, cancellation of which was recommended to the Congress.¹¹ At yearend, the drilling phase was nearly completed at the large Dos Cuadras field in the Channel. Sun Oil Co. was drilling the 42d and final well from one of three platforms used to develop the field. Earlier in the year, Union Oil Co. completed its drilling program of 80 wells

⁹ Oil and Gas Journal. California Find Might Launch Deep Play. V. 69, No. 36, Sept. 6, 1971, pp. 60-61.

¹⁰ Oil and Gas Journal. Deep Find Revives California's Oldest Oil Field. V. 69, No. 51, Dec. 20, 1971, p. 37.

¹¹ Oil and Gas Journal. Wildcatting Approved for 14 Channel Leases. V. 69, No. 31, Aug. 2, 1971, p. 45.

Table 9.—Oil and gas well drilling completions in 1971, by county

County	Development wells ¹			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Alameda	1	--	2	--	--	--	3	3,838
Butte	--	3	2	--	--	2	2	7,902
Colusa	--	3	2	--	1	6	12	95,777
Contra Costa	1	2	2	--	--	13	18	107,949
Fresno	114	1	9	1	--	9	134	293,982
Glenn	--	9	--	--	--	6	15	77,806
Humboldt	--	4	--	--	--	1	5	27,785
Kern	903	4	38	6	--	43	994	1,730,153
Kings	--	6	4	1	--	3	14	57,599
Los Angeles:								
Onshore	62	--	4	1	--	7	74	300,353
Offshore ²	19	--	--	--	--	--	19	47,755
Madera	--	2	--	--	--	1	3	17,800
Merced	--	--	--	--	--	2	2	13,172
Monterey	52	--	--	--	--	10	62	150,630
Orange:								
Onshore	64	--	--	--	--	1	65	127,849
Offshore ²	4	--	2	--	--	--	6	25,756
Riverside	6	--	--	--	--	2	8	29,735
Sacramento	--	2	4	--	--	3	9	59,027
San Benito	1	--	--	--	--	1	2	8,436
San Bernardino	5	--	--	1	--	7	13	41,676
San Joaquin	--	4	2	--	--	13	24	170,811
San Luis Obispo	10	--	--	--	--	3	13	30,084
San Mateo	--	--	--	--	--	1	1	1,994
Santa Barbara	102	--	1	3	--	5	111	443,906
Solano	--	9	10	--	--	8	27	185,835
Stanislaus	--	--	--	--	--	2	2	19,856
Sutter	--	4	1	--	1	2	8	46,994
Tehama	--	--	--	--	1	2	3	10,887
Tulare	--	2	2	--	--	2	6	16,598
Ventura	64	--	5	7	--	10	86	478,977
Yolo	1	3	4	--	2	10	19	96,665
Other: Federal offshore	30	--	--	1	--	14	45	269,543
Total	1,438	55	92	21	5	194	1,805	4,997,130

¹ As defined by American Petroleum Institute.² State leases.

Principal Source: American Petroleum Institute.

from two platforms. A permit for a third platform was denied.

In secondary recovery operations, CCCOP reported 9,695 wells treated by steam injection in 1971. These projects were mainly in old, shallow, heavy-oil fields in the San Joaquin Valley and the Coastal districts. Greater emphasis was placed on steam drive pattern flooding with continuous injection rather than steam cycling. It was estimated that thermal recovery added 150,000 barrels per day from 19,000 wells during the year. The CCCOP also reported 19 active gas injection projects, mainly in the San Joaquin Valley, and 187 water flood projects, including 11 new starts, mainly in the Los Angeles region, the San Joaquin Valley, and the Coastal districts. At East Wilmington, water injection continued in excess of 1 million barrels per day. Other water projects were in the pilot or planning stage. Unitization and cooperative projects were planned for the Los Angeles region.

Total secondary recovery projects were

distributed as follows, in percentage of development wells drilled: San Joaquin Valley, 68.5; Coastal districts (onshore), 14.8; Los Angeles Basin, 8.9; Northern California (gas), 4.3; and offshore (State and OCS), 3.5.¹²

Reserves.—Crude oil reserves, at year-end, were 7 percent (278,000 barrels) lower than those of a year earlier, according to the American Petroleum Institute. Newly developed reserves of only 80.2 million barrels were insufficient to offset production during the year, resulting in a substantial reduction in reserves.

Refineries.—As of yearend 1971, refineries in California had 13 percent of total U.S. throughput capacity and 15 percent of U.S. gasoline output capacity.

At yearend, construction was underway for expansion of throughput capacity by 5,000 barrels per day at the refinery of San Joaquin Oil Co. at Oildale.

¹² Higgins, J. W. Developments in West Coast Area in 1971. AAPG Bull., v. 56, No. 7, July 1972, pp. 1205-1215.

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

Commodity	Proved reserves Dec. 31, 1970	Changes in proved reserves due to extensions and discoveries in 1971	Proved reserves Dec. 31, 1971 (production deducted)	Changes from 1970 (percent)
Crude oil.....thousand barrels..	3,983,986	80,187	3,705,750	-7.0
Natural gas liquids.....do.....	170,184	(2,344)	151,091	-11.2
Natural gas.....million cubic feet..	6,299,759	19,091	5,729,499	-9.1

Sources: American Petroleum Institute and American Gas Association.

Edgington Oil Co., Long Beach, announced plans to add 15,000 barrels per day of throughput capacity at its Long Beach refinery, approximately doubling the existing capacity.

Union Oil Co. of California dedicated its new \$85 million uncracker-reformer complex at Rodeo, Contra Costa County, in September. The uncracker would allow production of 120 gallons of high-quality gasoline and jet fuel from 100 gallons of petroleum stock of lesser value; the reformer would increase the octane rating of gasoline. Another unit would improve the burning characteristics of the jet fuel, reducing exhaust pollutants. Other new facilities included two smokeless flare systems, a sulfur recovery plant, a rebuilt sulfur recovery unit, and a number of oil storage tanks with floating roofs to prevent loss of vapors in the air.

The following legislation governing oil spills and other petroleum matters was enacted in 1971:

SCR 24 (Res. Chap. 162).—Directed California Resources Agency to develop program to provide equipment for cleanup in coastal and inland waters, and cleanup service where needed.

AJR 46 (Res. Chap. 185).—Memorialized the President to assign emergency task forces specializing in oil pollution prevention to principal ports in State.

AJR 47 (Res. Chap. 186).—Requested President and U.S. Coast Guard to assign the next nucleus strike force team, established by Coast Guard, to West Coast.

AB 362 (Chap. 1763).—Imposed liability on vessel owner or operator for damage or injury to natural resources, caused by discharge or leakage of oil in navigable waters of State.

SJR 10 (Res. Chap. 59).—Memorialized President and Congress to enact "Ports and Water Ways Safety Act of 1971" for pro-

tection against accidents that cause oil spills.

AJR 110-114 inclusive (Res. Chaps. 204-206, 217, and 227).—Provided for State depository for data on oil spills, review of requirements and prevention measures around storage and transfer facilities, study of feasibility of creating forces and equipment for effective containment and abatement of oil spills, and citizen volunteer force in oil spill contingency plans; and urged cities and counties to formulate contingency plans for spills of oil and other hazardous materials.

SB 58 (Chap. 522).—Required California Resources Agency to contract for study of oil leaks in Santa Barbara Channel, including those from natural causes; \$50,000 was appropriated from Environmental Protection Program Fund.

SB 287 (Chap. 221).—Excluded State-owned tide and submerged lands in a 3-mile area surrounding Islands of Anacapa, Santa Cruz, Santa Rosa, and San Miguel from leasing by the State Lands Commission for oil and gas extraction.

SB 560 (Chap. 525).—Deleted oil and gas district boundary descriptions and authorized Director of Conservation to fix such boundaries.

SB 1327 (Chap. 1586).—Established procedures by which action may be brought to terminate all or part of right-of-entry or occupation in certain lands encumbered by mining rights lease, including community lease, for production of oil, gas, or other hydrocarbons.

SB 1326.—Required oil and gas production, in certain circumstances, be conducted on tracts of land, as defined under specified unit agreement approved by State Oil and Gas Supervisor; required Supervisor to adopt or amend, with approval of Director of Conservation, regulations gov-

erning matters relative to unit agreements and unit operations.

In other legislation, the depletion allowance was reduced from 27½ percent to 22 percent in accordance with Federal law.

A study was underway in CDOG to identify onshore oil and gas seeps. A report on offshore seeps was published.¹³ Another CDOG project was in locating and eliminating old, abandoned oil well sumps and general oilfield cleanup throughout the State, in cooperation with industry. Policies and guidelines were formulated to insure operations with minimal impact on the environment. An operating company in the Cat Canyon field, Santa Barbara County, planned new well sites to avoid tree removal and used drilling sands for road surfacing and repair. The CDOG reported no significant oil spills resulting from drilling or production operations during the year. A total of 103 spills were from ship traffic. Two major incidents involved a collision of two tankers in San Francisco Bay and the U.S. Navy refueling off the coast.¹⁴

In offshore State waters, the moratorium continued on drilling and, early in the year, was extended to geophysical work.¹⁵

According to a report prepared by the Resources Agency of California, entitled "The Offshore Petroleum Resource," the Continental Shelf of California to a depth of 1,200 feet has a potential of 5.72 billion barrels of crude oil. If the moratorium on new drilling was terminated and exploration and production permitted on 135 existing State leases, an additional \$258 million in royalties would accrue to the Government. If existing leases were terminated, the economic loss would be great in taxes, salaries, benefits to local communities, and possible liability for lease cancellations. The report also concluded that the chances for an oil spill would be substantially greater from imports by tanker than from offshore operations, if these operations were terminated. Reserves were estimated at 1 billion barrels of oil and 1.1 trillion cubic feet of gas.¹⁶

In OCS, Federal policies restricted drilling and prohibited further lease sales. Early in the year, the U.S. Department of the Interior retroactively applied the National Environmental Policy Act of 1969 to leases issued in 1968 for tracts in the Santa Barbara Channel. Approval was withheld

on 41 drilling permits, pending environmental clearance. Wildcatting on untested tracts was suspended, although development drilling continued from fixed platforms. In April, a federal bill sought termination of 35 leases in the Channel, which would stop time running on 5-year leases that had been granted.¹⁷ In May, Interior drafted an environmental impact statement and proposed approval for two drilling and production platforms to complete development of the Dos Cuadras and Carpenteria fields.

In March the Los Angeles City Planning Commission rejected a proposal by a City Councilman calling for termination of oil production operations in the city within 10 years. The Commission ruled that (1) oil production activities, when conducted in accordance with established regulations, do not pose an inordinate threat to urban development, and (2) oil production equipment does not present an undue fire or safety hazard when utilized in conformance with specified standards set forth in city and State laws and ordinances.

West coast oil companies were creating new, regional organizations to combat and clean up oil spills promptly. In the San Francisco Bay Area, the group was to be known as Clean Bay, Inc., covering the entire Bay and an indefinite area outside the Bay. Funds would be reimbursed by the five member companies: Standard Oil Co. of California, Union Oil Co. of California, Shell Oil Co., Humble Oil & Refining Co., and Sequoia Oil Co., a subsidiary of Gulf Oil Corp.

Another California-based nonprofit group, Clean Seas Inc., was a 14-firm operation based in Santa Barbara and functioning with a board of directors and an initial annual budget of \$250,000.

Petroleum Industry Coastal Emergency

¹³ Wilkinson, Elbert R. California Offshore Oil and Gas Seeps. Fifty-Seventh Annual Report of the State Oil and Gas Supervisor, California Department of Conservation, Division of Oil and Gas. V. 57, No. 1, 1972, pp. 5-28.

¹⁴ California Department of Conservation, Division of Oil and Gas. Oil, Gas, and Geothermal Production Statistics, 1971. Fifty-seventh Annual Report of the State Oil and Gas Supervisor, v. 57, No. 2, 1972, pp. 6-8.

¹⁵ Oil and Gas Journal. California Channel Ban Now Includes All Geophysical Work. V. 69, No. 19, May 10, 1971, p. 36.

¹⁶ Offshore. California County Files Charges Because of Oil Spill in San Francisco Bay. V. 31, No. 10, September 1971, p. 29.

¹⁷ Oil and Gas Journal. Termination of 35 Channel Leases Sought. V. 69, No. 17, Apr. 26, 1971, p. 46.

Cooperative (PICE) was to operate in the Los Angeles-Long Beach and San Diego areas. Other cooperatives would cover the States of Washington and Oregon. The Western Oil and Gas Association, with headquarters in Los Angeles, was to act as informal coordinator of the groups.

Clean Bay Inc. hired a full-time manager, who was on loan from Standard Oil Co. of California and was in charge of cleanup operations after a tanker oil spill in January. Priority programs included an inventory of available equipment in the area, development of emergency contracts, plans to include the services of wildlife agencies and volunteer organizations, and participation of new members.

Clean Seas Inc. hired a full-time executive vice president, a former district superintendent of Standard Oil Co. of California. The group planned to acquire equipment, train personnel, and develop operational plans. As of August, there were 15 member firms, including all the major oil companies. Territorial limits extended from Estero Bay, opposite San Luis Obispo, southward to Point Dume, south of Oxnard.

PICE operated informally during the year. The chairman was a refinery engineer for Union Oil Co. of California. The group planned to hire a full-time manager with headquarters in the Los Angeles-Long Beach Harbor area and would rely on arrangements with local cleanup contractors and members for equipment. In midyear there were 13 member companies, excluding the THUMS group, operator of the Wilmington field, which had not received approval to participate from the State Government and the City of Long Beach. Territorial limits extended from Point Dune south to the Mexican border. The San Diego unit, composed of several members of the Los Angeles group, would police a territory from Newport Beach to the Mexican border. In the event of an oil spill, the company responsible for the spill was to direct cleanup operations; if the responsible company were unidentified, the member companies would operate under the direction of the U.S. Coast Guard commander in charge.

Union Oil Co. of California reported development of a process for recovery of the small quantities of sulfur in waste gases from primary sulfur-recovery units, thereby

reducing pollution from refineries. In a pilot plant test at its Los Angeles refinery, 99.9 percent of the available sulfur was recovered, compared with 95 percent by former methods. Union Oil planned to install equipment for the new process at the Los Angeles refinery at an estimated cost of \$6 million. The company also was constructing a \$1.3 million air flotation and flocculation plant at its refinery in the San Francisco Bay area. This equipment would treat waste water from its API oil-water separator to remove most of the remaining traces of oil and solids before the water was discharged in the bay.

A total of 172 General Services Administration (GSA) vehicles in California were converted to dual use of gasoline and clean-burning, low-polluting liquid natural gas. The purpose was to demonstrate the practicality of the dual system for fleet operations.

Signal Oil and Gas Co. received an Engineering Merit Award from the Institute for the Advancement of Engineering for developing an oilfield in metropolitan Los Angeles with minimum disruption to the community through directional drilling, rigid sound and vibration control, and extensive screening and camouflage.

NONMETALS

Asbestos.—California continued as the nation's leading producer of asbestos, accounting for two-thirds of total U.S. output. Shipments, valued at \$7.8 million in 1971, increased 10 percent in quantity, compared with 1970. There were four producers in three counties. Pacific Asbestos Corp.'s, Pacific mine, Calaveras County, was the leading producer. Active mines in Fresno County were the Santa Cruz mine of Atlas Asbestos Co. and the Coalinga mine of Coalinga Asbestos Co., a subsidiary of Johns-Manville Corp. In San Benito County, Union Carbide Corp. produced asbestos at the Santa Rita mine. All mines were open pit and produced chrysotile asbestos, mainly of short fiber.

Pacific Asbestos Corp. completed a core-drilling program on its 480-acre property. Core log data were integrated into a computer program, which would determine future pit design. The exploration indicated a tabular ore body 1,800 feet long and 400 feet wide, with ore reserves of 12 million tons. The company had 185 workers at the

Pacific mine and mill. The production goal for 1971 was 30,000 tons of fiber from 1 million tons of ore. The chrysotile occurs in cross-fiber seams and veinlets in serpentine. The fibers are generally one-sixteenth inch to one-fourth inch in length, and up to 1 inch in length in occasional high-grade pockets. The milling process involved jaw crushers and impact crushers, which separate fiber from the host rock with minimum damage to fiber length. The ore is broken down in stages, and fibers are removed by forced air "floating" of the lightweight fraction and air suction at each stage. The company planned to install a wet-milling pilot plant for better recovery of the short fibers. The product was pressure-packed in 100-pound bags. Four grades (groups 4 to 7), valued at \$46 per ton (group 7) to \$212 per ton (group 4), were shipped. The chief overseas markets were in India and Southeast Asia. The largest volume domestic buyer was Johns-Manville Corp. for use in asbestos-cement pipe at a plant in Stockton, Calif.

In June, Pacific Asbestos completed installation of numerous dust abatement devices in the primary crushing plant. A sprinkler system was planned to prevent asbestos-laden fine material from being blown from the large tailing area.

In the Coalinga district, 20 miles northwest of Coalinga in the southern Coast Ranges, the asbestos deposit is one of the world's largest; reserves are estimated at more than 100 million tons of asbestos-bearing material. The chrysotile content is generally high, often more than 50 percent, although of short fiber. Mining is seasonal, April to December, and terminated during the rainy season. The mill was operated on a year-round basis. Most of the company's product was used in floor tile.

Union Carbide employed wet-process treatment in producing a short-fiber concentrate at its mill in Monterey City.

An extensive exploration project for asbestos was underway by American Smelting and Refining Co. in the Klamath Mountains of northern California. All known prospects in the region were being examined and drilled. Favorable host rocks (serpentine and peridotite) are widely distributed in the region.

In August, Minorex Ltd., the exploration subsidiary of Asbestos Corp. Ltd., the

second largest producer of asbestos in the world, completed an exploration drilling program on the Stark claims, 2 miles northwest of Washington, Nevada County. Minorex completed 1,500 to 1,600 feet by air-rotary methods. In addition, 800 feet of core were taken on a group of four lode claims, named the "Poor Man's Canyon" claims. Preliminary evidence indicated ore reserves of 2 million tons, although it was estimated that 10 million to 20 million tons would be required for an economically viable operation at prevailing market prices.

Demand for asbestos throughout California was based on products that utilize the short-fiber grades available in abundance within the State.

Assembly Bill 314 (Chap. 382), enacted during the year, required that asbestos-containing materials used in air-duct systems be overcoated with a sealant adequate to preclude erosion of asbestos fibers.

Barite.—Yuba Minerals and Milling Co., which operated the Castella mine, Shasta County, continued as the only producer of primary barite. Production was at a slightly reduced rate, compared with that of 1970. Exploration and development work was conducted at the Leviathon and Silver Bow mines, near Barstow, San Bernardino County.

Crushed and ground barite was marketed by five companies, largely from high-grade crude material mined in Nevada. The relatively low cost of the crude barite compensated in part for the high transportation costs to processing facilities in California. Estimated consumption of processed material was 44,000 tons valued at \$1,277,000, a slight reduction in quantity but a 30-percent increase in value, compared with that of 1970. Uses, in order of decreasing sales, were in chemicals, oil-well drilling mud, glass, filler or extender, and miscellaneous. Inorganic Chemicals Division, FMC Corp., Stanislaus County, was the only supplier of barium chemicals from its Modesto plant. Barite for well drilling mud was supplied by Wilbur Ellis Co., Fresno plant, Fresno County; Calada Materials Co., Harbor City plant, Los Angeles County; Yuba Minerals and Milling Co., Castella plant, Shasta County; and Industrial Minerals Co., Florin plant, Sacramento County. Industrial Minerals also

supplied barite for use in glass, fillers and extenders, and miscellaneous applications.

Calcite Corp., Rosamond, Kern County, purchased a grinding plant, formerly owned by Pacific Paramount Co., for processing barite and other nonmetallic minerals.

Boron Minerals and Compounds.—Output was in excess of 1 million tons per year and valued at \$89.9 million, a rate similar to that of 1970. Total U.S. production came from four operations at three locations in California: United States Borax & Chemical Corp. at Boron, Kern County; Kerr-McGee Chemical Corp. and Stauffer Chemical Co. at Searles Lake, San Bernardino County; and Tenneco Inc., near Ryan, Inyo County.

United States Borax & Chemical Corp., a subsidiary of Rio Tinto-Zinc Corp. and associated with Borax Holdings Ltd., continued as the leading producer in the State. A variety of sodium and calcium borates in bedded deposits were mined by open pit from a depth of 1,000 feet, with ore haulage by a 1,300-foot inclined conveyor. The principal products at the concentrating and refining plants were Rasorite 46 (borax pentahydrate), Rasorite 65 (anhydrous borax), and anhydrous boric acid. Dust emissions at the refinery were reduced 90 percent during the past 3 years at a cost of \$10 million, and the company planned additional dust-control equipment.

U.S. Borax also produced boric acid and specialty products (elemental boron, refined borax, ammonium borates, soap products, preservatives, herbicides, and plant food) at its processing plant and shipping-storage port at Wilmington, Los Angeles County. Crude products from Boron were exported to Borax Holdings Ltd. refineries and other foreign destinations, particularly Western Europe, Japan, and Latin America.

At Searles Lake, Kerr-McGee Chemical Corp. and Stauffer Chemical Co. continued to extract borax (and a variety of other nonmetallic products) from a complex chemical mixture in brines pumped from wells in the dry lake bed. Kerr-McGee exports were reduced by a west coast dock strike, despite accelerated export shipments late in the year. Stauffer produced boric acid, principally technical grade, and other chemical products at its processing plant in San Francisco.

At the southern end of Searles Lake, Hooker Chemical Corp., Chemical and Plastics Div. (a subsidiary of Occidental Petroleum Corp.), continued its \$20 million project for selective extraction of borax and other chemicals from brines by solar evaporation. Jacobs Engineering Co. was awarded a contract for design, procurement, and construction management for the solar evaporation system.

Open pit mining by Tenneco Inc. began near the town of Ryan, 9 miles west of Death Valley Junction, Inyo County. Overburden, 150-feet thick, was stripped preparatory to mining a colemanite (hydrous calcium borate) deposit 25- to 30-feet thick. Planned mine capacity was 150,000 tons per year, but operations were at partial capacity during the year. The crude colemanite was hauled to a calcining plant in nearby Nevada. The product was used in glass fiber manufacture.

Bromine.—Production by Kerr-McGee Chemical Corp., from brines at Searles Lake, San Bernardino County, returned to normal after a major labor strike curtailed operations during 1970. Sales of elemental bromine increased 47 percent in quantity and 66 percent in value. Purchases for the processing plant in Los Angeles were from Great Lakes Chemical Corp., El Dorado, Ark., and Dow Chemical Co., Midland, Mich.

Calcium Chloride.—Leslie Salt Co. and National Chloride Co. of America continued production of a liquid calcium-magnesium chloride, containing 40-percent CaCl_2 , from brines at Bristol Lake, San Bernardino County. In terms of 75 percent equivalent CaCl_2 , production increased nearly 14 percent, compared with 1970 output.

Cement.—Shipments of portland cement totaled nearly 48.5 million barrels (376 pounds per barrel), about 1 million barrels less than in 1970. Fourteen plants, including 13 with grinding and kiln facilities and one with grinding facilities only, produced portland cement in the following nine counties: Four in San Bernardino County, which also ranked first in production in the State; three in Kern County, which ranked second in output; and one each in Calaveras, Riverside, San Benito, San Mateo, Santa Clara, Santa Cruz, and Shasta Counties. In addition, a small quantity of ma-

sonry cement was produced by Kaiser Cement & Gypsum Corp. at Permanente, Santa Clara County.

About 88 percent of sales were of general use portland cement (Types I and II), and 5 percent was high-sulfide-resistance cement; the remainder, in decreasing order of quantity, was oil-well cement, high-ear-

ly-strength cement, expansive cement, white cement, and waterproof portland cement. Uses were approximately as follows, in percent: Ready-mixed concrete, 66; concrete products, 11; highway construction, 9; building industry, 8; and miscellaneous customers, including Government agencies, 6.

Table 11.—Portland cement salient statistics¹
(Thousand 376-pound barrels and thousand dollars)

	Northern California		Southern California		Total	
	1970	1971	1970	1971	1970	1971
Plants active during year ² -----	6	6	8	8	14	14
Rated clinker capacity, Dec. 31-----	17,602	17,120	39,029	38,036	56,631	55,156
Production-----	16,972	15,388	33,100	33,040	50,072	48,428
Shipments from mills:						
Quantity-----	16,368	16,535	33,131	31,958	49,499	48,493
Value-----	\$56,694	\$60,874	\$116,432	\$109,047	\$173,126	\$169,921
Stocks at mills, Dec. 31-----	2,124	1,574	1,847	2,081	3,971	3,655

¹ Revised.

² Includes white cement.

² Includes one plant that ceased kiln operation (1970) and grinding of clinker in March 1971.

Kaiser's Permanente plant, 12 miles west of San Jose in Santa Clara County, was the leading producer, followed by American Cement Corp. at Oro Grande, San Bernardino County, and Southwestern Portland Cement Co. at Victorville, also San Bernardino County. The Permanente plant with capacity of 8.5 million barrels per year, had six kilns, 12 feet in diameter and 450 feet long. These were among the world's largest pieces of moving equipment. A flotation unit removes chert by floating the limestone and depressing the chert, thereby upgrading the CaCO₃ content of the raw material. Air pollution is controlled effectively by electrostatic precipitators. Glass bag dust collectors were being installed to boost particulate collection efficiency to 99.9 percent.

The new limestone-slurry pipeline of Calaveras Cement Co., a division of the Flintkote Co., at Kentucky House, Calaveras County, was completed in October. The line, 7 inches in diameter and 17.5 miles long, will transport limestone in a 30-percent-water slurry from the new Cataract quarry, where development was completed at midyear. Construction continued on a 14,000-barrel bulk storage, packing, and distribution plant at Union City, Alameda County, for cement from Kentucky House.

In January, Ideal Cement Co., a division of Ideal Basic Industries Inc., announced its intention to continue operating the

plant at San Juan Bautista, San Benito County. The company had planned to phase out this plant, owing to the air pollution control regulations of 1970. The plant was reactivated for temporary operation during 1971 and possibly 1972 under variances. Ideal Cement's plant at Redwood City, San Mateo County, was to be closed because the aging and inefficient facilities could not meet the new environmental standards. The finish-grinding mills were operated until the clinker inventory was depleted. Production equipment was being dismantled. Ideal Cement planned to operate this site as a cement distribution terminal for both domestic customers and the export market. The cement would be supplied primarily from a company plant in Seattle, Wash. The company continued studies on a new plant in northern California.

Riverside Cement Co., a subsidiary of American Cement Corp., planned to install a portable crushing system in its room-and-pillar limestone mine at Crestmore, Riverside County. A bag house dust collector was completed in order to further reduce air pollution. The Crestmore plant was the State's only producer of white cement.

A new bagging machine, increased storage facilities, and an improved dust collection system were installed at the California Portland Cement Co. plant at Colton, San

Bernardino County. At the company's other plant, Mojave, Kern County, work continued on a new finish-grinding mill, bulk loading equipment, and an improved dust collection system.

The plant of Pacific Cement and Aggregates Division, Lone Star Cement Corp., at Davenport, Santa Cruz County, was operating with a new belt conveyor system (the longest in the State), new limestone and shale crushing plants, and two large new storage silos. Conveyor capacity was 1,000 tons of limestone or 630 tons of shale per hour. The limestone crushing plant was semi-portable, mounted on railroad tracks, and had a capacity of 1,140 tons per hour. The shale crusher, also semi-portable, had a capacity of 400 tons per hour. In August, the company shutdown six old kilns.

At Monolith, Kern County, Monolith Portland Cement Co. completed construction on a new 8,000-barrel-per-day finish mill, which was built in compliance with air pollution standards of the Kern County Environmental Control Board. The company planned two new large kilns—one in 1974 and the other in 1976—replacing five old kilns. New equipment included feed bins, conveyors, and dust collection apparatus. A second phase would include a two-stage crushing system in the quarry, a 1½-mile conveyor from the quarry to the mill, and dust control equipment.

Clays and Shale.—Production of shale and the various types of clays, including common clay, kaolin, fire clay, bentonite, fuller's earth, and ball clay, was similar to that of 1970 in quantity but increased 10 percent in value. There were 81 operations in 30 counties. Of the 2.8 million tons produced, 50 percent was shale, 46 percent was common clay, and the remainder was mainly kaolin, fire clay, and bentonite.

Common clay was mined at 39 operations in 20 counties; shale at 19 operations in 12 counties; kaolin at eight operations in eight counties; fire clay at four operations in three counties; bentonite at seven operations in five counties; ball clay at two operations in two counties; and fuller's earth at one operation.

The leading counties in shale production were Calaveras, Orange, Alameda, and Santa Cruz, which together accounted for 44 percent of total output of shale. The production in Calaveras County was by the Calaveras Cement Division, The Flintkote

Co., for its cement plant. Crestlite Inc., a division of Susquehanna Corp., was the leading producer in Orange County. In Alameda County, Kaiser Industries Corp. produced shale for company cement plants. Operations in Santa Cruz County were also largely for use in cement by Pacific Cement and Aggregates.

About 46 percent of the common clay was produced at 11 operations in Riverside County. Leading producer was Pacific Clay Products, Inc. at two operations. A further 12 percent was produced in Ventura County by Lightweight Processing Co., also a primary shale producer.

Orange, Placer, and San Bernardino Counties accounted for over 70 percent of the kaolin produced during the year. The principal producers were California Non-metallics in Orange and San Bernardino Counties and Interpace Corp. in Placer County. Interpace Corp. produced the bulk of fire clay at its pits in Amador County.

More than half of the bentonite output was mined by N L Industries, Inc. Baroid Div., in San Bernardino County. Wilbur Ellis Co., San Benito County, also was a large producer. Fuller's earth was produced in Inyo County, and ball clay, in San Bernardino and Stanislaus Counties.

About 2.7 million tons of common clay and shale were used in heavy pipe, tile, and other heavy products, construction brick, cement, and lightweight aggregate. Kaolin was used in ceramic tile; china and pottery; refractory firebrick; filler in paints, plastics, rubber, and insecticides; and miscellaneous chemical applications. Fire clay was used in refractory firebrick and mortar, as a refractory in foundries, and in pottery. Bentonite was sold for drilling muds, filler, pelletizing iron ore, and other uses; some was exported. Ball clay went to ceramic uses in tile and pottery ware. Fuller's earth was used as an absorbent and filler in insecticides.

Homestake Mining Co. sold its subsidiary, Port Costa Products Co., Northern California's largest brick manufacturer, to Rhodes-Jamieson, Oakland. An exchange of stock was involved.

In May, Crestline Inc., which produced expanded shale near San Clemente, Orange County, was placed under a restraining order after complaint by the Orange County Air Pollution Control District for dust and fumes violation. The company

continued operations but was required to keep the wet scrubber in operation at all times.

In July, Interpace Corp. was exploring for clay deposits near Hart, San Bernardino County.

In October, Calcite Corp. purchased the Pacific Paramount grinding plant at Rosamond, Kern County, which processed bentonite and other materials and performed custom grinding. Late in the year, the company was operating the Huntley deposit and mill for kaolin in Little Antelope Valley, Mono County.

Diatomite.—Compared with 1970, sales of crude and prepared diatomite were lower by nearly 15 percent in terms of quantity, but were 5 percent higher in value because of increased prices. Johns-Manville Products Corp. continued as the leading producer from its quarry and mill near Lompoc, Santa Barbara County. Johns-Manville owns or leases more than 5,000 acres in the area. Most ores were milled by crushing, calcining, and air classification, which separates the powder into grades by particle size. Some crude materials with low moisture content were dried by a current of heated air and graded by size with air separators.

GREFCO, Inc., the second producer in Santa Barbara County, produced most of the remainder of the State's output at its mine and mill, also in the Lompoc area. A third producer, Basalt Rock Co., Inc., mined a small quantity of diatomite at its pozzolan pit, near Napa, Napa County.

Sales were for use in filtration (65 percent), fillers (22 percent), insulation (4 percent), and miscellaneous (9 percent).

Feldspar.—Two companies, Owens-Illinois Glass Co. and Wedron Silica Co., produced feldspar near Pacific Grove at the north end of Monterey Peninsula, Monterey County. The quantity produced was about the same as in 1970, but value of marketable feldspar increased 19 percent.

Owens-Illinois processed clean quartz-feldspar dune sands, which contained an average of 46 percent feldspar. Wedron Silica discontinued this type of operation and was working a decomposed granite deposit. The material was mined with a scraper, hauled to a ball mill, screened, slurried, and transported 8,200 feet in a 7-inch pipeline to a mill. Wedron Silica prepared two products—a flotation concentrate high

in feldspar and a feldspar-quartz mixture. Output of the flotation concentrate, used in pottery, increased substantially. The mixed concentrate product was marketed in two forms—unground, for glass, stucco ingredient, and foundry sand; and ground, for specialty uses such as ceramics, glass, and cleansers.

Owens-Illinois produced a feldspar-quartz mixture, output of which decreased 18 percent in terms of feldspar content, for use in the glass industry.

In total shipments of feldspar, an estimated two-thirds was used in glassmaking and one-third in pottery and miscellaneous applications.

Fluorspar.—Several companies reportedly were investigating deposits in the desert area, particularly in San Bernardino County. United States Borax & Chemical Corp. was drilling in the Clark Mountain area, San Bernardino County. Molybdenum Corp. of America was seeking fluorspar in the vicinity of its rare-earths mine and processing facilities at Mountain Pass, San Bernardino County, in connection with a new process under development.

Gem Stones.—There was renewed interest in collection of tourmaline in the Pala district, San Diego County. Development work and mining were underway at the Stewart and Tourmaline Queen mines. Recovery of gem-quality material reportedly was good. Many of the stones were cut, polished, and set in shops in Hollywood.

A 5-ton specimen of jade, valued at an estimated \$180,000, was recovered from the ocean floor at Jade Cove, south of Big Sur, Monterey County. The discovery was made with use of scuba diving equipment in waters 30 feet deep.

Estimated value of gem stones collected in 1971 was \$205,000.

Graphite (Synthetic).—Graphite powder was derived from petroleum coke by Great Lakes Carbon Corp. at Antelope Valley, Kern County. Nearly all of this powder was used in the manufacture of various products, such as electrodes, crucibles, electric motor parts, cloth, and fiber; a small quantity was used as carbon raiser in steel-making.

Gypsum.—Output of crude gypsum totaled nearly 1.4 million tons, valued at \$3.9 million, a 19-percent increase over 1970 output. Crude gypsum was produced at 11 operations in four counties. The

leading producers were United States Gypsum Co. at the Fish Creek Mountain deposit, near Plaster City, Imperial County, and H. M. Holloway, Inc. at Lost Hills, Kern County. Four operations in Kern County produced gypsite (agricultural gypsum) for local use in soil conditioning. Crude gypsum also was a byproduct of the manufacture of phosphoric acid by Valley Nitrogen Producers, Inc., Fresno County, and Occidental Chemical Co., San Joaquin County. Sales of crude gypsum, totaling more than 1 million tons, were for uses in agriculture, portland cement retarder, and several minor applications.

Output of calcined gypsum was 881,000 tons, valued at \$10.8 million, an increase of 7 percent in quantity and 4 percent in value. The United States Gypsum operation was also the leading producer of calcined gypsum, followed by Kaiser Gypsum Co., Inc. at Long Beach, Los Angeles County. Kaiser also produced calcined gypsum at its plants near Antioch, Contra Costa County, and at Redwood City, San Mateo County. Most of Kaiser's output was used as retarder in the company's cement plants. The bulk of calcined gypsum sales were for plaster board products; other sales for construction use were in plaster, laths, and sheathing.

There were 18 gas-fired kettles, three rotary kilns, and seven board machines in operation producing calcined gypsum and products in 1971. Annual capacity was about 1.2 million tons.

Iodine.—Deepwater Chemical Co., Ltd., at Compton, Los Angeles County, produced potassium and silver iodide; potassium, calcium, and silver iodate; and re-sublimed iodine from imported crude iodine.

Lime.—Production of lime and dead-burned dolomite reached a record high in 1971, increasing 10 percent over 1970 production. About 78 percent of the output was quicklime; the remainder was hydrated lime. Lime was produced by 10 companies at 15 plants in 12 counties. Leading counties were Monterey, San Bernardino, Contra Costa, and Yolo. Leading producers were Kaiser Aluminum & Chemical Corp. in Monterey County; Holly Sugar Corp. in Glenn, Imperial, Orange, and San Joaquin Counties; and Amstar Corp. in Monterey and Yolo Counties.

Lime for sugar refineries, the principal

use, was produced in Glenn, Imperial, Monterey, Orange, San Joaquin, Santa Barbara, and Yolo Counties. Kaiser used dead-burned dolomite from the Natividad quarry, Monterey County, for precipitating magnesia from sea water at Moss Landing. Other uses were in construction, refractories, agriculture, and glass manufacture. Total consumption was estimated at 816,033 tons, 6 percent more than the 1970 rate. Lime produced in California also served Nevada and a few other States. Lime also was shipped into California from other States.

Lithium Compounds.—Kerr-McGee Chemical Corp. recovered lithium salts from Searles Lake brines at Trona, San Bernardino County, and converted them to marketable lithium carbonate. The brines, pumped from saline beds, contained an average of 0.015 percent lithium oxide. Production returned to normal, increasing 49 percent based on lithium content, following a major labor strike in 1970.

Magnesium Compounds.—In terms of magnesia (MgO) equivalent, output of magnesium compounds more than doubled, compared with that of 1970. In 1971 output in California comprised 23 percent of total U.S. output.

There were three producers of magnesium compounds from sea water or sea-water bittern (concentrate from salt works after salts have been removed). Two plants also used calcined dolomite with the sea water for producing magnesium compounds; one (FMC Corporation) used calcined dolomite.

Kaiser Aluminum & Chemical Corp. produced caustic calcined magnesia, refractory magnesia, and magnesium hydroxide at Moss Landing, Monterey County. These products were used in company steel and cement operations and in other refractory, pulp and paper, chemical, and electrical uses.

Merck & Co. Inc. produced magnesia, magnesium carbonate, magnesium hydroxide, and a small quantity of hydrated magnesium trisilicate for high-purity, high-priced pharmaceutical and other chemical products at a plant on San Francisco Bay in South San Francisco, San Mateo County. When concentrations in the bay water were diluted to only 65–70 percent of normal sea water, the bay water was blended with a magnesium-rich bittern, obtained

from the Leslie Salt Works at Baumberg. Dolomite was quarried at the Columbia Marble deposit, Tuolumne County, which is worked periodically, and a large stockpile accumulated. The magnesia, both light and heavy, was used mainly as a catalyst and filler in rubber. In addition to pharmaceuticals, the products were used in electrical fixtures, steel coatings (magnesia), and other, minor applications.

FMC Corporation, Inorganic Chemicals Div., at Chula Vista, San Diego County, used bitters to make magnesium chloride for marketing in liquid and precipitated forms.

Philadelphia Quartz Co. produced a high-purity magnesia and hydrous magnesium sulfate from magnesite at its Berkeley plant, Alameda County. The magnesite was from out-of-State sources. The magnesia was for chemical, medicinal, and fertilizer uses.

Perlite.—American Perlite Co., the only producer of crude perlite in the State, reduced output at the Fish Springs quarry, near Big Park, Inyo County. The crude perlite was sold to expansion plants in Los Angeles County. American Perlite did not operate its expansion plant during the year.

Seven perlite expansion plants were in operation—five in Los Angeles County, one in San Diego County, and one in Sonoma County. The plant of Perlite Materials Inc., Napa County, remained idle during the year. Production of expanded perlite was 23,512 tons, nearly 3 percent lower than in 1970. Consumption was 23,250 tons, valued at nearly \$1.8 million, distributed by use approximately as follows: Filter aid, 39 percent; plaster aggregate, 19 percent; concrete aggregate, 11 percent; horticulture aggregate, 11 percent; and miscellaneous, 20 percent.

Phosphate Rock.—Cuyama Phosphate Corp., the State's only producer of phosphate rock, reported no activity at its open pit near New Cuyama, Santa Barbara County, in 1971. The company had produced a 4-percent- P_2O_5 material for direct application to the soil in agricultural use.

United States Gypsum Co. continued evaluation of a deposit in the Pine Mountain area, Los Padres National Forest, Ventura County. Feasibility and pilot plant studies were underway. The company also made extensive environmental studies of

the area. A public hearing on impact of the proposed mining operation on the environment and on the California condor was held by the Bureau of Land Management at Ventura in July. An application for a Federal preference right lease remained pending.

Potassium Salts.—Production of potash salts (KCl and K_2SO_4) by Kerr-McGee Chemical Corp. from brines in the dry lake bed at Searles Lake, near Trona, San Bernardino County, was about 1 percent lower in quantity but 3 percent higher in value. Domestic and foreign sales were 7 percent lower in quantity and 4 percent lower in value, owing mainly to the west coast longshoremen's strike, which caused delays in export shipments during the year. About 85 percent of production and sales were in the form of KCl.

Hooker Chemical Corp., a subsidiary of Occidental Petroleum Corp., planned to produce K_2SO_4 at its solar evaporation complex at the southern end of Searles Lake. The plant was scheduled for completion in 1972.

Pumice.—Combined output of crude and prepared pumice, pumicite (volcanic ash), and scoria (volcanic cinder) advanced 40 percent in quantity and 42 percent in value, compared with 1970. These materials were produced at 28 operations (33 operations in 1970) in 11 counties. The principal producers, in Siskiyou and Lassen Counties, accounted for nearly half the total output. Major production was by the U.S. Forest Service, which produced nearly 366,000 tons in Lassen, Modoc, Shasta, Siskiyou, and Tehama Counties for use as road surfacing in national parklands. The principal private producer was Shastalite Cinder Co. in Siskiyou County. In addition, relatively small quantities were produced by State and county agencies in Modoc, Siskiyou, and Tehama Counties.

About 20 percent of the total output was crushed, screened, and/or ground pumice and pumicite for use as aggregate in lightweight cement. Small quantities of processed pumice were used in abrasives, soil conditioners, and miscellaneous applications.

Salt.—Production from 11 plants in six counties increased 14 percent over that of 1970 and reached \$21.1 million in value. Leslie Salt Co., the State's leading producer, continued expansion and integration

Table 12.—Pumice¹ sold or used by producers in 1971, by county

County	Crude		Prepared		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Kern.....	--	--	500	\$6,000	500	\$6,000
Lake.....	--	--	W	W	W	W
Lassen.....	133,076	\$128,786	18,636	27,500	151,712	156,286
Madera.....	--	--	W	W	W	W
Modoc.....	75,855	75,855	--	--	75,855	75,855
Mono.....	--	--	W	W	W	W
Napa.....	207	725	--	--	207	725
San Bernardino.....	37,569	W	--	--	37,569	W
Shasta.....	W	W	4,194	9,023	4,194	9,023
Siskiyou.....	89,405	85,637	W	W	89,405	85,637
Tehama.....	12,132	12,098	W	W	12,132	12,098
Undistributed.....	117,473	156,403	210,386	677,139	327,859	833,542
Total.....	465,717	459,504	233,716	719,662	699,433	1,179,166

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

¹ Includes pumicite and volcanic cinder.

of operations near Newark and Mt. Eden (Baumberg), both in Alameda County, and Redwood City, San Mateo County, in the Bay Area, where the company had four systems of solar evaporating ponds and the State's only salt refinery (Newark). Leslie Salt Co. also had a North Bay Works, situated north of San Pablo Bay, Napa and Solano Counties. Total annual capacity was expected to reach 1.15 million tons when expansion was completed. Only Redwood City and Newark No. 2 were complete salt works, consisting of concentrating and crystallizing ponds and washing plants. Baumberg and Newark No. 1 produced a partly concentrated brine for further processing at the other two works.

Long Beach Salt Co. completed modernization of its processing plant at Saltdale, Kern County, where salt is recovered by solar evaporating of well brines from Koehn Lake (dry). New equipment will provide better quality crude and kiln-dried salt for industrial use in the San Joaquin Valley and Los Angeles areas.

Kaiser Engineers started construction of a 3-million-gallon-per-day plant module at Fountain Valley, Orange County, to develop and demonstrate technology of vertical-tube evaporation and multistage flash distillation for water desalinization. The project, in cooperation with the Orange County Water District, was sponsored by the U.S. Department of the Interior, Office of Saline Water.

Hooker Chemical Corp., a subsidiary of Occidental Petroleum Corp., planned to produce byproduct salt at its new brines-processing complex under construction at

Searles Lake, San Bernardino County, and scheduled for completion in 1972.

Kerr-McGee Chemical Corp. continued byproduct salt operations, also at Searles Lake.

Other companies processing salt were Western Salt Co., Monterey and San Diego Counties; Oliver Bros. Salt Co., Alameda County; and Pacific Salt and Chemical Co., Standard Salt Co., and Southwest Salt Co., all in San Bernardino County.

About one-half of the salt produced by Leslie Salt Co. was consumed in the Bay Area; the other half went elsewhere in the State, to other States, and entered the export market, particularly to Canada and Japan.

The principal uses were in the chemical industry, water softening, and food and leather processing.

Sand and Gravel.—California continued as the leading producer and consumer of sand and gravel in the Nation, although a number of pits became inactive and output declined during the year, compared with 1970. The lower level was attributed to reduced activity by Government-and-contractor operations. Private commercial operations remained at a rate similar to that of 1970. Despite the reduced activity, the industry remained sizable, with production reported from 424 pits in all of the 58 counties in the State. The principal producing counties were Los Angeles (19 percent), San Diego (10 percent), and Alameda (9 percent). The largest number of pits were located in San Diego, Los Angeles, San Bernardino, Kern, Orange, Riverside, Humboldt, and Mendocino Counties.

Table 13.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Blast.....	179	\$1,168	W	W
Building.....	24,193	32,669	22,084	\$31,905
Engine.....	54	189	46	159
Fill.....	3,061	2,799	4,570	3,222
Foundry.....	W	W	115	569
Glass.....	1,513	7,446	W	W
Paving.....	14,978	18,195	14,085	17,687
Other uses ¹	1,118	3,052	4,798	10,922
Total ²	45,095	65,517	45,700	64,462
Gravel:				
Building.....	24,532	34,542	24,922	35,505
Fill.....	1,616	1,302	1,839	1,242
Paving.....	30,979	39,992	28,497	36,983
Railroad ballast.....	286	422	276	246
Miscellaneous.....	345	533	525	758
Other uses.....	874	1,151	2,461	3,082
Total ²	58,631	77,941	58,520	77,816
Government-and-contractor operations:				
Sand:				
Building.....	96	157	8	20
Fill.....	363	121	275	49
Paving.....	8,458	7,345	3,398	6,100
Other uses.....	--	--	6	6
Total ²	8,916	7,623	3,682	6,175
Gravel:				
Building.....	124	179	4	18
Fill.....	6,536	2,588	325	68
Paving.....	20,956	20,370	7,235	9,139
Other uses.....	--	--	2	5
Total ²	27,616	23,138	7,565	9,230
Total sand and gravel ²	140,259	174,221	115,468	157,683

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

¹ Includes abrasives (1970), chemical, fire or furnace, glass, filtration, oil (hydrafrac), fill, molding, pottery, railroad ballast, and other sands.

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

Most of the sand and gravel was used in paving, mainly for roads (46 percent) and construction (41 percent).

Kaiser Industries Corp., Sand and Gravel Div., completed a new \$10 million processing plant at Radium in Livermore Valley, Alameda County, replacing an old plant that had been working for many years. This Kaiser operation supplied sand and gravel for use in the Bay Area. The throughput capacity of the new plant was 2,600 tons per hour. The Livermore Valley alluvial deposit is 100 feet thick and interspersed with thin clay lenses. The lower portion of the deposit, below the water table, was mined by a dragline with a 140-foot boom and a 10-cubic-yard bucket. Normal mining in dry material, above the water table, was by bulldozer. Material handling and processing were computer

controlled. The operation produced 11 gravel products and two sand products.

Owl Creek Products Co. installed a walking dragline with a 160-foot boom and a 15-cubic-yard bucket at its Azusa pit, Los Angeles County. The dragline permitted mining to depths of 70 feet below the water table. The deposit is in the extensive San Gabriel River alluvial fan, locally known as the San Gabriel Wash.

Consolidated Rock Products Co. planned to develop new deposits near Irwindale, Los Angeles County, also in the San Gabriel Wash. The company's working properties were interconnected by a tunnel conveyor system. A number of innovations for increased efficiency, including computer-controlled operations, were planned. Designed screen capacity was to be 1,200 tons per hour, readily adaptable to 1,400 tons

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

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Alameda	15	9,427	\$12,847	12	10,497	\$14,497
Alpine	1	W	W	1	2	(¹)
Amador	9	776	3,327	4	W	W
Butte	7	574	750	6	908	1,246
Calaveras	10	303	301	5	W	W
Contra Costa	4	582	759	4	411	508
Del Norte	5	161	191	4	190	218
Fresno	21	5,594	6,018	9	3,670	4,837
Glenn	19	1,240	1,071	5	430	794
Humboldt	11	601	912	16	530	838
Imperial	11	1,664	1,703	9	1,911	2,958
Inyo	6	114	227	11	1,307	568
Kern	25	9,644	10,093	18	3,098	4,299
Kings	2	68	117	9	9	25
Lake	39	374	373	8	248	331
Lassen	6	194	205	2	W	W
Los Angeles	28	26,206	32,959	25	21,678	28,739
Marin	2	1	1	1	(¹)	(¹)
Mariposa	8	63	87	5	139	399
Mendocino	8	208	315	16	327	457
Merced	11	1,692	1,570	8	2,383	2,799
Modoc	6	184	141	6	288	W
Mono	7	299	346	5	49	91
Monterey	15	796	4,246	10	683	2,673
Napa	5	48	77	3	52	112
Nevada	7	637	843	4	667	953
Orange	22	9,132	11,839	18	8,619	10,696
Placer	7	432	758	4	307	W
Plumas	8	44	53	3	W	W
Riverside	37	3,695	6,112	17	3,749	6,590
Sacramento	14	5,673	6,249	8	5,644	6,087
San Benito	1	W	W	5	470	981
San Bernardino	46	14,231	13,499	20	9,082	10,208
San Diego	38	10,526	19,504	29	11,573	21,481
San Joaquin	14	2,845	4,192	7	3,398	4,589
San Luis Obispo	9	174	392	4	159	W
Santa Barbara	9	1,120	1,508	6	1,190	1,569
Santa Clara	11	2,301	2,422	11	3,231	3,645
Santa Cruz	6	1,928	2,173	6	2,146	2,294
Shasta	21	770	858	14	587	677
Sierra	1	31	34	1	14	37
Siskiyou	16	1,837	1,916	5	107	W
Solano	9	6,283	2,617	3	29	W
Sonoma	17	2,285	3,182	8	3,138	4,211
Stanislaus	11	1,784	2,405	11	1,644	2,182
Tehama	12	665	1,176	6	188	213
Trinity	7	219	285	2	W	W
Tulare	14	2,302	2,379	6	1,424	2,038
Ventura	13	6,048	6,648	8	4,872	4,842
Yolo	7	2,509	2,558	6	2,078	2,172
Yuba	9	680	643	4	591	579
Undistributed ²	32	1,298	1,898	15	2,749	5,213
Total ³	674	140,259	174,221	424	115,468	157,683

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

¹ Less than ½ unit.

² Includes Colusa, El Dorado, Madera, San Francisco, San Mateo, Sutter, and Tuolumne Counties.

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

per hour. Capacity may be doubled at a later date.

Northern California Aggregates Inc. announced plans to mine Russian River gravels near Jenner, Sonoma County. However, the proposed operation encountered strong environmental opposition.

Gold mine tailings dumps were more extensively used for aggregate as the natural deposits continued to be lost because of urban growth. Local sand and gravel sup-

ply was becoming more critical as urban construction continued because the low unit value of sand and gravel makes long-distance bulk haulage uneconomic. The existing economic haulage limit was considered to be less than 25 miles. The problem was recognized in a few cities, and sand and gravel areas were reserved as natural resources for future use. Billions of cubic yards of dumps and tailings from gold dredging and hydraulicking were considered of good quality for aggregate. Many

of these deposits are near expanding suburban areas. These materials were also used as road fill, ballast, glass sand, foundry sand, building materials, and sand for blasting.¹⁸

International Mill Services, Fontana, San Bernardino County, processed steel slag at a rate of 1.5 million tons per year. After crushing and screening, the material was marketed as landscaping or roofing granules, railroad ballast, and standard aggregate. A substantial expansion program was planned for 1972-73.

A number of developments were underway in specialty sand operations. John A. Lansden recovered quartz gravel and boulders along the Bear River, near Gold Run, Placer County. The material was milled and sold for glass-making, foundry sand, paint filler, enamels, ceramics, and abrasives.

Silica Sand Co. started a new sand pit near Byron, Contra Costa County. A quartz-rich sandstone was mined for glass, abrasive, fill, and special aggregate uses.

River Sand Co. was dredging in Suisun Bay, Contra Costa County, mining sand for special aggregates and fill. Also, there were operations in Monterey Bay, offshore from Monterey County.

At yearend, Owens-Illinois Inc. had nearly completed construction of a sand-processing plant near San Juan Capistrano, Orange County. The raw material is a white, friable, marine sandstone, containing 50 percent quartz and 50 percent feldspar, which will be processed for glass sand. The company planned to close its plant at Corona when the new plant becomes operational. Similar silica sand operations in San Diego County were interrupted when the plant of a Los Angeles glass company, a major buyer of silica sands, was badly damaged by the San Fernando earthquake in February.

Wedron Silica Co. was mining and milling decomposed granitic rocks near Pacific Grove at the north end of Monterey Peninsula. A silica-feldspar glass sand and a high-silica product were concentrated by flotation.

You Bet White Co. produced a high-silica sand (99.6 percent SiO₂) from gravels along the Bear River, east of Colfax, Placer County. The material was classified by size and sold to a mill in Colfax, where it was crushed and ground to minus 350

mesh for abrasive use in scouring powders and in making silica carbide.

Sodium Compounds.—Output of sodium compounds from brines increased 7 percent in quantity and 2.5 percent in value, compared with 1970 output. Kerr-McGee Chemical Corp. and Stauffer Chemical Co. produced both sodium carbonate (soda ash) and sodium sulfate (salt cake) at Searles Lake, San Bernardino County. Stauffer also produced anhydrous sodium sulfate at a plant in San Francisco as a by-product of the processing of sodium borates from Boron, Kern County. U.S. Borax & Chemical Corp. produced salt cake at its Wilmington refinery, Los Angeles County, as a byproduct of the Kern County crude borates.

Hooker Chemical Corp., a subsidiary of Occidental Petroleum Corp., planned to produce soda ash at a plant under construction at Searles Lake.

Stone.—Available data indicated decreased production and sales of various types of stone, including limestone, marble, dolomite, sandstone, quartzite, granite, slate, traprock, and other rock materials. Production was recorded at 320 quarries in at least 50 counties, of which San Bernardino County was the leader.

Each of twelve companies or agencies produced more than 1 million tons of stone during the year; twelve quarries produced more than 900,000 tons; 55 quarries produced 100,000 to 900,000 tons; 40 quarries produced 25,000 to 100,000 tons; and 213 quarries produced less than 25,000 tons.

The principal producers were the cement companies, which quarried limestone for cement manufacture. The principal rock types were limestone and dolomite (54 percent), granite and granitic rocks (14 percent), sandstone (10 percent), traprock (6 percent), and miscellaneous (16 percent).

The principal mode of transport for the rock products was by truck (71 percent); 7 percent was hauled by rail; and the remainder was hauled by other means, including conveyor belt and waterway.

The main uses were in cement (34 percent), base material for road construction (27 percent), and concrete aggregate (10 percent).

¹⁸ Sherriffs, Alex. Jr. Gold Mine Waste—A Mineral Commodity. Calif. Geol., v. 24, No. 10, October 1971, pp. 196-197.

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

(Thousand short tons and thousand dollars)

County	1970			1971			Type
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value	
Alameda.....	4	2,113	\$1,780	5	1,871	\$2,355	Traprock, other stone.
Contra Costa.....	4	2,608	4,707	9	2,849	5,853	Limestone, sandstone, traprock, other stone.
Del Norte.....	4	W	10	4	41	46	Granite, other stone.
El Dorado.....	7	456	1,759	7	W	1,664	Limestone, slate, other stone.
Fresno.....	5	W	109	6	53	100	Limestone, granite, traprock, other stone.
Humboldt.....	9	315	W	8	242	W	Shell, traprock, other stone.
Kern.....	10	3,051	3,267	14	2,984	4,011	Limestone, quartz, quartzite, other stone.
Lake.....	4	1	5	6	11	25	Traprock, other stone.
Los Angeles.....	2	2,617	3,987	15	1,346	3,013	Limestone, granite, other stone.
Mariposa.....	3	W	W	1	12	12	Slate.
Mendocino.....	3	(1)	1	3	W	W	Limestone, traprock, other stone.
Modoc.....	4	W	W	4	84	150	Sandstone, traprock, other stone.
Nevada.....	2	W	54	3	57	193	Quartzite, other stone.
Plumas.....	3	42	50	1	W	W	Granite.
Riverside.....	10	1,330	2,224	10	1,614	4,625	Limestone, quartzite, granite, traprock.
San Bernardino..	36	17,200	20,840	36	8,524	16,058	Limestone, dolomite, granite, marble, sandstone, quartz, quartzite, traprock, other stone.
San Diego.....	11	930	2,027	19	1,923	4,118	Granite, traprock, other stone.
San Mateo.....	6	1,102	2,109	6	1,176	1,713	Limestone, sandstone, shell, traprock, other stone.
Santa Clara.....	6	5,241	4,811	7	W	W	Limestone, granite, sandstone, other stone.
Santa Cruz.....	4	1,234	1,713	5	1,287	2,346	Limestone, granite.
Siskiyou.....	2	W	W	3	64	132	Granite, other stone.
Solano.....	4	705	1,420	8	35	85	Sandstone, traprock, other stone.
Sonoma.....	7	340	W	6	432	707	Sandstone, shell, traprock, other stone.
Tehama.....	1	1	1	6	27	50	Other stone.
Tulare.....	3	W	W	2	330	330	Do.
Tuolumne.....	15	129	585	15	627	4,287	Dolomite, granite, sandstone, marble, other stone.
Ventura.....	5	W	W	9	851	2,453	Granite, marl, sandstone, other stone.
Yuba.....	W	W	W	6	65	274	Traprock, other stone.
Undistributed ² ...	49	6,984	15,490	96	16,842	31,656	
Total ³	228	46,399	66,950	320	43,336	86,255	

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

¹ Less than 1/2 unit.² Includes Alpine (1971), Amador, Calaveras, Colusa (1971), Glenn (1971), Imperial, Inyo, Lassen, Madera, Marin, Merced (1971), Monterey, Mono (1970), Napa (1971), Placer, Sacramento (1971), San Benito, San Joaquin (1971), San Luis Obispo, Santa Barbara, Stanislaus (1971), Shasta, Trinity, and counties for which no breakdown is available.³ Data may not add to totals shown because of independent rounding.

Calaveras Cement Co., Div. of The Flintkote Co., quarried limestone at its Cataract quarry, northeast of Vallecito, Calaveras County, for use at the San Andreas cement plant. A 17-mile underground pipeline connected the two operations. At the quarry, new dust collection equipment and water pollution control facilities were installed. An extensive drilling program indicated a large deposit of high-calcium limestone. The quarrying rate was 1 million tons per year. Three grades of limestone

were stockpiled: High calcium, high magnesium, and high silica.

The U.S. Lime Products Division of Flintkote sold its limestone underground mine at Sonora and its dolomite quarry at Columbia, Tuolumne County, to Merck & Co. Merck used quarried material in fertilizer and at the company's seawater-processing plant for magnesia in South San Francisco, San Mateo County.

Diamond Springs Lime Co. produced limestone at its Mountain quarry, 4 miles

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

Type	1970		1971	
	Quantity	Value	Quantity	Value
Dimension:				
Limestone.....	27	W	W	W
Granite.....	5	\$515	5	\$345
Sandstone.....	1	2	W	W
Traprock.....	--	--	(¹)	3
Other stone.....	7	83	19	W
Slate.....	W	W	1	12
Undistributed.....	16	380	9	435
Total ².....	56	980	34	796
Crushed and broken:				
Limestone ³	17,386	22,780	23,275	44,115
Granite.....	4,526	7,630	5,919	12,584
Marble.....	20	401	W	W
Marl.....	--	--	54	W
Sandstone.....	3,526	7,405	4,263	9,233
Quartzite.....	297	621	4,309	4,739
Traprock.....	2,216	2,998	2,555	6,630
Other stone.....	17,396	20,059	6,784	11,421
Undistributed ⁵	976	4,076	144	732
Total ².....	46,343	65,970	43,302	85,459
Grand total.....	46,399	66,950	43,336	86,255

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

¹ Less than ½ unit, included with "Undistributed."

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

³ 1971 data include dolomite.

⁴ Data include quartz.

⁵ Includes dolomite (1970), quartz (1970), shell, and slate.

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

Use	1970		1971	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough construction.....	20	\$143	18	W
Other uses ¹	36	837	16	\$796
Total.....	56	980	34	796
Crushed and broken stone:				
Bituminous aggregate.....	1,843	3,891	2,422	7,350
Concrete aggregate.....	W	W	4,124	6,867
Dense graded road base stone.....	7,963	11,066	11,521	18,863
Macadam aggregate.....	111	273	162	397
Surface treatment aggregate.....	43	110	269	734
Unspecified aggregate and roadstone.....	1,599	2,794	1,829	3,978
Agricultural purposes.....	155	916	148	864
Cement manufacture.....	14,171	14,771	14,810	20,715
Fill.....	1,163	1,173	W	W
Glass.....	W	W	248	1,537
Lime manufacture.....	279	1,018	252	881
Riprap and jetty stone.....	14,602	17,875	2,185	5,384
Stone sand.....	W	W	75	370
Sugar refining.....	W	W	250	715
Terrazzo and exposed aggregate.....	W	W	20	315
Other uses ²	4,403	12,085	4,987	16,441
Total ³.....	46,343	65,970	43,302	85,459
Grand total.....	46,399	66,950	43,336	86,255

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

¹ Includes stone used for rough architectural, monumental, flagging, and other rough and dressed stone products.

² Includes railroad ballast, filter stone, deadburnt dolomite, ferrosilicon, flux stone, refractory stone, asphalt fill, whitening, other filler, acid neutralization, building products, chemicals, fill, flour, magnesia, roofing aggregates, and other crushed and broken stone in smaller quantities.

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

east of Auburn, El Dorado County, for use at its Diamond Springs lime plant. Crushed limestone was also sold at steel plants in the San Francisco Bay area. A Bureau of Reclamation dam project at Auburn, scheduled for completion in 1974, will inundate the area and terminate the quarry operation.

The underground limestone mine of El Dorado Limestone Co., 3 miles southwest of Shingle Springs, El Dorado County, was under new management and operated at increased efficiency. A clean, more uniform, high-calcium (more than 97-percent CaCO_3) product was shipped. Late in the year, shaft sinking below the 1,130 level was underway. A core drilling project was planned for 1972. The processing rate was 800 to 900 tons per day. The product was marketed for flux in plate glass and glassware, roofing granules, and decorative stone in the Bay Area. The company also planned to market an agricultural limestone product.

Architectural uses for limestone included special aggregate, roofing rock, landscaping rock, terrazzo chips, and pool sand. Specialty items included precast slabs.

Kaiser Aluminum & Chemical Corp., Refractories Div., quarried dolomite at Natividad, near Salinas, Monterey County. The coarser material from the crushing-screening operation was concentrated by heavy-medium separation for two stockpiles: White rock, used in specialized rock products, and material for calcining and dead-burned dolomite at Moss Landing. Kaiser used the dead-burned dolomite to make refractory mortar and brick at Moss Landing for high-temperature applications.

Expansion was underway at the dolomitic marble quarry of Premier Resources Inc. in Owens Valley, near Lone Pine, Inyo County. Output of architectural aggregate and building stone showed a marked growth. A new crushing and screening plant was installed. Premier Resources also produced roofing and landscaping rock at a quarry near Victorville, San Bernardino County.

Production of "black granite" dimension stone increased at a number of quarries in San Diego County. Heavier and larger equipment was installed to handle and cut blocks for larger plates. Specialized shapes were in demand for the aerospace and other industries.

Kaiser Industries Corp., Sand and Gravel Div., expanded quarry and plant capacity for granite and granitic rocks at Santa Margarita, San Luis Obispo County. The marketed material was used for aggregate and riprap in the southern Coastal Ranges.

There was increased quarrying activity for crushed rock in the San Jose and Cupertino areas, Santa Clara County. Several operations provided materials for fill and road construction. Also, waste materials from old gold mine dumps in Nevada and Amador Counties were used for fill, road base, and riprap.

Sulfur.—Shipments of sulfur, derived from sour natural gases and refinery gases, were 272,580 short tons (sulfur content), valued at \$5.2 million, compared with 233,685 tons and \$4.8 million in 1970. Nine companies recovered sulfur at 10 petroleum refineries in four counties, as follows: Monsanto Co., Shell Oil Co., and Union Oil Co. of California, in Contra Costa County; Collier Carbon & Chemical Corp., Douglas Oil Co., Gulf Oil Corp., Powerine Oil Co., and Stauffer Chemical Co., in Los Angeles County; Union Oil Co. of California in San Luis Obispo County; and Humble Oil & Refining Co. in Solano County.

Production and shipments of hydrogen sulfide (H_2S), in terms of sulfur content, were 17 percent lower compared with 1970 production. Five companies recovered H_2S at six refineries in two counties, as follows: Phillips Petroleum Co. and Standard Oil Co. of California in Contra Costa County; and Atlantic Richfield Co., Mobil Oil Corp., Shell Oil Co., and Standard Oil Co. of California, in Los Angeles County. Four plants recovered H_2S by the diethanolamine absorption process; two plants used the Girbotol process.

Recovery of SO_2 from stack gases at the smelter of American Smelting and Refining Co. at Selby, Contra Costa County, was terminated with closure of the plant at yearend 1970.

The Department of Oil Properties, City of Long Beach, Los Angeles County, installed a Stretford process plant for the extraction of H_2S from natural gas at its Long Beach unit. The facility, with capacity of 55 million cubic feet per day, went into operation in May. Waterflooding at the Wilmington oilfield resulted in a growth of 50 percent in potential H_2S , which had not been recoverable with for-

merly existing facilities. The Stretford plant was the first of its type in the United States and the first in the world to operate on oilfield gas. The patented process was used under license from the British North Western Gas Board.¹⁹

Talc, Soapstone, and Pyrophyllite.—Total output of these minerals was 153,227 tons, valued at nearly \$2.1 million, compared with 184,660 tons and \$2.5 million, respectively, in 1970. There were fewer producers in 1971. Seventeen of 22 operators reported production during the year; the remainder did assessment work or shipped from stockpiles. Two properties produced pyrophyllite; one produced soapstone; and the remainder were talc producers. Nine producing properties were in Inyo County, six in San Bernardino County, and one each in El Dorado and Mono Counties. L. Grantham Corp., which has a mine near Shoshone, Inyo County, was the leading producer in the State.

The only producer of soapstone was Commercial Minerals Co. at the Docs mine, El Dorado County. Interpace Corp. was the principal producer of pyrophyllite at its mine near Victorville, San Bernardino County. Standard Industrial Minerals Co. produced a relatively small quantity of pyrophyllite at its mine near Bishop, Mono County. Pyrophyllite production in San Diego County, Rancho Santa Fe district, was terminated in midyear. Operations had been marginal, and dust control standards of the county air pollution control regulations could not be met economically.

Most operators had their own grinding plants. Receipts at these plants were 145,906 tons, nearly 8 percent below the 1970 rate. A relatively small quantity of crude talc was sold directly to consumers. Estimated uses of ground talc, in order of importance, were in paint fillers, ceramics, insecticides, asphalt filler, rubber industry, and miscellaneous such as cosmetics, rice polishing, foundry, textile, and paper.

Vermiculite.—Crude vermiculite, obtained from out-of-State, was exfoliated at plants of W. R. Grace & Co., Construction Products Div., in Newark, Alameda County, and Los Angeles, Los Angeles County; and La Habra Products Inc., Anaheim, Orange County. Production and sales increased 15 percent over the 1970 rate.

Consumption, by end use, was estimated as follows: Acoustical and fireproofing materials, 47 percent; concrete aggregate, 27 percent; fertilizers, 8 percent; plaster aggregate, 7 percent; ceiling textures, 5 percent; and insulation, horticultural, soil conditioner, and industrial, 6 percent.

Wollastonite.—No production was reported by Amomet Co. and Interpace Corp., Western Div., from their deposits in Inyo County nor by Pfizer Inc., Minerals, Pigments & Metals Div., at its quarry, near Blythe, Riverside County.

METALS

Antimony.—Ford Mining Co. developed a few tons of ore at its Black Sambo mine, near Wofford Heights, Kern County. No ore was produced or shipped.

The Apollo mine, San Bernardino County, was abandoned by Monte Cristo Mining Co. in 1970 after 4 tons of antimony concentrate was mined and shipped.

Assessment work was performed at the Betty Lou No. 2 mine in Kern County.

A 50-50 joint venture of Monte Cristo and Consolidated General Corp. was underway for antimony near Wheaton Springs, San Bernardino County.

Copper.—Production was substantially lower than in 1970, owing to a labor strike and reduced recovery at the Pine Creek mine, Inyo County, of Union Carbide Corp., the principal producer, where copper was a coproduct of tungsten. In addition to this mine, small quantities of copper were recovered as byproducts of the treatment of gold-silver ores, lead and zinc ores, mine dumps and mill tailings. Output was from six producers at eight active mines in five counties. In Inyo County, where essentially all the copper was produced, Darwin Mines Dept. of West Hill Exploration Inc. (lead-zinc) and Santa Rosa Mining Association (lead) were active producers, in addition to the Pine Creek operation.

Exploration was underway at the Engels-Superior mine area in Moonlight Valley and at the Walker mine, both in Plumas County; at several properties in San Bernardino County; and in the Sierra Nevada foothills belt, comprising Yuba, Calaveras, Mariposa, and Madera Counties.

¹⁹ Department of Oil Properties, City of Long Beach. Fiscal 1970-71 Annual Report. P. 7.

Table 18.—Mine production (recoverable) of gold, silver, copper, lead and zinc, by county

County	Mines producing		Material sold or treated ¹ (short tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1969, total	27	14	111,485	7,904	\$328,097	491,927	\$880,879
1970, total	15	6	105,197	4,999	181,912	451,150	798,905
1971:							
Alpine, Fresno, Los Angeles, Merced, Mono, Placer, San Bernardino, San Diego, Sacramento, San Joaquin, Shasta, Sierra, Stanislaus ²	6	2	4,825	2,419	99,786	5,850	9,044
Inyo	2	--	84,932	506	20,873	437,911	677,011
Plumas	--	2	--	37	1,527	--	--
Trinity	--	1	--	4	165	--	--
Total	8	5	89,757	2,966	122,351	443,761	686,055
Copper							
	Short tons	Value	Short tons	Value	Short tons	Value	Total Value
1969, total	1,129	\$1,073,317	2,518	\$750,113	3,327	\$971,485	\$4,003,891
1970, total	2,308	2,663,374	1,772	553,381	3,514	1,076,727	5,274,299
1971:							
Alpine, Fresno, Los Angeles, Merced, Mono, Placer, San Bernardino, San Diego, Sacramento, San Joaquin, Shasta, Sierra, Stanislaus ²	1	884	113	31,243	67	21,527	162,484
Inyo	514	534,820	2,171	599,113	2,936	945,439	2,777,306
Plumas	--	--	--	--	--	--	1,527
Trinity	--	--	--	--	--	--	165
Total	515	535,704	2,284	630,356	3,003	967,016	2,941,482

¹ Does not include gravel washed.² Combined to avoid disclosing individual company confidential data.

In the Moonlight Valley area, American Exploration and Mining Co. (Amex) completed a 5-year exploration program at the Engels and Superior claims, a group of 800 claims. The company planned an open pit operation and a 70,000-ton-per-year mill. Delays in development were anticipated. The property is a heavily forested area, and the U.S. Forest Service must release cutting contracts, and the property cleared, before mining operations can begin.

Kansas City Mining Co. was exploring for copper at Copper Basin in the Whipple Mountains, southeastern San Bernardino County, and in the Palen Mountains area, Riverside County.

Exploration was also underway by several companies (unidentified but reportedly based in Salt Lake City, Utah) at the Pioneer-Lilyama mine area, near Pilot Hill, El Dorado County.

A small high-grade lens of copper ore was discovered during drilling under an Office of Minerals Exploration contract (for gold) at a property near Smartsville, Yuba County.

Gold.—Gold output dropped nearly 41 percent in 1971, owing to sharply reduced recovery at lode mining operations. Placer mining accounted for 78 percent of the total, with 2,307 ounces produced, valued at \$95,166, at 18 operations with 15 washing plants in 11 counties. Most of the placer gold was a byproduct of sand and gravel operations. Stream gravels were the principal source (15 operations); river beds and bench gravels were worked at only three operations. Principal producing counties, in order of production, were Sacramento (four operations), Stanislaus (two operations), Fresno (three operations), San Joaquin (one operation), and Plumas (two operations). Single operations were underway in Merced, Mono, Placer, Shasta, Sierra, and Trinity Counties.

The principal recovery method was by nonfloating washing plant, which accounted for 95 percent of the total output. Suction dredges (two operations) and small-scale mechanical and hand methods were responsible for the small remainder. Operations producing more than 100

Table 19.—Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1971, 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 ore:					
Smelting of concentrates ¹	621	441,176	514	2,261	3,003
Direct smelting.....	38	2,419	1	23	(?)
Total lode material.....	659	443,595	515	2,284	3,003
Placer.....	2,307	166	--	--	--
Grand total.....	2,966	443,761	515	2,284	3,003

¹ Includes byproduct recovery from tungsten ore.

² Less than ½ unit.

Table 20.—Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1971, by class of ore or other source materials

Source	Number of mines ¹	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode ore:							
Dry gold, gold-silver ²	3	715	152	5,521	1	(?)	(?)
Lead.....	3	2,792	1	1,549	(?)	135	1
Lead-zinc, zinc, and tungsten ore ² ..	3	486,250	506	436,525	514	2,148	3,002
Total.....	6	89,042	507	438,074	514	2,283	3,003
Total lode material ⁵.....	8	89,757	659	443,595	515	2,284	3,003
Placer.....	5	--	2,307	166	--	--	--
Total all sources.....	13	89,757	2,966	443,761	515	2,284	3,003

¹ Data does not add to totals shown because some mines produce more than one class of material.

² Combined to avoid disclosing individual company confidential data.

³ Less than ½ unit.

⁴ Excludes tungsten ore tonnage.

⁵ Data may not add to totals shown because of independent rounding.

ounces were 7/11 Material Inc., Stanislaus County; Claude C. Wood Inc., San Joaquin County; the Sacramento Gold Recovery Co. at the Perkins gravel pit and at Pacific Coast Aggregate Co.'s Fair Oaks property, both in Sacramento County; the Granite Construction Co. near Perkin, also in Sacramento County; and Pacific Cement Co. and Western Rock Inc. in Fresno County.

In lode mining, gold was recovered principally from lead-zinc ores at Darwin Mines, Inyo County. Small quantities were derived from straight precious metal ores and from lead ores. Total recoverable output of five producers in four counties was only 659 ounces, compared with 2,735 ounces in 1970. C. B. Lovestedt stockpiled a small tonnage of ore and planned a small mill at the Zaca mine, Alpine County, which was owned by Siskon Corp., Reno, Nev.

In Mono County, local claim holders were conducting exploration drilling for

gold and silver in the Masonic district, and Phelps Dodge Corp. continued sampling in mine dumps and underground workings in the Bodie district. Cyprus Mines Corp. conducted exploration drilling at Copper Mountain.

Office of Minerals Exploration projects for gold were pending at the Brown Bear mine, near Lewiston, Trinity County, and the Lucky Jack mine in the Granite Basin area, Plumas County.

Iron Ore.—Shipments of iron ore concentrate and pellets from the Kaiser Steel Corp.'s Eagle Mountain mine, Riverside County, totaled 4,704,000 short tons (2,439,000 tons of pellets, and 2,265,000 tons of concentrate), a substantial reduction from the 1970 rate. These raw materials went to the Kaiser steel works at Fontana, the ports at Long Beach and Los Angeles for export to Japan, and, in relatively small quantities, the domestic cement industry. The loss in shipments was

attributed primarily to a dock strike affecting the export market from July 1 to October 19 and an earlier rail strike. Approximately 3.1 million tons was shipped to Fontana, and 1.6 million tons entered the export market.²²

In December, Kaiser Steel Corp. discontinued the shipment of iron ore and pellets to Japan. According to company sources, the availability of high-grade iron ore at lower prices in world markets, coupled with reduced world demand, made the export of Eagle Mountain ore and pellets uneconomic. As a result of this decision, mine production was scheduled for a cutback of nearly 50 percent, and employment at the mine was to be reduced substantially. In addition, the company planned to stop mining and production operations for 4 to 6 weeks early in 1972 in order to reduce stockpiles to a level for normal shipping requirements to the Fontana steel works. From 1962 to 1971, 19.5 million tons was exported to Japan. In recent years, the rate was 3 million tons per year.

Experimental underground development continued at the Black Eagle ore body, near the northwest end of the Eagle Mountain property. Two crosscuts were driven to the vein from two 3,700-foot adits. Mining would be by sublevel caving. Data on mining costs were expected to aid in determining the maximum economic stripping ratio.

Standard Slag Co. reportedly started mine development for a 2,000-ton-per-day operation at the Kingston Peak deposit (also known as the Beck or Iron Gossan deposit), near Beck Springs in the north-central Kingston Range, San Bernardino County. The company held leases and mining claims on large parts of a 20,000-acre area between the Nevada State line and the southern border of Death Valley National Monument. Standard Slag spokesmen said that the company had a contract to supply 2.5 million tons of ore to Nippon Steel Corp., Japan, over a 5-year period. Plans included construction of a concentrating plant in the Kingston area for production of a 60 percent iron concentrate, which would be hauled by trucks south to the Cima siding for rail shipment to the Los Angeles harbor. When the mine reached full production, Standard Slag expected to employ more than 50 workers at the mine and mill.

An iron (and titanium) deposit in the Joshua Tree National Monument, owned by Southern Pacific Land Co., was under evaluation for a possible land exchange outside the Monument boundary.

Iron and Steel.—United States Steel Corp., which late in 1970 had been ordered by the Bay Area Water Quality Control Board to cease dumping steel-processing wastes from its Pittsburg plant, Contra Costa County, into the ocean by April 30, 1971, announced plans for conversion of these wastes into chemical byproducts for use mainly in sewage treatment. The conversion was to be made by Imperial West Chemical Co., Antioch, Contra Costa County.

United States Steel announced the closing of its Pacific Southwest District public relations office in San Francisco at yearend. The office was established in 1947 to serve the district comprising southern California, Arizona, New Mexico, and southern Nevada. Starting in 1972, the San Francisco office would cover only southern California and southern Nevada.²⁰

A Bureau of Mines report described the iron ore deposits, prices, production costs, and supply patterns and world markets for iron ore resources in California.²¹ Production, demand, and consumption of ore and mill products in California and in world markets were projected to the year 2000.

According to its annual report, Kaiser Steel Corp. produced 2,485,437 tons of crude steel at Fontana, San Bernardino County, the lowest output since 1963. The plant operated open-hearth furnaces and the State's only basic oxygen furnace. Shipments of steel products were the lowest since 1964, totaling 1,668,000 tons in 1971. However, operations at Fontana showed improved yields and reduced costs. The 86-inch hot-strip mill and the plate mill underwent major maintenance and repair work, which should improve performance in 1972. Two of the four blast furnaces were relined; the other two were scheduled for relining in 1972. Steel tubing sales in-

²² Skillings, D.N., Jr. Kaiser Steel Corp's Eagle Mountain Iron Ore Mine. *Skillings Min. Rev.*, v. 61, No. 3, Jan. 15, 1972, pp. 14-20.

²⁰ American Metal Market. U.S. Steel Closing Southern California PR Office. V. 78, No. 248, Dec. 29, 1971, p. 5.

²¹ Moore, Lyman. Economic Evaluation of California-Nevada Iron Resources and Iron Ore Markets. BuMines IC 8511, 1971, 207 pp.

creased, following the acquisition of the tubing division, M. S. L. Industries Inc., in 1970. Kaiser reported investing \$2.5 million per year in environmental control at Fontana. Equipment was installed for control of emissions from the sinter plant.

United States Steel Corp. at Torrance and Bethlehem Steel Corp. at Vernon, both in Los Angeles County, produced open-hearth and electric-arc steel from out-of-State pig iron and local scrap. Six smaller steel plants, operating on scrap, were Armco at Torrance, Southwest Steel Rolling Mills at Watts, and Soule Steel Co. at Long Beach, Los Angeles County; Judson Steel Corp. at Emeryville and Pacific States Steel Corp. at Union City, Alameda County; and Etiwanda Steel Producers Inc., San Bernardino County. These plants produced electric-arc steel, except for Pacific States, which operated open-hearth furnaces.

Airco Vacuum Metals Div., Airco Inc., produced a high-purity steel and super-pure stainless steel at its \$15 million plant in Berkeley. The company claimed its production facilities produced no air or water pollution and no industrial wastes to be dumped on the environment. Power was from a battery of Varian super power tetrodes, which fired a large electron beam furnace. There were 22 tetrodes, rated at 200 kilowatts each. The process and equipment were developed by Airco Temescal, a division of Airco Vacuum.

The steelmaking plant, which went on-stream early in the year, produced steel by electron beam continuous hearth refining, conducted in a high vacuum. The stainless steel reportedly was a new alloy, containing 26 percent chromium and 1 percent molybdenum, with high strength and corrosion resistance. The output rate was 120 tons per day.²³

Slag.—Steel slag from Kaiser's Fontana plant was processed by International Mill Service (IMS), also at Fontana. After the material was crushed and screened, residual iron is recovered by magnetic separation and returned to the Kaiser plant.

Scrap.—Steel companies in Japan, which for more than a year had not purchased iron and steel scrap in California, placed orders for more than 100,000 tons following an increase in value of the yen in relation to the dollar. Prior to 1970, Japan

was taking about 125,000 tons of scrap per month, shipped from San Francisco Bay ports, and 75,000 tons per month from Los Angeles ports. During this period, the scrap price had risen from \$30 per ton to \$50 per ton. With the cessation of Japanese purchases, the price dropped to \$25 per ton. Unlike Los Angeles, the San Francisco Bay Area has had limited outlets for scrap since United States Steel Corp. and Bethlehem Steel Corp. terminated steelmaking operations in the area several years ago.

Lead.—Mine production, in terms of recoverable lead content, increased nearly 29 percent in 1971. Lead was produced in three counties (Alpine, Inyo, and San Diego). Darwin Mines in Inyo County accounted for 94 percent of the output.

The 85-year-old lead smelter of American Smelting and Refining Co. at Selby, Contra Costa County, ceased production at yearend 1970. During 1971, activity was limited to cleanup and dismantling of the plant and equipment. Semirefined materials were shipped to the company's refinery in Omaha, Nebr.

A \$3 million battery plant was under construction in Los Angeles for General Battery Corp.

The California Department of Public Health planned a 1-year, \$110,000 study of lead levels in the State's environment. Five localities—Benicia and Crockett in the San Francisco Bay Area, two in the Los Angeles metropolitan area, and one remote rural area (undetermined)—were to be sampled to determine the lead content of the air, water, food, grass, and the inhabitants. The Bay Area sites were selected because of their proximity to the former lead smelter at Selby. Lead levels were reportedly high in parts of the Los Angeles basin because of heavy vehicular traffic.

According to the editors of Clear Creek, an environmental magazine published in San Francisco, an Environmental Protection Agency (EPA) report on atmospheric lead content in Los Angeles and six other cities allegedly was suppressed because of pressures from the oil and lead industries. Reportedly, the study was financed by the National Air Pollution Control Administration which later became a part of EPA, the American Petroleum Institute, and an

²³ American Metal Market. New Smokeless Steel-making Plant. Powered by Battery of Tetrodes. V. 78, No. 150, Aug. 4, 1971, pp. 1 and 7.

international lead-zinc research organization, under contract to Kettering Institute, Cincinnati, Ohio. According to the Clear Creek editors, representative measurements of atmospheric lead rose from an average of 2.29 micrograms per cubic meter in 1961-62, to 3.58 micrograms in 1968-69.

For the second consecutive year, the State Senate Transportation Committee killed a bill to remove lead from gasoline sold in California. Assembly Bill 399 would have required reduction of the lead content of regular and premium gasolines to specified standards within certain time limits in the Bay Area, Southern California, and the Central Valley.

Mercury.—Mining was in a downward trend during the year, owing to the depressed market and softening prices for mercury. Widespread publicity on contami-

nation by mercury, the banning of mercury for certain uses, and the efforts of users to find substitutes for mercury were significant factors in the weak market. Compared with 1970, production was reduced 29 percent in terms of quantity and 49 percent in terms of value. Shipments totaled 13,335 flasks in 1971, compared with 17,112 flasks in 1970. Mercury was produced in 12 counties; three counties (San Benito, Sonoma, and Santa Clara) accounted for nearly three-fourths of the total output.

Several mines were closed during the year and, at yearend, the number of active properties had been reduced by nearly one-half from those active in 1969. A number of these listed as active were operated at partial capacity or on a standby basis. In March, New Idria Mining & Chemical

Table 21.—Mercury production, by method of recovery

Year	Operating mines	Recovery method					Total	
		Furnaced ¹		Retorted		Unclassified (76-pound flasks) ²	76-pound flasks	Value ³
		Ore treated (short tons)	76-pound flasks	Ore treated (short tons)	76-pound flasks			
1967	78	184,656	13,942	67,895	2,438	5	16,385	\$8,018,164
1968	53	176,502	19,494	40,380	1,918	5	21,417	11,470,089
1969	72	215,495	16,093	37,199	2,387	W	18,480	9,333,139
1970	51	222,495	17,587	15,005	547	459	18,593	7,581,668
1971	38	129,399	12,697	16,704	536	W	13,233	3,869,462

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

¹ Includes ore and mercury from dumps not separable.

² Includes mercury recovered from old surface ores, dumps, and placers.

³ Value calculated at average New York price.

Table 22.—Principal producing mercury mines in 1971 ¹

County	District	Operator	Mine	Ore treatment method	Remarks
San Benito	New Idria	New Idria Mining and Chemical Co.	New Idria	Rotary furnace	Underground and surface mining. Output reduced steadily during year.
Santa Barbara	Los Prietas	Sunbird Mines, Ltd.	Gibraltar	do	Open pit mine.
Santa Clara	New Almaden	Guadalupe Mining Co.	Guadalupe	do	Underground mining by lessee; royalty basis.
Sonoma	Western Mayacmas	Sulfur Creek Mining Co.	Culver-Baer	do	Surface mining on Little Sulfur Creek; ore trucked to Big Sulfur Creek.
Do	Guerneville	Sonoma Mines Inc.	Mt. Jackson	do	Underground mining; mining curtailed in lower levels.

¹ Mines producing more than 1,000 flasks per year. In addition, seven mines were in the 100- to-1,000-flask class and about 10 were in the less-than-100-flask class.

Source: California Department of Conservation, Division of Mines and Geology.

Co., the State's principal producer, temporarily closed the New Almaden and Guadalupe mines, near San Jose, Santa Clara County because of continued weakening of the mercury price. In July, two former workers leased the New Almaden mine from the company and operated the smaller of two furnaces at about half capacity.

Quicksilver Products Inc. (QPI), San Francisco, which buys and sells prime virgin mercury and also distills to higher purity, closed its Precision Chemical Co., which manufactured mercurials, owing to the poor market. QPI continued to provide a redistillation service on a toll basis.

Late in the year, decisions by two major out-of-State companies to close mercury-cell soda plants would probably generate a larger mercury surplus and lead to further curtailment of mercury mining operations in California.

A report, *Distribution of Mercury in Surface Sediments in San Francisco Bay Estuary*, issued as Basic Data Contribution 14 of the San Francisco Bay Region Environment and Resources Planning Study, was issued in June. It was prepared jointly by the U.S. Geological Survey and the Research and Technology Group, Department of Housing and Urban Development. Based on a conservative average concentration of 0.25 part per million, it was estimated that a layer of sediments 1 foot thick in the floor of the estuary, which is 430 square miles in area, would contain 113 tons of mercury.

Another report, *Mercury in the California Environment*, compiled by the Interagency Committee on Environmental Mercury and published under the Department of Public Health's Environmental Health and Consumer Protection Program, indicated that although fish from both fresh and estuarine waters in California contain mercury, no direct evidence was found that California residents were adversely affected by these residues.

SB 309 (Chap. 1669), enacted into law during the year, directed the Secretary of the Resources Agency to conduct a study of the use of mercury and mercury compounds and their effects on humans and the environment, the disposal of mercury-bearing wastes, and to submit a report on the findings to the Legislature on or before June 30, 1973.

Late in the year, EPA proposed emission standards for furnace plants at mercury mines. Most operators were of the opinion that large capital outlays for new equipment would be necessary to meet these standards.

Molybdenum.—Shipments of molybdenum contained in concentrates was nearly 39 percent higher than in 1970, in terms of quantity, although value was lower because of depressed prices. The only producer, Union Carbide Corp. at the Pine Creek mine, Inyo County, marketed molybdenum concentrate as a coproduct of tungsten ores containing an average of 0.02 percent MoS₂.

Nickel.—There was renewed interest in nickel prospects when Hanna Mining Co. purchased the lateritic deposits at Red Mountain and Little Red Mountain, near Leggett, Mendocino County. Ore reserves were estimated at 35 million tons at 0.79 percent nickel. The lateritic material reportedly is leachable and may have potential despite the low grade.

Rare-Earth Minerals.—Molybdenum Corp. of America (Molycorp), the only producer of the rare-earth minerals in California and the world's leading producer, reported an increase of 60 percent in sales over those in 1970, reaching \$11,972,000 in 1971.²⁴ Production of bastnäsite at Mountain Pass, San Bernardino County, increased 8 percent, reaching 10,828 tons rare-earth oxides (REO). The improved position in production and sales of rare-earth minerals and metals was attributed to continued diversification of applications for rare-earth products. However, operations at the Mountain Pass mine, concentrating mill, and chemical products plant remained at about 45 percent of annual capacity of 450,000 tons of ore and 25,000 tons REO. During 1971, 181,000 tons of ore was processed through the mill. About 2,500 tons REO, or 23 percent of the output, was exported in bastnäsite concentrate. In addition to REO, the facilities produced cerium hydrate, europium oxide, lanthanum oxide, and gadolinium-samarium carbonate. According to company sources, reserves of bastnäsite at a 4-percent REO and 15-foot thick cutoff, as of October 1971, were 6.4 million tons.

Silver.—Output of both lode and placer

²⁴ Molybdenum Corporation of America. 1971 Annual Report. Apr. 12, 1972, p. 2.

silver were slightly reduced, compared with 1970 output. Lode silver, which comprised essentially the entire output, was derived from lead-zinc, tungsten, and straight precious metal ores at eight mines in four counties. By far the leading producer was Darwin Mines, Inyo County, which produced nearly 88 percent of total lode silver output as a byproduct of lead-zinc mining. Other lode silver producers were C. B. Lovestedt, the Zaca gold mine, Alpine County; Union Carbide Corp. at its Pine Creek tungsten mine and Santa Rosa Mining Co. at its Santa Rosa lead mine, both in Inyo County; the H. B. Cranmer Red Iron gold mine in San Bernardino County; and the gold mine of Noble Creek Mine and Mill Development Co. and the M. D. Goodrich and Co. lead mine, both in San Diego County.

In placer mining, small quantities of silver were recovered as a byproduct of sand and gravel at nine operations in six counties (Fresno, Merced, Sacramento, San Joaquin, Shasta, and Stanislaus).

An exploration agreement was concluded between Parnasse Delaware Co., Arizona, and Pan Minerals Inc., a Nevada-based company, for exploration in the Zaca district, Alpine County. Parnasse Delaware is a wholly owned subsidiary of Société Minière et Métallurgique de Peñarroya, the major French mining company.

West Coast Silver Refining Corp., which started operations in 1970, reclaimed silver from industrial and photographic scrap generated in 11 Western States at its new plant in Campbell, Santa Clara County.

Thorium.—Gulf General Atomic Co. (GGA), a division of Gulf Energy and Environmental Systems, San Diego, announced the first fully commercial sale of its High-temperature Gas-Cooled Reactor (HTGR), which used a thorium-based nuclear fuel. The sale involved two 1,150-megawatt HTGR's to a utility company in Pennsylvania. GGA continued research and development on new and advanced high temperature thorium-based nuclear fuel materials.

Tungsten.—Production of scheelite concentrate was 30 percent lower than in 1970 owing to an extended labor strike at Union Carbide Corp.'s Pine Creek mine and mill, Inyo County, the leading tungsten producer in the United States. The

strike, which started on May 22 and was settled on August 9, idled 325 workers.

Scheelite concentrate was produced at eight mines in four counties (Fresno, Inyo, Kern, and San Bernardino). The Pine Creek mine was the predominant producer. In addition, there were 21 small undistributed operations at unknown locations.

Union Carbide was engaged in meeting State Water Quality Control Board regulations. A water-clarifying unit was installed for the treatment of effluent water from the 8,100 adit, which formerly discharged into Morgan Creek. A plant to remove certain materials, chiefly sodium sulfate, from the mill effluent was also installed.

Union Carbide purchased concentrates from small mine operators in California, Arizona, Nevada, and Utah, for treatment at its Pine Creek mill. Several producers shipped to Kennametal, Inc., in Nevada. At the Meteor claims, Riverside County, only developmental work (shaft sinking and winzing) was done.

Mines Exploration, Inc., mined a small quantity of tungsten ore at its Red Mountain mine, Atolia district, San Bernardino County, and processed ore at its mill as it became available. The company planned construction of a new flotation-gravity-leaching mill, where full production was scheduled for 1972. Feed would be from the extensive tailings piles in the district.

Las Maderas Mining and Petroleum Ltd. planned production early in 1972 at its opencut mine and mill near Fresno. A consulting engineer reported that 12,000 tons of ore containing more than 2 percent WO_3 had been blocked out. The concentrated product was to be shipped to Union Carbide Corp.²⁵

Montecito Minerals Corp. began construction of a mill for recovery of tungsten from tailings piles at the lead-silver mines near Darwin, Inyo County. Mexicanas-Colorado Corp. acquired the mining lease from The Anaconda Company. Underground mining was contracted to the Brownstone Mining Co.

Comeback Consolidated Inc. worked during the summer at its Tongo mine and 5-ton-per-day mill, 7 miles southeast of Placerville, El Dorado County. No shipments of concentrate were made. The company planned to renovate the mill equipment

²⁵ Engineering and Mining Journal, v. 173, No. 1, January 1972, p. 134.

for a more efficient operation. The Water Quality Control Board, Central Valley Region, issued waste discharge requirements for the mine and mill.

Brine samples from the Searles Lake facilities of Kerr-McGee Chemical Corp. at Trona, San Bernardino County, were being studied at the Salt Lake City Metallurgy Research Center, Federal Bureau of Mines, to determine their tungsten potential. The tungsten content of these brines is only 0.005 to 0.008 percent WO_3 , but the brines represent a large potential resource of the metal.

Uranium.—According to the Atomic Energy Commission (AEC),²⁶ two nuclear powerplants—the small 69-megawatt Humboldt Bay, Eureka, plant of Pacific Gas & Electric Co. (PG&E) and the 430-megawatt San Onofre, Orange County, plant of Southern California Edison Co. and San Diego Gas & Electric Co.—were generating electric power. As of yearend 1971, seven large-capacity nuclear plants, totaling 7,569 megawatts (electric), were authorized or in application. Construction was authorized for PG&E's Diablo Canyon units 1 and 2, near Avila, San Luis Obispo County, rated at 1,060 megawatts each and scheduled for completion in 1974 and 1975, respectively. PG&E applied for license to build twin Mendocino power reactors, near Point Arena, each of 1,128-megawatt capacity and scheduled for completion in 1978 and 1979. Construction was underway on the 913-megawatt Rancho Seco plant of the Sacramento Municipal Utility District, at Clay Station. PG&E also applied for construction license for San Onofre units 2 and 3, each of 1,140 megawatts, and scheduled for completion in 1975 and 1976, respectively.

In June, an AEC appeals board rejected conservationist efforts to rescind PG&E's construction permit for the second Diablo Canyon unit. The Mendocino units 1 and 2 were estimated to cost \$742 million. In August construction on the Rancho Seco installation was delayed by the require-

ment for an AEC full environmental review, before work could proceed.

California became one of 23 States having agreements with AEC for assumption by the State of certain regulatory authority over byproduct, source, and special nuclear materials. The joint program included the discussion of regulatory policy and practice and the exchange of information on regulations and licensing, inspection, and enforcement data.

AB 2491 (Chap. 1456), among other things, repealed the California Atomic Energy Development and Radiation Protection Law and enacted California Atomic Energy Development Law, relating to coordination of laws, regulations, and programs on atomic energy. In addition to AEC, license for construction of nuclear powerplants had to be approved by the California Public Utilities Commission. New environmental standards for construction of generating plants (nuclear, fossil fuel, or hydroelectric) and transmission lines were proposed by the Commission. A new rule would require application to the Commission 5 years before anticipated construction at a new site and 1 year for construction at an existing plant. These regulations would prevent utility companies from seeking quick approval of requests on the basis of power shortages. The proposed regulations would require consideration of total environmental impact by the Commission.

Zinc.—Darwin Mines, Inyo County, again was the predominant source of mined zinc, accounting for nearly 98 percent of total recoverable output, although output dropped nearly 15 percent, compared with 1970 output. Zinc was produced at five properties in four counties. It was a byproduct of precious metals ore at the Zaca mine, Alpine County. Santa Rosa Mining Co. was a small producer in Inyo County. Small quantities came from unknown sources in Los Angeles and San Diego Counties.

²⁶ U.S. Atomic Energy Commission. Annual Report to Congress for 1971. January 1972, pp. 221-222.

Table 23.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos:			
Atlas Asbestos Co.....	P.O. Box 805 Coalinga, Calif. 93210	Open pit mine..	Fresno.
Coalinga Asbestos Co.....	P.O. Box 1045 Coalinga, Calif. 93210	....do.....	Do.
Pacific Asbestos Corp.....	P.O. Box 127 Copperopolis, Calif. 95228	....do.....	Calaveras.
Union Carbide Corp.....	P.O. Box K King City, Calif. 93930	....do.....	San Benito.
Barite:			
Yuba Minerals & Milling Co.....	P.O. Box 1478 Bakersfield, Calif. 93302	....do.....	Shasta.
Boron minerals and compounds:			
Kerr-McGee Chemical Corp.....	OMB-508, Kerr-McGee Bldg. Oklahoma City, Okla. 73102	Dry lake brines..	San Bernardino.
Stauffer Chemical Co.....	636 California St. San Francisco, Calif. 94119	....do.....	Do.
United States Borax & Chemical Corp.	P.O. Box 75128, Stanford Station Los Angeles, Calif. 90005	Open pit mine..	Inyo and Kern.
Bromine and bromine compounds:			
Kerr-McGee Chemical Corp.....	OMB-508, Kerr-McGee Bldg. Oklahoma City, Okla. 73102	Dry lake brines..	San Bernardino.
Calcium magnesium chloride:			
Leslie Salt Co.....	P.O. Box 364 Newark, Calif. 94560	....do.....	Do.
National Chloride Co. of America	Suite 803, Willflower Bldg. 615 South Flower St. Los Angeles, Calif. 90017	....do.....	Do.
Carbon dioxide:			
Standard Oil Co.....	225 Bush St. San Francisco, Calif. 94120	Natural gasoline processing plant.	Kern.
Cement:			
American Cement Corp.....	2404 Wilshire Blvd. Los Angeles, Calif. 90057	Dry process portland cement plants.	Riverside and San Bernardino.
Calaveras Cement Div., The Flintkote Co.	215 Market St. San Francisco, Calif. 94104	Wet and dry process portland cement plants.	Calaveras and Shasta.
California Portland Cement Co..	612 South Flower St., Mobil Bldg. Los Angeles, Calif. 90017	Dry process portland cement plants.	Kern and San Bernardino.
Ideal Cement Co., Div. of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	Wet process portland cement plants.	San Benito and San Mateo.
Kaiser Cement & Gypsum Corp...	Permanente Rd. Permanente, Calif. 95104	....do.....	San Bernardino and Santa Clara.
Monolith Portland Cement Co....	Box 65677, Glassell Station Los Angeles, Calif. 90065	....do.....	Kern.
Pacific Cement & Aggregates Division, Lone Star Cement Corp.	400 Alabama St. San Francisco, Calif. 94110	Dry process portland cement plant.	Santa Cruz.
Pacific Western Industries, Inc....	3810 Wilshire Blvd. Los Angeles, Calif. 90005	....do.....	Kern.
Southwestern Portland Cement Co.	1034 Wilshire Blvd. Los Angeles, Calif. 90017	Wet and dry process portland cement plant.	San Bernardino.
Clays and shale:			
American Cement Corp.....	P.O. Box 832 Riverside, Calif. 92501	Open pit mine..	Orange, Riverside, San Bernardino.
Atkinson Brick Co.....	13633 South Central Ave. Los Angeles, Calif. 90059	....do.....	Los Angeles.
Basalt Rock Co., Inc.....	8th and River Sts. Napa, Calif. 94458	....do.....	Napa.
Calaveras Cement Div., The Flintkote Co.	San Andreas, Calif. 95249	....do.....	Amador, Calaveras, Shasta.
California Non-Metallics.....	P.O. Box 328 Trabuco Canyon, Calif. 92678	....do.....	Orange.
Corona Clay Co.....	628 Lancer Lane Corona, Calif. 91720	....do.....	Riverside.
Crestlite Inc., Div. of Susquehanna Corp.	Camino De Estrella San Clemente, Calif. 92672	....do.....	Orange.
Davidson Brick Co.....	4701 East Floral Ave. Los Angeles, Calif. 90022	....do.....	Los Angeles.
Excel Mineral Co.....	3451 East 26th St. Los Angeles, Calif. 90023	....do.....	Kern.
Ideal Cement Co., Div. of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	....do.....	San Mateo and Santa Cruz.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clays and shale—Continued			
Interpace Corp.....	2901 Los Feliz Blvd. Los Angeles, Calif. 90039	Open pit mine..	Amador, Placer, Riverside, San Bernardino, Sutter, Yuba.
Kaiser Industries Corp.....	300 Lakeside Dr. Oakland, Calif. 94612	...do.....	Alameda.
Lightweight Processing Co.....	650 South Grand Ave. Los Angeles, Calif. 90017	...do.....	San Bernardino and Ventura.
Lincoln Clay Products.....	P.O. Box 367 Lincoln, Calif. 95648	...do.....	Placer.
L. P. McNear Brick Co.....	P.O. Box 1380 San Rafael, Calif. 94902	...do.....	Marin.
Mission Valley Brick Co.....	P.O. Box 3217 San Diego, Calif. 92103	...do.....	San Diego.
Monolith Portland Cement Co.....	Box 65677, Glassell Station Los Angeles, Calif. 90065	...do.....	Kern.
Pacific Cement & Aggregates.....	400 Alabama St. San Francisco, Calif. 94110	...do.....	Santa Cruz.
Pacific Clay Products, Inc.....	1255 West 4th St. Los Angeles, Calif. 90017	...do.....	Amador, Orange, Riverside.
Port Costa Products Co.....	P.O. Box 5 Port Costa, Calif. 94569	...do.....	Contra Costa.
Coal (lignite):			
Alpco Div. of Interpace Corp.....	P.O. Box 787 Ione, Calif. 95640	Strip mine.....	Amador.
Copper:			
Union Carbide Corp., Mining & Metals Div.	270 Park Ave., 38th Floor New York, N.Y. 10017	Underground mine.	Inyo.
West Hill Exploration Inc., T.A.C. Darwin Mines Dept.	Lone Pine, Calif. 93545	...do.....	Do.
Diatomite:			
GREFCO, Inc.....	630 Shatto Pl. Los Angeles, Calif. 90005	Open pit mine..	Santa Barbara.
Johns-Manville Products Corp.....	Lompoc, Calif. 93436	...do.....	Do.
Feldspar:			
Wedron Silica Co.....	P.O. Box 150 Pacific Grove, Calif. 93950	...do.....	Monterey.
Owens-Illinois Glass Co.....	P.O. Box 1035-1036 Toledo, Ohio 43601	...do.....	Do.
Gold:			
Dickey Exploration Co.....	Alleghany, Calif. 95901	Underground mine.	Sierra.
Heavy Metals Tech. Corp.....	406 Wilshire Blvd., Suite 204 Santa Monica, Calif. 90401	...do.....	San Bernardino.
Claude B. Lovestedt.....	P.O. Box 1496 Carson City, Nev. 89701	...do.....	Alpine.
West Hill Exploration, Inc., T.A.C. Darwin Mines Dept.	Lone Pine, Calif. 93545	...do.....	Inyo.
Gypsum:			
H. M. Holloway, Inc.....	714 6th St. Wasco, Calif. 93280	Open pit mine..	Kern.
Tembler Gypsum Co.....	Carrisa Plains, Star Rte. Box 80 Santa Margarita, Calif. 93453	...do.....	Do.
United States Gypsum Co.....	101 South Wacker Dr. Chicago, Ill. 60606	Open pit mine and calcining plant.	Imperial.
Iron ore: Kaiser Steel Corp.....	P.O. Box 158 Eagle Mtn., Calif. 92241	...do.....	Riverside.
Lead:			
Bare & Sherrod.....	P.O. Box 538 Lone Pine, Calif. 93545	Underground mine.	Inyo.
West Hill Exploration Inc., T.A.C. Darwin Mines Dept.	Lone Pine, Calif. 93545	...do.....	Do.
Lime:			
American Crystal Sugar Co.....	Box 419 Denver, Colo. 80201	Shaft kiln.....	Yolo.
Diamond Springs Lime Co.....	P.O. Box 407 Diamond Springs, Calif. 95619	Rotary kiln and continuous hy- drator.	El Dorado.
The Flintkote Co.....	P.O. Box 57367, Flint Station Los Angeles, Calif. 90057	Shaft and rotary kilns, contin- uous hydrator.	Contra Costa and Tuolumne.
Holly Sugar Corp.....	Box 1052 Colorado Springs, Colo. 80901	Shaft kilns and continuous hy- drator.	Glenn, Imperial, Orange, San Joaquin.
Kaiser Aluminum & Chemical Corp.	Moss Landing, Calif. 95039	Rotary kiln and continuous hy- drator.	Monterey.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Lime—Continued			
Pfizer Inc.	P.O. Drawer AD Victorville, Calif. 92392	Fluidized-bed kiln and con- tinuous hy- drator.	San Bernardino.
Spreckels Sugar Co.	2 Pine St. San Francisco, Calif. 94111	Shaft and rotary kilns.	Monterey and Yolo.
Stauffer Chemical Co.	636 California St. San Francisco, Calif. 94119	Rotary kiln and continuous hydrator.	San Bernardino.
Union Sugar Div.	230 California St. San Francisco, Calif. 94111	Shaft kiln.	Santa Barbara.
Lithium minerals:			
Kerr-McGee Chemical Corp.	OMB-508, Kerr-McGee Bldg. Oklahoma City, Okla. 73102	Dry lake brines.	San Bernardino.
Magnesium compounds:			
FMC Corp.	P.O. Box 344 Newark, Calif. 94560	Salt works bitterns.	San Diego.
Kaiser Aluminum & Chemical Corp.	Moss Landing, Calif. 95039.	Sea water processing.	Monterey.
Merck & Co., Inc.	Rahway, N.J. 07065. ....	.....do.....	San Mateo.
Mercury:			
Buena Vista Mines, Inc.	P.O. Box 753 Paso Robles, Calif. 93446	Underground mine.	San Luis Obispo.
Buttes Gas & Oil Co.	2150 Franklin St. Oakland, Calif. 94612	Open pit mine..	Marin.
Guadalupe Mining Co.	14900 Guadalupe Mine Rd. San Jose, Calif. 95120	Underground mine.	Santa Clara.
Hugh C. Ingle, Jr.	P.O. Box 553 Middletown, Calif. 95461	Open pit and underground mines.	Napa.
International Resources Inc.	2225 Hillside Dr. Santa Rosa, Calif. 95404	.....do.....	Colusa, Lake, Sonoma.
Lansdowne Mining & Manu- facturing Co.	P.O. Box 144 Lower Lake, Calif. 95457	Open pit mine..	Napa.
Mercury Fox, Ltd.	415 7th St. Petaluma, Calif. 94952	.....do.....	Marin.
New Idria Mining & Chemical Co.	3457 South Cedar Fresno, Calif. 93745	Open pit and underground mines.	San Benito and Santa Clara.
New Klau Mining & Construction Co.	Adelaide Rd. Paso Robles, Calif. 93446	Open pit mine..	San Luis Obispo.
One-Shot Mining Co.	755 Mathilda Ave. Sunnyvale, Calif. 94086	.....do.....	Napa.
Quad Metals Corp.	827 Lincoln Bldg. Spokane, Wash. 99201	Underground mine.	Inyo.
Sonoma Mines, Inc.	P.O. Box 226 Guerneville, Calif. 95446	.....do.....	Sonoma.
Sulphur Creek Mining	201 Ridge Rd. Ukiah, Calif. 95482	.....do.....	Do.
Sunbird Mines, Ltd.	1018-A Anacapa St. Santa Barbara, Calif. 93101	Open pit mine..	Santa Barbara.
Molybdenum:			
Union Carbide Corp., Mining & Metals Div.	270 Park Ave., 38th Floor New York, N.Y. 10017	Underground mine.	Inyo.
Natural gas:			
Amerada Div., Amerada Hess Corp.	Box 417 Rio Vista, Calif. 94571	Gasfield.	Contra Costa, Sacramento, San Joaquin, Solano.
Occidental Petroleum Corp.	10889 Wilshire Blvd. Los Angeles, Calif. 90024	.....do.....	Colusa, Contra Costa, Sacra- mento, San Joaquin, Solano, Sutter, Yolo.
Shell Oil Co.	1008 West 6th St. Los Angeles, Calif. 90017	.....do.....	Contra Costa, Fresno, Kern, Kings, Madera, Santa Barbara, Solano, Tulare, Yolo.
Signal Oil and Gas Co.	1010 Wilshire Blvd. Los Angeles, Calif. 90017	.....do.....	Contra Costa, Sacramento, San Joaquin, Solano, Yolo.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Natural gas—Continued			
Standard Oil Co. of California.....	225 Bush St. San Francisco, Calif. 94120	Gasfield	Butte, Contra Costa, Glenn, Kern, Kings, Los Angeles, Sacramento, San Joaquin, Santa Barbara, Solano, Sutter, Tulare, Ventura, Yolo.
Texaco, Inc.....	3350 Wilshire Blvd. Los Angeles, Calif. 90005	....do.....	Fresno, Glenn, Humboldt, Kern, Madera, Sacramento, San Joaquin, Santa Barbara, Solano, Sutter, Tehama.
Union Oil Co. of California.....	461 South Boylston Los Angeles, Calif. 90017	....do.....	Contra Costa, Kern, Sacramento, San Joaquin, Solano.
Natural gas liquids:			
Atlantic Richfield Co.....	445 South Figueroa St. Los Angeles, Calif. 90054	Natural gasoline plants.	Kern, Santa Barbara, Ventura.
Getty Oil Co.....	P.O. Box 54050 Los Angeles, Calif. 90005	....do.....	Kern and Ventura.
Mobil Oil Corp.....	612 South Flower St. Los Angeles, Calif. 90054	....do.....	Los Angeles.
Shell Oil Co.....	1008 West 6th St. Los Angeles, Calif. 90054	....do.....	Kern, Los Angeles, Santa Barbara, Ventura.
Standard Oil Co. of California.....	225 Bush St. San Francisco, Calif. 94120	....do.....	Fresno, Kern, Kings, Los Angeles, Orange, Santa Barbara, Ventura.
Texaco, Inc.....	3350 Wilshire Blvd. Los Angeles, Calif. 90005	....do.....	Los Angeles, Santa Barbara, Ventura.
Union Oil Co. of California.....	P.O. Box 7600 Los Angeles, Calif. 90054	....do.....	Fresno, Kern, Los Angeles, Orange, Santa Barbara, Ventura.
Peat:			
Peter J. Gambetta.....	Route 1, Box 78 Brentwood, Calif. 94513	Reed-sedge bog.	Contra Costa.
R. W. McClellan, Jr.....	151 Commercial Way Costa Mesa, Calif. 92627	Humus bog.....	Orange.
Vita-Peat Co., Inc.....	P.O. Box 428 Bethel Island, Calif. 94511	Reed-sedge bog.	Contra Costa.
Perlite:			
American Perlite Co.....	11831 Vose St. North Hollywood, Calif. 91605	Open pit mine..	Inyo.
Petroleum:			
Atlantic Richfield Co.....	5900 Cherry Ave. Long Beach, Calif. 90805	Oilfields.....	Kern, Los Angeles, Orange, San Luis Obispo, Santa Barbara, Ventura.
Belridge Oil Co.....	1300 West 4th St. Los Angeles, Calif. 90017	....do.....	Kern and Santa Barbara.
Chanslor-Western Oil & Development Co.	4549 Produce Plaza Los Angeles, Calif. 90058	....do.....	Kern, Los Angeles, Orange, Ventura.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Petroleum—Continued			
Getty Oil Co.....	3810 Wilshire Blvd. Los Angeles, Calif. 90005	Oilfields.....	Fresno, Kern, Los Angeles, Monterey, Orange, Riverside, San Bernardino, Santa Barbara, Ventura.
Gulf Oil Corp.....	5400 Rosedale Hwy. Bakersfield, Calif. 93302	....do.....	Fresno, Kern, Los Angeles, Orange, Santa Barbara, Ventura.
Humble Oil & Refining Co.....	1800 Avenue of the Stars Los Angeles, Calif. 90067	....do.....	Do.
Long Beach (City of), Dept. of Oil Properties.	925 Harbor Plaza Long Beach, Calif. 90801	....do.....	Los Angeles.
Mobil Oil Corp.....	612 South Flower St. Los Angeles, Calif. 90017	....do.....	Fresno, Kern, Kings, Los Angeles, Monterey, Orange, San Benito, San Luis Obispo, Santa Barbara, Ventura.
Occidental Petroleum Corp.....	10889 Wilshire Blvd. Los Angeles, Calif. 90024	....do.....	Contra Costa, Kern, Los Angeles, Orange.
Phillips Petroleum Co.....	1306 Santa Barbara St. Santa Barbara, Calif. 93104	....do.....	Santa Barbara.
Shell Oil Co.....	1008 West 6th St. Los Angeles, Calif. 90017	....do.....	Contra Costa, Fresno, Kern, Los Angeles, Orange, San Benito, Santa Barbara, Ventura.
Signal Oil and Gas Co.....	1010 Wilshire Blvd. Los Angeles, Calif. 90017	....do.....	Fresno, Kern, Los Angeles, Orange, San Luis Obispo, Santa Barbara, Ventura.
Standard Oil Co. of California.....	225 Bush St. San Francisco, Calif. 94120	....do.....	Contra Costa, Fresno, Kern, Kings, Los Angeles, Orange, San Luis Obispo, Santa Barbara, Ventura.
Texaco, Inc.....	3350 Wilshire Blvd. Los Angeles, Calif. 90005	....do.....	Fresno, Kern, Los Angeles, Monterey, Orange, Santa Barbara, Ventura.
Union Oil Co. of California.....	461 South Boylston Los Angeles, Calif. 90017	....do.....	Fresno, Kern, Los Angeles, Orange, San Luis Obispo, Santa Barbara, Ventura.
Union Pacific Railroad Co.....	5480 Ferguson Dr. Los Angeles, Calif. 90022	....do.....	Los Angeles and Ventura.
Potassium salts:			
Kerr McGee Chemical Corp.....	OMB-508, Kerr-McGee Bldg. Oklahoma City, Okla. 73102	Dry lake brines.	San Bernardino.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Pumice:			
Aiken Builders Products	P.O. Box 878 Las Vegas, Nev. 89101	Open pit mine ..	San Bernardino.
Cinder Products Co.	3450 Lakeshore Ave. Oakland, Calif. 94610	...do.....	Lake.
Alvin Lindgren	Redding Highway Alturas, Calif. 96101	...do.....	Siskiyou.
Red Lava Products of California ..	Star Rte. Clearlake, Calif. 95423	...do.....	Lake.
Shastalite Cinder Co.	P.O. Box 341 Weed, Calif. 96094	...do.....	Siskiyou.
Rare-earth metals:			
Molybdenum Corp. of America	Mountain Pass via Nipton, Calif. 92366	...do.....	San Bernardino.
Salt:			
Leslie Salt Co.	505 Beach St. San Francisco, Calif. 94111	Solar evaporation and open pit mine.	Alameda, Napa, San Bernar- dino, San Mateo.
Metropolitan Water Dist. of Southern California.	P.O. Box 54153 Los Angeles, Calif. 90054	Solar evapora- tion.	San Bernardino.
Pacific Salt & Chemical Co.	4262 Wilshire Blvd. Los Angeles, Calif. 90021	...do.....	Do.
Standard Salt Co.	Suite 803, Wilflower Bldg. 615 South Flower St. Los Angeles, Calif. 90017	...do.....	Do.
Western Salt Co.	P.O. Box 149 San Diego, Calif. 92112	...do.....	Kern and San Diego.
Sand and gravel:			
Azusa Western, Inc.	P.O. Box 575 Azusa, Calif. 91702	Open pit mine ..	Los Angeles.
Baldwin Contracting Co., Inc.	P.O. Box 311 Marysville, Calif. 95901	...do.....	Butte and Yuba.
Basalt Rock Co., Inc.	P.O. Box 2540 Napa, Calif. 94558	...do.....	Sonoma.
Blue Diamond Concrete Materials Div., The Flintkote Co.	P.O. Box 2678 Los Angeles, Calif. 90054	...do.....	Calaveras, Los Angeles, Orange.
California Materials Co.	P.O. Box 845 Sun Valley, Calif. 91352	...do.....	Los Angeles.
Chandler's Palos Verdes Sand & Gravel Co.	P.O. Box 295 Lomita, Calif. 90717	...do.....	Do.
Consolidated Rock Products Co.	Box 2950, Terminal Annex Los Angeles, Calif. 90054	...do.....	Los Angeles, Orange, San Bernardino, Ventura.
H. G. Fenton Material Co.	702 Washington St. San Diego, Calif. 92112	...do.....	San Diego.
Granite Construction Co.	7218 Perkins Branch Sacramento, Calif. 93940	...do.....	Sacramento and Yolo.
Kaiser Industries Corp.	300 Lakeside Dr. Oakland, Calif. 94612	...do.....	Alameda, Contra Costa, Glenn, Santa Clara, Santa Cruz, Sonoma.
Kern Rock Co.	P.O. Box 3329 Bakersfield, Calif. 93305	...do.....	Kern.
Livingston-Graham, Inc.	5500 North Peck Rd. El Monte, Calif. 91731	...do.....	Los Angeles, Orange, San Bernardino, Ventura.
Manning Bros. Rock & Sand Co.	P.O. Box 204 Irwindale, Calif. 91706	...do.....	Los Angeles.
Massey Sand & Rock Co.	P.O. Drawer P Indio, Calif. 92201	...do.....	Riverside.
Nelson & Sloan	P.O. Box 488 Chula Vista, Calif. 92012	...do.....	San Diego.
Niles Sand & Gravel Co., Inc.	P.O. Box 2248 Fremont, Calif. 94536	...do.....	Alameda.
Owens-Illinois Glass Co.	P.O. Box 1035 Toledo, Ohio 43601	...do.....	Amador and Riverside.
Owl Rock Products Co.	P.O. Box 47 Irwindale, Calif. 91707	...do.....	Fresno, Los Angeles, Orange, Riverside.
Owl Service Rock Co.	P.O. Box 309 Riverside, Calif. 92501	...do.....	San Bernardino.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
Pacific Cement & Aggregates, Div. of Lone Star Cement Corp.	400 Alabama St. San Francisco, Calif. 94110	Open pit mine...	Alameda, Fresno, Monterey, Sacramento, San Joaquin, San Mateo, Santa Cruz, Tulare, Yolo.
Pacific Rock & Gravel Co.....	P.O. Box 844 La Habra, Calif. 90631	...do.....	San Bernardino.
Rhodes & Jamieson Ltd.....	P.O. Box 118 Oakland, Calif. 94604	...do.....	Alameda.
San Diego Consolidated Co.....	P.O. Box 3093 San Diego, Calif. 92103	...do.....	San Diego.
Southern Pacific Milling Co.....	3555 Vineyard Ave. Oxnard, Calif. 93030	...do.....	Santa Barbara and Ventura.
Standard Materials Co.....	P.O. Box 3171 Modesto, Calif. 95350	...do.....	Merced and Stanislaus.
Sully-Miller Contracting Co.....	P.O. Box 432 Orange, Calif. 92669	...do.....	Orange.
Teichert Aggregates.....	P.O. Box 15002 Sacramento, Calif. 95813	...do.....	Nevada, Sacramento, San Joaquin, Yolo, Yuba.
Triangle Rock Products, Inc.....	P.O. Box 2083 San Bernardino, Calif. 92406	...do.....	Los Angeles and San Bernar- dino.
Silver:			
Bare and Sherrod.....	P.O. Box 538 Lone Pine, Calif. 93545	Underground mine.	Inyo.
Claude B. Lovestedt.....	P.O. Box 1496 Carson City, Nev. 89701	...do.....	Alpine.
Union Carbide Corp., Mining & Metals Div.	270 Park Ave., 38th Floor New York, N.Y. 10017	...do.....	Inyo.
West Hill Exploration, Inc., T.A.C. Darwin Mines Dept.	Lone Pine, Calif. 93545	...do.....	Do.
Sodium compounds:			
Kerr-McGee Chemical Corp.....	OMB-508, Kerr-McGee Bldg. Oklahoma City, Okla. 73102	Dry lake brines..	San Bernardino.
Stauffer Chemical Co.....	Box 3050, Rincon Ave. San Francisco, Calif. 94108	...do.....	Do.
United States Borax & Chemical Corp.	P.O. Box 75128, Sanford Station Los Angeles, Calif. 90005	Open pit mine..	Kern.
Stone:			
American Cement Corp.....	P.O. Box 832 Riverside, Calif. 92501	Open quarry and underground mine.	Los Angeles, Riverside, San Bernar- dino.
Basalt Rock Co., Inc.....	P.O. Box 2540 Napa, Calif. 94558	Open quarry....	Marin, Napa, Sonoma.
Calaveras Cement Div., The Flintkote Co.	San Andreas, Calif. 95249	...do.....	Calaveras and Shasta.
California Portland Cement Co...	612 South Flower St. Los Angeles, Calif. 90017	...do.....	Kern and San Bernardino.
Connolly-Pacific Co.....	1925 Water St. Long Beach, Calif. 90802	...do.....	Los Angeles.
Diamond Springs Lime Co.....	P.O. Box 407 Diamond Springs, Calif. 95619	Open quarry and underground mine.	El Dorado.
Dumbarton Quarry Associates....	P.O. Box 487 Fremont, Calif. 94537	Open quarry....	Alameda.
East Bay Excavating Co.....	28814 Mission Blvd. Hayward, Calif. 94544	...do.....	Do.
El Dorado Limestone Co.....	P.O. Box 8 Shingle Springs, Calif. 95682	Underground mine.	El Dorado.
Felton Quarry.....	326 Fall Creek Dr. Felton, Calif. 95018	Open quarry....	Santa Cruz.
Granite Rock Co.....	P.O. Box 151 Watsonville, Calif. 95076	...do.....	San Benito.
Hein Bros. Basalt Rock Co.....	P.O. Box 162 Petaluma, Calif. 94952	...do.....	Sonoma.
Hillsdale Rock Co., Inc.....	500 Hillsdale Ave. San Jose, Calif. 95123	...do.....	Santa Clara.
Ideal Cement Co., Div., Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	Open quarry and dredge.	San Benito and San Mateo.
Kaiser Aluminum & Chemical Corp.	Moss Landing, Calif. 95039	Open quarry....	Monterey.
Kaiser Cement & Gypsum Corp....	Permanente Rd. Permanente, Calif. 95014	...do.....	San Bernardino and Santa Clara.
Kaiser Industries Corp.....	300 Lakeside Dr. Oakland, Calif. 94612	...do.....	Contra Costa.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Minerals, Pigments & Metals Div., Pfizer Inc.	P.O. Drawer AD Victorville, Calif. 92394	Open quarry	San Bernardino.
Monolith Portland Cement Co.	Box 65677, Glassell Station Los Angeles, Calif. 90065	do	Kern.
Nearby Rock Quarry, Inc.	11920 Stonebrook Ave. Los Altos, Calif. 94022	do	Santa Clara.
Pacific Cement & Aggregates	400 Alabama St. San Francisco, Calif. 94110	do	Contra Costa, San Mateo, Santa Cruz.
Pacific Western Industries, Inc.	3810 Wilshire Blvd. Los Angeles, Calif. 90005	do	Kern.
Page Mill Quarry Corp.	P.O. Box 11487 Palo Alto, Calif. 94306	do	Santa Clara.
Quarry Products, Inc.	P.O. Box 1147 Richmond, Calif. 94802	do	Contra Costa.
South Coast Asphalt Co., Inc.	P.O. Box 218 Carlsbad, Calif. 92008	do	San Diego.
Southwestern Portland Cement Co.	1034 Wilshire Blvd. Los Angeles, Calif. 90017	do	San Bernardino.
Stauffer Chemical Co.	636 California St. San Francisco, Calif. 94119	do	Inyo.
Stringfellow Constructors, Inc.	P.O. Box 6 Riverside, Calif. 92502	do	Riverside and Solano.
Syar & Harms Industries, Inc.	P.O. Box 1272 Vallejo, Calif. 94590	do	Solano.
Vinnell Mining & Materials Corp.	1145 Westminster Ave. Alhambra, Calif. 91802	do	San Bernardino.
Talc, pyrophyllite, soapstone:			
L. Grantham Corp.	1915 South Coast Hwy. Laguna Beach, Calif. 92651	Underground mine.	Inyo.
Minerals, Pigments & Metals Div., Pfizer Inc.	P.O. Drawer AD Victorville, Calif. 92394	Open pit and underground mines.	Inyo and San Bernardino.
Pomona Tile Manufacturing Co.	216 South Reservoir St. Pomona, Calif. 91766	Underground mine.	San Bernardino.
Bill Tonkin	Box 113 Lone Pine, Calif. 93545	Open pit mine	Inyo.
The United Sierra Div., Cyprus Mines Corp.	P.O. Box 1201 Trenton, N.J. 08606	Open pit and underground mines.	Inyo and San Bernardino.
Western Talc Co.	Box 368 Yermo, Calif. 92398	Open pit and underground mine.	San Bernardino.
Tungsten:			
Mines Exploration, Inc.	P.O. Box 27 Red Mountain, Calif. 92374	Underground mine.	Do.
Union Carbide Corp., Mining & Metals Div.	270 Park Ave., 38th Floor New York, N.Y. 10017	do	Inyo.
Zinc:			
Bare & Sherrod	P.O. Box 538 Lone Pine, Calif. 93545	do	Do.
West Hill Exploration, Inc., T.A.C. Darwin Mines Dept.	Lone Pine, Calif. 93545	do	Do.

The Mineral Industry of Colorado

By Andrew Kuklis ¹

Value of mineral production in Colorado for 1971 totaled \$392.7 million, a gain of \$2.9 million over that of 1970. Primarily responsible for the gain was the significantly higher valued output in the fuel and nonmetal sectors which more than offset losses in the metal group. Despite lower production of some metals, Colorado continued to lead the nation in output of molybdenum, vanadium, and tin.

Thirty-three mineral commodities were produced during the year, the same as in 1970. Of these, 14 were classed as nonmetals, 12 as metals, and seven as fuels. The metals comprised 43 percent of the total

mineral value, fuels, 38 percent, and the nonmetals, 19 percent. Based on value, the leading commodity in each group was molybdenum, petroleum, and sand and gravel.

Within the nonmetal group, nine of the commodities gained in value and five declined, compared with 1970 figures. Sheet mica was reportedly produced for the first time since 1963. Five of the mineral fuels showed increases, only coal and peat declined in value. Six of the metals decreased in value and five had increases. Twenty-one of the 33 mineral commodities produced

¹ Mining engineer, Division of Ferrous Metals.

Table 1.—Mineral production in Colorado ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays..... thousand short tons...	2 637	² \$1,503	625	\$1,334
Coal (bituminous)..... do....	6,025	35,243	5,337	33,813
Copper (recoverable content of ores, etc.)... short tons...	3,749	4,326	3,938	4,096
Feldspar..... long tons.....	426	3	510	4
Gem stones.....	NA	120	NA	125
Gold (recoverable content of ores, etc.)... troy ounces...	37,114	1,351	42,031	1,734
Lead (recoverable content of ores, etc.)... short tons...	21,855	6,827	25,746	7,106
Lime..... thousand short tons...	119	1,613	193	3,039
Mica, sheet..... thousand pounds...			8,300	4
Natural gas (marketed)..... million cubic feet...	105,804	15,553	108,537	16,932
Natural gas liquids:				
LP gases..... thousand 42-gallon barrels...	1,542	2,529	1,653	3,190
Natural gasoline and cycle products..... do....	745	1,937	929	2,462
Peat..... thousand short tons...	34	210	28	156
Petroleum (crude)..... thousand 42-gallon barrels...	24,723	78,619	27,391	92,855
Pumice..... thousand short tons...	50	263	62	W
Sand and gravel..... do....	22,261	24,190	27,000	30,155
Silver (recoverable content of ores, etc.)... thousand troy ounces...	2,933	5,194	3,390	5,241
Stone..... thousand short tons...	3,552	8,076	3,785	7,933
Uranium (recoverable content U ₃ O ₈)... thousand pounds...	2,727	15,832	2,536	15,725
Zinc (recoverable content of ores, etc.)... short tons...	56,694	17,370	61,181	19,700
Value of items that cannot be disclosed: Bentonite, beryllium concentrate, carbon dioxide (natural), cement, fluorspar, gypsum, iron ore, scrap mica, molybdenum, perlite, pyrites, salt, tin, tungsten concentrate, vanadium and value indicated by symbol W	XX	^r 169,060	XX	147,117
Total.....	XX	^r 339,824	XX	392,721
Total 1967 constant dollars.....	XX	348,666	XX	^p 341,196

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

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

² Excludes bentonite; included with "Value of items that cannot be disclosed."

had output value of over \$1 million; and nine had values exceeding \$10 million.

Of the 63 counties, only Phillips County had no mineral production. Thirty-five of the 62 counties had decreases in value of mineral production, while only 27 showed increases. Thirty-six counties had an output valued at \$1 million or more, three between \$500,000 and \$1 million, 13 between \$100,000 and \$500,000, and 10 less than

\$100,000. Lake County with \$87.2 million and Rio Blanco County with \$46.8 million were the leading counties; production from the two counties together represented about 34 percent of the State value.

Employment and Injuries.—Preliminary data for 1971 and final data for 1970 for employment and injuries in the mineral industries, excluding mineral fuels except coal and peat, are shown in table 4.

Table 2.—Value of mineral production in Colorado, by county
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Adams.....	\$7,319	\$8,986	Petroleum, sand and gravel, natural gas, lime, gold, stone, lead, copper, silver, zinc.
Alamosa.....	W	W	Sand and gravel, stone, peat.
Arapahoe.....	3,798	14,178	Petroleum, sand and gravel, natural gas liquids, natural gas, stone.
Archuleta.....	W	W	Petroleum, sand and gravel, natural gas, stone.
Baca.....	1,401	1,238	Natural gas, sand and gravel, petroleum.
Bent.....	W	27	Sand and gravel, natural gas, petroleum, clays.
Boulder.....	8,592	14,730	Cement, sand and gravel, fluorspar, stone, lime, clays, peat, gold, petroleum, silver, copper.
Chaffee.....	W	W	Stone, sand and gravel, peat.
Cheyenne.....	1,954	1,380	Petroleum, sand and gravel, stone, natural gas.
Clear Creek.....	W	W	Molybdenum, sand and gravel, stone, mica.
Conejos.....	65	W	Sand and gravel, silver, gold.
Costilla.....	W	W	Pumice.
Crowley.....	W	67	Sand and gravel.
Custer.....	93	78	Perlite, sand and gravel, stone, clays.
Delta.....	5,028	4,962	Coal, sand and gravel, lime.
Denver.....	W	220	Sand and gravel.
Dolores.....	1,338	681	Zinc, lead, silver, copper, sand and gravel, stone, gold, natural gas, petroleum.
Douglas.....	755	2,094	Sand and gravel, stone, clays.
Eagle.....	11,257	11,918	Zinc, lead, silver, sand and gravel, gold, copper, pumice, stone.
Elbert.....	102	374	Petroleum, sand and gravel, clays, natural gas.
El Paso.....	2,159	4,076	Sand and gravel, stone, clays.
Fremont.....	12,137	14,933	Cement, stone, coal, gypsum, sand and gravel, clays, petroleum, uranium, beryllium, feldspar.
Garfield.....	3,400	2,779	Vanadium, sand and gravel, natural gas, pumice, stone, coal.
Gilpin.....	W	20	Peat, stone, silver, lead, gold, copper.
Grand.....	W	W	Sand and gravel, stone.
Gunnison.....	6,471	7,166	Coal, sand and gravel, silver, lead.
Hinsdale.....	50	W	Stone.
Huerfano.....	199	W	Coal, sand and gravel, stone.
Jackson.....	W	W	Fluorspar, natural gas, petroleum, sand and gravel, stone.
Jefferson.....	W	9,735	Uranium, sand and gravel, clays, stone, gold, silver.
Kiowa.....	3,713	4,546	Petroleum, natural gas, sand and gravel.
Kit Carson.....	W	W	Sand and gravel, petroleum.
Lake.....	109,820	87,174	Molybdenum, tungsten, zinc, lead, gold, silver, sand and gravel, tin, copper, pyrites, stone.
La Plata.....	7,515	7,103	Natural gas, natural gas liquids, sand and gravel, petroleum, coal, stone.
Larimer.....	8,397	9,996	Cement, stone, sand and gravel, petroleum, lime, gypsum, natural gas liquids, mica.
Las Animas.....	6,186	5,410	Coal, sand and gravel, clays, stone.
Lincoln.....	W	40	Sand and gravel.
Logan.....	W	6,958	Petroleum, natural gas, natural gas liquids, sand and gravel, lime.
Mesa.....	W	5,907	Vanadium, uranium, sand and gravel, natural gas, natural gas liquids, coal, stone.
Mineral.....	W	W	Silver, zinc, lead, copper, sand and gravel, gold.
Moffat.....	9,822	9,190	Natural gas, petroleum, natural gas liquids, coal, sand and gravel.
Montezuma.....	1,081	1,372	Petroleum, sand and gravel, natural gas, carbon dioxide, stone.
Montrose.....	13,506	12,022	Vanadium, uranium, coal, sand and gravel, salt, stone.
Morgan.....	W	4,325	Natural gas liquids, petroleum, natural gas, lime, sand and gravel.
Otero.....	379	W	Lime, sand and gravel.
Ouray.....	W	W	Zinc, lead, copper, silver, gold, sand and gravel.
Park.....	163	118	Sand and gravel, peat, stone, gold.
Phillips.....	W	--	

See footnotes at end of table.

Table 2.—Value of mineral production in Colorado, by county—Continued
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Pitkin	W	W	Coal, iron ore, sand and gravel, natural gas.
Prowers	W	W	Sand and gravel, petroleum, stone.
Pueblo	\$2,314	\$3,189	Sand and gravel, lime, clays, stone.
Rio Blanco	41,254	46,843	Petroleum, natural gas, natural gas liquids, stone.
Rio Grande	W	W	Copper, sand and gravel, gold, silver, stone.
Routt	7,823	7,335	Coal, sand and gravel, petroleum, pumice, natural gas.
Saguache	57	54	Sand and gravel, stone, pumice.
San Juan	W	4,890	Zinc, lead, gold, copper, silver, natural gas, sand and gravel.
San Miguel	18,518	20,096	Vanadium, uranium, zinc, copper, lead, silver, gold, sand and gravel, natural gas, petroleum, stone.
Sedgwick	725	W	Sand and gravel, lime, stone.
Summit	855	W	Sand and gravel, zinc, lead, silver, gold.
Teller	347	248	Natural gas, peat, sand and gravel, stone.
Washington	W	12,013	Petroleum, natural gas, sand and gravel, stone.
Weld	8,295	6,817	Petroleum, coal, sand and gravel, lime, stone.
Yuma	W	W	Sand and gravel, stone.
Undistributed ¹	82,935	37,423	
Total ²	† 389,824	392,724	

¹ Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

² Includes gem stones, some stone and sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

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

Table 3.—Indicators of Colorado business activity

	1970 ^a	1971 ^b	Change, percent
Employment and labor force, annual average:			
Total labor force.....thousands	920.2	950.7	+3.3
Employment.....do	889.2	919.1	+3.4
Unemployment.....do	31.0	31.6	+1.9
Nonagricultural employment:			
Wholesale and retail trade.....do	173.4	180.8	+4.3
Finance, insurance, and real estate.....do	39.6	41.4	+4.5
Mining.....do	14.0	13.4	-4.3
Construction.....do	41.1	45.0	+9.5
Government.....do	175.5	187.0	+6.6
Services.....do	130.3	134.7	+3.4
Transportation and public utilities.....do	51.3	52.5	+2.3
Personal income:			
Total.....millions	\$8,468	\$9,263	+9.4
Per capita.....do	\$3,806	\$4,057	+6.6
Construction activity:			
New housing units authorized.....do	31,177	53,307	+71.0
Value of nonresidential construction.....millions	\$194.2	\$212.2	+9.3
Highway construction contracts awarded.....do	\$71.5	\$69.7	-2.5
Cement shipments to and within the State.....thousand 376-pound barrels	5,535	6,590	+19.1
Mineral production value.....millions	\$389.8	\$392.7	+0.7

^a Preliminary. ^b Revised.

Sources: Area Trends in Employment and Unemployment; Employment and Earnings; Survey of Current Business; Construction Review; Roads and Streets; and U.S. Bureau of Mines.

At midyear, the Oil, Chemical, and Atomic Workers Union (OCAW) signed a 3-year labor contract with American Metal Climax, Inc. (AMAX), operator of the Climax and Urad molybdenum mines and the Henderson project. The contract provided for annual wage increases of 8½, 7½, and 7 percent, respectively, for each of the next 3 years. Improved insurance coverage and retirement benefits also were included in the labor agreement. Approximately 1,651 workers were covered by the contract.

Legislation and Government Programs.

—Governor John Love signed a bill permitting women to work in Colorado coal mines.

The U.S. Bureau of Mines awarded a \$71,812 research contract to the Colorado School of Mines' Mining Engineering Department. Under the contract, a theoretical study was made of tunnel boring machines.

Aquamarine, a beautiful blue-green gem stone of beryl, was adopted as Colorado's official gem stone. State representative Kay Munson sponsored the bill which was

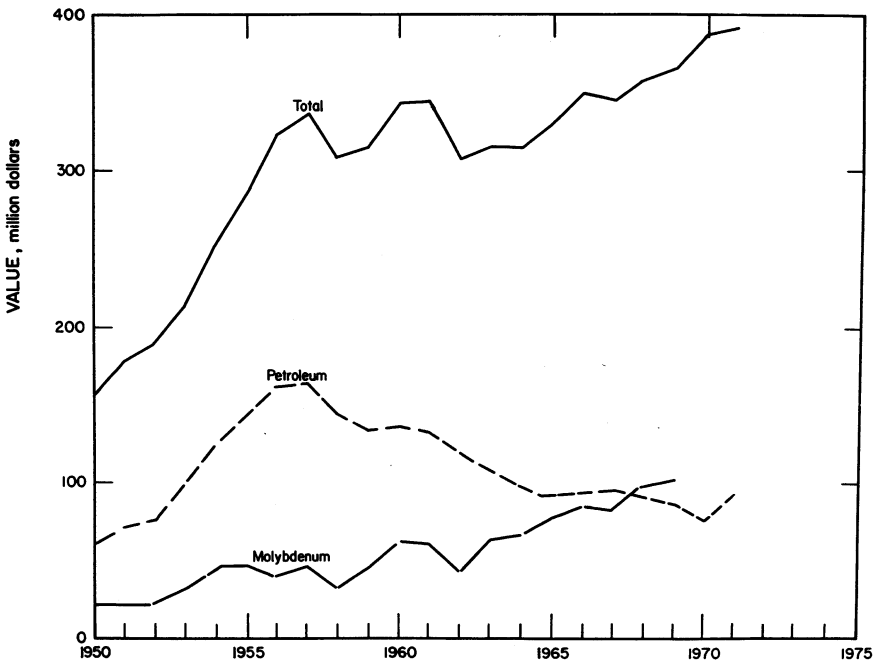


Figure 1.—Value of molybdenum, petroleum, and total value of mineral production in Colorado.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Coal.....	1,292	256	330	2,596	--	96	36.98	2,736
Peat.....	22	125	3	18	--	--	--	--
Metal.....	4,388	272	1,192	9,547	6	458	48.08	6,101
Nonmetal.....	481	219	106	844	2	52	64.01	18,656
Sand and gravel.....	1,451	201	292	2,423	1	52	21.87	3,021
Stone.....	683	246	168	1,385	--	19	13.72	215
Total ¹	8,317	251	2,091	16,812	9	672	40.51	5,276
1971: ^P								
Coal.....	1,420	242	344	2,713	1	114	42.38	3,346
Metal.....	4,300	260	1,116	8,926	3	411	46.38	4,603
Nonmetal ²	550	212	116	928	--	18	19.39	867
Sand and gravel.....	1,565	204	320	2,675	1	63	23.92	2,764
Stone.....	735	234	172	1,400	--	28	20.00	1,505
Total ¹	8,570	241	2,069	16,644	5	634	38.39	3,634

^P Preliminary.

¹ Data may not add to totals shown because of independent rounding.

² Beginning in 1971, data concerning peat operations are included in the nonmetals industry.

passed by the State Legislature and subsequently signed into law by Governor Love in April 1971.

Early in the year, a final census report on Colorado's 1970 population was issued by the Bureau of Census, Department of Commerce. The State's population totaled 2,207,529, or nearly 26 percent higher than in 1960, the last census report. However, over half of the 63 counties lost population during the past 10 years.

At midyear, the Department of the Interior announced an oil shale leasing program which will promote the development of vast oil shale deposits in Colorado, Utah, and Wyoming. The program calls for the issuing of leases on one-half of 1 percent of the potential oil shale area of approximately 11 million acres. Six oil shale tracts—two in each State and each containing 5,120 acres—will be selected for leasing under sealed and competitive bids during 1972. Also, any individual or company may conduct Government-supervised informational core drilling of the oil shale deposit at its own cost, but must share results with the agency involved. In addition to collecting bonus bids for leasing and development, the U.S. Treasury would receive royalties and annual lease rentals.

Denver University conducted a study on the psychological and safety factors affecting miners in deep-shaft coal mines. The \$55,000 research project was conducted

under contract to the Bureau of Mines and the U.S. Naval Ammunition Depot. Additionally, the study will focus on the attitudes of workers and their families toward mining in general, the mine owners and managers, the union, and their communities.

Colorado Mountain Junior College, East Campus at Leadville, conducted a training program in practical mining under a U.S. Government grant totaling \$129,481. The course included two weeks of classroom work and four weeks of actual underground mining. The school was provided with an entire mine level at the Climax mine of AMAX to conduct training under simulated mine conditions. AMAX also furnished mine equipment, machinery, air, water, and electricity.

At yearend, the U.S. Geological Survey and the Colorado Water Pollution Control Commission were authorized funds to initiate an intensive stream sampling project of 20 watershed areas in the State. The project's purpose was to determine sources of mineral acid that have destroyed aquatic life in numerous streams. In most cases, the contaminant acid was suspected of originating from abandoned and active mines. Ultimately, it was expected that the study would result in the establishment of a permanent stream monitoring network within Colorado and a Statewide inventory of mine and mineral acid drainage problems.

REVIEW BY MINERAL COMMODITIES

METALS

Beryllium.—Colorado's output of beryllium concentrate in 1971 was significantly lower than that produced in 1970. Only one operation was active in the State—that of U.S. Beryllium Corp. The drop in output was due to a decline in the grade of ore mined at the Boomer mine near Lake George, Fremont County.

Colorado was one of three States in the Nation that produced beryllium concentrate. The other States, Utah and South Dakota, had more production than Colorado.

Cadmium, Indium, and Thallium.—American Smelting and Refining Co. (Asarco) recovered cadmium, indium, and thallium metal and thallous sulfate at its

Denver plant from flue dust, dross, and other byproduct material from out-of-State smelters and processing plants. The value of these products was not included in Colorado's mineral value because of its out-of-State origin.

Copper.—Output of copper increased 5 percent in quantity but decreased 5 percent in value compared to 1970 figures. The decrease in value reflected a 10-percent drop in the weighted average price of the commodity. During the year, 18 operations in 11 counties yielded copper, compared with 24 operations in 10 counties during 1970.

The Idarado mine of Idarado Mining Co., located in the Red Mountain and Upper San Miguel mining districts, accounted for nearly 65 percent of the out-

put. Other mines that had substantial production (over 100 tons of copper), in order of output, were the Sunnyside mine of Standard Metals Corp., the Summitville mine of Summitville Joint Ventures and the Camp Bird mine of the Federal Resources Corp.

Colorado Central Mines, Inc., was evaluating a disseminated low-grade copper, gold, lead, silver, and zinc deposit on the Summit property near Frisco, Colo. The deposit had been intermittently mined in the late 1920's and was closed during the depression. The company acquired the property in 1968 and reopened portions of the mine. Sixty-four exploratory holes totaling 508 feet were drilled from underground workings in the mine. A 10-ton bulk sample was mined for metallurgical testing purposes.

Copper ores were mined and milled at the Summitville operations in Rio Grande County. The mill was placed onstream at midyear. In past years, the mineral deposit was mined for gold and silver; however, recent mine exploration activity was focused on copper mineralization. Sufficient ore was developed to justify expenditures for reopening the mining facility.

Base Metals Mining and Milling Inc. continued development work at the Poughkeepsie and Imogene mines near Ouray and construction of a mill near Colona. Ore containing copper, lead, gold, silver, and zinc will be mined and trucked to the mill from whence the concentrates will be shipped to custom smelters in Utah and Texas.

Gold.—The output of gold increased 4,917 ounces, or 13 percent. Most of the gold was recovered as a byproduct from milling base metal ores. Of the 17 base metal mines with some reported gold production, only three—the Idarado mine in Ouray and San Miguel Counties, the Sunnyside mine in San Juan County, and the Leadville mine in Lake County—had production of over 1,000 troy ounces. Seven lode mines had production between 100 and 1,000 troy ounces; the other seven lode operations had production varying from 1 ounce up to 100 troy ounces.

Production from placer mines totaled 1,623 troy ounces, 4 percent of the State gold production. Of the six mining operations classed as placer mines, five were sand and gravel operations in the Denver

area at which gold was recovered as a byproduct. A few ounces of gold was recovered from mill tailings and smelter cleanups.

The free world market gold price rose gradually from \$37.50 per troy ounce in January 1971 to \$43.00 in August, fluctuated in a \$42–\$43 range until mid-November, and rose to \$44 at yearend. On December 14, 1971, the U.S. agreed to devalue the dollar and raise the official price of gold from \$35.00 to \$38.00 per ounce.

Among the 15 counties with gold output during the year, San Juan, San Miguel, and Lake County were the leading sources; their production in 1971 totaled 36,913 ounces and accounted for 91 percent of the State output.

Iron Ore.—The output of iron ore was 20 percent below that of 1970, mainly because of a drop in production from the principal source, the Copper Basin mine of Pitkin Iron Corp. in Pitkin County. The mine, operated by Morrison-Knudsen Co., Inc., under contract to Colorado Fuel and Iron Steel Corp. (CF&I), was the source of all the State's output. The magnetite ore from the mine was shipped to the Pueblo plant of CF&I.

Agglomerates containing about 65 percent iron were obtained by the Industrial Chemical Div., Allied Chemical Corp., from processing pyrite at its sulfuric acid plant (Denver works) near Denver. The plant was shut down on August 1, 1971. The output was classified as a secondary product, hence not considered mineral production for inclusion in table 1.

Lead.—Output of lead increased 18 percent in quantity and 4 percent in value. The lower percentage increase in value was due to a drop in the weighted average price per pound of lead; the price was 13.80 cents in 1971 compared with 15.61 cents in 1970. The published New York lead price was 13.5 cents during the first half of 1971, and increased to a range of 14–14.5 cents until mid-December. At yearend, the effective price was 14 cents per pound on a delivered basis. With 31 percent of the State production, the Idarado mine of Idarado Mining Co. was the largest single source of lead; output from this mine was up 12 percent. Idarado Mining Co. used multidrill jumbos and rubber tire loading and haulage equipment underground to improve productivity. As a con-

sequence, mine production of ore rose to 391,300 tons from 349,200 tons in 1970. According to the firms' annual report, ore reserves at yearend totaled nearly 3 million tons averaging 0.04 ounce of gold, 1.9 ounces of silver, 3.42 percent lead, 0.76 percent copper, and 4.91 percent zinc. Lower metal prices and a continued shortage of skilled miners resulted in a significant drop in the company's income compared with that of 1970.

Lead was produced at 18 mines in 11 counties. Mines with lead output of 1,000 tons or more, in order of production, were the Idarado in Ouray and San Miguel Counties, Leadville in Lake County, Eagle in Eagle County, Sunnyside in San Juan County, Camp Bird in Ouray, and Bulldog Mountain in Mineral County.

Six of the 11 counties with lead production had output of over 1,000 tons.

Ranked according to output, the principal counties were San Miguel, San Juan, Lake, Eagle, Ouray, and Mineral.

Development of the \$15 million lead-zinc mine by American Smelting & Refining Co. (Res-Asarco) was completed early in the year. The 700-ton-per-day concentrator commenced operation in April 1971. Because of a shortage of experienced workers, the facility was not operated at full capacity until late in the year. At yearend, ore reserves in the mine totaled over 2.7 million tons averaging 5.16 percent lead, 9.94 percent zinc, 2.58 ounces of silver, and 0.09 ounce of gold.

The Leadville Corp. contracted to spend \$500,000 for engineering and design of a pilot plant to process oxide and sulfide base metal ores by a chemical refining method. Ultimately, a \$9 million chemical refinery having an initial capacity of 500

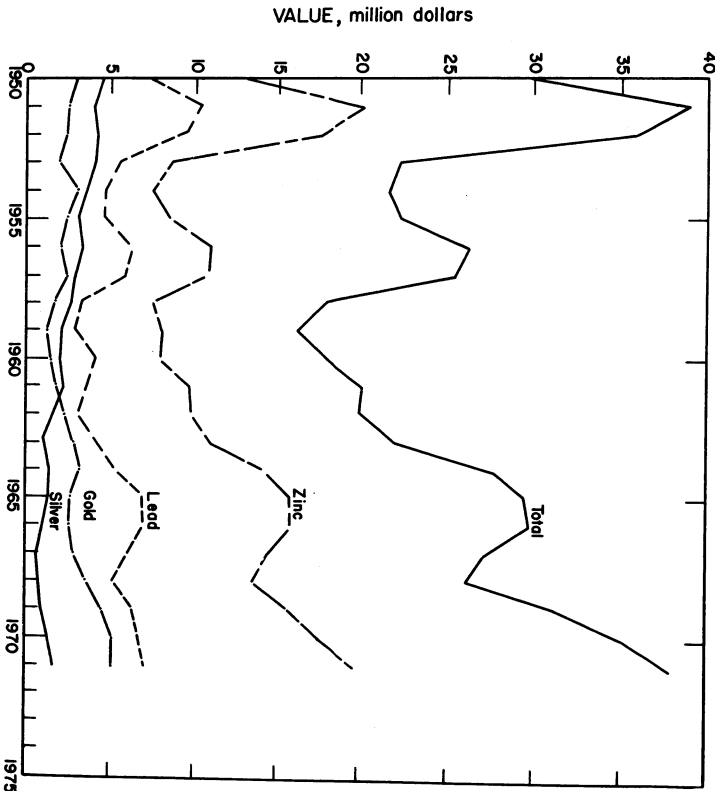


Figure 2.—Value of mine production of gold, silver, lead, and zinc and total value of these minerals (including copper) in Colorado.

Table 5.—Mine production (recoverable) of gold, silver, copper, lead and zinc, by county

County	Mines producing ¹		Material sold or treated ² (short tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1969, Total	37	10	1,090,329	25,777	\$1,070,003	2,598,563	\$4,653,169
1970, Total	28	2	1,133,220	37,114	1,350,579	2,933,363	5,194,453
1971:							
Adams	--	--	--	900	37,126	120	186
Boulder, Conejos, Dolores, Gilpin, Lake, and Rio Grande	7	--	160,021	9,129	376,572	293,551	453,830
Eagle	1	--	311,654	869	35,847	158,217	244,603
Gunnison	1	--	100	--	--	14,260	22,046
Jefferson	3	--	119,951	581	23,966	89	138
Mineral	1	--	119,911	185	7,631	2,063,993	3,190,933
Ouray	1	--	119,611	2,400	99,001	129,434	200,131
Park	--	1	--	42	1,733	--	--
San Juan	5	--	191,154	14,703	606,500	219,790	339,794
San Miguel	1	--	331,780	13,081	539,591	495,244	765,643
Summit	1	--	5,000	141	5,816	15,000	23,190
Total	20	1	1,239,271	42,031	1,733,783	3,389,748	5,240,549
Copper							
Lead							
Zinc							
	Short tons	Value	Short tons	Value	Short tons	Value	Total value
1969, Total	3,598	\$3,420,547	21,767	\$6,484,389	53,715	\$15,684,780	\$31,312,888
1970, Total	3,749	4,326,067	21,855	6,827,177	56,694	17,370,019	35,068,300
1971:							
Adams	--	--	--	--	--	--	37,312
Boulder, Conejos, Dolores, Gilpin, Lake, and Rio Grande	450	468,468	4,612	1,272,774	7,379	2,376,166	4,947,810
Eagle	30	31,044	3,612	996,898	32,239	10,380,953	11,639,350
Gunnison	--	--	42	11,523	--	--	33,569
Jefferson	--	--	--	--	--	--	24,104
Mineral	145	151,164	2,640	728,736	2,382	767,020	4,845,484
Ouray	579	601,952	3,079	849,788	3,997	1,287,147	3,038,069
Park	--	--	--	--	--	--	1,733
San Juan	548	570,388	4,787	1,321,130	5,201	1,674,772	4,512,584
San Miguel	2,186	2,273,336	6,815	1,880,913	9,765	3,144,201	8,603,689
Summit	--	--	160	44,050	218	70,261	143,317
Total	3,938	4,096,352	42,576	7,105,812	61,181	19,700,525	37,877,021

¹ Operations, from which gold, silver, copper, lead, or zinc were recovered as byproducts from fluorspar, sand and gravel, or cleanup not counted as mines.

² Does not include gravel washed.

³ Combined to avoid disclosing individual company confidential data.

⁴ Data does not add to total shown because of independent rounding.

tons of ore per day was scheduled for construction. In the chemical refining process, sulfide ores are roasted and then placed in chemical solution from which the metals are separated from the waste product. Company officials stated that the process will permit profitable treatment of low-grade ore which is not economically feasible by conventional methods. The facility is expected onstream by late 1973.

Operation of Standard Metals Corp.'s Sunnyside mine in the Silverton area was interrupted at midyear because of a strike which closed copper smelters in Utah and Montana. Earlier in the year, the mine was closed because the company filed vol-

untary bankruptcy but then reopened under a management committee. Approximately 135 workers were employed by the company; currently only 88 remain. At yearend, production rates of 1,250 tons of zinc concentrate and 700 tons of lead concentrate per month were obtained.

Dixilyn Corp. closed lead-zinc mining operations in the San Juan region because of large operating losses. Company officials stated that the continued failure to develop ore in sufficient quantity and grade, a decline in metal prices, and an increase in smelter costs contributed to a negative financial report for the past year. Approximately 56 workers were employed. In 1971,

Table 6.—Mine production of gold, silver, copper, lead, and zinc in 1971, by type of material processed and method of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode:					
Amalgamation: Ore.....	3,071	993	--	--	--
Smelting concentrates from ore.....	37,294	3,342,041	3,930	25,700	61,181
Direct smelting of ore.....	43	46,505	9	46	--
Placer.....	1,623	209	--	--	--
Grand total.....	42,031	3,389,748	13,938	25,746	61,181

¹ Data does not add to total shown because of independent rounding.

Table 7.—Mine production of gold, silver, copper, lead, and zinc in 1971, by class of ore or other source materials, in terms of recoverable metals

Source	Number of mines ¹	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode ore:							
Dry silver.....	4	99,823	64	2,051,236	99	1,728	1,393
Copper-lead-zinc.....	1	391,250	15,427	584,015	2,578	8,086	11,515
Copper, zinc, and fluorspar ²	2	322,349	1,331	158,407	298	3,629	32,239
Lead.....	3	143	4	15,350	1	46	--
Lead-zinc.....	12	452,701	23,582	580,531	963	12,306	16,085
Total.....	17	1,139,443	40,344	1,338,303	3,840	24,017	59,789
Placer.....	4	--	1,623	209	--	--	--
Total all sources ⁵	21	1,239,271	42,031	3,389,748	3,938	25,746	61,181

¹ Detail may not add to total because some mines produce more than one class of material.

² Combined to avoid disclosing individual company confidential data.

³ Excludes tonnage of fluorspar ore.

⁴ Sand and gravel operations not counted as producing mines.

⁵ Data may not add to totals shown because of independent rounding.

the company reported production of copper, gold, lead, silver, and zinc from four mines, namely, the Osceola-Price, Old Hundred, Ransom, and the Henrietta.

Molybdenum.—The second largest source of mineral wealth in the State was molybdenum, accounting for over 20 percent of the total value of mineral production. Shipments of molybdenum dropped significantly from the 1970 figures. The metal remained in oversupply because of lower than anticipated consumption, principally by the steel industry, a major consumer of molybdenum. The Climax and Urad mines of Climax Molybdenum Co., a division of AMAX, accounted for over 50 percent of the molybdenum produced in the United States.

Mine development continued at the AMAX Henderson molybdenum ore deposit near Empire. Major work projects underway in 1971 include construction and preparation of a mill site, tailings disposal area, and pond. The Western section of a 9.3-mile ore haulage tunnel was under con-

struction; Dravo Corp. was the contractor. About 12,000 feet of development drifts were advanced in the mine. Satisfactory progress was made at sinking the No. 2 shaft; its completion was scheduled for mid-1972. The \$250 million project was scheduled for completion in the mid-1970's, and has a designed capacity of 50 million pounds of molybdenum annually.

Silver.—Although the quantity of silver was up 456,385 troy ounces, the value rose only slightly, owing to a substantial decrease in silver prices. The weighted average price was \$1.55 per ounce in 1971 compared with \$1.77 in 1970. As with gold, most of the silver was obtained as a by-product of milling base metal ores. The two largest base metal mines, the Idarado mine in Ouray and San Miguel Counties and the Bulldog Mountain mine in Mineral County accounted for 77 percent of the State output.

The State silver production came from 22 operations in 15 counties. Lode mines accounted for nearly all of the output;

only 209 ounces were obtained from placer operations. Mines with production exceeding 100,000 troy ounces, in order of output, were the Bulldog Mountain mine of Homestake Mining Co., Idarado mine of Idarado Mining Co., Leadville mine of Res-Asarco, Sunnyside mine of Standard Metals Corp., and Eagle mine of New Jersey Zinc Co.

Of the 15 counties which had silver production, Mineral County had the highest, over 2.0 million troy ounces, about 60 percent of the State output. Other counties with production over 100,000 ounces were Eagle, Lake, Ouray, San Juan, and San Miguel.

The Emperius Mining Co. curtailed mining operations at its Emperius mine near Creede because of a decline in lead and zinc prices. Employment of about 40 workers were terminated during the first quarter.

Extensive exploration and development were reportedly conducted at the Bulldog Mountain mine of Homestake Mining Co., the State's largest silver producing mine. A 450-foot winze was completed from the 9,400-foot level by Centennial Development Co., a mine development contractor from Eureka, Utah. Also, an active exploratory drilling program was in progress throughout the year.

Silver Bell Industries Inc. planned to expand production at its Silver Clad mine near Ophir. The ore contains copper, gold, lead, silver, and zinc. Concentrate was shipped to Asarco smelters in El Paso and Amarillo, Tex., under a long-term contract. About 30 men were employed at the facility.

Tin.—Colorado and Alaska were the only States in the Nation with tin production; the State's output approximated that of 1970, but exceeded that of Alaska. The source of tin in Colorado was AMAX's molybdenum mine in Lake County.

Tungsten.—The State's output of tungsten concentrate was recovered as byproduct of milling operations at the AMAX molybdenum mine in Lake County. Production decreased 661 tons in 1971 and was nearly 30 percent lower than in 1970.

Uranium.—Output of uranium oxide (U_3O_8) decreased 190,695 pounds in 1971 and was 7 percent lower than in 1970. The State ranked third in the nation in pro-

duction of U_3O_8 with 10 percent of the total; only New Mexico and Wyoming exceeded Colorado in output.

The number of operations declined from 147 in the previous year to 121 in 1971. These yielded 555,947 tons of uranium ore compared with 599,277 tons mined in 1970. Average grade of the ore was 0.25 percent U_3O_8 , the same as in 1970.

The three uranium mills operated during the year were Uravan and Rifle mills of Union Carbide Corp., and the Canon City mill of Cotter Corp. Some of the uranium ore mined in Colorado was processed at the Moab, Utah, mill of Atlas Minerals Div., Atlas Corp., and the Shiprock, N. Mex., mill of Foote Mineral Co.

Union Carbide Corp. closed two of its Uravan Mineral Belt uranium mines (Martha Belle and Ura) because of low-grade ore and high mining costs. The closing affected about 34 percent of the company's employment in the area. The two mines produced about 5 percent of the company's production.

Fire Fly Enterprises Inc. announced discovery of three vanadium-uranium ore deposits along the Colorado-Utah border. Development of these deposits was underway and the company expects to be making ore shipments by early spring 1972.

To replace an existing hoisting unit, construction of a new two-compartment production shaft was completed at the Schwartzwald uranium mine near Golden. The new shaft facilitated mining operations underground and reduced costs. Production was continued at a rate of about 300 tons daily and the output was hauled by truck to the mill near Canon City. The mine and mill facility, operated by Cotter Corp., was the State's largest producer of uranium oxide.

Vanadium.—Although vanadium production declined over 400 tons, 14 percent below the 1970 output, the State supplied nearly one half of the Nation's output. Production was in the form of fused vanadium oxide (V_2O_5) recovered from processing of uranium-vanadium ores at the Rifle and Uravan mills of Union Carbide Corp. In order of output, counties with mine production were San Miguel, Montrose, Mesa, and Garfield.

Zinc.—One of the few metal commodities having a production value over \$10 million was zinc. Output increased 8 per-

cent in quantity and 13 percent in value; the higher increase in the latter was reflected by the rise in price of zinc during 1971. The price of Prime Western zinc was 17 cents at yearend compared with 15 cents in January 1971.

Production came from 16 operations, one less than in 1970. The leading mines, in order of output, were the Eagle mine in Eagle County, Idarado mine in Ouray and San Miguel Counties, Leadville mine in Lake County, Sunnyside mine in San Juan County, Camp Bird mine in Ouray County, and the Bulldog Mountain and Emperius mines in Mineral County. A total of 58,683 tons of zinc, 96 percent of the State output was produced by these mines. Eagle County alone accounted for about 53 percent of the State total output. Five other counties with substantial zinc production (1,000 tons or more) were, in order of output, San Miguel, Lake, San Juan, Ouray, and Mineral.

Early in the year, mining operations at the Eagle mine of New Jersey Zinc Co. were curtailed because of a decline in metal prices. The zinc concentrate was reportedly stockpiled at the mine and in Leadville; hence shipments ceased to the company smelter in De Pue, Ill. which was shutdown.

MINERAL FUELS

Carbon Dioxide.—Production of carbon dioxide increased 61 percent. Most of the marketed carbon dioxide output was from the McElmo field in Montezuma County; sales from this one-well pool were 50 million cubic feet more than in 1970.

Coal (Bituminous).—Coal production dropped nearly 12 percent in quantity compared with 1970 figures. This was the first significant decline in output since 1962. Forty-one operations had production over 1,000 tons—41 underground and nine strip mines. Four mines were shutdown during the year. Production from the underground mines was 3.3 million tons, 62 percent of the total output, and strip mines 2 million tons, 38 percent of the total. Of the 5.3 million tons produced, about 3.6 million tons were consumed in Colorado; the remainder was shipped to out-of-State markets.

Twelve mines had output between 1,000 and 10,000 tons, 15 between 10,000 and 100,000 tons, nine between 100,000 and

500,000 tons, and five over 500,000 tons. The five mines with the largest production were, in order of output, the Somerset of United States Steel Corp. in Gunnison County, Edna Strip of Pittsburg & Midway Coal Mining Co., Seneca Strip #2 of Seneca Coals, Ltd., Energy Strip of Energy Coal Co., all in Routt County, and Allen of CF&I in Las Animas County.

Fifty-seven percent of the State output was shipped to electric power generating plants, 41 percent to steel mills, and the balance was used for heating.

The average price of coal produced was \$6.34 per ton, up 49 cents from the 1970 average. Coal from underground mines averaged \$7.25 per ton, while that from strip mines averaged \$4.50, compared with \$6.50 and \$4.25, respectively, in 1970.

Coal production was reported in 13 counties, one less than in 1970. Routt County, with four operations had the highest production with 1.7 million tons, 32 percent of the State output. Three other counties had production of over 500,000 tons of coal, namely Gunnison, Las Animas, and Pitkin.

North American Resources Corp. sold the Thompson Creek coal mine located near Carbondale to International Mines, Inc., for about \$2 million. Fluor Utah Contractors and Engineers, Inc., prepared a feasibility study of the property and estimated coal reserves at 32 million tons.

Public Service Co. of Colorado started construction of a 350,000-kilowatt, coal-fired, electric generating facility on a 312-acre site near Pueblo. Stearns-Rogers Corp. will build the plant for about \$63 million; its completion is scheduled for late 1973. Ayrshire Collieries Corp., subsidiary of AMAX, will supply 1.2 million tons of coal annually from its reserves located south of Gillette, Wyo., under a long-term agreement.

Natural Gas.—Marketed production of natural gas increased 3 percent in quantity and 9 percent in value compared with 1970 figures. The increase in sales was largely attributed to construction of gas pipelines to new natural gas resources in eastern Colorado. Also, a rise in the average wellhead price from 14.7 cents to 15.6 cents per thousand cubic feet was reflected in the increase in the marketed value of natural gas.

According to the Colorado Oil and Gas

Table 8.—Bituminous coal production, by type of mine and county

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

County	Number of mines			Production (thousand short tons)		
	Under-ground	Strip	Total	Under-ground	Strip	Total
1970:						
Delta.....	W	W	W	W	W	W
Fremont.....	9	3	12	179	106	285
Garfield.....	1	--	1	2	--	2
Gunnison.....	6	--	6	680	--	680
Huerfano.....	2	--	2	23	--	23
La Plata.....	4	--	4	23	--	23
Las Animas.....	1	--	1	602	--	602
Mesa.....	1	--	1	14	--	14
Moffat.....	3	--	3	469	--	469
Montrose.....	W	W	W	W	W	W
Pitkin.....	3	--	3	827	--	827
Rio Blanco.....	2	--	2	3	--	3
Routt.....	1	3	4	12	1,990	2,002
Weld.....	3	--	3	581	--	581
Undistributed ¹	4	2	6	443	70	513
Total.....	40	8	48	3,858	2,166	6,024
1971:						
Delta.....	3	1	4	389	2	391
Fremont.....	8	2	10	91	152	243
Garfield.....	2	--	2	3	--	3
Gunnison.....	4	--	4	683	--	683
Huerfano.....	2	--	2	11	--	11
La Plata.....	1	1	2	10	2	12
Las Animas.....	1	--	1	510	--	510
Mesa.....	1	--	1	15	--	15
Moffat.....	3	--	3	388	60	448
Montrose.....	--	1	1	--	54	54
Pitkin.....	3	--	3	744	--	744
Routt.....	1	3	4	13	1,738	1,751
Weld.....	3	--	3	474	--	474
Undistributed.....	--	--	--	--	--	--
Total.....	32	9	41	3,331	2,008	5,339

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

¹ Includes data indicated by symbol W.

Conservation Commission, production of natural gas in 1971 was 111.1 billion cubic feet, a decrease of over 2 percent compared with 1970 figures.²

Leading counties for marketed natural gas were: La Plata was first with 31.1 billion cubic feet, Moffat second with 23.5 billion, and Rio Blanco third with 21.4 billion. The three countries accounted for nearly 66 percent of the State output.

The principal source of dry gas was the Ignacio-Blanco field, La Plata County, with 25.7 billion cubic feet. The productive horizons were Cretaceous in age: the Dakota, Fruitlands-Pictured Cliffs, and Mesaverde formations. Piceance Creek, Rio Blanco County, with a yield of 8.9 billion cubic feet ranked second among dry-gas fields; Dragon Trailfield, Rio Blanco County, ranked third with 6.6 billion cubic feet; and Hiawatha West and Powder Wash fields, Moffat County, ranked fourth and fifth with 6.1 and 5.4 billion cubic feet, respectively.

The Rangely reservoir, Rio Blanco County, yielded the largest quantity of wet gas; all its output of 2.4 billion cubic feet was processed for removal of liquids. The Wilson Creek field, also in Rio Blanco County, produced 2.1 billion cubic feet of wet gas; 1.3 billion cubic feet was returned to the reservoir.

Natural gas reserve estimates of the (API)³ for yearend 1971 were 1.6 trillion and the American Petroleum Institute (API)³ for yearend 1971 were 1.6 trillion cubic feet for Colorado, the same as in 1970. New fields and new pools added 18.4

² Colorado Department of Natural Resources, Oil and Gas Conservation Commission. Oil and Gas Statistics 1971. Production review, p. 13; all natural gas and petroleum production data cited in the text of this chapter are from this publication.

³ American Gas Association, Inc., American Petroleum Institute, and Canadian Petroleum Association. Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas in the United States and Canada and United States Productive Capacity as of Dec. 31, 1971. V. 26, May 1972, p. 22, 23, 114, 116, 117.

billion cubic feet, and extensions and revisions had a net of 273.1 billion cubic feet. This addition to reserves exceeded marketed production of natural gas in 1971 by 186 percent.

The six natural gas storage projects, with an ultimate capacity in excess of 25 billion cubic feet, contained at yearend 18.7 billion cubic feet. With 19.0 billion cubic feet in storage at the beginning of the year, 5.7 billion cubic feet were injected and 6.0 billion cubic feet were withdrawn. Largest of the projects was the Fort Morgan field, owned by Colorado Interstate Gas Co. (CIG). Its capacity was 13.9 billion; at yearend the reservoir had in storage 11.3 billion cubic feet.

Following the Fort Morgan reservoir in order of capacity was the Springdale reservoir, Logan County, owned by Kansas-Nebraska Natural Gas Co., and the Leyden mine, Jefferson County, owned by Public Service Co. of Colorado.

As in past years, the Fort Morgan reservoir was the most active, with 3.7 billion cubic feet injected and 4.2 billion cubic feet withdrawn. The second most active reservoir was the Leyden mine, a converted coal mine, with 1.2 billion cubic feet injected and 1.1 billion cubic feet withdrawn. The Springdale reservoir ranked third in activity with 0.3 billion cubic feet injected and 0.5 billion cubic feet withdrawn.

The Wattenberg gasfield was extended by drilling during the year and now encompasses an area of over 625,000 acres. Some 109 wells were completed within the field spaced area, nine in Adams County and 100 in Weld County. Of this total, 105 were productive, comprising 102 gas wells and three oil wells. Reserves were estimated at 1.3 trillion cubic feet. Large expenditures were made by numerous companies in a drilling and development program of the gasfield. Three pipeline companies have constructed pipeline outlets for transporting gas to marketing centers. In August, the first gas from the Wattenberg field was marketed. Panhandle Eastern Pipe Line Co. connected 18 wells to a gathering system for temporary sales to Western Slope Gas Co., a subsidiary of Public Service Co. of Colorado. At yearend, the company was reportedly preparing to seek Federal Power Commission authority to build a permanent pipeline outlet for the gas.

Colorado had eight new gasfield discoveries in 1971. On the basis of initial potential, the most important was the Totem field discovery by Amoco Production Co. in Adams County. The discovery well UPRR 48 Pan Am, Sec. 17, T2S, R 62W, was completed, and flows 3.8 million cubic feet of gas and 185 barrels of condensate per day from the "J" sandstone formation (Cretaceous). In Arapahoe County, the discovery well 1 Jo Ann, Sec. 31, T4S, R 63W in the Bombing Range field was completed, and flows 1.4 million cubic feet of gas and 90 barrels of oil per day.

Beaver Mesa Exploration Co. sold gas reserves on 41,000 acres in eastern Colorado to Panhandle Eastern Pipe Line Co. Company officials stated that the acreage involved was in the Denver-Julesburg Basin and included interest in 6,500 acres in the Wattenberg gasfield north of Denver.

Panhandle Eastern Pipe Line Co. constructed a 30-mile pipeline gathering system in Weld County. Natural gas was collected from 11 newly developed gas wells and sold to Western Slope Gas Co., a subsidiary of Public Service Co. of Colorado. In addition to the pipeline gathering system, a compressor station and processing plant was built on 10 acres of land, 20 miles south of Greeley, Colo.

CIG completed a major expansion program to meet higher natural gas requirements in the Rocky Mountain marketing area. New gas transportation and processing facilities were constructed to increase the company's peak daily sale capability by 90 thousand cubic feet, or 8 percent above the 1970-71 winter capacity.

Natural Gas Liquids.—Total output of natural gas liquids increased 13 percent in quantity and nearly 27 percent in value. The higher increase in value was due to a rise in the average price per barrel.

The 14 plants in Colorado processed 106.0 billion cubic feet of gas which yielded 3.0 million barrels of liquids.⁴ Gas input increased 27 percent and output increased 15 percent compared with 1970 figures. The Peoria gas processing plant was placed onstream in Arapahoe County, 40 miles east of Denver by the Amoco Production Co. As a consequence, oil production was increased from about 4,000 barrels per day to 12,000 barrels per day in the Peoria field to supply raw feed to the fa-

⁴ Page 112 of reference cited in footnote 2.

Table 9.—Gas input and products at natural gas liquids extraction plants in 1971

Plant	County	Owner	Gas input (million cubic feet)	Products (thousand barrels)
Adena	Morgan	Union Oil Company of Calif.	3,616	395
Comanche	Prowers	Cannon & Gilmore	14	
Dragon Trail	Rio Blanco	Sun Oil Co.	3,121	92
Fruita	Mesa	Continental Oil Co.	5,190	114
Loveland	Larimer	Vallery Corp.	25	2
McClave	Kiowa	Fleetwood Drilling Co.	1,283	41
Peoria	Arapahoe	Amoco Production Co.	2,245	297
Piceance Creek	Rio Blanco	Chadbourne Corp.	8,850	110
Rangely	do	Chevron Oil Co.	2,395	202
San Juan	La Plata	El Paso Natural Gas Co.	73,621	1,157
Vallery	Morgan	Vallery Corp.	742	64
Wattenberg	Weld	Production Operators Inc.	701	3
Wilson Creek	Rio Blanco	Texaco, Inc.	2,142	273
Yenter	Logan	Excelsior Oil Corp.	2,051	209

Source: Colorado Department of Natural Resources, Oil and Gas Conservation Commission, Oil and Gas Statistics 1971, Plant Intake and Products, pp. 109-112.

cility. The plant was designed for a throughput of 8 million cubic feet of gas per day. The processed gas was consigned to CIG.

Three other new gas processing plants were placed onstream during 1971. Production Operators Inc. completed the Wattenberg plant in Weld County in September. The refrigerated-absorption plant had a daily input capacity of 10 million cubic feet of gas; planned output was 10,000 barrels of product. The Sun Oil Co. completed the Dragon Trail plant in Rio Blanco County. The refrigerated-absorption plant had a daily input capacity of 30 million cubic feet of gas. At yearend, Canon & Gilmore Inc. completed the Comanche plant in Prowers County. The refrigerated-absorption plant processed a small volume of gas during December.

Oil Shale.—The Bureau of Land Management issued a permit for drilling six oil shale test holes in the Piceance Basin to the Cameron Engineers Inc. of Denver. The holes, 3 inches in diameter and located about 15 miles southeast of Rangely, will be drilled to depths ranging from 1,300 to 1,700 feet. According to regulations, one-fourth of each core recovered from a drill hole will be submitted to the U.S. Geological Survey. It was expected that the drilling would provide detailed information on oil shale thickness, mineral content, and hydrology. Should the testing indicate an economically favorable oil shale deposit, the companies, represented by Cameron Engineer, Inc., would exercise an option to lease the property. Under the Department of Interior test-lease regulations, only two tracts are offered for lease,

each containing 5,120 acres of potential mineral land.

Field operations for Project Rulison, Colorado's nuclear detonation experiment to stimulate natural gas flow in low-permeable reservoir rock in Garfield County, was placed in "mothballs" at yearend. The experiment was considered a technical success by officials of Austral Oil Co., cosponsors of the \$11 million project. The company was negotiating with a Federal regulatory agency for approval to distribute and market the gas to CIG. The marketing of nuclear-stimulated natural gas will be a first, hence it will result in a thorough investigation by Federal regulatory agencies.

Peat.—Output of peat declined 18 percent in quantity and 26 percent in value compared with 1970 figures. The drop in output was due to lower demand for peat as a general soil conditioner.

Peat was produced at 11 operations; three in Teller County, two each in Boulder, Gilpin, and Park Counties, and one each in Alamosa and Chaffee Counties. Gilpin, Park, and Teller were the largest producing counties and accounted for 89 percent of the State production.

Of the 28,283 tons produced, 18,950 tons was used directly for general soil improvement and 9,333 tons as filler material in mixed fertilizer. Eighty-eight percent was sold in bulk, the remaining 12 percent as packaged peat.

The average value for peat was \$5.57 per ton, 12 percent below that of 1970.

Petroleum.—Output of crude oil increased 2.7 million barrels in 1971 and was 11 percent higher than that produced in

Table 10.—Crude petroleum production, by county

(Thousand 42-gallon barrels)

County	Production		Principal fields in 1971 in order of production
	1970	1971	
Adams.....	1,229	1,353	Nile, Hombre, Poncho, Bennett.
Arapahoe.....	615	3,197	Peoria, Peoria North, Poncho, Byers.
Archuleta.....	49	54	Chromo.
Baca.....	61	59	Flank, Greenwood.
Bent.....	(¹)	(¹)	Bent's Fort, McClave.
Boulder.....	1	1	Boulder.
Cheyenne.....	614	403	Golden Spike, Ladder Creek.
Dolores.....	(¹)	(¹)	Papoose Canyon.
Elbert.....	19	78	Comanche Creek, Dull Knife.
Fremont.....	28	21	Florence—Canon City.
Jackson.....	168	154	McCallum, Battleship.
Kiowa.....	1,096	1,266	Brandon, Cavalry.
Kit Carson.....	-	5	Smoky Hill.
La Plata.....	23	20	Red Mesa.
Larimer.....	211	166	Wellington, Loveland.
Logan.....	2,094	1,703	Padroni-West, Saber, Graylin-N.W., Yenter.
Moffat.....	1,149	974	Maudlin Gulch, Powder Wash, Iles, Buck Peak.
Montezuma.....	257	261	Cache, Flodine Park, Papoose Canyon.
Morgan.....	715	629	Adena, Boxer, Peterson.
Prowers.....	4	3	Comanche.
Rio Blanco.....	11,540	12,518	Rangely, Wilson Creek, Nine Mile.
Routt.....	78	76	Grassy Creek, Sage Creek-North Tow Creek.
San Miguel.....	2	11	Lisbon, Andy's Mesa.
Washington.....	3,761	3,359	Rush Willadel, Cimarron, Bison, Big Beaver.
Weld.....	1,006	1,079	Pierce, Black Hollow, Border, Jasper.
Total ²	24,723	27,391	

^r Revised.¹ Less than ½ unit.² Data may not add to totals shown because of individual rounding.

Source: Colorado Department of Natural Resources. Oil and Gas Conservation Commission. Oil and Gas Statistics 1971. Oil and Gas Statistics by Counties, pp. 15-95.

1970. Increased production was due to development of oil resources in the newly discovered Peoria oilfield. The field now is the State's second largest producer of crude oil, outranked only by the Rangely-Weber field.

Leading county in production was Rio Blanco with 46 percent of the State total; also the county had the first and third leading oilfields in Rangely-Weber and Wilson Creek. Washington and Arapahoe Counties ranked second and third respectively, each accounting for 12 percent of the output. The Peoria oilfield, Arapahoe County, was discovered in 1970 and now ranks second in production, a position held by Wilson Creek for a number of years.

The Rangely-Weber oilfield continued to dominate the State's oil yield. With a cumulative output at yearend of 447.8 million barrels of oil, it had produced 46 percent of Colorado's cumulative oil production. Output in 1971 approximated that produced in 1970.

Active fluid injection projects during the year totaled 41 in 37 fields. Thirty-nine were waterflood projects and two were combined gas and water injections. One

waterflood injection project was inactive in 1971; the Danforth Hills in the Morrison formation. Water injected in all projects amounted to 138.7 million barrels; of this, 87.0 million barrels or 63 percent was injected into the Rangely reservoir. Again, the State data does not differentiate between "new" water and water produced with the oil and recycled.

The API and AGA estimated crude oil reserves for Colorado, on December 31, 1971, at 332.8 million barrels, a decrease of 56.4 million barrels or nearly 15 percent below yearend 1970 figures. An additional 101.5 million barrels are considered economically available by fluid injection. New fields and pools added 4.1 million barrels; revisions and extensions resulted in a loss of 48.6 million barrels.⁵

Drilling activity reached a total of 937 wells, the highest on record. The overall increase of 227 wells was nearly 32 percent over that reportedly drilled in 1970. There was a significant increase in exploratory well drilling (187 wells), and it reflected an interest in the "J" sandstone in the Denver-Julesburg Basin in the Rocky

⁵ Reference cited in footnote 3.

Table 11.—Principal oilfields in 1971

Field	County	Production		Cumulative production to Jan 1, 1972	
		Oil (thousand barrels)	Gas (thousand cubic feet)	Oil (thousand barrels)	Gas (thousand cubic feet)
Rangely (Weber)	Rio Blanco	10,041	2,133,895	447,803	667,585,108
Peoria	Arapahoe	2,764	2,710,096	3,250	3,165,479
Wilson Creek	Rio Blanco	2,203	2,141,513	70,508	52,322,587
Brandon	Kiowa	1,032	383	4,771	2,085
Pierce	Weld	478	49,282	7,454	315,501
Nile	Adams	425	1,026,048	1,229	1,716,143
Maudlin Gulch	Moffat	352	55,292	5,681	1,013,251
Hombre	Adams	283	295,495	291	301,537
Rush Willadel	Washington	278	--	3,462	12,464
Cimarron	do	228	--	983	--
Cavalry	Kiowa	225	10,660	604	28,823
Bison	Washington	206	--	3,889	2,467
Black Hollow	Weld	204	11,307	9,490	299,463
Big Beaver	Washington	193	17,966	10,913	1,555,973
Akron-East	do	194	78,874	1,668	1,070,662
Adena	Morgan	193	1,128,220	56,150	81,374,380
Golden Spike	Cheyenne	185	--	736	250
Rangely (Mancos)	Rio Blanco	184	--	12,034	646
Plum Bush Creek	Washington	172	22,437	17,865	2,086,990
Ladder Creek	Cheyenne	152	15,750	504	37,000
Powder Wash (Wasatch)	Moffat	134	2,061,423	4,350	62,862,138
Lindon	Washington	131	--	2,901	10,464
Saber	Logan	123	1,021,836	1,746	10,000,535
Belle	Washington	122	43,377	547	168,393
Westfork	do	103	--	3,276	888,049

Source: Colorado Department of Natural Resources, Oil and Gas Conservation Commission. Oil and Gas Statistics. Production by Leases, pp. 15-95.

Table 12.—Oil and gas well drilling completions in 1971, by county¹

County	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Adams	23	9	19	4	6	75	136	946,206
Arapahoe	39	2	21	10	1	61	134	896,772
Baca	--	1	2	--	--	1	4	17,643
Cheyenne	--	--	1	1	--	5	7	39,989
Conejos	--	--	--	--	--	1	1	2,077
Delta	--	--	--	--	--	1	1	2,600
Dolores	--	--	--	--	--	2	2	12,129
Douglas	--	--	--	--	--	1	1	9,674
Elbert	2	--	2	2	--	68	74	515,002
El Paso	--	--	--	--	--	14	14	100,764
Fremont	--	--	1	--	--	2	3	9,313
Garfield	--	--	--	--	1	1	2	24,434
Huerfano	--	--	--	--	1	1	2	6,737
Jackson	--	--	--	--	--	3	3	19,076
Kiowa	5	1	5	--	--	7	18	86,379
Kit Carson	--	--	--	--	--	1	1	4,726
La Plata	2	1	--	--	--	1	4	18,225
Larimer	--	--	1	--	--	--	1	5,060
Las Animas	--	--	--	--	--	1	1	2,281
Lincoln	--	--	--	--	--	28	28	131,935
Logan	4	2	8	3	1	26	44	226,405
Moffat	4	7	5	1	2	14	33	181,651
Montezuma	2	1	2	--	1	3	9	35,845
Montrose	--	--	--	--	--	1	1	14,400
Morgan	5	1	7	2	--	21	36	206,750
Prowers	--	--	--	--	--	1	1	6,146
Rio Blanco	21	15	19	1	1	1	58	233,309
Routt	--	--	--	1	--	6	7	24,245
San Miguel	--	--	--	--	1	2	3	29,698
Sedgwick	--	--	--	--	--	4	4	14,427
Washington	14	--	28	1	--	86	129	592,634
Weld	4	81	7	3	12	65	172	1,293,658
Yuma	--	--	--	--	--	3	3	10,846
Total	125	121	128	29	27	507	937	5,726,036

¹ Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

Mountain area. The success ratio for wildcat wells was 10 percent compared with 9 percent in 1970.

Weld County was the leader in drilling activity with 172 completions compared with only 68 in 1970. Adams County, the leading county in drilling activities for 1970, was second with 136 completions at yearend. The third ranking county in drilling activities in 1971 was Arapahoe County with 134 completions. Other counties, in order of amount of drilling activity, were Washington, Elbert, and Rio Blanco.

There were 29 oilfield discoveries for the year. The most significant of these, based on initial potential, was the Third Creek oilfield in Adams County. The discovery well, drilled by Koch Exploration Co. on the Kallsen lease, 12 miles northeast of Denver, flowed 435 barrels of oil per day from the "J" sandstone of Cretaceous Age.

Burton-Hawks Exploration Inc. discovered the Lone Pine oilfield in the North Park area of western Colorado, Jackson County, 12 miles west of Walden, Colo. The discovery well, located in Sec. 28, T9N, R81W on the Margaret Spaulding lease, flowed 515 barrels of oil per day from the Lakota formation. A Dakota sandstone section in the discovery well indicated possible gas production which would be evaluated in the future.

The Poncho oilfield was the most significant discovery in Arapahoe County. Nine of 14 wells drilled produced oil from the "J" sandstone, and two of these extended the field into Adams County. Midwest Oil Co. and Tiger Oil Co. drilled two wells, and each flowed more than 600 barrels of oil per day. Through September, Poncho's cumulative production was more than 95,000 barrels of oil and the oilfield's daily average production in December exceeded 1,800 barrels of oil.

The State had three active refineries, two in Denver and one in Fruita. The two in Denver, Continental Oil Co. and The Refinery Corp., were the largest, with daily crude oil capacity of 26,500 and 16,000 barrels, respectively. The American Gilsonite Co. refinery at Fruita processed only gilsonite from company operations in Utah. Total refining capacity in Colorado declined from 49,700 to 47,950 barrels of crude per day, a decrease of over 3 percent compared with the 1970 total.

Refineries in the State processed 15.2 million barrels of crude oil; of this, 13.1 million barrels were imported from out of the State. Wyoming provided most of the imported oil, 11.5 million barrels, followed by Montana, Utah, and Canada. Of the 27.4 million barrels produced in Colorado, 23.4 million were shipped out of State. Utah, with Salt Lake City as a refinery and marketing center, received 12.8 million barrels, chiefly from the Rangely-Weber and other northwestern Colorado oilfields. Other recipients, in order of quantity, include Illinois (4.1 million barrels), Kansas (3.1 million barrels), Ohio (1.5 million barrels), and Indiana (1.1 million barrels). A small quantity was shipped to Texas and Wyoming.

American Gilsonite contracted for nearly \$500,000 of air pollution control equipment at its refinery near Fruita. As part of the company's program to protect the environment, the firm was building an incinerator and a 130-foot stack to exhaust burned waste gases from its rotary coke-roasting kiln and the coke dust particles contained in the effluent.

NONMETALS

Cement.—Shipments of portland and masonry cement were higher than in 1970. The former increased by 24 percent and the latter by 16 percent. Increased shipments were due to higher demand for cement by the highway, industrial, and residential construction industries. As in 1970, cement was produced at the Boettcher plant, Larimer County, and the Portland plant, Fremont County, both operated by Ideal Cement Co., a division of Ideal Basic Industries Inc. and the Lyons plant, Boulder County, operated by Dewey Rocky Mountain Cement Co., a division of Martin Marietta Corp. Of the output, 90 percent of the portland and 95 percent of the masonry cement went to consumers in Colorado, the balance was shipped to out-of-State markets.

Seventy-six percent of portland cement shipments were consumed by ready-mix concrete companies. Other uses, in order of quantity, were concrete product manufacturers, highway contractors, and building material dealers.

Two cement price increases were instituted by Ideal Cement Co.; of an average of 25 cents per barrel on January 1, 1971,

Table 13.—Principal oil and gas discoveries in 1971

County and field	Well	Operator	Location			Producing formation	Barrels of oil per year	Thousand cubic feet of gas per year	Remarks
			Section	Town-ship	Range				
Adams:									
Campana	Ford	Tiger Oil Co.	12	2S	59W	J sandstone	295	9,000	Flowing.
Hawkeye	Trupp	Conestoga Oil Co.	32	2S	63W	do.	3,095	1,892	Do.
Third Creek	Kalsen	Koch Exploration Co.	18	2S	65W	do.	23,818	60,640	Do.
Toten	UPRR 48 Pan Am.	Amoco Production Co.	17	2S	62W	do.	8,195	--	Do.
Trapper	Cimiyoti	Webb Resources Inc.	6	2S	64W	D sandstone	8,512	--	Do.
Trigger	State-Walters	Leclair Operating Co.	16	2S	61W	do.	989	1,498	Do.
Arapahoe:									
Bombing Range	Jo Ann	Davis Oil Co.	31	4S	63W	J sandstone	9,316	--	Do.
Dragoon	Drake	J. H. Bander Inc.	4	5S	62W	D sandstone	2,182	--	Do.
Latigo	UPRR 29 Pan Am.	Amoco Production Co.	23	5S	61W	J sandstone	2,924	3,706	Do.
Poncho	Price	Champlin Petroleum Co.	4	4S	59W	do.	21,282	31,901	Do.
Yucca	Victor Michaud	Jack A. Prather Inc.	26	5S	62W	do.	1,162	464	Do.
Jackson:									
Lone Pine	North Park	Burton-Hawks Exploration Inc.	28	9N	81W	Lakota	--	--	Do.
Kiowa:									
Tonto	Tennel	Belco Petroleum Corp.	28	17S	45W	Mississippian	945	--	Do.
Logan:									
Frontier	Hatch	C. W. Hughes Inc.	3	11N	55W	J sandstone	10,600	4,364	Pumping.
Wahoo	Donovan	Pattco, Inc.	83	11N	52W	do.	4,229	--	Do.
Morgan:									
Bowstring	Brenemen	Enbrook Oil & Gas Co.	27	1N	58W	do.	1,263	--	Flowing.
Routt:									
Focus Ranch	Govt. 060047	Kirby Petroleum Co.	28	12N	87W	Cretaceous (intrusive sill)	2,164	--	Pumping.
Washington:									
Caballero	Colo. Development	Patrick A. Doheny Inc.	25	2N	54W	D sandstone	9,121	596	Do.
Weld:									
Prospect	Dyess-UPRR	Leon Zimbelman Inc.	29	1N	62W	do.	150	135	Flowing.
Tapadero	Dunning	Frank H. Walsh Inc.	27	9N	56W	do.	619	6,100	Do.
War Dance	Bartram	Sundance Oil Co.	12	7N	56W	do.	5,488	9,481	Do.
Wild Wood	Graeff	Joe D. Mechalke Inc.	26	9N	62W	J sandstone	358	--	Do.

Source: Colorado Department of Natural Resources, Oil and Gas Conservation Commission. Oil and Gas Statistics, 1971. Production by Leases, pp. 15-95.

Table 14.—Clay sold or used by producers, by county¹

County	1970		1971	
	Short tons	Value (thousands)	Short tons	Value (thousands)
Bent.....	--	--	98	(?)
Boulder.....	25,800	\$44	14,891	\$19
Fremont.....	28,790	92	23,760	74
Jefferson.....	418,217	696	415,091	763
Pueblo.....	78,796	427	62,431	265
Other counties ³	84,977	244	108,963	214
Total.....	636,580	1,503	625,234	4,1334

¹ Includes common clay and shale, fire clay, and bentonite (1971).

² Less than ½ unit.

³ Includes Custer, Douglas, Elbert, El Paso, Huerfano (1970), Las Animas.

⁴ Data does not add to total shown because of independent rounding.

and another of 20 cents on July 1, 1971. Higher prices for cement were the result of increases in the cost of fuel, electric power, and large capital expenditures attributed to compliance with Colorado's anti-pollution regulations.

Clays.—Clay production was 2 percent lower in quantity and 11 percent lower in value than in 1970. The larger drop in value was caused by a decline in output of the higher priced fire clay. Of the total production, 93 percent was common clay and shale and 7 percent was fire clay, compared with 62.5 and 37.5 percent, respectively, in 1970.

Seventy-five percent of the clay mined was captive production; the balance was sold as raw material to clay product manufacturing plants. Fire clay was used for making heavy clay products (building brick and sewer pipe) and refractory (fire brick, zinc retorts, and bonding agents for making foundry molds). Common clay and shale were used for building brick, lightweight aggregate, and pottery.

Eighteen companies with 56 mines accounted for the State's output compared with 21 companies and 56 mines in 1970. Nineteen mines were in Jefferson County, nine each in Fremont and Douglas Counties, six in Pueblo County, five in Boulder County, three in El Paso County, two each in Elbert and Las Animas Counties, and one in Custer County.

Jefferson County produced 66 percent of Colorado's output, the same as in 1970. The largest mine was that operated by Ideal Basic Industries Inc. (Idealite) in Jefferson County. The company produced shale for lightweight aggregate. Other leading producers were Robinson Brick and Tile Co. and Conda Wesley.

Idealite, with only one mine, was the only company producing more than 100,000 tons. Eleven companies had production between 10,000 and 100,000 tons, 5 between 1,000 and 10,000 tons, one less than 1,000 tons.

The average unit price for common clay and shale was \$1.87 per ton, that of fire clay \$5.69 per ton, compared with \$1.39 and \$3.98 per ton, respectively, for 1970.

Feldspar.—Feldspar was produced at the Mica Lode mine, Fremont County, by Lockhart and Sons. Output totaled 510 long tons and was nearly 20 percent over that produced in 1970. The material was sold for use in making decorative aggregate.

Fluorspar.—Shipments of fluorspar declined 3 percent in quantity but increased 20 percent in value compared with 1970 shipments. The increase in value was due to a significant rise in average unit price of fluorspar, from \$52.86 per ton in 1970 to \$65.19 per ton in 1971. The State fluorspar production was acid-grade, hence consumed in making hydrofluoric acid.

As in the past 2 years, fluorspar was mined at the Burlington mine, Boulder County, by Allied Chemical Corp. and at the Northgate and Crystal mines, Jackson County, by the Ozark-Mahoning Co. Colorado ranked second in quantity and value of fluorspar produced among States in the Nation; only Illinois had more production. At yearend, Ozark-Mahoning Co. completed a \$200,000 water treatment and recycling system at its Northgate fluorite mill. The recycled water was reported to have increased fluorite recovery at the mill.

Gypsum.—Gypsum production increased about 44,000 tons, 54 percent over that

mined in 1970. The output came from four open pit operations—three in Fremont County and one in Larimer County. Part of the production was calcined, and was used in the manufacture of gypsum building products. Uncalcined gypsum was marketed as a soil conditioner and cement retarder, the former to farm supply stores, the latter to cement manufacturing plants. A significant increase in output was reported for calcined gypsum. It reflected a higher demand for gypsum building products by the home construction industry.

Lime.—CF&I Steel Corp., The Great Western Sugar Co., American Crystal Sugar Co., and Holly Sugar Corp. produced 193,000 tons of lime in 10 counties, for steel manufacturing, sugar refining, and soil stabilization. Leading counties were Pueblo, Morgan, and Larimer. Output expanded 61 percent, due mainly to CF&I's new kiln, and was 52 percent above the 1969 record. The lime was consumed in Colorado, Nebraska, and New Mexico. Total consumption of lime in Colorado was 217,241 tons.

Mica.—Flake and scrap mica was produced at the JBT mine, Clear Creek County, by the Georgetown Lumber and Timber Co. Russell Johnson produced sheet mica from pegmatite deposits at the Corral Pole mine in Larimer County.

Perlite.—Crude perlite was mined by Persolite Products Inc. at its Rosita operations near Florence. Output increased in quantity but decreased in value compared with that of 1970. The loss in output value was due to a drop in the average unit value from \$12.56 per ton in 1970 to \$7.00 per ton in 1971. Most of the production was expanded at the company plant and sold for use as aggregate material in plaster, horticulture, and concrete mixtures.

The Building Products Division of Grecco, Inc. expanded crude perlite at its Antonito plant for use as a filter aid. At its plant in Denver, Zonolite Div., Western Region, W.R. Grace & Co. expanded crude perlite for use as aggregate material in plaster and concrete mixtures. Crude perlite used at the expanding plants of Grecco, Inc. and W.R. Grace & Co. was shipped from deposits in New Mexico.

Pumice.—Production of pumice-type material increased 24 percent in quantity compared with 1970. Output was from four operations, the same number as dur-

ing the previous year. Scoria was produced at the Mesita Hill quarry, Costilla County, by Colorado Aggregate Co. Inc. and at the McCoy mine, Routt County, by the McCoy Aggregate Co. Volcanic cinder was mined at the Dotsero mine, Eagle County, by the Dotsero Block Co., Inc. and at the Saguache mine, Saguache County, by the Volcanic Materials Inc.

Pumice-type material was consumed as pozzolonic admixture to concrete (29 percent), base material for road construction (3 percent), landscaping (4 percent), roofing material (12 percent), railroad ballast (48 percent), and the remaining 4 percent for miscellaneous uses.

Pyrites.—Output of pyrite concentrate dropped to nearly one-half of that produced in 1970. The material was recovered as a byproduct of molybdenum production at the Climax mill of AMAX in Lake County. Lower production was due to closing of the Denver Works plant of Allied Chemical Corp., the only consumer of pyrite concentrate in the Rocky Mountain area. Allied Chemical Corp. roasted pyrite concentrate to produce iron sinter and sulfuric acid.

Salt.—Salt output, 11 percent below that of 1970, was obtained as a brine by Union Carbide Corp. in Montrose County. The brine was consumed in the company's uranium-vanadium mill at Uravan.

Sand and Gravel.—Sand and gravel output increased over 4.7 million tons in 1971 and was 21 percent higher than in 1970. Based on value, sand and gravel was the most important nonmetallic mineral commodity produced in the State; the value, \$30.2 million, represented 8 percent of the State's value of mineral production.

Production of sand and gravel consisted of 22.7 million tons of gravel (84 percent) and 4.3 million tons of sand. The average price for gravel was \$1.08 per ton and for sand, \$1.32 per ton.

Commercially classed operators produced 19.1 million tons of sand and gravel, 70 percent of the State output. The five leading commercial producers, ranked in order of output, were Cooley Gravel Co., Peter Kiewit & Sons Co., Asphalt Paving Co., the Brannan Sand and Gravel Co. and Flatiron Sand and Gravel Co.; their combined output was 15.0 billion tons.

Noncommercial production, that produced for Government agencies, either by

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

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Adams.....	15	2,794	\$3,096	16	3,047	\$3,818
Alamosa.....	4	W	W	1	236	29
Arapahoe.....	10	1,562	1,842	8	1,386	2,175
Archuleta.....	2	W	W	3	92	103
Bent.....	2	W	W	1	57	22
Boulder.....	7	1,596	1,920	12	3,051	3,634
Chaffee.....	3	W	114	2	200	258
Cheyenne.....	1	W	W	1	29	6
Clear Creek.....	4	359	464	2	W	W
Conejos.....	1	W	W	1	20	20
Crowley.....	2	W	W	2	44	67
Custer.....	1	W	33	2	W	W
Delta.....	6	206	223	4	86	153
Denver.....	4	W	W	1	129	220
Dolores.....	1	W	W	1	W	84
Douglas.....	4	611	W	2	1,312	W
Eagle.....	7	495	545	6	W	202
Elbert.....	2	W	W	2	45	60
El Paso.....	10	1,453	1,303	18	3,010	3,037
Fremont.....	6	105	65	9	245	279
Garfield.....	4	W	W	2	127	319
Grand.....	8	288	353	4	W	W
Gunnison.....	5	117	90	5	W	386
Hinsdale.....	1	30	47	-	-	-
Huerfano.....	1	W	W	3	51	W
Jackson.....	3	55	W	2	43	51
Jefferson.....	19	2,223	2,434	12	2,117	2,473
Kiowa.....	2	W	W	2	71	18
Kit Carson.....	2	W	W	2	31	W
Lake.....	1	152	W	2	189	210
La Plata.....	10	483	689	7	312	401
Larimer.....	11	676	659	12	1,130	1,466
Las Animas.....	5	W	274	3	W	117
Lincoln.....	5	315	W	5	136	40
Logan.....	4	W	87	4	W	W
Mineral.....	10	348	1,387	7	1,130	1,041
Moffat.....	1	(1)	(1)	3	W	W
Montezuma.....	10	332	486	7	477	354
Montezuma.....	5	90	107	10	921	332
Montrose.....	5	281	266	10	246	294
Morgan.....	7	279	184	7	209	98
Ouray.....	1	120	43	3	W	W
Park.....	2	W	W	4	52	54
Pitkin.....	10	286	333	5	371	514
Pueblo.....	10	1,299	1,432	8	1,093	1,500
Routt.....	3	140	W	5	W	W
Saguache.....	4	W	W	2	107	38
San Juan.....	2	W	W	2	W	41
San Miguel.....	2	57	W	4	W	W
Sedgwick.....	7	440	W	3	381	W
Summit.....	6	493	855	5	W	W
Teller.....	5	151	W	2	W	W
Washington.....	4	W	W	2	494	249
Weld.....	10	663	553	8	250	335
Yuma.....	3	W	W	3	221	85
Various.....	-	-	-	2	337	392
Undistributed ²	18	3,253	4,296	10	3,507	5,130
Total ³	300	22,261	24,190	274	27,000	30,155

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

¹ Less than ½ unit.

² Includes Baca, Costilla (1970), Gilpin (1970), Otero, Phillips (1970), Prowers, Rio Blanco (1970) Rio Grande, and some sand and gravel that cannot be assigned to specific counties.

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

contractors or by Government employees, was 7.9 million tons, 29 percent of total sand and gravel output.

Of the 274 operations, 173 were commercial and 101 were classed as Government-and-contractor.

Sand and gravel used for road construc-

tion and maintenance was 14.8 million tons, and that used for building construction was 7.2 million tons; decreases of 1.7 million and 1.0 million tons, respectively. The balance of 5.0 million tons was used for fill, railroad ballast, engine sand, and miscellaneous uses.

Table 16.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	2,438	\$2,951	2,533	\$3,420
Fill.....	129	105	344	355
Paving.....	661	463	277	343
Other uses ¹	358	577	477	900
Total².....	3,586	4,086	3,632	5,023
Gravel:				
Building.....	3,275	5,252	4,270	7,076
Fill.....	523	516	427	407
Paving.....	7,438	7,176	9,375	10,515
Railroad ballast.....	--	--	90	129
Miscellaneous.....	114	146	562	677
Other uses.....	423	652	789	1,046
Total.....	11,773	13,742	15,513	19,850
Government-and-contractor operations:				
Sand:				
Building.....	78	16	186	191
Fill.....	2	3	25	25
Paving.....	722	897	431	443
Other uses.....	--	--	60	14
Total².....	802	915	702	677
Gravel:				
Building.....	384	14	165	228
Fill.....	1,429	499	1,700	443
Paving.....	4,224	4,910	4,738	3,853
Other uses.....	62	24	551	79
Total².....	6,099	5,447	7,153	4,606
Total sand and gravel².....	22,261	24,190	27,000	30,155

¹ Includes blast, engine, filtration, oil (hydrafrac), and other sands.

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

Of the 63 counties in the State, 59 had sand and gravel production; only Costilla, Gilpin, Phillips, and Rio Blanco Counties had no production. A total of 35 counties had some Government-and-contractor production, 52 counties had commercial production. Nine counties had production of 1 million tons or more; their combined output was 12.5 million tons, 42 percent of the total production. Twenty-nine counties each produced between 100,000 tons and 1 million tons; 21 counties produced less than 100,000 tons.

Stone.—Stone production increased 233,000 tons in 1971 and was 7 percent above that produced in 1970. Stone was mined at 133 operations in 40 counties.

Except for about 103,000 tons of dimension stone, the output was crushed and broken stone. The principal uses for crushed and broken stone, ranked according to quantity (100,000 tons or more) were for making cement; flux stone, riprap, road-base aggregate, lime, and sur-

face-treatment aggregate.

Cooley Gravel Co. purchased large acreage of undeveloped land along State Highway 8 for a rock quarry site. Operation at the quarry started at midyear. The cost of the project, land, and equipment was estimated at about \$1 million.

Sulfur.—Elemental sulfur was recovered from sour gas, a byproduct of petroleum refining, by the Continental Oil Co. in Denver. Output in 1971 increased by 81 long tons and was 5 percent higher than in 1970. Elemental sulfur was not included in table 1 as part of mineral production of Colorado because it is considered a secondary product.

Vermiculite.—W.R. Grace & Co. produced exfoliated vermiculite at its expanding plant in Denver. Crude vermiculite used in the plant was shipped from the company's mine in Montana. The exfoliated product was sold for use as loose-fill insulation, concrete and building-plaster additive, and for agricultural purposes.

Table 17.—Stone sold or used by producers, by use
(Thousand short tons and thousand dollars unless otherwise specified)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough:				
Irregular-shaped stone and rubble.....	4	\$68	2	\$87
Architectural..... thousand cubic feet.....				
Monumental ¹ do.....	26	26	15	16
Other ² do.....	39	45	26	23
Dressed:				
Architectural..... do.....	29	79	40	83
Monumental ³ do.....	16	145	10	154
Flagging..... do.....				
Total (approximate thousand short tons).....	13	4 362	9	313
Crushed and broken stone:				
Bituminous aggregate.....	W	W	506	554
Concrete aggregate.....	W	W	846	1,381
Surface treatment aggregate.....	248	240	83	137
Unspecified aggregate and roadstone ⁴	1,176	2,530	120	116
Riprap and jetty stone.....	155	324	120	460
Terrazzo.....	24	222	W	110
Other ⁵	1,936	4,398	2,100	4,911
Total.....	3,539	7,714	3,775	7,619
Grand total.....	3,552	8,076	3,785	7,933

W Withheld to avoid disclosing individual company confidential data; included with "Unspecified aggregate and roadstone."

¹ Rough monumental and architectural stone combined to avoid disclosing individual company confidential data.

² Data includes rough flagging and uses not specified.

³ Dressed monumental and stone for flagging combined to avoid disclosing individual company confidential data.

⁴ Data does not add to total shown because of independent rounding.

⁵ Data includes stone used in road base stone; 1970 data also includes stone used in macadam aggregate.

⁶ Data includes stone used in cement, stone sand, mine dusting (1970), refractory stone, roofing aggregate, soil conditioners (1970), railroad ballast, filter (1971), sugar refining (1971), lime manufacturing (1971), metallurgical purposes, and other unspecified uses.

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

Kind of stone	1970		1971	
	Quantity	Value	Quantity	Value
Dimension:				
Limestone.....	(¹)	W	--	--
Dolomite.....	(¹)	W	W	W
Granite.....	W	W	W	W
Sandstone.....	11	\$220	8	\$157
Quartz.....	(¹)	(¹)	(¹)	1
Undistributed.....	2	142	1	154
Total ²	13	362	9	313
Crushed and broken:				
Limestone.....	2,100	4,542	2,512	5,375
Dolomite.....	133	399	W	W
Granite.....	103	164	490	759
Marble.....	W	W		
Sandstone.....	W	113	70	96
Quartz.....	26	241	17	194
Quartzite.....	W	W	W	W
Traprock.....	W	W	382	W
Other stone.....	562	753	W	179
Undistributed.....	615	1,502	304	1,017
Total ²	3,539	7,714	3,775	7,619
Grand total ²	3,552	8,076	3,785	7,933

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

¹ Less than 1/2 unit included with "Undistributed."

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

Table 19.—Stone sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	1970			1971			Kind of stone produced in 1971
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value	
Alamosa-----	--	--	--	1	(¹)	\$1	Other stone.
Boulder-----	9	228	W	8	W	W	Sandstone, limestone, granite.
Chaffee-----	5	360	\$1,105	2	W	W	Limestone, granite.
Dolores-----	1	W	54	1	W	21	Sandstone.
Douglas-----	6	15	54	5	W	W	Dolomite, quartz, traprock, other stone.
Fremont-----	14	W	1,574	9	W	W	Limestone, dolomite, granite, sandstone, quartz, quartzite, other stone.
Grand-----	2	W	W	1	(¹)	(¹)	Granite.
Jefferson-----	16	W	387	17	W	W	Granite, quartz, quartzite.
Lake-----	1	W	62	1	W	W	Other stone.
Larimer-----	23	W	1,438	24	560	1,558	Granite, sandstone, quartz, limestone.
Mesa-----	3	W	33	4	W	16	Sandstone, granite.
Montrose-----	1	15	90	1	W	W	Granite.
Pueblo-----	--	--	--	3	3	20	Do.
Saguache-----	1	1	8	1	W	12	Quartz.
San Miguel-----	1	W	16	2	W	W	Sandstone, limestone.
Undistributed ² -----	74	2,933	3,256	53	3,222	6,304	Various.
Total³-----	157	3,552	8,076	133	3,785	7,933	

¹ Withheld to avoid disclosing company confidential data; included with "Undistributed."

² Less than $\frac{1}{8}$ unit.

³ Includes Adams, Arapahoe (1971), Archuleta (1971), Baca (1970), Cheyenne, Clear Creek (1971), Crowley (1970), Custer, Delta (1970), Eagle, El Paso, Garfield, Gilpin, Gunnison (1970), Hinsdale (1971), Huerfano, Jackson (1971), Kit Carson (1970), La Plata (1971), Las Animas (1971), Moffat (1970), Montezuma (1971), Otero (1970), Park (1971), Prowers (1971), Rio Blanco, Rio Grande (1971), Sedgwick (1971), Teller, Washington (1971), Weld, and Yuma (1971) Counties, and counties for which no county breakdown is available.

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

Table 20.—Principal producers

Commodity and company	Address	Type of activity	County
Beryllium: U.S. Beryllium Corp-----	303 Bon Durant Bldg. Pueblo, Colo. 81003	Open pit mine and mill.	Park.
Carbon dioxide, natural: Tenneco Oil Co.	Box 2410 Denver, Colo. 80201	Well in McElmo field..	Montezuma.
Cement:			
Dewey Rock Mountain Cement Co.	Box 467 Lyons, Colo. 80540	Dry process, 1-rotary-kiln plant.	Boulder.
Ideal Basic Industries, Inc-----	Box 231 Florence, Colo. 81226 Box 579 Fort Collins, Colo. 80521	Wet process, 2-rotary-kiln plant. Dry process, 2-rotary-kiln plant.	Fremont. Larimer.
Clays:			
A. P. Green Refractories Co-----	2500 North Santa Fe Pueblo, Colo. 81003	Mine-----	Pueblo.
Colorado Brick Co-----	Valmont Road Boulder, Colo. 80302	Mine and plant-----	Boulder.
Colorado Refractories Corp-----	Box 1001 Canon City, Colo. 81212	Mine-----	Las Animas.
Denver Brick & Pipe Co-----	Box 2329 Denver, Colo. 80201	---do-----	Elbert.
Lakewood Brick & Tile Co-----	1325 Jay Street Lakewood, Colo. 80215	---do-----	Jefferson.
The Idealite Co., a division of Ideal Basic Industries, Inc.	Box 1140 Boulder, Colo. 80302	Open pit mine and expanding plant.	Do.
Robinson Brick & Tile Co-----	Box 1619 Denver, Colo. 80223	Underground mine and 3 open pit mines. Open pit mine----- ---do-----	Douglas. Elbert. El Paso. Jefferson.
Coal, bituminous:			
CF&I Steel Corp-----	Box 316 Pueblo, Colo. 81002	Underground mine-----	Las Animas.
Energy Coal Co-----	2850 North Meridian St. Indianapolis, Ind. 46208	Strip mine and crushing plant.	Routt.
Mid-Continent Coal and Coke Co--	Carbondale, Colo. 81623--	3 underground mines; cleaning and thermal drying plant.	Pitkin.
Peabody Coal Co-----	301 North Memorial Drive St. Louis, Mo. 63102	Strip mine and crushing plant. ---do-----	Montrose. Routt.

Table 20.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Coal, bituminous—Continued			
The Pittsburg & Midway Coal Mining Co.	Ten Main Center Kansas City, Mo. 64105	Strip mine; crushing and oil treatment plant.	Routt.
United States Steel Corp. Western District-Coal.	Box 807 Dragerton, Utah 84520	Underground mine; cleaning and crushing plant.	Delta and Gunnison.
Copper:			
Idarado Mining Co.	Ouray, Colo. 81427	See Zinc	Ouray and San Miguel.
Summitville Joint Venture	Box 209 South Fork, Colo. 81154	Underground mine and mill.	Rio Grande.
Flourspar:			
Industrial Chemicals Division, Allied Chemical Corp.	Box 228 Boulder, Colo. 80202	Underground mine and plant.	Boulder.
Ozark-Mahoning Co.	Box O Cowdrey, Colo. 80434	do	Jackson.
Gold:			
Dixilyn Corp.	Box 373 Silverton, Colo. 81433	Underground mine and mill.	San Juan.
Idarado Mining Co.	Ouray, Colo. 81427	See Zinc	Ouray and San Miguel.
Standard Metals Corp.	Telluride, Colo. 81435 Box 247 Silverton, Colo. 81433	do	San Juan.
Gypsum:			
Johns-Manville Product Corp.	Box 80 Coaldale, Colo. 81222	Open pit mine and wall-board plant.	Fremont.
L & L Trucking Co.	105 West Main Street Florence, Colo. 81226	Plant	Florence.
Iron ore: Pitkin Iron Corp.	105 West Adams St. Chicago, Ill. 60603	Open pit mine	Pitkin.
Lead:			
American Smelting & Refining Co.	Box 936 Leadville, Colo. 80461	See Zinc	Lake.
Emperius Mining Co.	Creede, Colo. 81130	do	Mineral.
Homestake Mining Co.	Box 98 Creede, Colo. 81130	See Silver	Do.
Idarado Mining Co.	Ouray, Colo. 81427	See Zinc	Ouray and San Miguel.
The New Jersey Zinc Co.	Telluride, Colo. 81435	do	Eagle.
Rico Argentine Mining Co.	Gilman, Colo. 81634 Box 158	do	Dolores.
Standard Metals Corp.	Rico, Colo. 81332 Box 2471 Silverton, Colo. 81433	do	San Juan.
Lime:			
The Great Western Sugar Co.	Box 5308 Denver, Colo. 80217	Pot-kiln plant. 2 pot-kiln plants do Pot-kiln plant. Shaft-kiln plant. Pot-kiln plant. 2 pot-kiln plants. Natural-frequency-vibrating kiln plant.	Adams. Boulder. Larimer. Logan. Morgan. Sedgwick. Weld. Pueblo.
CF&I Steel Corp.	Box 316 Pueblo, Colo. 81002		
Molybdenum:			
American Metal Climax, Inc.	Mines Park Golden, Colo. 80401	Underground mine and mill.	Clear Creek.
Climax Molybdenum Co.	Climax, Colo. 80429	Underground mine, mill, and byproducts plant.	Lake.
Natural gas and petroleum:			
Bright & Schiff.	107 Mercantile Continental Bldg. Dallas Tex. 75201	Crude oil and gas wells: Saber field.	Logan.
Champlin Petroleum Co.	Box 9365 Fort Worth, Tex. 76107	Crude oil and gas wells: Boxer field. Crude oil and gas wells: Bison, Ramp, and West-fork fields.	Morgan. Washington.
Chevron Oil Co., Western Division.	Box 599, 1700 Broadway Denver, Colo. 80201	Crude oil and gas wells: Black Hollow and Pierce fields. Crude oil and gas wells and gas processing plant: Rangely field.	Weld. Rio Blanco.
Clinton Oil Co.	6810 West Highway 54 Wichita, Kans. 67209	Crude oil and gas wells: Belle field.	Washington.
Continental Oil Co.	Box 2197 Houston, Tex. 77001	Crude oil and gas wells: McCallum field. Crude oil and gas wells: Big Beaver, Bobcat, Little Beaver, and Plum Bush Creek fields. Refinery	Jackson. Washington. Adams.

Table 20.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Natural gas and petroleum—Continued			
Don M. Rounds Co.....	925 Petroleum Club Bldg. Denver, Colo. 80202	Crude oil wells: Cimarron field.	Washington.
El Paso Natural Gas Co.....	Box 1492 El Paso, Tex. 79999	Gas processing plant...	La Plata.
International Nuclear Corp.....	308 Lincoln Tower Bldg. Denver, Colo. 80203	Crude oil wells: Brandon field.	Kiowa.
Monsanto Co., Hydrocarbons & Polymers Division.	800 North Lindbergh Blvd. St. Louis, Mo. 63116	Crude oil wells: Battleship field. Crude oil and gas wells: Marble Wash field.	Jackson. Montezuma.
Pan American Petroleum Corp....	Box 591 Tulsa, Okla. 74102	Crude oil and gas wells: Little East Beaver and Nugget fields. Crude oil and gas wells: Black Jack field.	Washington. Arapahoe.
Texaco Inc.....	Box 2100 Denver, Colo. 80201	Crude oil and gas wells: Cache field. Crude oil and gas wells: Big Beaver field.	Montezuma. Washington.
Union Oil Co. of California, Northern Division.	1860 Lincoln St. Denver, Colo. 80203	Crude oil and gas wells: Danforth Hills and Maudlin Gulch fields.	Moffat.
Union Texas Petroleum.....	3000 Richmond Ave. Houston, Tex. 77001	Crude oil and gas wells and gas processing plant: Adena field. Crude oil wells: Blade Lindon, Ranger, Ring, and Rush Willadel fields.	Rio Blanco. Washington.
Peat:			
Alpen Meadows, Inc.....	Box 1074 Colorado Springs, Colo. 80901	Bog.....	Teller.
Universal Peat Co.....	5926 West Arizona Ave. Denver, Colo. 80226	Bog.....	Park.
Pperlite: Persolite Products, Inc.....			
	Box 105 Florence, Colo. 81226	Open pit mine..... Expanding plant.....	Custer. Fremont.
Pumice:			
Colorado Aggregate Co., Inc.....	Box 106 Mesita, Colo. 81142	Open pit mine and plant.	Costilla.
Dotsero Block Co., Inc.....	Box 933 Glenwood Springs, Colo. 81601	.....do.....	Eagle.
McCoy Aggregate Co.....	Box 575 McCoy, Colo. 80463	.....do.....	Routt.
Pyrites: Climax Molybdenum Co.....	Climax, Colo. 80429	See Molybdenum.....	Lake.
Rare-earths, monazite: Climax Molybdenum Co.			
.....do.....	.....do.....	.....do.....	Do.
Sand and gravel (commercial):			
Asphalt Paving Co.....	14802 West 44th Ave. Golden, Colo. 80401	Pit and plant..... .....do..... Pit and 2 plants..... Pit and plant..... .....do.....	Douglas. Garfield. Jefferson. Lincoln. Larimer.
Big Thomspon Sand & Gravel Co..	Star Rt. Box 442 Loveland, Colo. 80537	Pit and 4 plants.....	Adams.
The Brannan Sand & Gravel Co..	4800 Brighton Blvd. Denver, Colo. 80216	Pit and plant..... .....do.....	Arapahoe. Jefferson.
Broderick & Gibbons, Inc.....	Box 2167 Colorado Springs, Colo. 80901	4 pits and plant.....	El Paso.
	Box 313 Pueblo, Colo. 81002	7 pits and plant.....	Pueblo.
Cooley Gravel Co.....	5631 Tennyson St. Arvada, Colo. 80002	Pit and plant.....	Adams.
Flatiron Sand & Gravel Co.....	Box 229 Boulder, Colo. 80302	2 pits and plants..... Pit and plant.....	Arapahoe. Boulder.
Fremont Paving Inc.....	Box 229 Boulder, Colo. 80302	.....do.....	Fremont.
Peter Kiewit & Sons Co.....	729 River St. Canon City, Colo. 81212	Pit.....	Arapahoe.
Pre-Mix Sand and Gravel Co.....	5200 West Clifton Rd. Littleton, Colo. 80120	Pit.....	Arapahoe.
	7620 Madison St. Denver, Colo. 80204	Pit and plant..... .....do.....	Adams. Douglas.
Rio Grande Gravel Co.....	123 Santa Fe Dr. Denver, Colo. 80223	.....do.....	Jefferson.
Rocky Mountain Oil & Paving, Inc.	Box 6238 Colorado Springs, Colo. 80904	.....do.....	El Paso.

Table 20.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Silver:			
American Smelting and Refining Co. (McFarland & Hullinger, lessee.)	120 Broadway New York, N.Y. 10005	See Zinc	Gunnison.
Emperius Mining Co.	Creede, Colo. 81130	do	Mineral.
Federal Resources Corp.	Ouray, Colo. 81427	Mine and mill	Ouray.
Homestake Mining Co.	Box 98 Creede, Colo. 81130	Underground mine and mill.	Mineral.
Idarado Mining Co.	Ouray, Colo. 81427 Telluride, Colo. 81435	See Zinc	Ouray and San Miguel.
The New Jersey Zinc Co.	Gilman, Colo. 81634	do	Eagle.
Rico Argentine Mining Co.	Box 158 Rico, Colo. 81332	do	Dolores.
Silver Bell Industries, Inc.	Ophir, Colo. 81426	Underground mine and mill.	Do.
Standard Metals Corp.	Box 247 Silverton, Colo. 81433	See Zinc	San Juan.
U.S. Silver Mining Co.	Box 749 Salida, Colo. 81201	Underground mine and mill.	Saguache.
Stone:			
Castle Concrete Co.	Box 2379 Colorado Springs, Colo. 80901	2 quarries and plants	El Paso.
CF&I Steel Corp.	Box 489 Salida, Colo. 81201	Quarry and plant	Chaffee.
	Box 847 Canon City, Colo. 81212	do	Fremont.
Dolores County Highway Department.	Dove Creek, Colo. 81324	do	Dolores.
Frank H. Norberg Co.	418 Guaranty Bank Bldg. Denver, Colo. 80202	do	Garfield.
Ideal Basic Industries, Inc.	Box 231 Florence, Colo. 81226	2 quarries and plants	Larimer.
	Box 579 Fort Collins, Colo. 80521	do	Larimer.
Neil Sprague.	Rt. 2, Box 99A Berthoud, Colo. 80513	Quarry	Boulder.
Winslow Construction Co.	3002 South Huron Street Englewood, Colo. 80110	do	Jefferson.
Tin: Climax Molybdenum Co.	Climax, Colo. 80429	See Molybdenum	Lake.
Tungsten: Climax Molybdenum Co.	do	do	Do.
Uranium:			
Climax Uranium Co.	Box 1629 Grand Junction Colo. 81501	Underground mines and mill.	Mesa, Montrose, and San Miguel.
Cotter Corp.	Box 468 Golden, Colo. 80401	do	Fremont and Jefferson.
Union Carbide Corp., Mining and Metals Div.	Box 43, Rt. 1 Rifle, Colo. 81650	do	Garfield, Montrose, and San Miguel.
Vanadium:			
Climax Uranium Co.	Box 1629 Grand Junction, Colo. 81501	See Uranium	Mesa, Montrose, and San Miguel.
Union Carbide Corp., Mining and Metals Div.	Box 43, Rt. 1 Rifle, Colo. 81650	do	Garfield, Montrose, and San Miguel.
Zinc:			
American Smelting & Refining Co.	Box 936 Leadville, Colo. 80461	Mine and mill	Lake.
American Smelting and Refining Co. (McFarland & Hullinger, lessee.)	120 Broadway New York, N.Y. 10005	Underground mine and mill.	Gunnison.
Emperius Mining Co.	Creede, Colo. 81130	do	Mineral.
Homestake Mining Co.	Box 98 Creede, Colo. 81130	See Silver	Do.
Idarado Mining Co.	Ouray, Colo. 81427	Underground mine and mill.	Ouray.
	Telluride, Colo. 81426	do	San Miguel.
The New Jersey Zinc Co.	Gilman, Colo. 81634	do	Eagle.
Rico Argentine Mining Co.	Box 158 Rico, Colo. 81332	do	Dolores.
Standard Metals Corp.	Box 247 Silverton, Colo. 81433	3 underground mines and mill.	San Juan.

The Mineral Industry of Connecticut

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

By Robert A. Clifton ¹

Mineral production in Connecticut declined 1 percent in value in 1971, from \$28.4 million to \$28.0 million.

Sand and gravel and stone continued to be the principal commodities produced in the State. Their output accounted for 93 percent of the value of all minerals produced. The combined production of these commodities was down 7 percent.

There was an apparent increase in the building of roads, bridges, buildings, dams, and recreation facilities by the State Department of Highways and the Department of Public Works.

During 1971 the Geological and Natural History Survey published the following:

Quadrangle Report No. 26, Surficial Geology of the Spring Hill Quadrangle
 Quadrangle Report No. 27, Bedrock Geology of the Moodus and Colchester Quadrangles
 Quadrangle Report No. 28, Surficial Geology of the Guilford and Clinton Quadrangles

The U.S. Geological Survey published four surficial geologic maps, GQ-917 Oneco Quadrangle, GQ-936 Ashley Halls Quadrangle, GQ-939 Torrington Quadrangle, and GQ-940 Mystic Quadrangle, and one Bedrock Geologic Map, GQ-930 Oneco Quadrangle.

¹ Chemist, Division of Nonmetallic Minerals.

Table 1.—Mineral production in Connecticut ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays..... thousand short tons	171	\$386	174	\$322
Gem stones.....	NA	8	NA	15
Mica (scrap)..... thousand short tons	W	W	3	W
Sand and gravel..... do	6,765	9,202	6,921	10,262
Stone..... do	8,338	16,915	7,193	15,649
Value of items that cannot be disclosed:				
Feldspar, lime, and values indicated by symbol W.....	XX	1,872	XX	1,713
Total.....	XX	28,383	XX	27,961
Total 1967 constant dollars.....	XX	24,659	XX	25,011

² Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data. XX Not applicable.

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

Table 2.—Value of mineral production in Connecticut, by county
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Fairfield.....	\$936	\$871	Sand and gravel.
Hartford.....	8,801	7,433	Stone, sand and gravel, clays.
Litchfield.....	3,486	4,204	Stone, sand and gravel, lime.
Middlesex.....	1,747	2,186	Sand and gravel, feldspar, stone, clays, mica.
New Haven.....	9,679	9,600	Stone, sand and gravel, clays.
New London.....	1,310	1,253	Stone, sand and gravel.
Tolland.....	W	W	Sand and gravel.
Windham.....	W	W	Sand and gravel, stone.
Undistributed ¹	2,424	2,413	
Total.....	28,383	² 27,961	

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

¹ Includes sand and gravel, stone, and gem stones that cannot be assigned to specific counties, and values indicated by symbol W.

² Data may not add to total shown because of independent rounding.

Table 3.—Indicators of Connecticut business activity

	1970	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force..... thousands..	1,387.2	1,410.2	+1.7
Manufacturing..... do.....	445.7	406.0	-8.9
Durable goods..... do.....	327.0	290.6	-11.1
Nondurable goods..... do.....	118.7	115.4	-2.8
Nonagricultural..... do.....	1,200.7	1,173.0	-2.3
Unemployment..... percent of work force..	5.6	8.7	+55.4
Personal income:			
Total..... millions..	\$14,786	\$15,503	+4.8
Per capita.....	\$4,865	\$5,032	+3.4
Construction activity:			
New building permits.....	1,696	1,873	+10.4
Business activity:			
New incorporations.....	297	321	+8.1
Electric power sales..... million kilowatt hours..	442.4	431.8	-2.4
Mineral production value..... thousands..	\$28,383	\$27,961	-1.5

^p Preliminary.

Sources: New England Economic Indicators; Survey of Current Business; Connecticut Economic Indicators.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Nonmetal.....	75	250	19	145	1	6	48.29	45,120
Sand and gravel.....	422	213	90	729	--	11	15.09	226
Stone.....	408	245	100	812	--	30	36.96	1,112
Total ¹	905	230	209	1,686	1	47	28.47	4,513
1971: ^p								
Nonmetal.....	75	247	18	139	--	4	23.69	717
Sand and gravel.....	390	221	87	693	--	14	20.20	332
Stone.....	365	246	89	720	--	52	72.24	1,075
Total ¹	825	234	194	1,552	--	70	45.10	711

^p Preliminary.

¹ Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—There are no cement manufacturing plants in Connecticut. Cement shipment origin data are unavailable, but the destination data in preliminary form

suggest little change from the 1970 consumption. Apparent 1971 consumption was 4,436,000 barrels.

Clays.—Common clay production increased nearly 2 percent in volume but the

value was only 83 percent of the 1970 value. The five mines operated by four companies were in Hartford, Middlesex, and New Haven Counties. Most of the clay was consumed in the manufacture of building brick; approximately 5 percent was utilized by the ceramic and specialty clay products industry.

Feldspar.—The production of crude feldspar in 1971, from one mine in Middlesex County, was 6 percent higher in volume than in 1970, but its value was only 89 percent of that year's output. The recovered product was concentrated by flotation. The concentrate was primarily used by manufacturers of glass and ceramic products in New Jersey, Pennsylvania, and Rhode Island. Small quantities were exported.

Gem Stones.—Mineralogical societies, dealers, and individuals collected specimens from dumps, quarries, and pegmatite deposits in the State. The value of the collectors' items was about \$15,000.

Gypsum.—National Gypsum Co. imported crude gypsum for processing into

finished building plaster products and board and sheathing materials at its New Haven plant.

Lime.—Pfizer, Inc., produced lime in Litchfield County for mason's lime, sewage treatment, and other uses. Output decreased 13 percent and was 36 percent below the 1965 record. The lime was consumed in Connecticut, Massachusetts, and other States. Total consumption of lime in Connecticut was 67,075 tons.

Sand and Gravel.—Commercial production of sand and gravel decreased 1 percent in quantity but value increased 8 percent in 1971. Output at Government-and-contractor operations increased greatly and reached 136 percent of the volume and 244 percent of the value that was recorded in 1970. The value of all sand and gravel produced in 1971 was 12 percent over that of 1970, with a rise in the unit selling price from \$1.36 per ton to \$1.48.

Of the 6.9 million tons produced, commercial operators sold or used 95 percent and Government-and-contractor operations used 5 percent. The 6.9 million tons pro-

Table 5.—Sand and gravel sold or used by producers, by classes of operation and use

(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,579	\$2,185	1,983	\$3,005
Fill	329	205	352	331
Paving	1,653	2,450	939	1,456
Other uses ¹	477	562	425	634
Total ²	4,038	5,402	3,700	5,426
Gravel:				
Building	917	1,552	1,178	1,991
Fill	389	277	417	221
Paving	832	1,122	976	1,742
Other uses ³	439	720	295	434
Total ²	2,577	3,671	2,867	4,388
Government-and-contractor operations:				
Sand:				
Fill	--	--	15	30
Paving	27	22	22	18
Other uses	32	23	224	318
Total ²	59	45	260	366
Gravel:				
Fill	--	--	51	38
Paving	41	48	43	43
Other uses	51	37	--	--
Total ²	91	85	94	81
Total sand and gravel ²	6,765	9,202	6,921	10,262

¹ Includes molding (1970), foundry (1971), and other sand.

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

³ Includes railroad ballast (1970), miscellaneous, and other gravel.

duced were used primarily as aggregate in concrete for structural and paving construction. Other uses were fill, railroad ballast, molding sand, and other.

Sand and gravel was produced in each of the State's eight counties; the leaders were Hartford and New Haven Counties. Connecticut Sand & Stone Corp., Waterbury Sand & Gravel Co., C. W. Blakeslee & Sons, Inc., and The New Haven Trap Rock Co. were the leading producers.

Stone.—Production of stone decreased 14 percent in volume and 7 percent in value in 1971 compared to 1970 totals.

Crushed basalt, used chiefly as construction aggregate and railroad ballast, was the major product in both volume and value. It was produced in Hartford, Litchfield, and New Haven Counties.

Crushed limestone and dolomite were produced in Litchfield County only, by three operators. It was marketed for metallurgical flux, soil neutralizer, lime manufacturing, and filler.

Crushed sandstone produced in Middlesex County was used in manufacturing fine aggregate and terrazzo. Quartz and quartzite were also produced for use in glass, asphalt filler, and abrasives. Dimension sandstone was produced in Windham County and was sold primarily for use as rubble and in rough construction work.

The dressed stone was marketed as building stone veneer.

The New Haven Trap Rock Co. (Division of Ashland Oil, Inc.), Balf Co., and Roncari Industries, Inc., were the leading stone producers.

METALS

Pfizer, Inc., at Canaan, Litchfield County, produced metallic barium and calcium, and an iron-copper powder registered under the trade name Prefiltron. This firm is the only known producer of calcium metal in the United States, which is used to remove impurities during steel-making, and in the production of aluminum, magnesium, uranium oxide and thorium. Barium metal is used by the electronics, metals, and chemical industries. Prefiltron is used in the manufacture of electrodes. Although the production of metallic magnesium has stopped there was some sold during 1971.

The State has six steel mills that produced bars, rods, coils, strip, and wire rope. Approximately 75 foundries produced ferrous and nonferrous castings, and 11 foundries produced ferrous and nonferrous forgings and ingots.

About 25 scrap metal dealers collected and processed ferrous metal for export and for sale to area foundries.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
The Michael Kane Brick Co.....	654 Newfield St. Middletown, Conn. 06475	Pit.....	Middlesex.
The Keller Pottery Co.....	North Wales, Pa. 19454.....	Pit.....	Hartford.
The Kelsey Ferguson Brick Co.....	East Windsor Hill, Conn. 06028	Pit.....	Do.
Plasticrete Corp., Stiles Brick Div....	P.O. Box 248 New Haven, Conn. 06478	Pit.....	New Haven.
Feldspar:			
The Feldspar Corp.1.....	Spruce Pine, N.C. 28777....	Pit.....	Middlesex.
Lime:			
Pfizer, Inc.....	Daisy Hill Road Canaan, Conn. 06018	Plant.....	Litchfield.
Gypsum (calcined):			
National Gypsum Company.....	325 Delaware Ave. Buffalo, N.Y. 14202	....do.....	New Haven.
Sand and gravel:			
The Balf Co.2.....	190 Huyshope Ave. Hartford, Conn. 06106	Pit.....	Hartford.
Beard Sand & Gravel Co., Inc.....	127 Boston Post Road Milford, Conn. 06460	Pit.....	New Haven.
C. W. Blakeslee & Sons, Inc.....	58 Waverly St. New Haven, Conn. 06511	Pit.....	Middlesex.
The D. J. Carten Sand & Gravel Co..	Naugatuck Ave. S. P.O. Box 155 Devon, Conn. 06460	Pit.....	New Haven.
Chapman Sand & Gravel.....	Box 442 Melrose, Conn. 06049	Pit.....	Hartford.
Connecticut Sand & Stone Corp.....	7 West Main St. Plainsville, Conn. 06062	Pit.....	Hartford and Litchfield.
John J. Doyle Sand & Gravel Co., Inc.	P.O. Box 732 New London, Conn. 06321	Pit.....	New London.

Table 6.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Hamden Sand & Gravel Co.....	P.O. Box 4312 Hamden, Conn. 06514	Pit.....	New Haven.
John Lomazzo & Sons Corp.....	Route 57, Weston Rd. Weston, Conn. 06388	Pit.....	Fairfield.
Meriden-Wallingford Sand & Stone Co., Inc.	No. Colony Rd. Wallingford, Conn. 06492	Pit.....	New Haven.
The New Haven Trap Rock Co., Div. of Ashland Oil, Inc.	265 Church St. New Haven, Conn. 06510	Pit.....	Windham.
Newington Construction Co.....	187 Richard St. Newington, Conn. 06111	Pit.....	Hartford.
Oneglia & Gervasini Building Materials, Inc. ²	P.O. Box 907 Torrington, Conn. 06790	Pit.....	Litchfield.
Roncari Industries, Inc.....	1776 South Main St. East Granby, Conn. 06026	Pit.....	Hartford.
Sega Sand & Gravel, Inc.....	271 Danbury Rd. New Milford, Conn. 06776	Pit.....	Litchfield.
Waterbury Sand & Gravel Co.....	551 So. Leonard St. Waterbury, Conn. 06708	Pit.....	New Haven.
Stone:			
Basalt, crushed and broken:			
The Balf Co.....	190 Huyshope Ave. Hartford, Conn. 06106	Quarry.....	Hartford.
C. W. Blakeslee & Sons, Inc.....	58 Waverly St. New Haven, Conn. 06511	...do.....	New Haven.
A. N. Farnham, Inc.....	90 Pine Rock Ave. New Haven, Conn. 06514	...do.....	Do.
The New Haven Trap Rock Co., Div. of Ashland Oil, Inc.	265 Church St. New Haven, Conn. 06510	...do.....	Do.
Oneglia & Gervasini Building Materials, Inc.	P.O. Box 907 Torrington, Conn. 06790	...do.....	Litchfield.
Roncari Industries, Inc.....	1776 South Main St. E. Granby, Conn. 06026	...do.....	Hartford.
Angelo Tomasso, Inc.....	P.O. Box 76	...do.....	Do.
Tomasso of Farmington, Inc.....	...do.....	...do.....	Do.
The York Hill Trap Rock Quarry Co.	Westfield Rd. Meriden, Conn. 06450	...do.....	New Haven.
Granite, dimension:			
Castellucci & Sons, Inc.....	West River St. Providence, R.I. 02904	...do.....	Do.
R. B. Merriott & Sons.....	Oneco, Conn. 06373	...do.....	Windham.
Tower Hill Granite Co.....	305 Manchester Rd. E. Glastonbury, Conn. 06025	...do.....	Hartford.
Granite, crushed and broken:			
The New Haven Trap Rock Co., Div. of Ashland Oil, Inc.	265 Church St. New Haven, Conn. 06510	...do.....	Windham.
Limestone and dolomite, crushed:			
Allyndale Corp.....	East Canaan, Conn. 06024	...do.....	Litchfield.
The Conklin Limestone Co., Inc.	Canaan, Conn. 06018	...do.....	Do.
Pfizer, Inc.....	Daisy Hill Road Canaan, Conn. 06018	...do.....	Do.
United States Gypsum Co. (Falls Village).	101 So. Wacker Dr. Chicago, Ill. 60606	...do.....	Do.
Quartzite, crushed:			
Ottawa Silica Co., Connecticut Silica Div.	P.O. Box 577 Ottawa, Ill. 61350	...do.....	New London.
Sandstone and quartzite, dimension:			
Helene Stone Corp.....	Danielson, Conn. 06239	...do.....	Windham.
Hughes Stone Co.....	R.D. Box 150 Dayville, Conn. 06241	...do.....	Do.
Robert V. Olson.....	P.O. Box 684 Danielson, Conn. 06239	...do.....	Do.

¹ Also quartzite and scrap mica.² Two operations.

The Mineral Industry of Delaware

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

By Robert T. MacMillan ¹

Total mineral production in Delaware was valued at \$2.2 million in 1971, an increase of 39 percent compared with the previous year. Of the minerals produced in the State, sand and gravel was produced in the greatest quantity and value. Comparatively small quantities of clay and gem stones also were produced. Following generally lower mineral production in 1970, all minerals exhibited increases in quantity of production in 1971. Sand and gravel

and gem stones also showed increases in value, but clays decreased in value by 23 percent.

In addition to the previously mentioned minerals, other mineral-related activities were carried on in the State including the recovery of sulfur from petroleum and the calcining of gypsum.

¹ Physical scientist, Division of Nonmetallic Minerals.

Table 1.—Mineral production in Delaware ¹

Mineral	1970		1971	
	Quantity (thousands)	Value (thousands)	Quantity (thousands)	Value (thousands)
Clays..... thousand short tons..	11	\$11	14	\$8
Gem stones.....	NA	1	NA	2
Sand and gravel..... thousand short tons..	1,565	1,603	2,205	2,231
Total.....	XX	1,615	XX	2,241
Total 1967 constant dollars.....	XX	1,445	XX	1,947

^p Preliminary. NA Not available. XX Not applicable.
¹ Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Indicators of Delaware business activity

	1970	1971 ^p	Change, percent
Employment and labor force, annual average:			
Civilian work force..... thousands..	250.9	252.8	+0.8
Unemployment..... percent of work force..	4.0	4.9	+22.5
Manufacturing..... thousands..	71.2	69.0	-3.1
Durable goods..... do..	18.0	17.4	-3.3
Nondurable goods..... do..	53.4	51.6	-3.4
Nonmanufacturing..... do..	141.9	144.4	+1.8
Personal income:			
Total..... millions..	\$2,383	\$2,550	+7.0
Per capita.....	\$4,332	\$4,570	+5.5
Construction activity:			
Cement shipments to Delaware..... thousand 376-pound barrels..	860	950	+10.5
Mineral production value..... thousands..	\$1,615	\$2,241	+38.8

^p Preliminary.
 Sources: Delaware Department of Labor; Survey of Current Business; U.S. Bureau of Mines; Employment and Earnings; Area Trends in Employment and Unemployment.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours		
					Fatal	Non-fatal	Frequency	Severity	
1970:									
Nonmetal.....	2	313	1	5	--	--	--	--	--
Sand and gravel.....	54	189	10	85	--	--	--	--	--
Total ¹	56	193	11	90	--	--	--	--	--
1971: ^p									
Nonmetal.....	(²)	313	1	5	--	--	--	--	--
Sand and gravel.....	55	184	10	81	--	3	36.81	810	--
Total ¹	55	188	11	86	--	3	34.68	763	--

^p Preliminary.¹ Data may not add to totals shown because of independent rounds.² Less than 3.

Legislation and Government Programs.—The Bureau of Mines State Liaison Office for the States of Delaware, Pennsylvania, New Jersey, and Maryland was established Oct. 3, 1971. Mr. Arnold H. Harvey was designated as the liaison officer

with offices in room 1150, Federal Building, Harrisburg, Pa. The liaison office functions as a coordinator between the Federal Government and various State agencies and private organizations on matters related to mining and minerals.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Clays.—The Delaware Brick Co., the only producer of clay in Delaware, produced nearly 14,000 tons of common clay in 1971, an increase of 27 percent compared with that of 1970. The average unit value was \$0.60 per ton. The clay was produced just south of New Castle, and was used to produce building brick.

Gem Stones.—Small quantities of gem stones and mineral specimens were collected in a beach area chiefly by hobbyists.

Sand and Gravel.—Sand and gravel was produced by 11 companies in Delaware, six in New Castle County, four in Kent County, and one in Sussex County. The total production was 2.2 million tons valued at \$2.2 million. This production was divided into 1.03 million tons of sand val-

ued at \$1.18 million and 1.18 million tons of gravel valued at \$1.05 million.

Sand was used for the following purposes: Building, 35 percent; paving, 25 percent; fill 38 percent; and other uses, 2 percent. Gravel was used for the following purposes: Paving, 88 percent; building, 9 percent; and other uses, 3 percent.

Of the total sand and gravel produced, 1,736,000 tons valued at \$1,950,000 was processed, and 469,000 tons valued at \$281,000 was unprocessed. All sand and gravel produced in the State was transported by truck.

Sulfur.—One company produced sulfur as a byproduct of the production of petroleum products from imported crude petroleum. Delaware was the third largest producer of recovered sulfur.

Table 4.—Principal producers

Commodity and company	Address	Type of activity	County
Clay:			
Delaware Brick Co.....	River Rd. New Castle, Del. 19720	Pit.....	New Castle.
Gypsum, calcined:			
Georgia-Pacific Corp.....	P.O. Box 311 Portland, Oreg. 97207	Plant.....	Do.
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.

Table 4.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
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	Pit-----	Do.
Petrillo Brothers, Inc.-----	Box 426 Wilmington, Del. 19809	Pit-----	Do.
St. Jones River Gravel Co.-----	Box 426 Dover, Del. 19901	Pit-----	Do.
Swain Construction Co.-----	Lincoln, Del. 19960-----	Pit-----	Sussex.
Whittington's Sand & Gravel Co.	U.S. Route 40 Bear, Del. 19701	Pit-----	New Castle.
Woodlawn Gravel Co.-----	Box 2561 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 William F. Stowasser¹

The value of mineral production in Florida was \$343.7 million. This was an increase of \$44 million or 15 percent more than in 1970. Cement, kyanite, magnesia, zircon, peat, and petroleum all showed significant increases in production in 1971 over 1970 levels. Natural gas was produced for the first time in 1971. Other minerals showed smaller increases with lime and staurolite reporting less output in terms of quantity in 1971 than in 1970, although value was somewhat higher.

For the 78th consecutive year, Florida produced more phosphate rock than any other State. Florida again ranked first in the production of fuller's earth and zircon, second in the production of titanium concentrates, and third in peat and kyanite production. Staurolite was not produced in any other State.

Florida and North Carolina supplied 83 percent of the domestic phosphate rock market. Only Morocco exported more phosphate rock to world markets than did Florida. Florida increased exports 9 percent over the 1970 level; this represented 89 percent of phosphate rock exports from the United States. Exports from Florida moved through the ports of Tampa, Boca Grande, and Jacksonville to 32 countries. Japan and Canada each received over 2 million short tons and over 1 million short tons was shipped to Italy and West Germany.

The production by Humble Oil and Refining Co. from the Jay field in the northern Panhandle near the Alabama border was limited to about 14,000 barrels

¹ Physical scientist, Division of Nonmetallic Minerals.

Table 1.—Mineral production in Florida¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland..... thousand 376-pound barrels..	W	W	11,581	\$48,970
Masonry..... thousand 280-pound barrels..	W	W	1,283	4,877
Clays..... thousand short tons..	872	\$12,661	² 993	² 12,834
Lime..... do.....	167	2,810	159	2,958
Natural gas..... million cubic feet..	--	--	903	270
Peat..... thousand short tons..	46	304	57	412
Petroleum (crude)..... thousand 42-gallon barrels..	2,999	W	5,347	W
Sand and gravel..... thousand short tons..	12,482	12,254	23,228	18,836
Stone..... do.....	³ 43,089	³ 61,302	42,816	64,332
Value of items that cannot be disclosed: Koalin (1971), kyanite concentrates, magnesium compounds, natural gas liquids, phosphate rock, staurolite, stone (dimension) (1970), titanium concentrates, zirconium concentrates, and values indicated by symbol W.....	XX	210,711	XX	190,242
Total.....	XX	300,042	XX	343,731
Total 1967 constant dollars.....	XX	268,388	XX	^p 298,633

^p Preliminary. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

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

² Excludes kaolin; included with "Value of items that cannot be disclosed."

³ Excludes dimension limestone; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Florida, by county¹
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Alachua.....	\$1,335	\$1,596	Stone.
Bay.....	W	94	Sand and gravel.
Bradford.....	--	W	Natural gas liquids.
Brevard.....	W	W	Stone, sand and gravel.
Broward.....	11,930	13,627	Stone, zirconium concentrates, sand and gravel.
Calhoun.....	4	W	Sand and gravel.
Charlotte.....	W	W	Sand and gravel, stone.
Citrus.....	1,941	2,274	Stone, clays, phosphate rock.
Clay.....	W	W	Ilmenite, sand and gravel, staurolite, clays, kyanite.
Collier.....	W	W	Petroleum, stone, natural gas.
Dade.....	35,184	55,022	Cement, stone, sand and gravel.
Duval.....	W	--	--
Escambia.....	W	W	Sand and gravel, clays.
Franklin.....	W	4	Peat, sand and gravel.
Gadsden.....	W	11,803	Clays.
Gilchrist.....	W	W	Phosphate rock.
Glades.....	W	--	--
Gulf.....	W	W	Magnesium compounds, lime.
Hamilton.....	W	W	Phosphate rock.
Hendry.....	W	W	Petroleum, sand and gravel, natural gas.
Hernando.....	W	W	Stone, lime.
Hillsborough.....	20,041	W	Cement, stone, sand and gravel, peat.
Jackson.....	W	W	Stone, sand and gravel.
Lake.....	1,437	1,600	Sand and gravel.
Lee.....	W	W	Stone, petroleum, natural gas.
Leon.....	W	409	Sand and gravel.
Levy.....	W	W	Stone.
Manatee.....	W	--	--
Marion.....	2,562	2,634	Stone, clays, sand and gravel, phosphate rock.
Monroe.....	615	W	Stone.
Okaloosa.....	W	W	Sand and gravel.
Orange.....	W	W	Sand and gravel, peat.
Palm Beach.....	W	1,038	Stone, sand and gravel.
Pinellas.....	W	W	Do.
Polk.....	140,598	150,725	Phosphate rock, sand and gravel, peat.
Putnam.....	W	W	Sand and gravel, clays, peat.
Santa Rosa.....	W	2 W	Petroleum, natural gas.
St. Lucie.....	2,444	1,589	Sand and gravel, stone, peat.
Sumter.....	W	W	Stone, lime, peat.
Suwannee.....	W	W	Stone.
Taylor.....	W	W	Do.
Volusia.....	W	W	--
Walton.....	W	W	Sand and gravel.
Undistributed ²	81,953	101,315	--
Total⁴.....	300,042	343,731	

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

¹ The following counties are not listed because no production was reported: Baker, Columbia, DeSoto, Dixie, Flagler, Hardee, Highlands, Holmes, Indian River, Jefferson, Lafayette, Liberty, Madison, Martin, Nassau, Okeechobee, Osceola, Pasco, St. John's, Sarasota, Seminole, Union, Wakulla, and Washington.

² Includes value of petroleum and natural gas from Escambia County.

³ Includes value of natural gas (1970), natural gas liquids (1970), and counties indicated by symbol W.

⁴ Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Florida business activity

	1970	1971 ^p	Change, percent	
Employment and labor force, annual average:				
Total nonagricultural employment.....	thousands..	2,152.1	2,208.7	+2.6
Manufacturing.....	do.....	321.6	316.0	-1.8
Mining.....	do.....	8.6	9.2	+7.0
Construction.....	do.....	171.8	166.3	-3.2
Other ¹	do.....	1,650.1	1,717.2	+4.1
Personal income:				
Total.....	millions..	\$13,545	\$16,545	+22.1
Per capita.....		\$3,334	\$3,547	+6.4
Construction activity:				
Housing units authorized.....		136,198	167,944	+23.3
Value of nonresidential construction.....	millions..	\$623.0	\$819.0	+31.5
Farm marketing receipts.....	do.....	\$1,255.4	NA	NA
Mineral production.....	do.....	\$300.0	\$343.7	+14.6
Export trade.....	do.....	\$1,116.5	\$1,131.6	+1.4
Import trade.....	do.....	\$968.9	\$1,176.6	+21.4

^p Preliminary. NA Not available.

¹ Includes transportation and public utilities; services; wholesale and retail trade; finance, insurance, and real estate; and government.

Sources: Employment and Earnings; Highlights of U.S. Exports and Imports; Survey of Current Business; U.S. Bureau of Mines.

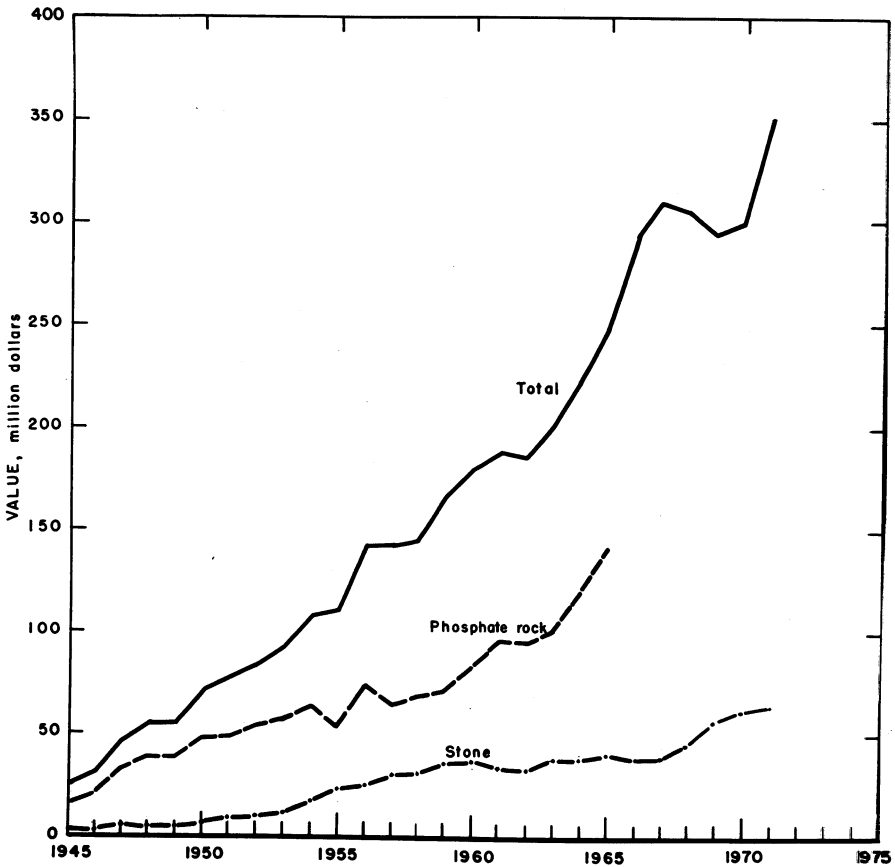


Figure 1.—Value of phosphate rock, stone, and total value of mineral production in Florida.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Peat.....	38	247	9	73	--	1	13.66	96
Metal.....	149	358	53	427	--	--	--	--
Nonmetal.....	3,523	309	1,090	8,720	1	43	5.05	852
Sand and gravel.....	466	254	118	1,102	--	37	33.59	513
Stone.....	2,462	289	712	6,266	3	121	19.79	3,460
Total ¹	6,638	299	1,982	16,587	4	202	12.42	1,790
1971: ^p								
Metal.....	145	364	53	422	--	--	--	--
Nonmetal ²	3,525	314	1,106	8,862	1	78	8.91	1,422
Sand and gravel.....	560	248	140	1,284	--	37	28.81	1,304
Stone.....	2,840	307	871	7,533	6	163	22.43	5,777
Total ¹	7,070	307	2,169	18,102	7	278	15.74	3,193

^p Preliminary.

¹ Data may not add to totals shown because of independent rounding.

² Beginning in 1971 data concerning peat operations are included in the nonmetals industry.

of oil and 14 million cubic feet of natural gas per day. This was the maximum capacity of the separation and treatment plant which removes hydrogen sulfide from oil and gas and converts it to elemental sulfur. By mid-1972 production will increase to 26,000 barrels of oil, 26 million cubic feet of natural gas, and 170 tons of sulfur each day.

Total production from the Jay field is estimated to increase to 60,000 to 70,000 barrels of oil daily in 1972.

Legislation and Government Programs.—The Environmental Protection Agency awarded a research and development grant to Harfluor, Inc. of Tampa to develop the "Hartig Pond Closing System" to recover phosphates and fluorine from phosphate plant waste effluent water. The grant of approximately \$500,000 would ascertain if the process could successfully recover an estimated 275,000 tons per year of fluorine from phosphate chemical plants.

The Bureau of Mines Tuscaloosa Metallurgy Research Laboratory, Tuscaloosa, Ala., worked to develop economic methods of beneficiating low-grade (47 to 62 percent BPL) pebble-concretionary Florida phosphate ore.

The State of Florida enacted a severance tax on the extraction of "solid minerals." The law is designed to encourage conservation and land reclamation with tax credits

to promote this work. The law specifies a 3 percent tax during 1971-1973, 4 percent during 1974-1975, and 5 percent after June 30, 1975.

In July the Florida Attorney General filed suit in U.S. District Court, Washington, D.C., charging that the Secretary of the Interior, the Secretary of Agriculture, the Director of the Bureau of Land Management, and the Chief of the Forest Service had committed "unconstitutional and illegal action" by approving phosphate prospecting permits in the Osceola National Forest. The court was asked to issue an injunction to prevent the issuance of permits to mine in the forests and to order Federal agencies to undertake thorough ecological and economic studies on the effect of phosphate mining in the Osceola National Forest.

Secretary Morton placed a 1-year moratorium on oil drilling in the Ocala National Forest.

The State of Florida enacted a 5-percent corporate income tax on income in excess of \$5,000 per year.

A three-judge Federal Court ruled that Florida's oil spill prevention and pollution control law was unconstitutional. The court contended that the State law intrudes into maritime matters which the U.S. Constitution reserves as exclusive Federal domain.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Nonmetals represented 92 percent of the value of the State's total mineral production in 1971. The principal nonmetals produced were, in decreasing order of value, phosphate rock, stone, cement, sand and gravel, and clays.

Cement.—Shipments of portland cement and masonry cement increased compared with 1970. Portland and masonry cement was produced in four plants. The average mill value of portland and masonry cement was \$4.23 and \$3.80 per barrel, respectively. The yearend stocks of portland cement totaled 571,759 barrels. Ninety-two percent of portland cement shipments were Type I (general use) and Type II (moderate heat). The remainder was Type III (high early strength) and water-proof cement.

Portland and masonry cement consumption in the State was 20.9 million barrels and 2.0 million barrels respectively. The distribution pattern of portland cement from the State's plants was as follows: 52 percent in ready-mix concrete, 17 percent in concrete products, 17 percent in building materials, 12 percent to contractors, and the balance to miscellaneous applications. The raw materials from which portland cement was manufactured were limestone, clay and shale, sand, gypsum, slag, and iron-bearing materials. The plants burned natural gas and fuel oil and used 291.3 million kilowatt hours of electrical energy.

Medusa Cement Co., Division of Medusa Corp., acquired the Penn-Dixie Corp. distribution terminals at Jacksonville and Orlando, Fla. General Portland Cement Co. completed new facilities at their Tampa plant to receive and use aragonite

which is dredged from ocean deposits in the Bahamas and barged to the plant. The kilns at the company's Dade County plant were modified to increase production 20 percent.

Clays.—Clay production and value increased over 1970 levels.

Fuller's earth production increased 3 percent in quantity and its value increased 5 percent over those of 1970. This was the 14th consecutive year that Florida's fuller's earth production was the highest in the Nation. Three companies operated four mines in Gadsden County and one company operated a mine in Marion County. Fuller's earth was used for fillers, absorbers, insecticides and fungicides, drilling mud, filter aids, and other purposes.

Kaolin production increased but value declined compared with that of 1970. Kaolin was produced in Putnam County for manufacturing whiteware, pottery, and wall tile.

Production of common clay for manufacturing cement, lightweight aggregate, and building bricks increased a significant 31 percent and its value increased 32 percent. Four companies in Citrus, Clay, Escambia, and Gadsden Counties produced common clay.

Gypsum.—Imported crude gypsum was processed into various building products at two plants in Duval County and one in Hillsborough County. The three plants used nine kettles, one rotary kiln, and one Holoflite unit to calcine gypsum and four board machines to manufacture gypsum products.

A total of 518,000 short tons of calcined gypsum was produced, an increase of 18 percent over 1970 production. The value of the production was approximately \$5.8 million, an 11-percent increase over 1970 value.

Crude gypsum was imported from mines in Nova Scotia, Canada.

Kyanite.—The kyanite-sillimanite recovered from a heavy minerals separation plant represents approximately 2 percent of the national production. The production from the Trail Ridge Plant of E. I. duPont de Nemours & Co. increased 53 percent in 1971; value was 62 percent greater. The mixture was marketed to refractory manufacturers.

Lime.—Quicklime and lime hydrate sold or used totaled 159,000 short tons and was

valued at nearly \$3.0 million. Compared with 1970 figures, the quantity decreased 5 percent but value increased 5 percent.

Basic Magnesia, Inc., Gulf County; Chemical Lime, Inc., Hernando County; and Dixie Lime and Stone Co., Sumter County produced lime for paper and pulp industries, recovery of magnesia from sea water, construction, waste neutralization, water treatment, and other chemical processes. Florida lime consumption was approximately double its production.

Magnesia.—The Basic Magnesia, Inc., plant, Port St. Joe, Gulf County, produced both caustic calcined magnesia and refractory magnesia from sea water. The design capacity of the plant is 60,000 net tons per year. Production increased 46 percent from 1970 levels and value increased 24 percent. This was a significant improvement over the decline of shipments and value of magnesia in 1970.

Perlite.—From ore mined in Colorado and New Mexico, four companies produced 17,547 short tons of expanded perlite compared with 14,390 short tons in 1970. Of the production nearly 17,000 short tons valued at \$909,000 were sold or used. Sales and value increased 16 and 6 percent, respectively, over 1970 levels. Plants were located in Dade, Duval, Escambia, and Indian River Counties.

The expanded perlite was principally used in plaster aggregates, formed products, and concrete aggregates with minor quantities consumed filling masonry cavities and conditioning soil.

Phosphate Rock.—Production of marketable phosphate rock, including production from the one producing plant in North Carolina, increased over 1970 levels. Phosphate rock was the major part of the mineral production and value of all minerals produced in the State.

It is necessary to conceal the production from a single operation in North Carolina and therefore it is combined with Florida's data. The combined marketable production from both States was 32.2 million short tons valued at \$168 million. This represents approximately 83 percent of the total national production. This was a 3 percent increase above the 31.3 million tons produced in 1970 and 6-percent increase in value. Marketable production sold or used totaled 33.2 million tons valued at \$174.1 million a 6.6-percent increase from the 31.1

million tons sold or used and a 10-percent increase in value from that of 1970.

Agricultural applications consumed 20.9 million tons or 63 percent of the total. These included ordinary superphosphate, triple superphosphate, wet-process phosphoric acid, direct application to the soil, animal feed supplements, and fertilizer filler.

Electric furnace operations to produce elemental phosphorus and phosphoric acid for industrial applications consumed approximately 1 percent of the total phosphate rock.

Production of crude dry ore in Florida and North Carolina was 118.1 million short tons and the P_2O_5 content was 16.6 million short tons.

Land pebble phosphate rock was produced by 10 companies from 17 open-pit mines in three Florida counties.

Soft phosphate rock was produced by five companies operating six open-pit mines in three counties in Florida. Total soft rock sold or used was 20,000 short tons reporting 4,000 short tons of P_2O_5 and valued at \$141,000. Applications were direct soil fertilization and animal feed supplements.

American Cyanamid Co. and Kerr-McGee Corp. formed a partnership to mine and process phosphate rock. According to the published agreement, American Cyanamid Co. will continue to operate the mine and plant under the new company name, Brewster Phosphates, and retain 70 percent of the production. The new company will, in the future, mine the extensive ore reserves that were held by Kerr-McGee near the Haynsworth mine, Bradley, Fla.

American Cyanamid closed its fertilizer plant at Bradley in April 1971 and arranged to have Freeport Minerals Corp. produce phosphoric acid from rock produced by Brewster Phosphates. One-half of the capacity, 600,000 short tons per year of equivalent P_2O_5 as phosphoric acid, of the Freeport Minerals Corp., Uncle Sam, La., plant was made available for this purpose.

Brewster Phosphates purchased Monsanto Co.'s diammonium phosphate plant at Luling, La. Monsanto Co. will continue to operate the plant.

CF Industries, Inc., Chicago, Ill., acquired Central Phosphates, Inc., Plant City, a fertilizer manufacturing firm. CF Industries, Inc., a cooperative organization, was formerly Central Farmers Fertilizer Co., manufacturers and distributors of chemical fertilizers.

Cities Service Co. started construction on a \$4 million superphosphate plant at its Tampa facility that was scheduled for completion in 1972. A \$3 million phosphoric acid concentration plant with provisions for recovery of hydrofluosilicic acid was scheduled for completion in 1972. The State of Florida filed a \$20 million damage suit against Cities Service Co. after a slime pond dam failed on December 3, 1971. The waste slimes, estimated to vary from 1 to 2 billion gallons, spilled into Whidden Creek and flowed into the Peace River. The fish kill and damage to the environment of the stream was significant. The Polk County Circuit Court questioned the stability of other Cities Service Co. dams and suspended their mining operations until the Court was assured that the slime pond dams would not fail. The injunction was lifted on January 28, 1972.

In August 1971, Mobil Chemical Co. started operating a new mine and beneficiation plant near Nichols that is designed to produce 1.5 million short tons per year of marketable rock.

International Minerals & Chemical Corp. closed its Achan washing plant.

In 1971, Agrico Chemical Co., a division of Continental Oil Co., shut down two of its three electric furnaces at Pierce, Fla.

Farmland Industries completed a new 225,000-short-ton-per-year P_2O_5 equivalent phosphoric acid plant near Bartow, Fla.

Sand and Gravel.—Sand and gravel production was 23.2 million tons valued at \$18.8 million. The 1971 production and value were significantly higher than the 1970 production of 12.5 million tons valued at \$12.3 million reflecting the effects of increased survey coverage and increased construction activity. Charlotte, Dade, Polk, St. Lucie, and Lake Counties accounted for 78 percent of the total sand and gravel output. Ninety-one percent of the production was hauled by trucks and the remaining 9 percent was transported by rail. The sand and gravel was principally consumed by construction industries.

A new plant, constructed near Plant City, Fla., to produce glass sand, started operating in 1971. Designed to operate at 125 tons per hour, the Edgar Plastic Kaolin Co. wet process plant utilizes a dredge, cyclones to deslime, scrubbers, flotation when necessary, classification, and a rotary dryer in the flowsheet.

Staurolite.—This complex silicate of iron and aluminum is recovered from the ilmenite production at the Highland and Trail Ridge plants of E. I. duPont de Nemours & Co., Clay County. Commercial quantities of staurolite are not produced in other States. Production declined 4 percent from 1970 levels and the value increased 2 percent.

Stone.—Crushed limestone production was 40.5 million tons and was valued at \$59.3 million. Tonnage and value increased 1 and 8 percent, respectively, over 1970 levels. Limestone was produced from 65 quarries in 15 counties compared with 90 quarries in 16 counties in 1970. Dade, Hernando, and Broward Counties were, in the

order noted, the leading limestone-producing counties in the State, supplying 70 percent of the total tonnage and value. Nine companies operated 10 quarries and their combined production represented 40 percent of the State's production and 38 percent of the total value.

Seventy-nine percent of the crushed limestone was hauled by truck, 15 percent by rail, 0.6 percent was transported on water, and 5.4 percent of the total was moved by an unspecified method.

Oystershells were processed in three counties for road-base material and a minor quantity was sold for poultry grit. The production and value of oyster shells were 1.2 million tons and \$2.6 million. This was a decrease of 48 percent in tonnage and 38 percent in value below 1970 levels.

One company in Manatee County produced dimension stone for decorative purposes.

Shands & Baker, Inc. started construction on a new crushed limestone plant south of Fort Myers. The plant will produce 500

Table 5.—Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Bay.....	2	W	W	3	87	\$94
Broward.....	3	744	\$627	2	W	W
Calhoun.....	1	4	4	2	W	W
Escambia.....	5	511	421	5	585	342
Jackson.....	1	17	17	1	W	W
Lake.....	5	1,806	1,437	6	1,843	1,600
Orange.....	7	W	W	1	243	131
Palm Beach.....	1	60	30	1	62	31
Polk.....	9	3,255	3,423	12	3,187	3,665
Putnam.....	4	438	574	4	W	W
Undistributed ¹	25	5,648	5,722	19	17,221	12,975
Total ²	63	12,482	12,254	56	23,228	18,836

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

¹ Includes Brevard, Charlotte, Clay, Dade, Franklin, Gadsden (1970), Glades (1970), Hendry, Hillsborough, Leon, Marion, Okaloosa (1970), Pinellas, Putnam (1971), St. Lucie, Volusia (1970), and Walton Counties.

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

Table 6.—Sand and gravel sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Building sand.....	8,288	\$7,700	8,687	\$8,764
Paving sand.....	471	266	1,276	1,230
Paving gravel.....	2	15	499	775
Other sand and gravel ¹	3,721	4,273	12,767	8,018
Total sand and gravel ²	12,482	12,254	23,228	18,836

¹ Includes glass, molding (1970), blast, engine, filtration, chemical (1970), fill, railroad ballast (1971), and other sands, and structural, fill (1970), and miscellaneous gravel (1971).

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

Table 7.—Crushed limestone sold or used by producers, by county

County	(Thousand short tons and thousand dollars)					
	1970			1971		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Alachua.....	4	1,744	\$1,335	4	1,817	\$1,596
Broward.....	16	6,924	11,303	16	6,939	10,661
Collier.....	6	1,679	2,502	3	W	W
Dade.....	14	11,134	13,356	12	13,596	18,570
Hernando.....	6	7,719	13,023	5	7,657	12,480
Levy.....	2	249	155	2	115	W
Marion.....	10	924	2,121	5	844	W
Monroe.....	2	917	615	1	W	W
Palm Beach.....	2	W	W	5	733	1,007
Sumter.....	3	2,604	2,456	3	3,317	3,782
Undistributed ¹	25	6,316	8,310	9	5,441	11,222
Total ²	90	40,210	55,176	65	40,458	59,319

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

¹ Includes Brevard (1971), Charlotte (1970), Citrus, Lee, St. Lucie (1970), Suwannee, and Taylor Counties, and counties indicated by symbol W.

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

Table 8.—Crushed limestone sold or used by producers, by use

Use	(Thousand short tons and thousand dollars)			
	1970		1971	
	Quantity	Value	Quantity	Value
Bituminous aggregate.....	W	W	2,721	\$5,104
Concrete aggregate.....	9,824	\$16,302	9,275	15,714
Dense graded road base stone.....	15,232	20,398	15,552	21,706
Other roadstone ¹	2,820	4,214	1,562	2,093
Unspecified aggregate and roadstone.....	2,866	2,788	2,911	3,072
Agricultural purposes ²	375	1,353	502	1,782
Cement and lime manufacture.....	W	W	3,761	4,128
Fill.....	3,373	2,651	999	776
Railroad ballast.....	120	165	W	W
Stone sand.....	W	W	2,673	3,953
Other uses ³	5,600	7,306	501	1,041
Total ⁴	40,210	55,176	40,458	59,319

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

¹ Data include stone used for macadam and surface treatment aggregate.

² Data include agricultural limestone and stone used in poultry grit.

³ Data include stone used for railroad ballast and other filler; 1970 data also include stone used in asphalt filler, and chemical stone.

⁴ Data may not add to totals shown because of independent rounding.

tons per hour of washed and sized stone. Reserves at this location were estimated to be sufficient to permit operation for at least 50 years.

Sulfur.—Oil and associated natural gas from new fields in Escambia and Santa Rosa Counties contain hydrogen sulfide that is separated from the hydrocarbons and converted to elemental sulfur. A total of 4,059 long tons of sulfur were produced and 3,861 long tons were sold. This is the first sulfur recovered in the State of Florida. As additional plant modules are brought on stream, sulfur recovery will increase proportionately.

Vermiculite.—Exfoliated vermiculite was produced at six plants in Dade, Duval, Hillsborough, and Palm Beach Counties.

Compared with 1970, tonnage was lower but value was greater.

METALS

Ferroalloys.—Two companies produced ferrophosphorus as a byproduct of elemental phosphorus manufacture. The value of ferroalloys is not included in the total State mineral production value.

Rare-Earth Minerals.—Rare-earth minerals were not produced in the State during this year, however, Titanium Enterprises was constructing a mine and mill to extract monazite from a heavy mineral sand deposit near Green Cove Springs.

Titanium Concentrates.—Both shipments and value of ilmenite concentrates

Table 9.—Oil and gas well drilling completions, by county

County	Proved field wells ¹			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Bradford.....	--	--	--	--	--	1	1	3,171
Charlotte.....	--	--	--	--	--	2	2	26,432
Collier.....	1	--	--	--	--	2	3	36,131
Hendry.....	5	--	--	--	--	2	7	81,196
Jefferson.....	--	--	--	--	--	1	1	7,034
Lee.....	1	--	--	--	--	--	1	11,875
Okaloosa.....	--	--	--	--	--	1	1	15,008
Orange.....	--	--	--	--	--	1	1	7,119
Santa Rosa.....	1	--	--	--	--	1	2	32,479
Taylor.....	--	--	--	--	--	1	1	7,036
Walton.....	--	--	--	--	--	1	1	12,340
Total.....	8	--	--	--	--	13	21	239,821

¹ Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

decreased 9 percent from 1970 levels, reflecting a continuing reduction in demand for titanium from the aerospace industry.

American Cyanamid Co. and Union Camp Corp. formed a new company, Titanium Enterprises, to mine titanium and other heavy minerals near Green Cove Springs. The deposit is a typical ancient beach sand formation and will be mined with conventional dredging equipment and processed with wet gravity, magnetic, and high-tension techniques to produce ilmenite, rutile, leucoxene, zircon, and monazite. Production was scheduled in 1972.

Zircon Concentrates.—Shipments of zircon concentrates increased 14 percent above 1970 levels. The value of the shipments increased 7 percent over 1970 values, but was less than 1969 value. E. I. duPont de Nemours & Co. recovered these concentrates from ilmenite production at their Highland and Trail Ridge plants, Clay County.

MINERAL FUELS

Mineral fuels produced were natural gas, crude petroleum, and peat.

Natural Gas.—Florida did not produce hydrocarbons until 1943, when Humble Oil and Refining Co. brought in the Sunniland field in Collier County in southern Florida. Casing-head gas is extracted from five fields in southern Florida. The gas, which has a gas-oil ratio of 100 to 1, is used to operate heater treaters and is not of sufficient quantity to market commercially. The Jay field in the northwestern part of the State was discovered in

1970, and the National Petroleum Council estimates 13 trillion cubic feet of gas reserves. The 1971 marketed production of natural gas from Florida was 903 million cubic feet valued at \$270,000 for an average wellhead value of 29.9 cents per thousand cubic feet. The production and value figures of State natural gas liquids are concealed.

Peat.—Peat production increased from 46,000 short tons valued at \$304,000 in 1970 to 57,000 short tons valued at \$412,000 in 1971. These were increases of 24 and 36 percent in production and value, respectively. Ten operations produced humus, moss, and reed-sedge peat in seven counties; however, two-thirds of the production was from St. Lucie, Putnam, and Orange Counties. The majority of sales were in bulk form, with 60 percent sold for packing flowers, plants, and shrubs, 20 percent sold for general soil improvement, and 20 percent sold for earthworm culture and as an ingredient for potting soils.

Petroleum.—Crude petroleum production increased from approximately 3 million barrels of oil in 1970 to 5,347,000 barrels in 1971. Although this was a significant increase of 78 percent, it is probable that with current and planned surface facilities, State production of crude oil will double in 1972. This reflects the development of the new field in the Panhandle of Florida. The cumulative oil production during the period 1943 through 1971 was approximately 24.7 million barrels. According to the American Petroleum Institute, Florida's petroleum reserves are estimated

at 204 million barrels. For comparison, the Alaskan reserve estimate is 10 billion barrels.

Eight proved field wells and 13 exploratory dry wells were completed. The wells totaled 239,821 feet.

Because of recent challenges to the 1945

initial legislation and the regulatory code developed from this and subsequent legislation for the State's oil and gas industry, the State has been working for the past 2 years to revise the rules and regulations. The new code is expected to become effective early in 1972.

Table 10.—Crude oil production in 1971, by county

(Thousand 42-gallon barrels)

County	Production	Principal fields in 1971, in order of production
Collier	695	Sunniland, Lake Trafford.
Hendry	3,787	West Sunoco-Felda, Sunoco-Felda.
Lee	175	Lehigh Acres.
Santa Rosa & Escambia	690	Jay, Mt. Carmel.
Total	5,347	

Source: Florida Department of Natural Resources.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Cement, portland and masonry:			
General Portland Cement Co.	Box 1528 Tampa, Fla. 33601	2 plants	Dade and Hillsborough.
Lehigh Portland Cement Co.	718 Hamilton St. Allentown, Pa. 18105	Plant	Dade.
Maule Industries, Inc.	100 Biscayne Blvd. Miami, Fla. 33132	...do.....	Do.
Clays:			
Fuller's earth:			
Dresser Industries, Inc.	Box 6504 Houston, Tex. 77005	Open pit mine ..	Gadsden.
Engelhard Minerals & Chemicals Corp.	Menlo Park Edison, N.J. 08817	2 open pit mines	Do.
Floridin Co.	Berkley Springs, W. Va. 25411	Open pit mine ..	Do.
Mid-Florida Mining	Box 68-F Lowell, Fla. 32663	...do.....	Marion.
Kaolin:			
Edgar Plastic Kaolin Co.	Edgar, Fla. 32049 .....	...do.....	Putnam.
Miscellaneous:			
Appalachee Correctional Institute.	Box 127 Chattahoochee, Fla. 32324	...do.....	Gadsden.
Bickerstaff Clay Products Co., Inc.	Box 1178 Columbus, Ga. 31902	Open pit mine and plant.	Escambia.
Florida Solite Co.	Box 297 Green Cove Springs, Fla. 32043	...do.....	Clay.
General Portland Cement Co.	Box 1528 Tampa, Fla. 33601	Open pit mine ..	Citrus.
Gypsum, calcined:			
Kaiser Gypsum Co., Inc.	300 Lakeside Drive Oakland, Calif. 94612	Plant	Duval.
National Gypsum Co.	325 Delaware Ave. Buffalo, N.Y. 14202	...do.....	Hillsborough.
U.S. Gypsum Co.	101 S. Wacker Drive Chicago, Ill. 60606	...do.....	Duval.
Lime: Primary:			
Basic Magnesia, Inc.	Box 160 Port St. Joe, Fla. 32456	...do.....	Gulf.
Chemical Lime, Inc.	Box 250 Ocala, Fla. 32670	...do.....	Hernando.
Dixie Lime & Stone Co.	Box 910 Ocala, Fla. 32670	...do.....	Sumter.
Magnesium compounds:			
Basic Magnesia, Inc.	Box 160 Port St. Joe, Fla. 32456	...do.....	Gulf.
Peat:			
M.L.S. Industries	Drawer 567 Stuart, Fla. 33494	Bog	St. Lucie.
F. E. Stearns Peat	Rt. 1 Box 347-I Valrico, Fla. 33594	Bog	Hillsborough.
Traxler Peat Co.	Box 86 Florahome, Fla. 32635	Bog	Putnam.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Peat—Continued			
Zellwood Peat Co.-----	Box 555 Zellwood, Fla. 32798	Bog-----	Orange.
Perlite, expanded:			
Airlite Processing Corp.-----	Rt. 3 Box 417 Vero Beach, Fla. 32960	Plant-----	Indian River.
Armstrong Cork Co.-----	Box 351 Pensacola, Fla. 32502	---do-----	Escambia.
Chemrock Corp.-----	End of Osage St. Nashville, Tenn. 37208	---do-----	Duval.
W. R. Grace & Co.-----	62 Whittemore Ave. Cambridge, Mass. 02140	---do-----	Dade.
Petroleum:			
Humble Oil & Refining Co.-----	Box 2024 Houston, Tex. 77001	Sunniland field.	Collier.
Sun Oil Company-----	Box 2880 Dallas, Tex. 75221	Sunoco-Felda field.	Collier and Hendry.
Phosphate rock:			
Land-pebble:			
Agrico Chemical Co.-----	Box 3166 Tulsa, Okla. 74101	3 open pit mines.	Polk.
Borden, Inc.-----	Box 790 Plant City, Fla. 33566	Open pit mine.	Do.
Brewster Phosphates-----	Wayne, N.J. 07470-----	---do-----	Do.
Cities Service Co.-----	Box 3269 Tampa, Fla. 33601	---do-----	Do.
W. R. Grace & Co.-----	Box 471 Bartow, Fla. 33830	---do-----	Do.
International Minerals & Chemical Corp.	Box 867 Bartow, Fla. 33830	3 open pit mines.	Do.
Mobil Oil Corp., Chemical Div.	Box 311 Nichols, Fla. 33863	2 open pit mines.	Do.
Occidental Petroleum Corp., Suwannee River Phosphate Div.	Box 300 White Springs, Fla. 32096	Open pit mine.	Hamilton.
Swift Agric Chemical Corp.	Box 208 Bartow, Fla. 33830	2 open pit mines.	Polk.
U.S.S. Agri-Chemicals, Inc.---	Box 867 Ft. Meade, Fla. 33841	---do-----	Do.
Phosphorus, elemental:			
Agrico Chemical Co.-----	5050 Poplar Ave. Memphis, Tenn. 38117	3 electric furnaces.	Do.
Mobil Chemical Co.-----	Box 311 Nichols, Fla. 33863	Electric furnace.	Do.
Sand and gravel:			
General Development Corp.-----	1111 South Bayshore Dr. Miami, Fla. 33131	3 open pit mines.	Brevard, Charlotte, St. Lucie.
E. R. Jahna Industries, Inc.-----	First & East Tillman Lake Wales, Fla. 33853	Open pit mine.	Lake and Polk.
Orange Sand Company-----	Box 4667 Jacksonville, Fla. 32204	---do-----	Lake.
Seminole Rock Products, Inc.---	3100 N.W. 74th St. Miami, Fla. 33166	---do-----	Dade.
Standard Sand & Silica Co.-----	Box 35 Davenport, Fla. 33837	Open pit mine.	Polk.
Staurolite: E. I. du Pont de Nemours & Co., Inc.	Du Pont Bldg., D-10084 Wilmington, Del. 19898	Plant-----	Clay.
Stone:			
Limestone, crushed:			
Dixie Lime & Stone Company.	Box 910 Ocala, Fla. 32670	5 quarries----	Jackson, Levy, Marion, Sumter.
Florida Rock Products Corp.	Box 4667 Jacksonville, Fla. 32201	2 quarries----	Hernando and Suwannee.
General Development Corp.---	1111 South Bayshore Dr. Miami, Fla. 33166	3 quarries----	Charlotte, St. Lucie.
Houdaille-Duval-Wright Co.	Box 8068 Seminole Annex Ft. Lauderdale, Fla. 33310	5 quarries----	Alachua, Broward, Dade.
Maule Industries, Inc.-----	Box 2601 Hialeah, Fla. 33012	2 quarries----	Broward and Dade.
Oystershell:			
Bay Dredging & Construc- tion Co.	Box 1484 Tampa, Fla. 33601	Dredge-----	Hillsborough.
Benton & Company, Inc.---	Box 1347 St. Petersburg, Fla. 33731	---do-----	Pinellas.
Houdaille-Duval-Wright Co.	Box 1588 Jacksonville, Fla. 32201	---do-----	Duval.
Radcliff Materials, Inc.-----	Box 1288 Mobile, Ala. 36601	---do-----	Walton.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Titanium concentrates: E. I. du Pont de Nemours & Co., Inc.	Du Pont Bldg. D-10084 Wilmington, Del. 19898	2 dredges and plants.	Clay.
Vermiculite, exfoliated: W. R. Grace & Company-----	62 Whittemore Ave. Cambridge, Mass. 02140	4 plants-----	Dade, Duval, Hillsborough, Palm Beach, Hillsborough.
Verlite Company-----	Box 11385 Tampa, Fla. 33610	Plant-----	Hillsborough.
Schmelzer Sales Association, Inc.	3519 Cantrell Road Little Rock, Ark. 72207	----do-----	Do.
Zirconium concentrates: E. I. du Pont de Nemours & Co., Inc.	Du Pont Bldg. D-10084 Wilmington, Del. 19898	----do-----	Clay.

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 Mines, Mining and Geology (superseded in early 1972 by the Earth and Water Division, Georgia Department of Natural Resources) under a cooperative agreement for collecting information on all minerals except fuels.

By J. Robert Wells ¹ and Sam M. Pickering, Jr. ²

Georgia's mines in 1971 provided a diversity of minerals ranging from barite and bauxite to zirconium concentrate. Value of minerals produced in 1971 exceeded \$200 million. That figure placed Georgia 29th in the nation in that respect and also marked the 18th in an uninterrupted series of annual increases for the State. Nonmetallic minerals, with clays and stone holding first and second places, respectively, made up 98 percent of the total value, leaving 2 percent for the joint contribution of a number of materials classified as metallic minerals and fuels. Value of Georgia kaolin, long established as the State's foremost mineral in economic importance, continued a record that may be unequalled in U.S. mining by scoring the

25th annual increase in the 26 years since the close of World War II.

Legislation and Government Programs.—

The 1971 issue of the annual progress report of the Georgia Department of Mines, Mining and Geology contained sections dealing with the research programs, regulatory functions, land rehabilitation policies, special services, and administration of that agency and included maps indicating the location of known mineral resources and mining operations in the State.³ The sec-

¹ Physical scientist, Division of Nonmetallic Minerals.

² State geologist and Director, Earth and Water Division, Georgia Department of Natural Resources.

³ Georgia Department of Mines, Mining and Geology. Annual Report of Progress, 1971. Jan. 1, 1972, 36 pp.

Table 1.—Mineral production in Georgia ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland..... thousand 376-pound barrels ..	W	W	6,458	\$22,470
Masonry..... thousand 280-pound barrels ..	W	W	443	1,470
Clays..... thousand short tons ..	5,684	\$110,149	² 5,791	² 119,096
Iron ore (usable)..... thousand long tons, gross weight ..	243	1,467	W	W
Peat..... thousand short tons ..	W	W	1	13
Sand and gravel..... do ..	3,667	4,437	3,697	5,310
Stone..... do ..	26,635	59,200	30,669	69,897
Talc..... short tons ..	45,900	289	53,000	334
Value of items that cannot be disclosed:				
Barite, bauxite, fire clay, feldspar, kyanite, mica, rare-earth mineral concentrate, titanium concentrate, zircon concentrate, and value indicated by symbol W.....	XX	27,683	XX	10,807
Total.....	XX	203,225	XX	229,397
Total 1967 constant dollars.....	XX	181,785	XX	^p 199,300

^p Preliminary. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed". XX Not applicable.

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

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

Table 2.—Value of mineral production in Georgia, by county ¹
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Baldwin	W	W	Clay.
Bartow	\$4,238	\$5,046	Barite, stone, clay.
Bibb	W	W	Clay, sand and gravel.
Charlton	W	W	Titanium, zircon, rare-earth mineral concentrate.
Chatham	W	W	Sand and gravel.
Chattooga	W	--	
Cherokee	W	W	Mica.
Clarke	975	975	Stone.
Clayton	W	W	Do.
Cobb	W	W	Do.
Columbia	W	W	Clay.
Cook	W	--	
Crawford	W	W	Sand and gravel.
Decatur	W	W	Clay.
De Kalb	W	5,612	Stone, sand and gravel.
Dougherty	W	W	Sand and gravel.
Douglas	W	W	Stone, clay.
Early	W	W	Stone.
Effingham	W	W	Sand and gravel.
Elbert	W	2,609	Stone.
Evans	42	57	Sand and gravel.
Fannin	W	--	
Fayette	W	W	Stone.
Floyd	W	W	Stone, clay.
Fulton	11,920	17,391	Cement, stone, clay, sand and gravel.
Gilmer	W	W	Stone.
Glynn	W	--	
Gordon	W	--	
Greene	W	W	Sand and gravel.
Gwinnett	W	W	Stone.
Hall	W	W	Do.
Hancock	W	W	Stone, clay.
Hart	W	W	Mica.
Henry	W	--	
Houston	W	W	Cement, stone, clay.
Jasper	W	W	Feldspar, stone, mica.
Jefferson	W	W	Clay.
Jones	W	W	Stone.
Lincoln	W	W	Kyanite.
Long	W	W	Sand and gravel.
Lowndes	W	168	Do.
McDuffie	W	--	
Madison	W	W	Stone.
Miller	W	4	Peat.
Mitchell	W	--	
Monroe	W	W	Stone.
Montgomery	20	W	Sand and gravel.
Morgan	W	W	Stone.
Murray	W	334	Talc.
Muscogee	W	W	Stone, sand and gravel.
Oglethorpe	1,350	1,562	Stone.
Pickens	W	W	Do.
Polk	W	W	Cement, stone, clay.
Quitman	644	W	Iron ore.
Rabun	W	W	Stone.
Richmond	4,859	4,581	Stone, clay.
Rockdale	W	--	
Screven	W	8	Peat.
Spalding	W	--	
Stephens	W	W	Stone.
Stewart	823	W	Iron ore.
Sumter	W	2,880	Clay, bauxite.
Talbot	W	W	Sand and gravel.
Taylor	W	W	Do.
Thomas	W	4,854	Clay, sand and gravel.
Twiggs	W	42,271	Clay.
Walker	W	3,289	Stone, clay.
Ware	W	W	Sand and gravel.
Warren	W	W	Clay.
Washington	43,013	45,655	Do.
Whitfield	W	W	Stone.
Wilkinson	W	W	Clay.
Undistributed	135,341	92,101	
Total ²	203,225	229,397	

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

¹ The following counties are not listed because no production was reported: Appling, Atkinson, Bacon, Baker, Banks, Barrow, Ben Hill, Berrien, Bleckley, Brantley, Brooks, Bryan, Bulloch, Burke, Butts, Calhoun, Camden, Candler, Carroll, Catoosa, Chattahoochee, Clay, Clinch, Coffee, Colquitt, Coweta, Crisp, Dade, Dawson, Dodge, Dooly, Echols, Emanuel, Forsyth, Franklin, Glascock, Grady, Habersham, Haralson, Harris, Heard, Irwin, Jackson, Jeff Davis, Jenkins, Johnson, Lamar, Lanier, Laurens, Lee, Liberty, Lumpkin, McIntosh, Macon, Marion, Meriwether, Newton, Oconee, Paulding, Peach, Pierce, Pike, Pulaski, Putnam, Randolph, Schley, Seminole, Taliaferro, Tattnall, Telfair, Terrell, Tift, Toombs, Towns, Treutlen, Troup, Turner, Union, Upson, Walton, Wayne, Webster, Wheeler, White, Wilcox, Wilkes, and Worth.

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

Table 3.—Selected economic indicators of Georgia business activity

	1970	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total work force available..... thousands.....	1,940.0	1,960.9	+1.1
Total unemployed..... do.....	70.7	78.4	+10.9
Employment:			
Manufacturing..... do.....	462.2	455.2	-1.5
Transportation and public utilities..... do.....	106.7	106.7	--
Mining..... do.....	6.9	6.9	--
Contract construction..... do.....	76.5	76.6	+0.1
Service..... do.....	187.3	205.6	+8.5
Government..... do.....	297.8	317.3	+6.5
Wholesale and retail trade..... do.....	330.8	340.9	+3.1
Finance, insurance, and real estate..... do.....	77.5	80.4	+3.7
Personal income:			
Total..... millions.....	\$15,345	\$16,545	+7.8
Per capita.....	\$3,334	\$3,547	+6.4
Construction activity:			
Number of private and public residential units authorized.....	53,848	75,087	+39.4
Value of authorized nonresidential construction..... millions.....	\$338.4	\$306.8	-9.3
Cement shipments to and within Georgia..... thousand 376-pound barrels.....	10,125	11,552	+14.1
Mineral production value..... millions.....	\$203.2	\$229.4	+12.9
Export trading..... do.....	\$352.9	\$341.2	-3.3
Import trading..... do.....	\$277.7	\$348.5	+25.5

^p Preliminary. † Revised.

Sources: Employment and Earnings; Area Trends in Employment and Unemployment; Construction Review; Streets and Roads; Highlights of U.S. Export and Import Trade; and U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Metal.....	120	306	37	309	--	2	6.48	55
Nonmetal and peat.....	3,592	300	1,077	8,684	2	228	26.49	2,496
Sand and gravel.....	227	267	61	537	1	11	22.33	11,496
Stone.....	2,848	259	737	6,446	1	165	25.75	1,994
Total.....	6,787	282	1,911	15,976	4	406	25.66	2,549
1971:^p								
Metal.....	120	318	38	318	--	7	22.01	421
Nonmetal.....	3,875	307	1,189	9,571	1	251	26.33	1,848
Sand and gravel.....	230	266	61	549	--	15	27.31	444
Stone.....	2,910	264	769	6,711	2	148	22.35	2,390
Total.....	7,135	288	2,056	17,149	3	421	24.72	1,989

^p Preliminary.¹ Beginning in 1971, data concerning peat operations are included in the nonmetals industry on a continuing basis.

tion on administration highlighted the establishment of a Georgia Liaison Office by the Bureau of Mines, U.S. Department of the Interior. A chapter prepared by the Bureau's State Liaison Officer for Georgia was included in a publication issued by Georgia State University.⁴ A report printed and distributed by the Georgia Department of Mines, Mining and Geology (prepared by the Georgia Geological Society for distribution to participants in a field trip) presented information on several subjects closely related to mining in Georgia.⁵

In June 1971, Governor Jimmy Carter announced an allotment of a combination of Coastal Plains Regional Commission funds and Georgia State funds to the Georgia Department of Industry and Trade for a research project with the purpose of exploring the technological, strategic, and economic implications of a possible replacement of imported bauxite by Georgia

⁴ Cooper, James D. Georgia Minerals Serve the Nation and the World. Atlanta Economic Review, v. 21, No. 7, July 1971, pp. 30-32.⁵ Georgia Geological Society. 6th Annual Field Trip, October 8-9, 1971. 21 pp.

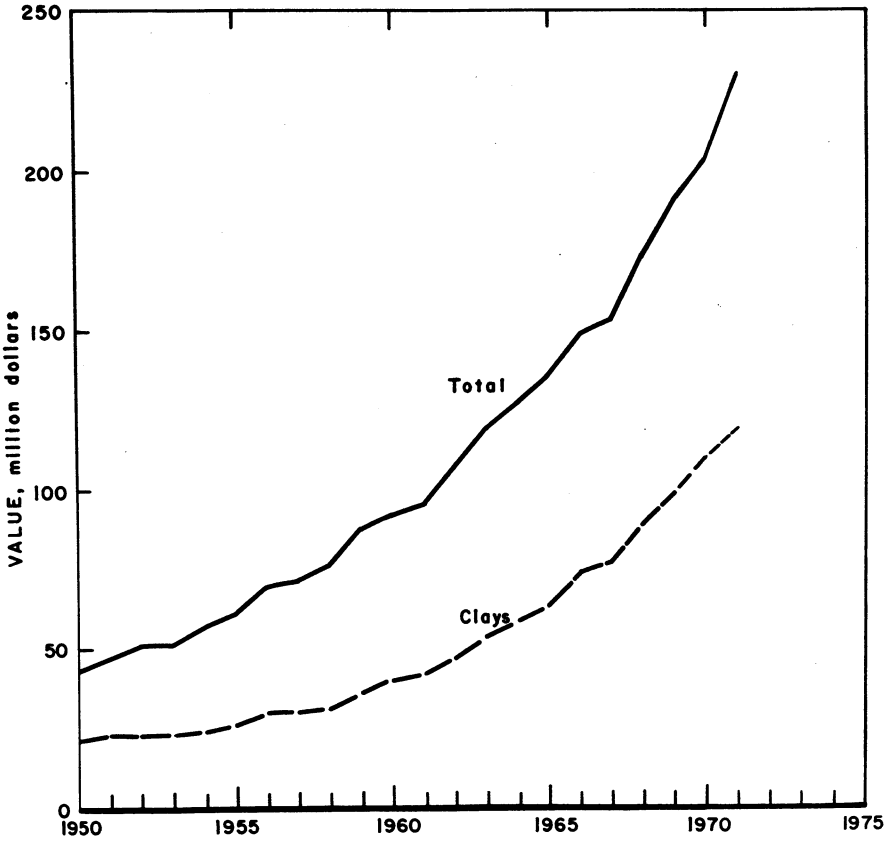


Figure 1.—Value of clays, and total value of mineral production in Georgia.

kaolin as a raw material for supplying at least part of the alumina required for pot-line feed in U.S. aluminum smelters.

With explicit pertinence to Georgia's mining industry, a Federal Bureau of Mines

report detailed conclusions in one of a projected series of analyses of the interaction of a number of forces that influence mineral supply in specific centers of population.⁶

REVIEW BY MINERAL COMMODITIES

NONMETALS

Barite.—Production of Georgia barite in 1971, the combined output of three open-pit mines in Bartow County (each operated by a different company), exceeded that of the previous year by 15 percent in tonnage and 24 percent in total value. The mineral was consumed as a densifier in oil-well drilling muds; as a filler, extender, or pigment for paints and rubber goods; as a raw material for the manufacture of glass; and in barium chemicals produced in Bartow County by Chemical Products Corp.

Cement.—Marquette Cement Manufacturing Co., Penn-Dixie Cement Corp., and Southern Cement Co. operated portland cement plants, one each, in Polk County, Houston County, and Fulton County, respectively, and their combined 1971 output was higher in total value than that of 1970.

The Fulton and Houston County plants also produced masonry cement, the total value of which also was above the corresponding figure for 1970.

The Penn-Dixie plant in Houston County was acquired at yearend by Medusa Cement Co., Div. of Medusa Corp., and plans were announced to replace part of the existing plant there with more modern and efficient units. The Marquette Cement Manufacturing Co. installed an electrostatic precipitator at its Polk County plant to control emissions of particulate matter.

Approximately half of the portland cement shipped in 1971 from plants in Georgia was consumed within the State's borders, mostly for making ready-mix concrete and other concrete products, or for sale to contractors and suppliers of building materials. Georgia's consumption of masonry cement in 1971 amounted to more than three times the total quantity of that type of material shipped during the year from the State's producing plants.

Raw materials originating in Georgia that were used in the making of portland cement included limestone, clay, sand, and iron-bearing materials.

Clays.—Georgia continued to hold first place in the nation in the production of clays, well ahead of all other States in output and without close rivals in terms of value. Four classifications of clays (kaolin, common clay and shale, fuller's earth, and fire clay) were produced by 21 firms from a total of 84 pits distributed throughout 20 counties, among which Washington and Twiggs Counties were in first and second places, respectively, in both tonnage and total value.

Kaolin, accounting for more than half the total value of all Georgia's mineral production in 1971, was mined by 17 companies from 55 pits in eight counties. Total value of the State's 1971 kaolin production climbed to 9 percent above the previous alltime high recorded in 1970, and the tonnage produced in 1971 was second only to the 1970 figure. In alphabetical order, the five leading producers, which jointly contributed nearly three-fourths of the State's total 1971 kaolin tonnage and more than four-fifths of the corresponding total value, were Engelhard Minerals & Chemical Corp., Freeport Kaolin Co., Georgia Kaolin Co. (and a subsidiary, American Industrial Clay Co.), J. M. Huber Corp., and Thiele Kaolin Co. Anglo American Clays Corp., a subsidiary of English China Clays, Ltd., formed an association with Union-Camp Corp. for the purpose of exploring and evaluating kaolin deposits on land that Union-Camp owns or controls in Georgia. The area involved was not specified but was believed to be extensive. Two major producers made substantial additions to their kaolin production facilities in the State; Freeport Kaolin Co., expanding for the third time in seven years, increased by 25 percent its capacity for the mining and milling of paper-grade material at Gordon, Wilkinson County; and Thiele Kaolin Co. completed a new plant

⁶ French, R. R., A. W. Stuart, and D. H. White. Socioeconomic Aspects of Mining in Selected Cities. Urbanization and Surface Mining, Atlanta, Ga. BuMines Inf. Circ. 8477, 1970, 50 pp.

near Wrens, Jefferson County, for the air-float processing of kaolin for filler applications. The Babcock & Wilcox Co. installed a pollution-control system at its Albion kaolin mine in Richmond County at a cost of \$250 thousand. Restoration and rehabilitation of mined-out lands continued to be a prime concern and received the diligent attention of the State's kaolin producers. The Georgia Department of Industry and Trade received a \$35,000 grant from the Coastal Plains Regional Commission and additional funds and services from Georgia State agencies for the financing of a research project with important implications for the State's mining industry. The study, to be carried out at the Georgia Institute of Technology Engineering Experiment Station and scheduled for completion in 1972, will feature a detailed analysis of the possibility of using high-grade Georgia clays, especially kaolin, as economically feasible sources of alumina of potline

quality for the electrolytic production of aluminum metal.

Fuller's earth was produced in 1971 by seven firms that operated a total of eight mines in four Georgia counties. Production of this clay material in Georgia in 1971 was 4 percent more in tonnage and 1 percent higher in total value than in 1970. Oil-Dri Corp. of America replaced a fuller's earth processing plant formerly operated by a subsidiary, Cairo Production Co., Inc., near Cairo, Thomas County, with a new installation at a site 9 miles north of Thomasville in the same county. The new facility will provide increased capacity for the preparation of animal litter, oil and grease absorbents, insecticide carriers, and other products from material drawn from the company's extensive reserves of fuller's earth in Thomas and Grady Counties.

Material classed as common clay and shale, used principally in the manufacture of structural clay products (brick and tile)

Table 5.—Kaolin sold or used by producers, by county
(Thousand short tons)

County	1970		1971	
	Number of mines	Quantity	Number of mines	Quantity
Twiggs.....	5	1,309	6	1,246
Washington.....	19	1,558	17	1,452
Wilkinson.....	5	W	5	472
Other counties ¹	7	881	8	513
Total ²	36	3,749	36	3,682

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

¹ Includes Baldwin, Jefferson (1971), McDuffie (1970), Richmond, Sumter, and Warren counties, and data indicated by symbol W.

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

Table 6.—Kaolin sold or used by producers, by use
(Short tons)

Use	1970	1971
Paper coating.....	¹ 2,491,230	1,370,468
Paper filling.....	(?)	301,084
Firebrick and block.....	354,232	260,073
Whiteware.....	99,980	140,555
Rubber.....	104,475	128,436
Fiberglass.....	NA	105,614
Paint.....	100,866	99,239
Plastics.....	W	78,365
Other chemicals.....	W	38,391
Exports.....	NA	512,106
Other uses ²	598,649	147,974
Total.....	3,749,432	3,682,305

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

¹ Includes paper filling.

² Included with paper coating.

³ Includes cement, catalysts, floor and wall tile, other pottery, mortar (1970), high-alumina brick (1970), other refractories, insecticides and fungicides, foundries and steelworks, and kiln furniture.

and cement, was mined by 17 companies from 20 pits in 14 counties. Tonnage and value in 1971 were 10 percent and 14 percent, respectively, above the comparable figures for the previous year. A minor quantity of fire clay, produced by one company from a pit in Floyd County, was consumed in the manufacture of refractories, as was also an indeterminate but substantial tonnage of kaolin.

Feldspar.—The Feldspar Corp. processed pegmatite in 1971 from deposits in Jasper County, recovering feldspar in the form of a flotation concentrate. The year's production was 7 percent more in quantity than in 1970, and the total value was 37 percent higher. The product was ground and shipped to destinations in Georgia and at least 15 other States and one foreign country, where it was used in ceramic bodies, glassmaking batches, and latex formulations.

Gypsum.—Three companies, each operating one gypsum calcination plant (The Flintkote Co. and National Gypsum Co., both in Chatham County, and Georgia-Pacific Corp., in Glynn County), prepared material from sources outside Georgia for use in plaster and wallboard. The tonnage of calcined product was 14 percent greater than the comparable figure for 1970, and the total value was 17 percent higher.

Kyanite.—C-E Minerals, Div. of Combustion Engineering, Inc., operated an open-pit mine and a flotation plant to recover disseminated kyanite from an extensive deposit of metamorphic quartzose rock at Graves Mountain, Lincoln County. The 1971 kyanite output marked the eighth annual increase in succession and established new highs (in terms of both quantity and total value) for production of that mineral in Georgia. Most of the kyanite concentrate recovered in 1971 went, as usual, into the production of superior refractories for high-temperature applications such as linings for glassmaking and smelting furnaces. Refractory materials of the mullite type, in addition to those derived from kyanite, were produced by two firms, Babcock & Wilcox Co., at an electric-furnace installation in Richmond County; and Mulcoa, Div. of Combustion Engineering, Inc., at a high-temperature sintering facility in Sumter County. The quantity of these substances produced (collectively classified as synthetic mullite) was notably higher than in the previous year, but the

corresponding unit value reported in 1971 showed a sharp reduction, reflecting a major shift in emphasis from the arc-fused product to the lower cost sintered material.

Mica.—Two firms mined scrap mica in Georgia in 1971, Franklin Mineral Products Co. in Hart County and Jones Mining Co. in Cherokee County; and The Feldspar Corp. recovered the mineral as a byproduct from a feldspar operation in Jasper County. Total mica production for the year was 7 percent less in tonnage but was valued at 18 percent more than in 1970. The material was either ground for filler use in paints, rubber, and joint cement or was marketed unground for decorative purposes, to coat roofing, or for well sealing.

Perlite.—Crude perlite originating outside Georgia was expanded, principally for use as lightweight aggregate or soil conditioner, in one plant operated by Armstrong Cork Co. in Bibb County. The 1971 output of processed perlite was more than double that of 1970 in both tonnage and total value.

Sand and Gravel.—Significant commercial production of sand and gravel in Georgia was reported in 1971 by 20 firms from open pits or dredging operations (about 18 and 8 of which, respectively, were active during the greater part of the year) at locations in 17 counties. Almost two-thirds of the total tonnage came from operations in Bibb, Crawford, Effingham, Talbot, and Thomas Counties. The five largest producers, which jointly accounted for 70 percent of the total quantity and 78 percent of the total value, were Atlanta Sand & Supply Co. (Crawford County), Cornell-Young Co. (Bibb County), Dawes Silica Mining Co. (Dougherty, Effingham, Long, and Thomas Counties), Drake's Eye Mining Co. (De Kalb County), and Taylor County Sand Co. (Talbot County). Total output was 1 percent more than in 1970, and the total value was 20 percent higher. Most of the material produced was consumed by the building industry (plaster, cement, and concrete products) or for paving, fill, molding, and water filtration, or as sand-blast abrasive, engine sand, and railway ballast. Smaller but economically important quantities of higher unit-value sand were used as the major component in glass-furnace feeds. Approximately three-quarters of the State's total 1971 tonnage of sand and gravel was shipped by truck and one-quarter by rail.

Table 7.—Sand and gravel sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Evans.....	1	28	\$42	--	38	\$57
Lowndes.....	--	--	--	1	224	168
Montgomery.....	1	20	20	1	W	W
Undistributed ¹	23	3,621	4,377	24	3,434	5,085
Total ²	25	3,667	4,437	26	3,697	5,310

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

¹ Includes Bibb, Chatham, Cook (1970), Crawford, DeKalb (1971), Dougherty, Effingham, Fulton, Glynn (1970), Greene, Long, Muscogee, Richmond (1970), Rockdale (1970), Talbot, Taylor, Thomas, and Ware counties.

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

Table 8.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	2,737	\$2,637	2,523	\$2,384
Fill.....	22	23	43	44
Paving.....	387	313	W	W
Other uses ¹	445	1,278	1,049	2,723
Total ²	3,591	4,251	3,620	5,151
Gravel: Other uses ²	76	185	78	159
Total sand and gravel ²	3,667	4,437	3,697	5,310

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

¹ Includes blast, engine, filtration, foundry, glass molding, paving (1971), and other sands.

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

³ Includes building miscellaneous and other gravel.

Stone.—Stone, next in importance in the State after clays, accounted for 30 percent of the total value of Georgia's 1971 mineral production. The total tonnage of stone produced was 15 percent more than in 1970, and the total value was higher by 18 percent. Stone production was reported in 30 counties from 72 quarries operated by 55 private firms and one governmental agency. Production of more than 1 million tons was recorded in each of 12 counties, among which De Kalb, Fulton, Gwinnett, Jones, and Walker Counties were in the top bracket. Stone with a total value in excess of \$2 million was quarried in each of 13 counties, with De Kalb, Fulton, Gwinnett, Jones, and Pickens Counties holding top honors in that respect. The State's 1971 output of crushed stone, all types, amounted to more than 30 million tons, of which 71 percent was shipped by truck, 27 percent by rail, and 2 percent by waterborne barge.

Crushed granite was produced from 23 quarries in 17 counties by 12 firms, among which Davidson Mineral Properties, Inc.; Dixie Lime & Stone Co.; Henry Co.; Hitchcock Corp.; and Vulcan Materials Co. were principal suppliers. Quantity and total value of this material, used chiefly as concrete and bitumen aggregate or for railroad ballast, surpassed the 1970 figures by 15 percent and 19 percent, respectively, establishing new high marks for the State.

Dimension granite was quarried at 28 locations in five counties by Davidson Granite Co.; H. B. Brown Granite Co., Inc.; Coggins Granite Industries, Inc.; Bennie & Harvey Quarries, Inc.; Star Granite Co., Inc.; and 22 smaller producers; accounting in all for 37 percent more tonnage and 19 percent more total value than in 1970. More than half of this material (by weight) was used for monuments, and lesser quantities were marketed as curbing, rubbing stones, and rough blocks.

Crushed limestone, produced by 10 private organizations and one city highway department from 12 quarries in ten counties, amounted to 22 percent more in quantity and 24 percent more in total value than in the previous year. This material served as road metal, concrete aggregate, cement-making raw material, and agricultural limestone. The five largest private producers in 1971 were Georgia Rock Products, Div. of Vulcan Materials Co.; L B I Quarries, Inc.; Medusa Corp., Medusa Cement Co.; The Stone Man, Inc.; and Dalton Rock Products Co.

Crushed marble was produced in 1971 by Marble Products Co. and by two divisions of Georgia Marble Co. from three quarries, all in Pickens County. Output of this material, which was used chiefly for industrial filler, whiting, concrete aggregate, agricultural stone, roofing granules, and terrazzo stone, was lower in tonnage and value than in 1970.

Dimension marble, credited with the highest unit value among the various classifications of stone produced in the State, was quarried in 1971 only by Georgia Marble Co. at two locations in Pickens County. The year's output was 35 percent greater and represented a total value 58 percent higher than that of the preceding year.

Dimension sandstone or flagstone was produced from two quarries in Pickens County by Carl S. Johnson Quarries and North Georgia Stone Co. for use as building stone, especially for floors, walks, patios, and terraces. The tonnage was greater than in 1970, but the total value was lower.

Minor quantities of crushed sandstone and crushed miscellaneous stone, produced in Jasper and Polk Counties, were used mostly as concrete aggregate and in the manufacture of portland cement.

Slate, either crushed to serve as roofing material or low-density aggregate, or else ground for filler purposes, was produced by G A F Corp., Industrial Products Div.; and by Georgia Lightweight Aggregate Co. from one quarry each in Bartow County and Polk County, respectively. The year's output of slate was less than in 1970, but the corresponding total value, reflecting emphasis on selected material, was substantially greater.

Georgia Marble Co. was awarded a contract in December 1971 to supply the dimension stone needed for the construction in Washington, D.C., of the new Library of Congress annex, to be known as the James Madison Memorial Building and scheduled for completion in 1975. About \$2 million of the contract's \$5.2 million total will be spent for blocks of a special white marble quarried at Tate, Ga., a type of building stone used in a number of existing structures in the District of Columbia, notably the Lincoln Memorial, the east face of the National Capitol, and the Tomb of the Unknown Soldier in Arlington National Cemetery just across the Potomac in Virginia.

Strontium.—Strontium carbonate, in refined form suitable for use in the manufacture of ferrites and glass for color television picture tubes, was extracted from Mexican celestite ore by Chemical Products Corp. in a plant in Bartow County.

Table 9.—Crushed granite sold or used by producers, by use
(Thousand short tons and thousand dollars)

Use	1970			1971		
	Value			Value		
	Quantity	Total	Average per ton	Quantity	Total	Average per ton
Bituminous aggregate.....	W	W	W	5,305	\$8,721	\$1.64
Concrete aggregate.....	6,680	\$10,566	\$1.58	7,383	11,884	1.61
Dense graded road-base stone.....	1,942	3,124	1.61	2,834	4,624	1.63
Macadam aggregate.....	4,296	6,773	1.58	591	1,055	1.79
Surface treatment aggregate.....	948	1,589	1.68	1,305	2,036	1.56
Unspecified construction aggregate.....	2,521	3,991	1.58	2,943	4,838	1.64
Railroad ballast.....	2,145	3,002	1.40	2,331	3,480	1.49
Riprap and jetty stone.....	W	W	W	179	333	1.86
Other uses ¹	2,480	3,662	1.48	1,294	1,878	1.45
Total ²	21,013	32,706	1.56	24,167	38,849	1.61

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

¹ Includes agricultural uses and uses indicated by symbol W.

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

Table 10.—Dimension granite sold or used by producers, by county

County	1970				1971			
	Number of quarries	Thousand cubic feet	Short tons (equiv- alent)	Value (thou- sands)	Number of quarries	Thousand cubic feet	Short tons (equiv- alent)	Value (thou- sands)
De Kalb	4	354	31,573	\$863	4	549	46,001	W
Elbert	10	338	30,524	1,747	11	454	47,743	\$2,217
Oglethorpe	9	531	45,305	1,350	10	746	67,579	1,562
Undistributed ¹	3	369	30,559	1,307	3	327	27,190	2,463
Total ²	26	1,592	137,961	5,267	28	2,076	188,513	6,243

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

¹ Includes Hancock and Madison Counties.

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

Table 11.—Dimension granite sold or used by producers, by use

(Thousand cubic feet and thousand dollars)

Use	1970			1971		
	Quantity	Value		Quantity	Value	
		Total	Average per cubic foot		Total	Average per cubic foot
Rough:						
Architectural	W	W	W	308	\$478	\$1.55
Construction	W	W	W	255	120	.47
Monumental	1,013	\$3,980	\$3.93	1,067	3,601	3.37
Dressed:						
Sawed stone	W	W	W	45	120	2.67
Curbing	W	W	W	291	W	W
Other uses ¹	579	1,237	2.22	110	1,924	17.49
Total	1,592	5,267	3.31	2,076	6,243	3.01

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

¹ Includes data for cut stone; 1971 data also includes data for dressed monumental stone, paving blocks, and uses not specified.

Table 12.—Crushed limestone ¹ sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Bituminous aggregate	W	W	251	\$398
Concrete aggregate	689	\$1,231	676	1,041
Dense graded road base stone	1,291	1,766	1,338	1,923
Surface treatment aggregate	W	W	223	418
Unspecified construction aggregate	W	W	553	1,714
Agricultural limestone	445	W	W	W
Cement manufacture	1,301	1,982	1,581	2,462
Other uses ²	681	3,607	746	2,708
Total ³	4,407	8,586	5,366	10,662

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

¹ Includes dolomite.

² Includes macadam aggregate, riprap and jetty stone, railroad ballast, stone sand, and uses indicated by symbol W.

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

Talc.—Southern Talc Co. ground talc from its underground mines in Murray County for use principally to coat roofing and to serve as asphalt and rubber filler, insecticide carrier, or pigment for paints. In terms of tonnage, mine production of the crude mineral was the largest since that of 1959, and the total value was the highest on record.

METALS

Bauxite.—Two operators, American Cyanamid Co. and Mulcoa, Div. of Combustion Engineering, Inc., mined material classified as bauxite or bauxitic clay in 1971 at two sites (one each) in Sumter County. The year's production of this material, about half that of 1970, was consumed principally in the manufacture of high-alumina firebrick and other types of refractories. Mulcoa installed three new kilns at its Andersonville bauxite and clay processing plant, substantially increasing the production capacity of that facility.

Iron Ore.—Three firms, operating open-pit mines in western Georgia (Dunbar & Layton Mining Co., Inc., and Luverne Mining Co., both in Stewart County, and Lumpkin Mining Co., in Quitman County), produced limonite for blending with foreign iron ores at iron and steel smelters in Alabama. The State's total output of this material in 1971 was substantially less than in the previous year. As distinguished from the steelmaking ore, iron-oxide minerals classified as ochres and umbers were produced from an open-pit operation in Bartow County by New Riverside Ochre Co. These minerals, amounting to 4 percent less in quantity than in 1970 but 7 percent higher in total value, were used as pigment materials for paints, mortars, concrete, and

clay products or as chemical reagents.

Rare-Earth Minerals.—Monazite concentrate (chiefly rare-earth phosphates and silicates) was one of the coproducts recovered by Humphreys Mining Co. from mineral-bearing sands in Charlton County. Output of this material, from which thorium and other rare-earth metals were extracted for electrical, chemical, and medical applications, was about one-fourth less than in 1970.

Titanium.—Ilmenite concentrate (essentially ferrous titanate) was the principal target of a dredging and milling operation conducted by Humphreys Mining Co. for the recovery of valuable minerals from pegmatite-derived sands laid down in ancient river terraces in what is now Charlton County. The quantity of this titanium mineral produced in 1971 was not significantly different from that in 1970 and was used in ceramics, as a pigment in paints, and as a source of titanium metal.

Zirconium.—Zircon concentrate (zirconium silicate) was another mineral fraction recovered by Humphreys Mining Co. from a Charlton County sand deposit. Production of this material, used in refractories, ceramics, molding sands, and foundry facings, fell 11 percent below the level of 1970.

FUELS

Peat.—Decomposed vegetable matter, accumulated in limestone sinks and classified as humus peat, was processed by three firms, Atlantic Peat Co. and Colonial Peat Co., both operating in Screven County, and Shep Peat Co., in Miller County. The State's 1971 output of this material, which was dried and shredded for use as soil conditioner or greenhouse packaging, was more than double the 1970 figure.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Barite, primary:			
Milchem, Inc.	3920 Essex Lane Houston, Tex. 77027	Open pit mine....	Bartow.
New Riverside Ochre Co.	Box 387 Cartersville, Ga. 30120	....do.....	Do.
Paga Mining Co., Div. Thompson-Weinman & Co.	Box 180 Cartersville, Ga. 30120	Open pit mine and grinding mill.	Do.
Bauxite: American Cyanamid Co.	Berdan Ave. Wayne, N.J. 07472	Open pit mine and drying plant.	Sumter.
Cement, portland:			
Marquette Cement Manufacturing Co.	20 N. Wacker Dr. Chicago, Ill. 60606	Plant.....	Polk.
Penn-Dixie Cement Corp.	Box 152 Nazareth, Pa. 18064	....do.....	Houston.
Southern Cement Co., Div. Martin Marietta Corp.	18th Floor, Daniel Bldg. Birmingham, Ala. 35233	....do.....	Fulton.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clays:			
Fuller's earth:			
Cairo Production Co., Inc.	Box 358 Cairo, Ga. 31728	Open pit mine	Thomas.
Englehard Minerals & Chemicals Corp.	Menlo Park Edison, N.J. 08817	do	Decatur.
Milwhite Co., Inc.	Attapulgus, Ga. 31715	do	Do.
Georgia-Tennessee Mining & Chemical Co.	Box 307 Wrens, Ga. 30833	do	Jefferson.
Thor Mining Co.	Berkeley Springs, W. Va. 25411	do	Thomas.
Waverly Mineral Products Co.	Meigs, Ga. 31765	do	Do.
Kaolin:			
American Industrial Clay Co. of Sandersville.	Sandersville, Ga. 31082	Open pit mine	Washington.
Englehard Minerals & Chemicals Corp.	Menlo Park Edison, N.J. 08817	do	Washington and Wilkin- son.
Freeport Kaolin Co.	405 Lexington Ave. New York, N.Y. 10017	do	Twiggs.
Georgia Kaolin Co.	433 North Broad St. Elizabeth, N.J. 07208	do	Do.
J. M. Huber Corp.	630 3rd Ave. New York, N.Y. 10017	2 open pit mines	Twiggs and Warren.
Thiele Kaolin Co.	Box 1056 Sandersville, Ga. 31082	6 open pit mines	Washington.
Miscellaneous:			
Burns Brick Co.	Box 4787 Macon, Ga. 31208	Open pit mine	Bibb.
Chattahoochee Brick Co.	3195 Brick Plant Rd. Atlanta, Ga. 30321	3 open pit mines	Floyd (1), Fulton (2).
Cherokee Brick & Tile Co.	Box 4567 Macon, Ga. 31208	Open pit mine	Bibb.
Merry Brothers Brick & Tile Co.	415 Masonic Bldg. Augusta, Ga. 30902	do	Richmond.
Southern Cement Co., Div. Martin Marietta Corp.	18th Floor, Daniel Bldg. Birmingham, Ala. 35233	do	Fulton.
Feldspar: The Feldspar Corp.	Spruce Pine, N.C. 28777	Open pit mine and flotation plant.	Jasper.
Gypsum, calcined:			
The Flintkote Co.	480 Central Ave. East Rutherford, N.J. 07073	Plant	Chatham.
Georgia-Pacific Corp.	Commonwealth Bldg. Portland, Ore. 97207	do	Glynn.
National Gypsum Co.	325 Delaware Ave. Buffalo, N.Y. 14202	do	Chatham.
Iron ore:			
Dunbar & Layton Mng. Co., Inc.	P.O. Box 267 Lumpkin, Ga. 31815	Open pit mine	Stewart.
Lumpkin Mining Co.	Box 234 Greenville, Ala. 36037	do	Quitman.
Luverne Mining Co.	P.O. Box 409 Luverne, Ala. 36104	do	Stewart.
Iron oxide pigment materials:			
New Riverside Ochre Co.	Box 387 Cartersville, Ga. 31020	do	Bartow.
Kyanite: Aluminum Silicates, Inc., Div. of C-E Minerals.	Box 649 Washington, Ga. 30673	Open pit mine and mill.	Lincoln.
Mica, scrap:			
Franklin Mineral Products Co.	Box 0 Wilmington, Mass. 01887	Open pit mine and grinding mill.	Hart.
Peat:			
Colonial Peat Co.	P.O. Box 130 Rt. 3 Sylvania, Ga. 30467	Open pit mine	Screven.
Shep Peat Co.	P.O. Box 307 Colquitt, Ga. 31727	Open pit mine	Miller.
Perlite, expanded:			
Armstrong Cork Co.	Macon, Ga. 30312	Plant	Bibb.
Rare-earth minerals: Humphreys Mining Co.			
	Box 8 Folkston, Ga. 31537	Dredge and plant.	Charlton.
Sand and gravel:			
Atlanta Sand & Supply Co.	604 Forsyth Bldg. Atlanta, Ga. 30303	Open pit mine	Crawford.
Cornell-Young	4496 Mead Rd. Macon Ga. 31206	3 open pit mines	Bibb.
Dawes Silica Mining Co., Inc.	Drawer 920 Thomasville, Ga. 31792	4 open pit mines	Dougherty, Effingham, Long, and Thomas.
Taylor County Sand Co.	Junction City, Ga. 31812	do	Talbot.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone:			
Granite, crushed:			
Davidson Mineral Properties	P.O. Box 458 Lithonia, Ga. 30058	2 quarries	De Kalb, Fulton.
Dixie Lime & Stone Co.	Box 910 Ocala, Fla. 32670	5 quarries	Clayton, Fayette, and Monroe.
H. B. Brown Granite Co., Inc.	P.O. Box 871 Elberton, Ga. 30635	do	Elbert.
Hitchcock Corp.	Box 35 Murphy, N.C. 28906	3 quarries	Fulton and Jones.
Vulcan Materials Co.	Box 12078 N. Side Sta. Atlanta, Ga. 30305	6 quarries	Cobb, DeKalb, Fulton, Gwinnett, and Muscogee.
Weston & Brooker Co.	Box 335 Gray, Ga. 31032	Quarry	Jones.
Granite, dimension:			
Bennie & Harvey	Box 958 Elberton, Ga. 30635	do	Oglethorpe.
Coggins Granite Industries, Inc.	Box 250 Elberton, Ga. 30635	2 quarries	Elbert and Madison.
Comolli Granite Co.	Box 898 Elberton, Ga. 30635	Quarry	Elbert.
Davidson Granite Co., Inc.	Lithonia, Ga. 30058	do	De Kalb.
Georgia Marble Co.	Elberton, Ga. 30635	do	Madison.
Henry Co.	P.O. Box 7324A Birmingham, Ala. 35223	Quarry	Fulton.
Star Granite Co., Inc.	Elberton, Ga. 30635	do	Oglethorpe.
Stone Mountain Granite Co.	Stone Mountain, Ga. 30083	do	De Kalb.
Limestone, crushed:			
Dalton Rock Products Co.	Box 1608 Dalton, Ga. 30720	do	Whitfield.
Georgia Rock Products Co.	Arlington, Ga. 31713	do	Early.
LBI Quarries, Inc.	P.O. Box 1067 Rome, Ga. 31061	do	Floyd.
Penn-Dixie Cement Corp.	Box 152 Nazareth, Pa. 18064	do	Houston.
The Stone Man, Inc.	3814 Tennessee Ave. Chattanooga, Tenn. 37409	do	Walker.
Marble, crushed:			
Georgia Marble Co.	Tate, Ga. 30177	2 quarries	Pickens.
Marble Products Co.	67 Peachtree Park Dr., Atlanta, Ga. 30309	1 quarry	Do.
Marble, dimension:			
Georgia Marble Co.	Tate, Ga. 30177	Quarry and finishing plant.	Do.
Sandstone, crushed:			
Marquette Cement Manufacturing Co.	20 No. Wacker Dr. Chicago, Ill. 60606	Quarry	Polk.
Sandstone, dimension:			
Carl S. Johnson	Route 1 Talking Rock, Ga. 30175	Quarry	Pickens.
North Georgia Stone Co.	Whitestone, Ga. 30186	do	Do.
Slate, crushed:			
GAF Corp.	Fairmont, Ga. 30139	Underground quarry.	Bartow.
Georgia Lightweight Aggregate Co.	Box 19781, Station N Atlanta, Ga. 30325	Quarry and ex- panding plant.	Polk.
Talc: Southern Talc Co.	Box 278 Chatsworth, Ga. 30705	5 underground mines.	Murray.
Titanium concentrate:			
Humphreys Mining Co.	Box 8 Folkston, Ga. 31537	Dredge and plant.	Charlton.
Zircon concentrate:			
Humphreys Mining Co.	Box 8 Folkston, Ga. 31537	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 Avery H. Reed ¹

Mineral output declined for the second straight year. Total value decreased 3 percent and was 5 percent below the 1969 rec-

ord. The decline was due to decreased building activities in the State.

¹Physical scientist, Division of Nonmetallic Minerals.

Table 1.—Mineral production in Hawaii ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland.....thousand 376-pound barrels..	2,105	\$9,968	1,993	\$10,196
Masonry.....thousand 280-pound barrels..	77	366	79	431
Clays.....thousand short tons..	2	11	W	W
Lime.....do..	9	338	8	228
Pumice, pumicite, and volcanic cinder.....do..	350	933	289	779
Sand and gravel.....do..	514	1,679	836	1,967
Stone.....do..	6,332	15,538	6,056	14,357
Value of items that cannot be disclosed:				
Gem stones, salt, and dimension stone	XX	132	XX	149
Total.....	XX	28,965	XX	28,107
Total 1967 constant dollars.....	XX	25,909	XX	24,419

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

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

Table 2.—Value of mineral production in Hawaii, by county

County	(Thousands)		Minerals produced in 1971 in order of value
	1970	1971	
Hawaii.....	\$2,215	\$2,155	Stone, pumice.
Honolulu.....	23,919	22,976	Stone, cement, sand and gravel, lime, clays, salt.
Kauai.....	766	766	Stone, sand and gravel, volcanic cinder.
Maui.....	2,065	2,210	Sand and gravel, stone, volcanic cinder, lime, gem stones.
Total.....	28,965	28,107	

Table 3.—Indicators of Hawaii business activity

	1970	1971 [▷]	Change, percent
Total nonagricultural employment.....	293.7	301.7	+2.7
Manufacturing.....	25.6	24.8	-3.1
Contract construction.....	25.7	23.4	-9.0
All other industries ¹	242.4	253.5	+4.6
Personal income:			
Total.....	\$3,445	\$3,732	+8.3
Per capita.....	\$4,521	\$4,797	+6.1
Construction activity:			
Number of private and public residential units authorized.....	10,678	NA	NA
Value of nonresidential construction.....	\$112.0	NA	NA
Farm marketing receipts.....	\$206.6	NA	NA
Mineral production value.....	\$29.0	\$28.1	-3.1

[▷] Preliminary. NA Not available.

¹ Includes transportation and public utilities; wholesale and retail trade; finance, insurance, and real estate; services; and government.

Sources: Survey of Current Business, Construction Review, Employment and Earnings and Annual Report on the Labor Force, Farm Income Situation, and Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Nonmetal.....	79	137	11	86	--	5	58.32	1,225
Sand and gravel.....	48	156	7	60	--	3	50.21	954
Stone.....	542	286	155	1,273	--	57	44.76	1,522
Total ¹	669	259	173	1,419	--	65	45.81	1,507
1971: [▷]								
Nonmetal.....	80	120	9	75	--	3	39.84	385
Sand and gravel.....	65	131	9	67	--	2	29.78	596
Stone.....	540	270	146	1,158	--	60	51.81	724
Total ¹	690	239	164	1,301	--	65	49.98	698

[▷] Preliminary.

¹ Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Kaiser Cement & Gypsum Corp. operated a cement plant at Nana-kuli, and Hawaiian Cement Corp. operated a cement plant at Honolulu. Shipments of portland cement were 1,992,995 barrels valued at \$10,195,846, a decrease of 5 percent below the 1970 record. Shipments of masonry cement were a record 78,561 barrels valued at \$430,802, an increase of 2 percent.

Of the total portland cement produced, 6 percent was from imported clinker.

Portland cement was consumed for ready-mix concrete (78 percent), concrete products (11 percent), building materials (6 percent), and other uses.

Raw materials used in making portland cement included 439,461 tons of coral, 65,991 tons of basalt, 35,517 tons of silica

sand (imported from New Zealand and Australia), 17,126 tons of gypsum (imported from Mexico), and 19,668 tons of clinker (imported from Japan).

The two plants consumed 299,000 barrels of imported fuel oil and purchased 49 million kilowatt-hours of electric energy.

Hawaiian Cement Corp. proceeded with plans for an additional 1.5 million barrel expansion, to be on stream in July 1972.

Clays.—Pacific Clay Corp. mined a small quantity of common clay at Waimanalo, Oahu, in Honolulu County. The clay was used at the company's brick plant at Barbers Point, Oahu.

Gem Stones.—Output of red and black coral was considerably more than in recent years.

Lime.—Gaspro Ltd. and Hawaiian Commercial & Sugar Co. Ltd. produced lime in Honolulu and Maui Counties for sugar re-

fining, steel furnaces, mason's lime, sewage treatment, and water purification. Output decreased 11 percent and was 20 percent below the 1966 record. The lime was consumed in Hawaii. Total consumption of lime in Hawaii was 8,472 tons.

Pumice and Volcanic Cinder.—Twenty operators produced pumice and volcanic cinder at 20 mines for concrete, roads, landscaping, and fill. Output declined 17 percent. Leading counties were Hawaii and Maui. Leading producers were Volcanite, Ltd., Fong Construction Co., Ltd., and Hutchinson Sugar Co., Ltd.

Salt.—Tanaka Hawaiian Salt produced a small quantity of salt by evaporation of seawater near Honolulu.

Sand and Gravel.—Thirteen operators mined sand and gravel at 14 mines for concrete and roads, fill, and other uses. Output increased 63 percent, due mainly to the new operation of Lone Star Industries. Leading counties were Honolulu and Maui. Leading producers were Lone Star Industries, HC&D, Ltd., and Maui Concrete & Aggregates, Inc.

Stone.—Fourteen operators crushed 4,532,628 tons of traprock valued at \$10,818,318, a decrease of 5 percent. The stone was used for concrete and roads, fill, and other uses. Leading counties were Honolulu and Hawaii. Leading producers were Lone Star Industries, HC&D, Ltd., and Hawaiian Bitumuls & Paving Co., Ltd.

Ten producers crushed 1,186,160 tons of

limestone valued at \$3,045,409, a decrease of 1 percent. The limestone was used for concrete and roads, cement, fill, landscaping, and other uses. The leading county was Honolulu. Leading producers were Pacific Concrete & Rock Co., Ltd., Kaiser Cement & Gypsum Corp., and Hawaiian Cement Corp.

Ten operators crushed miscellaneous stone at 11 quarries in Hawaii and Kauai Counties. Output was 337,514 tons valued at \$493,549, a decrease of 11 percent. The stone was used for concrete and roads, and for other uses. Leading producers were Laupahoehoe Sugar Co., and Puna Sugar Co., Ltd.

Joe's Moss Rock, Inc., and James Kuwana quarried a small quantity of dimension miscellaneous stone in Hawaii and Honolulu Counties for rough blocks, rubble, and rough architectural use.

Total crushed stone production was 6,056,302 tons valued at \$14,357,276, a decrease of 4 percent.

Vermiculite.—Crude vermiculite from Montana was exfoliated on Oahu by Vermiculite of Hawaii, Inc.

MINERAL FUELS

Hawaiian Independent Refinery, Inc., was constructing a refinery at Barbers Point, Oahu. Capacity will be 30,000 barrels of crude oil per day and aviation fuel, marine fuel, and residual oil will be recovered.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	Island
Cement:			
Hawaiian Cement Corp.....	1600 Kapiolani Blvd., Suite 1200 Honolulu, Hawaii 96814	Dry process port- land cement plant.	Oahu.
Kaiser Cement & Gypsum Corp.....	Permanente Rd. Permanente, Calif. 95014	Wet process port- land cement plant.	Do.
Clays: Pacific Clay Corp.....	547 Halekauwila St. Honolulu, Hawaii 96813	Open pit mine...	Do.
Lime:			
Gaspro, Ltd.....	P.O. Box 2454 Honolulu, Hawaii 96804	Rotary kiln and continuous hydrator.	Do.
Hawaiian Commercial & Sugar Co. Ltd.	Puunene, Hawaii 96784	...do.....	Maui.
Pumice and volcanic cinder:			
Fong Construction Co., Ltd.....	237 Dairy Rd. Kahului, Hawaii 96732	Open pit mine...	Do.
Grove Farm Co., Ltd.....	Puhi Rural Station Lihur, Hawaii 96766	...do.....	Kauai.
Hawaiian Agricultural Co., Ltd.....	Pahala, Hawaii 96777	...do.....	Hawaii.
HC&D, Ltd.....	P.O. Box 190 Honolulu, Hawaii 96810	...do.....	Molokai.
Hutchinson Sugar Co., Ltd.....	Naalehu, Hawaii 96772	...do.....	Hawaii.
James Kuwana.....	P.O. Box 406 Pahoa, Hawaii 96778	...do.....	Do.
Pepeekeo Sugar Co.....	Pepeekeo, Hawaii 96783	...do.....	Do.

Table 5.—Principal producers—Continued

Commodity and company	Address	Type of activity	Island
Pumice and volcanic cinder—Continued			
Volcanite, Ltd.-----	8282 Fort St. Honolulu, Hawaii 96813	Open pit mine---	Hawaii.
Salt: Tanaka Hawaiian Salt-----	968 D Akepo Lane Honolulu, Hawaii 96817	Solar evaporation	Oahu.
Sand and gravel:			
Concrete Industries, Inc.-----	P.O. Box 86 Puunene, Hawaii 96784	Open pit mine---	Maui.
Hawaiian Commercial & Sugar Co., Ltd.	Puunene, Hawaii 96784	----do-----	Maui.
HC&D, Ltd.-----	P.O. Box 190 Honolulu, Hawaii 96810	----do-----	Molokai.
Kekaha Sugar Co., Ltd.-----	Kekaha, Hawaii 96752	----do-----	Kauai.
Lone Star Industries, Pacific Region	400 Alabama St. San Francisco, Calif. 94110.	2 portable plants.	Oahu.
Maui Concrete & Aggregates, Inc.---	8 Central Ave. Wailuku, Hawaii 96793	Open pit mine---	Maui.
Louis K. Rego Trucking-----	Lihue, Hawaii 96766	----do-----	Kauai.
Stone:			
Concrete Industriis, Inc.-----	P.O. Box 86 Puunene, Hawaii 96784	Open quarry----	Maui.
James W. Glover, Ltd.-----	P.O. Box 275 Hilo, Hawaii 96720	----do-----	Hawaii.
Grove Farm Co., Inc.-----	Puhi Rural Station Puihi, Hawaii 96766	----do-----	Kauai.
Hawaiian Agricultural Co., Ltd.-----	Pahala, Hawaii 96777	----do-----	Hawaii.
Hawaiian Bitumuls & Paving Co., Ltd.	P.O. Box 2240 Honolulu, Hawaii 96804	----do-----	Oahu.
Hawaiian Cement Corp.-----	1600 Kapiolani Blvd. Suite 1200 Honolulu, Hawaii 96814	----do-----	Do.
HC&D, Ltd.-----	P.O. Box 190 Honolulu, Hawaii 96810	----do-----	Do.
Honokaa Sugar Co.-----	Haina, Hawaii 96709	----do-----	Hawaii.
Kaiser Cement & Gypsum Corp.-----	Permanente Rd. Permanente, Calif. 95014	----do-----	Oahu.
Kohala Sugar Co.-----	Hawi, Hawaii 97619	----do-----	Hawaii.
Laie Concrete & Aggregate, Inc.-----	Laie, Hawaii 97662	----do-----	Oahu.
Laupahoehoe Sugar Co.-----	Papaaloa, Hawaii 96780	----do-----	Hawaii.
Lihue Plantation Co., Ltd.-----	P.O. Box 751 Lihue, Hawaii 96766	----do-----	Kauai.
Lone Star Industries, Pacific Region	400 Alabama St. San Francisco, Calif. 94110	----do-----	Oahu.
Paauhau Sugar Co. Ltd.-----	Paauhau, Hawaii 96775	----do-----	Hawaii.
Pacific Concrete & Rock Co., Ltd.---	2344 Pahounui Dr. Honolulu, Hawaii 96819	----do-----	Molokai, Oahu.
Puna Sugar Co., Ltd.-----	Keaau, Hawaii 96749	----do-----	Hawaii.
Ultramar Chemical Co.-----	P.O. Box 395 Hilo, Hawaii 96720	----do-----	Oahu.
Yamada Sons, Inc.-----	P.O. Box 577 Hilo, Hawaii 96720	----do-----	Do.
Vermiculite (exfoliated): Vermiculite of Ha- waii, Inc.	842-A Mapunapuna St. Honolulu, Hawaii 96819	Exfoliating plant.	Do.

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 Francis C. Mitko ¹

The value of Idaho's mineral production decreased 6 percent from its 1970 record high; the 1971 production was \$112.3 million. As in the past, silver was the leading commodity in value, accounting for 26 percent of Idaho's total mineral production value. Although the quantity of silver produced increased slightly, there was a drop

in the average annual price. Lead, the second commodity in total value, increased in production but fell in total value. Significant increases were made in the output and value of gold, tungsten ores, vanadium, zinc, portland cement, garnet, and lime.

¹ Economist, Division of Nonferrous Metals.

Table 1.—Mineral production in Idaho ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony ore and concentrate short tons, antimony content..	993	W	857	\$817
Clays..... thousand short tons..	² 13	² \$23	W	W
Copper (recoverable content of ores, etc.).. short tons..	3,612	4,163	3,776	3,927
Gem stones.....	NA	90	NA	100
Gold (recoverable content of ores, etc.).. troy ounces..	3,123	114	3,596	148
Lead (recoverable content of ores, etc.).. short tons..	61,211	19,121	66,610	18,334
Mercury..... 76-pound flasks..	1,038	423	1,057	309
Pumice..... thousand short tons..	41	83	W	W
Sand and gravel..... do.....	12,953	10,022	11,279	11,437
Silver (recoverable content of ores, etc.) thousand troy ounces..	19,115	33,849	19,140	29,590
Stone..... thousand short tons..	³ 4,240	³ 6,368	4,149	6,118
Tungsten ore and concentrate (60 percent WO ₃ basis)..... short tons..	W	W	25	66
Zinc (recoverable content of ores, etc.).. do.....	41,052	12,578	45,078	14,515
Value of items that cannot be disclosed: Cement, fire clay (1970), fluorspar (1971), garnet, iron ore, lime, peat, perlite, phosphate rock, stone (dimension) (1970), vanadium, and values indicated by symbol W.....	XX	32,904	XX	26,869
Total.....	XX	119,748	XX	112,230
Total 1967 constant dollars.....	XX	107,114	XX	^p 97,550

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

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

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

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

Table 2.—Value of mineral production in Idaho, by county¹
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Ada	W	W	Sand and gravel, clays.
Adams	W	W	Sand and gravel, pumice.
Bannock	W	\$4,399	Cement, sand and gravel, stone, peat.
Bear Lake	W	324	Sand and gravel.
Benewah	W	W	Garnet, sand and gravel.
Bingham	W	W	Phosphate rock, sand and gravel.
Blaine	\$380	10	Lead, silver, zinc, copper.
Boise	W	77	Sand and gravel.
Bonner	W	W	Sand and gravel, stone.
Bonneville	755	1,281	Lime, sand and gravel, stone, pumice.
Boundary	28	90	Sand and gravel, lead, silver, zinc.
Butte	W	--	
Camas	1	--	Sand and gravel.
Canyon	710	1,655	Sand and gravel, lime, stone, pumice.
Caribou	17,798	14,204	Phosphate rock, vanadium, stone, sand and gravel.
Cassia	W	147	Sand and gravel, clays.
Clark	11	58	Stone, sand and gravel, clays.
Clearwater	W	W	Stone, sand and gravel.
Custer	W	1,344	Copper, lead, silver, zinc, tungsten, gold.
Elmore	W	W	Sand and gravel, clays.
Franklin	W	566	Sand and gravel.
Fremont	64	W	Do.
Gem	4	W	Do.
Gooding	--	W	Do.
Idaho	--	W	Stone, sand and gravel.
Jefferson	W	--	
Jerome	--	33	Sand and gravel.
Kootenai	W	W	Sand and gravel, stone.
Latah	1,164	W	Clays, stone, sand and gravel.
Lemhi	86	175	Fluorspar, sand and gravel, copper, gold, lead, silver, zinc.
Lincoln	W	W	Sand and gravel.
Madison	W	W	Sand and gravel, stone.
Minidoka	W	W	Lime, sand and gravel, clays.
Nez Perce	W	W	Sand and gravel, stone.
Oneida	116	232	Stone, perlite, pumice.
Owyhee	1	--	
Payette	W	W	Stone, sand and gravel.
Power	W	12	Sand and gravel.
Shoshone	70,185	66,073	Silver, lead, zinc, copper, antimony, gold.
Teton	281	292	Sand and gravel.
Twin Falls	887	W	Sand and gravel, lime.
Washington	W	W	Mercury, iron ore, sand and gravel.
Undistributed ²	27,277	21,312	
Total	119,748	³ 112,280	

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

¹ Lewis and Valley Counties are not included because no production was reported in 1970 and 1971.

² Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

³ Data may not add to total shown because of independent rounding.

Table 3.—Indicators of Idaho business activity

	1970	1971 ^P	Change, percent
Employment and labor force, annual average:			
Total labor force	303.8	311.8	+2.6
Unemployment	15.4	17.3	+12.3
Employment:			
Construction	10.9	11.4	+4.6
Lumber and wood products	12.8	13.3	+3.9
Food products	15.2	15.0	-1.3
All manufacturing	41.1	40.7	-1.0
All industries	288.4	294.5	+2.1
Personal income:			
Total	\$2,310	\$2,490	+7.8
Per capita	\$3,222	\$3,402	+5.6
Construction activity:			
Residential building permits issued	\$2,419	\$3,235	+33.7
Nonresidential building permits issued	\$2,331	\$1,662	-28.7
State highway commission:			
Value of contracts awarded	\$44.2	NA	NA
Cement shipments to and within Idaho	2,704.0	NA	NA
Farm marketing receipts	\$637.9	\$690.1	+8.2
Mineral production value	\$119.7	\$112.3	-6.2

^P Preliminary. r Revised. NA Not available.

Sources: Idaho Economic Indicators, Survey of Current Business, Construction Review, and U.S. Bureau of Mines.

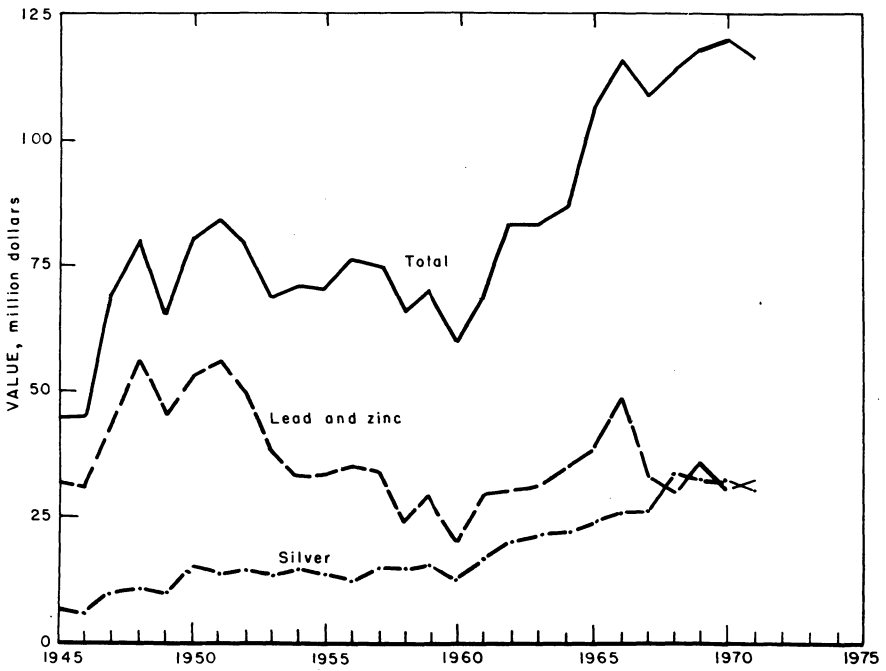


Figure 1.—Value of silver, lead and zinc, and total value of mineral production in Idaho.

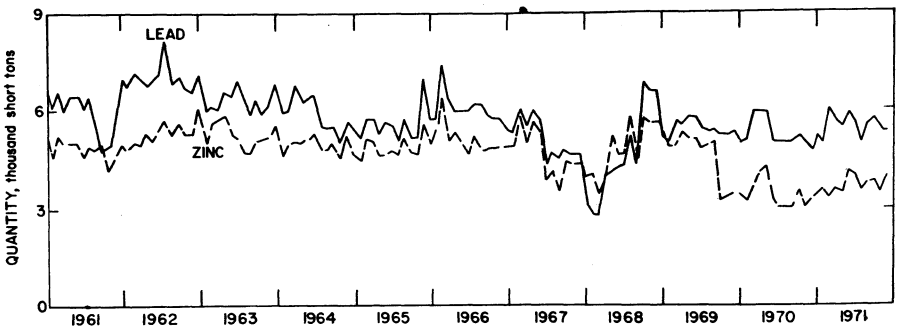


Figure 2.—Mine production of lead and zinc in Idaho, by months, in terms of recoverable metals.

Regarding other metals, The Bunker Hill Co. planned to mine zinc from its new 1,200-foot adit. Norandex, Inc., announced the discovery of a second large molybdenum deposit in Idaho, on the Little Falls Creek in the Lost River Drainage area, east of the White Clouds. Development was being fought by environmentalists. NL Industries, Inc. and Stansbury Mining Corp. of Salt Lake City, Utah, approved an option agreement for NL to start a 30,000-foot drilling project on Stansbury property near Clayton. Sunshine Mining Co. opened its second electrolytic antimony plant at Big Creek. Production from this and its other plant (the only two electrolytic antimony plants

in the world) were expected to reach 5 million pounds per year in a few years.

On April 13, Standard Oil Co. of California was given a 10-year oil and gas exploration lease on 51,332 acres of State lands in Gem, Washington, Payette, Canyon, Ada, and Owyhee Counties. The company has leases on Federal lands in the same general area. The company was to pay the State \$13,078.56 per year for the leases. The Raft River Rural Electric Cooperative filed the first application in Idaho for a geothermal site for a powerplant to be built southeast of Burley.

Employment, earnings, worktime, and injuries are shown in table 3 and 4.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Metal.....	2,252	257	578	4,617	1	365	79.27	3,891
Nonmetal & peat.....	418	217	91	740	1	12	17.57	8,302
Sand and gravel.....	693	167	116	988	--	21	21.26	477
Stone.....	329	184	61	489	--	9	18.42	475
Total ¹	3,692	229	845	6,834	2	407	59.85	3,631
1971: ^p								
Metal.....	2,255	251	565	4,510	6	352	79.38	10,881
Nonmetal ²	455	217	99	813	1	11	14.76	7,509
Sand and gravel.....	685	157	108	887	--	24	27.05	3,574
Stone.....	300	196	58	476	--	14	29.42	456
Total ¹	3,695	225	830	6,686	7	401	61.03	8,759

^p Preliminary.

¹ Data may not add to totals shown because of independent rounding.

² Beginning in 1971, data concerning peat operations are included in the nonmetals industry on a continuing basis.

REVIEW OF MINERAL COMMODITIES

METALS

Antimony.—Output of antimony concentrates decreased 14 percent, to 857 short tons of contained antimony. Sunshine Mining Company's new electrolytic plant near Kellogg, Shoshone County, was the nation's predominant source of antimony. The antimony was a byproduct of silver ores from the Sunshine mine and was recovered from tetrahydrite concentrates as cathode metal. The Sourdough mine (Shoshone County) of Antimony Mining & Milling Co. produced 200 tons of ore containing 120 short tons of antimony.

Cadmium.—Recovery of electrolytic cadmium at the Bunker Hill Co. zinc plant declined 11 percent below the 1970 total.

Copper.—Production of copper increased 5 percent, to 3,776 short tons; total value decreased 6 percent, to \$3,927,000.

Silver King Mines, Inc., of Salt Lake City, Utah, was developing a copper deposit near Cuprum. Sachem Prospects Corp., also of Salt Lake City, reported that exploration of copper claims on the North Fork of Iron Creek, southwest of Salmon, indicated a potential sulfide system in excess of 100 million tons of ore.

Table 5.—Mine production (recoverable) of gold, silver, copper, lead and zinc, by county

County	Mines producing ¹		Material sold or treated ² (short tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
Total:							
1969	53	2	1,801,247	3,403	\$141,259	18,929,697	\$33,896,841
1970	50	1	1,539,408	3,128	113,826	19,114,829	33,848,922
1971:							
Blaine	³ 3	--	³ 458	³ 8	³ 330	³ 3,578	³ 5,531
Boundary	(³)	--	(³)	(³)	(³)	(³)	(³)
Custer	5	--	110,202	618	25,493	200,044	309,268
Lemhi	3	--	517	2	83	221	342
Shoshone	15	--	1,535,484	2,968	122,430	18,935,732	29,274,644
Total	26	--	1,646,661	3,596	148,336	19,139,575	29,589,785
	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Total:							
1969	3,332	\$3,167,666	65,597	\$19,541,346	55,900	\$16,322,800	\$73,069,912
1970	3,612	4,167,785	61,211	19,121,110	41,052	12,577,513	69,829,156
1971:							
Blaine	(³) (⁴)	³ 260	³ 34	³ 9,301	³ 7	³ 2,367	³ 17,789
Boundary	(³)	(³)	(³)	(³)	(³)	(³)	(³)
Custer	360	374,244	1,162	320,616	774	249,115	1,278,736
Lemhi	12	12,480	1	400	(⁴)	48	18,353
Shoshone	3,404	3,539,744	65,413	18,054,127	44,297	14,263,506	65,254,451
Total	3,776	3,926,728	66,610	18,384,444	45,078	14,515,036	66,564,329

¹ Operations at old mill or miscellaneous cleanups not counted as producing mines.² Does not include gravel washed.³ Production of Blaine and Boundary Counties combined to avoid disclosing individual company confidential data.⁴ Less than 1/2 unit.

Table 6.—Mine production of gold, silver, copper, lead, and zinc in 1971, by class of ore or other source material, in terms of recoverable metals

Source	Number of mines	Material sold or treated (thousand short tons)	Gold (troy ounces)	Silver (thousand troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Ore:							
Silver	4	557	805	12,808	5,688	2,418	1,274
Copper	3	26	555	9	689	--	--
Lead	7	275	1,659	3,938	606	56,959	5,012
Lead-zinc, zinc and lead-zinc tailings ¹	12	788	577	2,384	568	73,844	83,869
Total	26	1,646	3,596	² 19,140	7,551	133,221	90,155

¹ Combined to avoid disclosing individual company confidential data.² Data may not add to total shown because of independent rounding.

Table 7.—Mine production and gold, silver, copper, lead, and zinc in 1971 by type of material processed and method of recovery, in terms of recoverable metals

Method of recovery and type of material processed	Gold (troy ounces)	Silver (thousand troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode:					
Smelting of concentrates from:					
Ore	3,581	19,132	7,527	133,071	90,131
Tailings	--	5	--	104	24
Total	3,581	¹ 19,138	7,527	133,175	90,155
Direct smelting of:					
Ore	15	2	24	46	(²)
Grand total	3,596	19,140	7,551	133,221	90,155

¹ Data may not add to total shown because of independent rounding.² Less than 1/2 unit.

Gold.—Production of gold rose 15 percent in output and 30 percent in total value, to 3,596 ounces worth \$148,000. All of the production was obtained as a byproduct from 26 lode mines throughout the State. Most production was from the Coeur d'Alene region lead, zinc, and silver ores in Shoshone County. No placer gold mines operated in Idaho in 1971. The Lucky Friday mine, Shoshone County, with 1,517 ounces, or 42 percent of the State's total, was the leading source.

Iron Ore.—The Iron Mountain magnetite deposit near Weiser, Washington County, operated by C & W Sand & Gravel Co., shipped about the same amount of iron ore as in 1970. However, total shipments of iron ore declined because Porter Bros. Corp. terminated its magnetite operation near Lowman, Boise County, and did not ship in 1971.

Lead.—Lead production of 66,610 tons was 9 percent above the comparable figure for 1970. However, the total value of production, \$18,384,000, was 4 percent less than in 1970, due to the declining average annual price for lead. The seven primary lead ore mines produced 28,480 tons of lead and the rest of production was byproduct. The three largest mines were the Lucky Friday mine of Hecla Mining Co., the Star Unit of Hecla and Bunker Hill Co., and the Bunker Hill mine of Bunker Hill. All three mines are in Shoshone County.

Mercury.—The Idaho-Almaden mine near Weiser, Washington County, accounted for all the mercury production in the State. Production of 1,057 flasks (76 pounds each) was slightly above 1970 production. Total value of mercury produced was placed at \$309,077; the average market price declined to \$292 per flask from \$408 in 1970.

Silver.—Silver, the leading mineral commodity in dollar output, increased slightly in quantity, but fell 13 percent in value due to the declining average annual price for the commodity. The total value of silver, \$29,590,000, was still 26 percent of the total value for all mineral production in Idaho. Hecla Mining Co. completed diamond drilling of two holes ranging in depth from 1,500 to 2,000 feet for the preliminary phase of the Alice Consolidated project, near Wallace, Shoshone County. Sunshine Mining Co. and Silver Bowl, Inc., agreed to explore and develop the Silver Bowl property south of the Sunshine mine on Big Creek, Shoshone County. The

Bunker Hill Co. employed a drilling company to do subsurface exploration on two properties outside of Mullan, Shoshone County. Bunker Hill also diamond drilled the Royal Apex Silver property near Osburn, Shoshone County.

Day Mines, Inc., reported finding ore assaying 10.3 ounces of silver per ton at the new 1,900-foot level of its Dayrock mine, Shoshone County. Sunshine Mining Company planned to open up a high-grade silver ore zone at the 5,400-foot level of the Chester vein, Sunshine mine, Shoshone County. The company plans to go to 7,000 feet and have a \$700,000 hoist installed at No. 10 shaft to permit the deepening. Allied Silver-Lead Co. leased an additional 200 acres of city-owned land under the city limits of Mullan. Apparently, the land will be explored by Hecla from its Lucky Friday mine, which extends to the city limits. The city of Mullan will receive 35 percent of royalty payments received from production and Allied Silver-Lead will receive 65 percent.

Tungsten.—The Tungsten Jim mine (Custer County) of Salmon River Scheelite Corp. was the only reported tungsten producer in the State. Total output was to 25 tons of tungsten concentrate valued at \$66,000. In Lemhi County, Midwest Oil Co. conducted exploration and development work on the Ima mine, near Challis, which included 870 feet of drifting and crosscutting, 2,055 feet of diamond drilling, and 250 feet of percussion drilling.

Vanadium.—The production of vanadium in the State increased by 10 percent over that of 1970. Vanadium was recovered from byproduct ferrophosphorus at the Kerr-McGee Corp. plant at Soda Springs, Idaho, and the Union Carbide Corp. plant at Hot Springs, Ark.

Zinc.—Total State production of zinc was 45,078 tons, up 10 percent from 1970. The value of production rose 15 percent. The three largest producers were the Bunker Hill mine of Bunker Hill Co., the Lucky Friday mine of Hecla Mining Co., and the Star unit of Bunker Hill and Hecla.

NONMETALS

Cement.—Portland and masonry cements were produced and shipped from the Inkom, Bannock County, operation of Idaho Portland Cement Co., an operating division of Oregon Portland Cement Co.,

Portland, Oreg. Production of portland cement increased 50 percent and the value of the production increased 44 percent. Production of masonry cement remained the same as in 1970, but the value increased 9 percent. Consumption (including shipments from out-of-State) was 2,332,000 barrels of portland cement and 12,000 barrels of masonry cement.

Clays.—The quantity and value of clays sold or used by producers declined in 1971. Kaolin production rose slightly, but fire clay declined by 64 percent. Fire clay and kaolin were produced in Latah County; bentonite was produced in Clark and Elmore Counties; and miscellaneous clays were produced in Ada, Cassia, and Minidoka Counties. In 1971, the largest use was as filler, but usage in refractories, oil refinery catalyst supports, and heavy building brick were each only slightly smaller in total usage than in 1970.

Fluorspar.—Seaforth Mining Co., Cleveland, Ohio, produced fluorspar from the Meyers Cove fluorspar deposits in Lemhi County. This was the first production from the area since 1953. A heavy-media separation plant, built in 1970, was used to treat and upgrade the fluorspar ore to a metallurgical-grade product which was sold to the steel industry. Exploration was underway to find enough reserves to justify building a froth flotation plant, since problems were encountered with heavy-media separation of the ores. St. Joe Minerals Corp. and Ozark Mahoning Co. were also doing exploratory drilling for fluorspar near Meyers Cove.

Garnet.—Quantity and value of shipments of abrasive garnet by Idaho producers were up 15 and 34 percent, respectively, in 1971. As in previous years, output was from operations near Fernwood, Benewah County, of Idaho Garnet Abrasive Co. and Emerald Creek Garnet Milling Co. The processed material was used mainly as an airblast abrasive.

Gem Stones.—Value of gem materials collected in the State was estimated at \$100,000, up 11 percent from the total estimate for 1970. Collection, mainly by individuals, continued to be centered at the Star garnet digging area near Fernwood, Benewah County, and at the precious opal digging site northeast of Spencer, Clark County.

Lime.—Amalgamated Sugar Co. and Utah-Idaho Sugar Co. produced lime in Bonneville, Canyon, Minidoka, and Twin Falls

Counties, for sugar refining and water purification. Output increased 31 percent and established a new annual record. The lime was consumed in Idaho. Total consumption of lime in Idaho was 137,201 tons.

Perlite.—Production of crude perlite from the open pit operation of Oneida Perlite Corp. north of Malad, Oneida County, remained at the same level as in 1970. The crude material was screened, sized, and shipped to the firm's plant at Malad for expanding and storage; crude perlite also was used as loose-fill insulation, concrete and plaster aggregate, and for soil conditioning.

Phosphate Rock.—Production of marketable phosphate rock by Idaho producers declined 8 percent in quantity and 30 percent in value compared with the respective totals for 1970. J. R. Simplot Co. continued producing from the Conda and Gay mines in Caribou and Bingham Counties, respectively. Monsanto Co. production was from the Henry mine in Caribou County; Stauffer Chemical Co. continued mining at the Wooley Valley deposits, Caribou County. The Stauffer production was shipped to the firm's elemental phosphorus plant at Silver Bow, Mont.

Elemental phosphorus was produced by FMC Corp., Mineral Products Division, Pocatello, Power County, and Monsanto Co., Soda Springs, Caribou County. Output was shipped to phosphorus conversion plants of the respective firms in the Western and Midwestern States for manufacturing into industrial phosphate products.

J. R. Simplot Co. manufactured phosphate fertilizer products at the firm's Pocatello works. Phosphate rock from the company mines in Bingham and Caribou Counties supplied the raw material requirements. The Bunker Hill Co. marketed phosphate fertilizer products at Kellogg, Shoshone County. Purchased calcined phosphate rock from western sources and sulfuric acid manufactured from waste gases at the firm's Kellogg smelter complex were the principal raw materials used in manufacturing the fertilizer products.

Pumice.—Production of pumice dropped in quantity and value in 1971. Production by commercial firms was used mainly as an aggregate and admixture for lightweight concrete; smaller quantities of scoria went for ballast and decorative landscaping uses.

Sand and Gravel.—Sand and gravel sold or used by producers fell 13 percent in quantity, but rose 14 percent in value. Bannock County was the principal producing area, and production exceeded 500,000 short tons in each of Ada, Bonneville, Canyon, Clearwater, Franklin, Gooding, Kootenai, Teton, and Twin Falls Counties. Production was reported from operations in 35 of the 44 counties in the State; however, significant tonnages were also produced that could not be assigned to a specific county of origin.

Stone.—Production of stone for all purposes decreased 2 percent in quantity and 4 percent in value. The 26 quarries oper-

ating in 1971 produced 4,149,000 short tons of stone valued at \$6,118,000. Clearwater County, with three quarries produced the largest tonnage of stone. Other major producing counties were Bannock, Caribou, Idaho, and Latah. A total of 14 counties in Idaho produced stone in 1971.

MINERAL FUELS

Peat.—Production of reed-sedge peat from an operation near Downey, Bannock County, was continued by Idaho Peat Co., Inc. The output, which went for general soil improvement use, declined substantially in 1971.

Table 8.—Sand and gravel sold or used by producers, by class of operation and use

(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	188	\$327	591	\$1,219
Fill.....	28	22	50	47
Paving.....	22	44	W	W
Other uses ¹	1,019	628	213	316
Total².....	1,258	1,020	853	1,582
Gravel:				
Building.....	275	491	1,452	1,786
Fill.....	2,494	1,414	211	108
Paving.....	748	829	1,726	2,641
Other uses ³	122	157	163	303
Total².....	3,637	2,890	3,550	4,839
Government-and-contractor operations:				
Sand:				
Fill.....	20	1	61	50
Paving.....	4,651	3,893	2,653	2,476
Other uses.....	10	2	7	4
Total.....	4,681	3,896	2,721	2,530
Gravel:				
Building.....	66	80	136	105
Fill.....	706	86	673	254
Paving.....	2,020	1,750	3,222	1,991
Other uses.....	585	299	126	135
Total².....	3,377	2,215	4,155	2,485
Total sand and gravel².....	12,953	10,022	11,279	11,437

W Withheld to avoid disclosing individual company confidential data; included with other sand.

¹ Includes railroad ballast (1971), and sand for other uses.

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

³ Includes railroad ballast (1971), miscellaneous and other gravel.

Table 9.—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 & Refining Co.....	Wallace, Idaho 83873	Mine and mill....	Do.
Sunshine Mining Co.....	Kellogg, Idaho 83837	do.....	Do.
Gold:			
American Smelting & 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.
Iron Ore: C & W Sand & Gravel Co.....	Route 1 Weiser, Idaho 83672	Mine.....	Washington.
Lead:			
American Smelting & Refining Co.....	Wallace, Idaho 83873	Mine and mill....	Shoshone.
Bunker Hill Co.....	Kellogg, Idaho 83837	Mine, mill, smelter.	Do.
Canyon Silver Mines, Inc.....	Wallace, Idaho 83873	Mine.....	Do.
Clayton Silver Mines.....	do.....	Mine and mill....	Custer.
Day Mines, Inc.....	do.....	do.....	Shoshone.
Federal Resources Corp.....	Mine—Hailey, Idaho 83333 Mill—Bellevue, Idaho 83313	Mine..... Mill.....	Blaine. Do.
Hecla Mining Co.....	Wallace, Idaho 83873	Mine and mill....	Shoshone.
Mercury: El Paso Natural Gas Co.....	P. O. Box 1492 El Paso, Tex. 79999 (Weiser, Idaho 83672)	Mine and plant....	Washington.
Silver:			
American Smelting & Refining Co.....	Wallace, Idaho 83873	Mine and mill....	Shoshone.
Bunker Hill Co.....	Kellogg, Idaho 83837	do.....	Do.
Clayton Silver Mines.....	Wallace, Idaho 83873	do.....	Custer.
Day Mines, Inc.....	do.....	do.....	Shoshone.
Hecla Mining Co.....	do.....	do.....	Do.
Sunshine Mining Co.....	Kellogg, Idaho 83837	do.....	Do.
Tungsten: Salmon River Scheelite Corp.....	Clayton, Idaho 83227	Mine and plant....	Custer.
Vanadium: Kerr-McGee Corp. ¹	Soda Springs, Idaho 83276	Plant.....	Caribou.
Zinc:			
Bunker Hill Co.....	Kellogg, Idaho 83837	Mine, mill, smelter.	Do.
Canyon Silver Mines, Inc.....	Wallace, Idaho 83873	Mine.....	Shoshone.
Clayton Silver Mines.....	do.....	Mine and mill....	Custer.
Day Mines, Inc.....	do.....	do.....	Caribou.
Federal Resources Corp.....	Mine—Hailey, Idaho 83333 Mill—Bellevue, Idaho 83313	do.....	Blaine.
Hecla Mining Co.....	Wallace, Idaho 83873	do.....	Do.
NONMETALS			
Cement: Idaho Portland Cement Co.....	Inkom, Idaho 83245	Plant.....	Bannock.
Clays:			
Burley Brick & Sand Co.....	P. O. Box 497 Burley, Idaho 83318	Pit and plant....	Cassia.
A. P. Green Refractories Co.....	Troy, Idaho 83871	do.....	Latah.
Idaho Falls Brick & Tile Co., Inc.....	Route 3, Box 53 Idaho Falls, Idaho 83401	do.....	Jefferson.
Pullman Brick Co., Inc.....	7901 Warm Springs Ave. Boise, Idaho 83706	do.....	Ada and Elmore.
J. R. Simplot.....	P. O. Box 647 Bovill, Idaho 83806	do.....	Latah.
Snake River Pottery.....	Bliss, Idaho 83314	do.....	Twin Falls.
Garnet:			
Emerald Creek Garnet Milling Co.....	Box 192 Kellogg, Idaho 83837	Mine and plant....	Benewah.
Idaho Garnet Abrasive Co.....	P. O. Box 1080 Kellogg, Idaho 83837	do.....	Do.
Peat: Idaho Peat, Inc.....	Downey, Idaho 83234	Bog.....	Bannock.
Perlite (crude and exported):			
Oneida Perlite Corp.....	P. O. Box 162 Malad City, Idaho 83252	Pit and plant....	Oneida.
Phosphate Rock:			
Monsanto Co.....	Soda Springs, Idaho 83276	Mine and plant....	Caribou.
J. R. Simplot Co.....	Box 912, Pocatello, Idaho 83201	Mine.....	Bingham.
Stauffer Chemical Co.....	Conda, Idaho 83230	Mine and plant....	Caribou.
	Box 160, Montpelier, Idaho 83245	Mine.....	Do.
Pumice:			
Hess Pumice Products.....	P. O. Box 209 Malad City, Idaho 83252	Mine and plant....	Oneida.
Producer's Pumice.....	2743 East Lincoln Idaho Falls, Idaho 83401	Mine.....	Bonneville.
Western Block, Inc.....	224 First St., South Nampa, Idaho 83651	do.....	Canyon.

See footnote at end of table.

Table 9.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
NONMETALS—Continued			
Sand and Gravel:			
Curtis Construction Co.....	1401 North Fancher Rd. Spokane, Wash. 99206	Stationary plant..	Clearwater.
Materne Bros.....	Box 0, Rosewood Station Spokane, Wash. 99208	Pit and plant.....	Kootenai.
Quinn Robbins Co., Inc.....	708 South 16th Boise, Idaho 83707	---do.....	Ada.
Bryon C. Rambo Crushing Co.....	Nampa, Idaho 83651.....	---do.....	Do.
Strang Sand & Gravel.....	Route 2, Nampa, Idaho 83651	Stationary plant..	Canyon.
Twin Falls Construction Co.....	Box 325 Twin Falls, Idaho 83301	Pit and plant.....	Twin Falls.
Stone:			
DeAtley Corp.....	Box 648 Lewiston, Idaho 83501	Quarry and plant..	Nez Perce.
Dworshak Dam Construction.....	Box 1422 Orofino, Idaho 83544	---do.....	Clearwater.
L. C. Fountain & Sons.....	636 2d St. Clarkstown, Wash. 99403	---do.....	Latah.
Idaho Portland Cement Co.....	Inkom, Idaho 83245.....	Pit and plant.....	Bannock.
Monsanto Chemical Co.....	800 North Lindberg Ave. St. Louis, Mo. 63166	---do.....	Caribou.
Sather & Sons.....	Box 326, Parkwater Station Spokane, Wash. 99211	---do.....	Clearwater.

¹ 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 except mineral fuels.

By Grace N. Broderick ¹

The mineral production of Illinois in 1971 was valued at \$700.8 million, an increase of 1.8 percent over the record high of \$688.7 million set in 1970. Decreases in both quantity and value of production were recorded for coal, petroleum, fuller's earth, lead, and zinc. Output in terms of quantity declined for portland cement, fluorspar, and LP gases, but increased in terms of value. Masonry cement, peat, natural gasoline, stone, and tripoli increased in both quantity and value. Sand and gravel and common clay registered increases in tonnage, but decreases in value.

Mineral fuels continued to account for the major part of the State's total mineral value. Nationally, in both quantity and value, Illinois ranked fourth in output of coal and second in output of peat. Coal, which accounted for more than 45 percent of the State total, remained the leading commodity in mineral value.

Illinois continued to rank first among the States producing fluorspar, providing 51 percent of the Nation's total. It ranked third in sand and gravel production and second in production of stone in the

United States. Illinois also ranked high in processing mineral raw materials.

On September 17, 1971, a new strip mine bill (H.B. 1626) was signed into law for the State of Illinois. The law calls for higher performance bonds and requires approval of a feasible plan for reclaiming land before mining can begin. Environmental impact of the strip mining must be determined before mining starts, and local governments must be allowed to participate in the reclamation process.

House Bill 1859, amending the Oil and Gas Act to increase the blanket surety bond to \$10,000 to cover all wells drilled, deepened, or acquired in connection with the production of oil or gas, became effective August 27, 1971.

Other bills signed into law were a bill affecting licensing of explosives handlers from manufacturers to users and a bill tightening mine inspections.

Employment.—Preliminary data for 1971 and final data for 1970 compiled by the Federal Bureau of Mines for employment and injuries in the mineral industries are shown in table 4.

¹Physical scientist, Division of Ferrous Metals.

Table 1.—Mineral production in Illinois ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland..... thousand 376-pound barrels..	7,946	\$25,252	7,578	\$25,975
Masonry..... thousand 280-pound barrels..	508	1,874	522	2,336
Clays..... thousand short tons..	² 1,676	² 3,862	1,788	4,294
Coal (bituminous)..... do.....	65,119	320,705	58,402	318,878
Fluorspar..... short tons..	148,208	8,637	138,051	9,883
Lead (recoverable content of ores, etc.)..... do.....	1,532	479	1,238	342
Natural gas..... million cubic feet..	4,850	761	³ 498	³ 88
Peat..... thousand short tons..	63	711	72	W
Petroleum (crude)..... thousand 42-gallon barrels..	43,747	141,994	39,084	135,621
Sand and gravel..... thousand short tons..	43,926	60,155	45,364	59,397
Stone..... do.....	55,776	86,502	⁴ 61,991	⁴ 106,084
Zinc (recoverable content of ores, etc.)..... short tons..	16,797	5,146	12,706	4,091
Value of items that cannot be disclosed:				
Fuller's earth (1970), gem stones, lime, natural gas liquids, silver (1971), stone (dimension) (1971), tripoli, and value indicated by symbol W.....	XX	32,619	XX	33,830
Total	XX	688,697	XX	700,819
Total 1967 constant dollars.....	XX	616,049	XX	^p 608,872

^p Preliminary. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

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

² Excludes fuller's earth; included with "Value of items that cannot be disclosed."

³ Owing to change in reporting system, figure not comparable with previous years.

⁴ Excludes dimension stone; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Illinois, by county ¹

(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Adams.....	W	\$3,907	Stone, lime, sand and gravel, petroleum.
Alexander.....	\$240	248	Tripoli, sand and gravel.
Bond.....	W	W	Sand and gravel, petroleum, clay.
Boone.....	W	W	Sand and gravel, stone.
Brown.....	W	63	Sand and gravel, petroleum, clay, stone.
Bureau.....	825	613	Sand and gravel.
Calhoun.....	W	W	Stone.
Carroll.....	W	407	Stone, sand and gravel.
Champaign.....	748	780	Sand and gravel, petroleum.
Christian.....	W	W	Coal, petroleum, stone.
Clark ²	3,084	W	Stone, petroleum, sand and gravel.
Clay.....	W	W	Petroleum, stone.
Clinton.....	2,691	2,765	Petroleum, stone, sand and gravel.
Coles.....	W	W	Do.
Cook.....	39,575	45,632	Stone, lime, sand and gravel, clay, peat.
Crawford.....	W	7,072	Petroleum, sand and gravel, stone.
Cumberland ²	205	W	Stone, petroleum.
De Kalb.....	W	W	Stone, sand and gravel.
De Witt.....	1,001	W	Petroleum, sand and gravel.
Douglas.....	W	22,671	Natural gas liquids, coal, petroleum, stone.
Du Page.....	W	4,008	Sand and gravel, stone, natural gas liquids, clay.
Edgar.....	308	357	Petroleum.
Edwards.....	W	2,040	Do.
Effingham.....	W	1,252	Petroleum, sand and gravel.
Fayette.....	16,239	16,829	Petroleum, stone, sand and gravel, clay.
Ford.....	334	W	Sand and gravel.
Franklin.....	44,549	45,081	Coal, petroleum.
Fulton.....	28,206	24,858	Coal, sand and gravel.
Gallatin.....	W	14,280	Coal, petroleum, sand and gravel, natural gas.
Greene.....	W	W	Stone.
Grundy.....	W	3,568	Sand and gravel, clay, stone.
Hamilton.....	5,320	4,857	Petroleum, sand and gravel.
Hancock.....	687	362	Stone.
Hardin.....	14,952	14,635	Fluorspar, stone, zinc, lead, silver.
Henderson.....	458	507	Stone.
Henry.....	W	W	Stone, sand and gravel.
Iroquois.....	W	W	Sand and gravel.
Jackson.....	1,255	1,211	Stone, coal, sand and gravel.
Jasper.....	3,434	2,882	Petroleum, sand and gravel.
Jefferson.....	W	46,656	Coal, petroleum.
Jersey.....	199	211	Stone.
Jo Daviess.....	2,877	2,785	Zinc, stone, lead, sand and gravel, silver.

See footnotes at of end table.

Table 2.—Value of mineral production in Illinois, by county 1—Continued
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Johnson.....	W	W	Stone, coal, sand and gravel.
Kane.....	\$7,557	\$8,403	Sand and gravel, stone, peat.
Kankakee.....	9,832	8,424	Coal, stone, clay, sand and gravel.
Kendall.....	W	W	Stone, sand and gravel.
Knox.....	W	W	Coal, stone, clay.
Lake.....	W	W	Sand and gravel, stone, peat.
La Salle.....	W	W	Stone, sand and gravel, cement, clay.
Lawrence.....	17,273	16,239	Petroleum, sand and gravel.
Lee.....	W	W	Cement, stone, sand and gravel.
Livingston.....	W	4,565	Stone, clay, sand and gravel.
Logan.....	W	W	Sand and gravel, stone.
McDonough.....	W	W	Stone, petroleum, clay, sand and gravel.
McHenry.....	6,691	W	Sand and gravel, stone.
McLean.....	1,256	W	Sand and gravel.
Macon.....	593	577	Sand and gravel, petroleum.
Macoupin.....	W	W	Coal, stone, petroleum.
Madison.....	W	W	Stone, sand and gravel, petroleum.
Marion.....	W	W	Petroleum, stone.
Marshall.....	W	W	Sand and gravel.
Mason.....	W	W	Sand and gravel, stone.
Massac.....	W	W	Cement, stone, sand and gravel.
Menard.....	W	W	Stone.
Mercer.....	415	450	Coal, stone, sand and gravel.
Monroe.....	W	W	Stone.
Montgomery.....	W	W	Coal, stone, petroleum.
Morgan.....	2	W	Sand and gravel.
Moultrie.....	W	W	Stone, sand and gravel, petroleum.
Ogle.....	W	W	Sand and gravel, stone.
Peoria.....	15,977	15,500	Coal, sand and gravel, stone.
Perry.....	30,517	34,037	Coal, petroleum.
Pike.....	W	W	Stone, sand and gravel.
Pope.....	69	W	Coal, sand and gravel.
Pulaski.....	W	W	Clay, stone, sand and gravel.
Putnam.....	W	W	Sand and gravel.
Randolph.....	W	W	Coal, stone, petroleum, sand and gravel.
Richland.....	5,570	4,650	Petroleum.
Rock Island.....	W	W	Stone, sand and gravel.
St. Clair.....	W	31,722	Coal, stone, petroleum.
Saline.....	21,600	19,095	Coal, petroleum, natural gas.
Sangamon.....	W	1,467	Sand and gravel, petroleum, stone, clay.
Schuyler.....	W	W	Sand and gravel, stone.
Scott.....	245	618	Stone, clay, sand and gravel.
Shelby.....	473	528	Sand and gravel, stone, petroleum.
Stark.....	W	3,351	Coal, sand and gravel.
Stephenson.....	770	W	Stone, sand and gravel.
Tazewell.....	W	W	Sand and gravel, clay.
Union.....	W	W	Stone, sand and gravel.
Vermilion.....	W	W	Stone, coal, sand and gravel, clay.
Wabash.....	W	W	Petroleum, sand and gravel.
Warren.....	W	W	Stone.
Washington.....	W	W	Petroleum, stone.
Wayne.....	15,778	14,397	Petroleum.
White.....	W	19,465	Petroleum, sand and gravel.
Whiteside.....	1,260	1,360	Peat, stone, sand and gravel.
Will.....	10,143	11,496	Stone, sand and gravel.
Williamson.....	23,101	26,611	Coal, petroleum, natural gas.
Winnebago.....	2,031	2,253	Stone, sand and gravel.
Woodford.....	W	W	Sand and gravel.
Undistributed ³	350,355	205,073	
Total ⁴	688,697	700,819	

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

¹ Cass and Piatt Counties are not included because no production was reported.

² Value of petroleum production in Cumberland County is included with Clark County because actual source of production cannot be identified.

³ Includes some sand and gravel and gem stones that cannot be assigned to specific counties, and values indicated by symbol W.

⁴ Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Illinois business activity

	1970 ^p	1971 ^p	Change, percent
Labor force and employment, annual average:			
Total labor force.....	5,056.9	5,019.4	-0.7
Unemployment.....	206.0	238.0	+15.5
Employment (nonagricultural):			
Manufacturing.....	1,342.1	1,266.4	-5.6
Construction.....	184.9	184.5	-.2
Mining.....	4.6	4.5	-2.2
Transportation and public utilities.....	283.9	283.3	-.2
Wholesale and retail trade.....	941.1	943.5	+.3
Finance, insurance, and real estate.....	233.4	238.0	+2.0
Services.....	681.1	687.5	+.9
Government.....	638.9	648.0	+1.4
Personal income:			
Total.....	\$50,181	\$53,422	+6.6
Per capita.....	\$4,501	\$4,772	+6.0
Construction activity:			
Valuation of authorized nonresidential private construction.....	\$657.1	\$708.7	+7.9
Number of private and public residential permits issued.....	54,204	84,566	+56.0
Portland cement shipments to and within Illinois thousand 376-pound barrels.....	17,595	20,816	+18.3
Mineral production value.....	\$688.7	\$700.8	+1.8

^p Preliminary. ^r Revised.

Sources: Survey of Current Business; Area Trends in Employment and Unemployment; Employment and Earnings; Construction Review; and the U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Coal.....	9,139	269	2,462	19,235	15	783	41.49	6,767
Peat.....	49	62	3	29	--	1	34.60	104
Metal.....	59	248	15	117	1	8	76.78	69,176
Nonmetal.....	1,007	267	269	2,188	--	84	38.39	4,010
Sand and gravel.....	1,647	229	376	3,237	--	55	16.99	672
Stone.....	3,523	271	955	7,999	3	173	22.00	3,054
Total.....	15,424	264	4,080	32,805	19	1,104	34.23	5,293
1971:^p								
Coal.....	9,400	251	2,363	18,511	15	870	47.86	7,175
Metal.....	60	236	14	109	--	4	36.58	274
Nonmetal ¹	1,040	263	273	2,216	7	91	44.23	21,253
Sand and gravel.....	1,745	229	399	3,424	--	47	13.73	396
Stone.....	3,675	265	974	8,167	4	203	25.35	3,857
Total².....	15,920	253	4,022	32,428	26	1,215	38.30	6,562

^p Preliminary.

¹ Beginning in 1971, data concerning peat operations are included in the nonmetals industry.

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

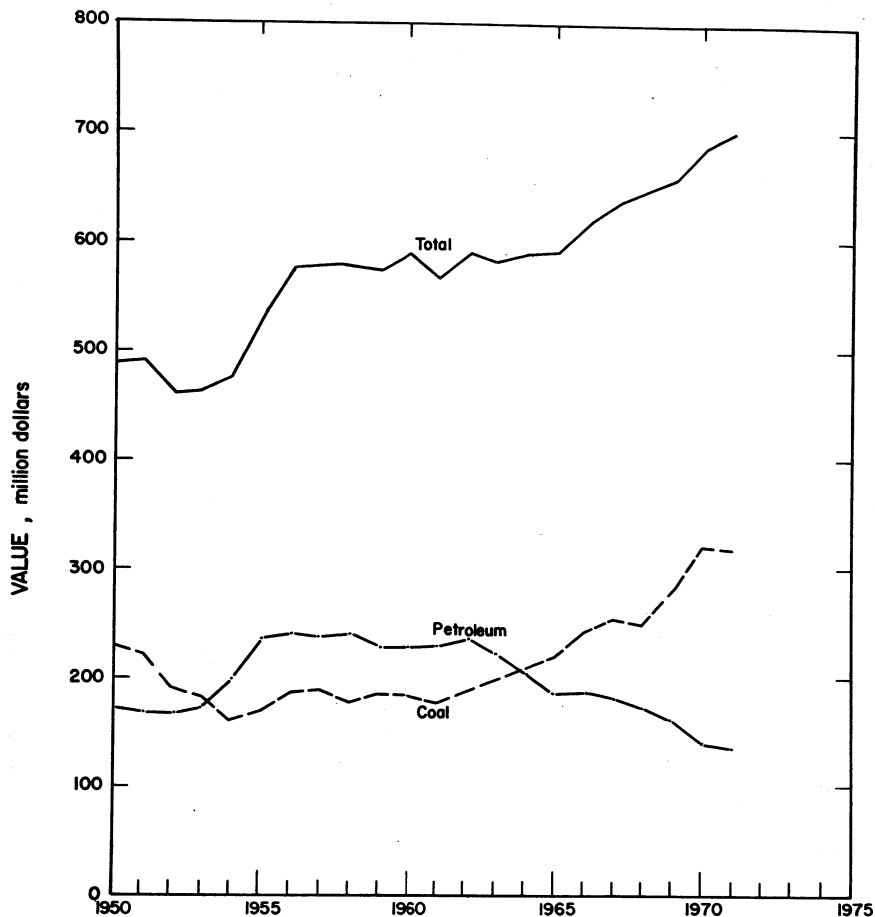


Figure 1.—Value of coal, petroleum, and total value of mineral production in Illinois.

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 58.4 million tons valued at \$318.9 million, which represented a decrease of over 10 percent in tonnage but less than 1 percent in value from 1970 levels. Value of bituminous coal production accounted for more than 45 percent of the State's total mineral production value in 1971.

Production in 1971, excluding mines producing less than 1,000 short tons annually, was reported by 63 mines, four more than were operating in 1970, in 22 of

the State's 102 counties. Major producing counties, in order of decreasing tonnage were Perry, Franklin, Jefferson, St. Clair, Fulton, Williamson, Christian, Randolph, Saline, Peoria, Montgomery, Gallatin, Knox, and Macoupin. A little more than half of the coal produced in the State in 1971 was from underground mines, whereas in 1970 strip mines produced slightly more than half of the coal produced.

Coal mining activity in Illinois in 1971 included opening two new underground mines. These were Amax Coal Co.'s (formerly Ayrshire Coal Co.) Wabash No. 1

mine in Wabash County and Peabody Coal Co.'s Baldwin No. 1 mine in Randolph County. Amax Coal Co. also opened the Leahy strip mine in Perry County.

The Bell & Zoller Co. and Moffat Coal Co., subsidiaries of the Zeigler Coal Co., merged into the Zeigler Coal & Coke Co., effective July 1, 1971. Inland Steel Co. planned to expand its coal mine near Sesser. Freeman Coal Mining Corp.'s Crown mine at Farmersville, Montgomery County, closed permanently on November 24, 1971; the reason given by company officials was that it could no longer be economically operated.

Seven Illinois utility companies formed a Coal Gasification Group (CGG) to study ways to convert Illinois coal into a sulfur-free, high-Btu fuel that can supplement natural gas. Participants are the Peoples Gas system, Northern Illinois Gas Co., Commonwealth Edison Co., Central Illinois Light Co., Central Illinois Public Service Co., Illinois Power Co., and Iowa-Illinois Gas and Electric Co. Coal gasification would increase utilization of one of the most abundant of the State's resources. Illinois leads the United States in high-sulfur bituminous coal reserves, which are estimated to be 144 billion tons.

Table 5.—Bituminous coal production, by type of mine and county
(Excludes mines producing less than 1,000 short tons annually)

County	Number of mines ¹			Production ¹ (thousand short tons)			Value (thousands)
	Under-ground	Strip	Total	Under-ground	Strip	Total	
Christian.....	1	--	1	4,079	--	4,079	W
Douglas.....	1	--	1	930	--	930	W
Franklin.....	4	--	4	7,443	--	7,443	\$42,399
Fulton.....	--	5	5	--	4,413	4,413	23,992
Gallatin.....	2	1	3	1,701	433	2,134	11,431
Jackson.....	--	2	2	--	87	87	434
Jefferson.....	3	1	4	6,019	1,018	7,037	42,853
Johnson.....	--	3	3	--	9	9	33
Kankakee.....	--	1	1	--	706	706	W
Knox.....	--	1	1	--	1,432	1,432	W
Macoupin.....	1	--	1	1,158	--	1,158	W
Mercer.....	1	1	2	33	17	50	W
Montgomery.....	2	--	2	2,206	--	2,206	W
Peoria.....	--	3	3	--	2,269	2,269	13,299
Perry.....	--	4	4	--	7,890	7,890	39,978
Pope.....	--	1	1	--	7	7	W
Randolph.....	1	2	3	739	2,462	3,201	15,817
St. Clair.....	2	2	4	1,607	4,535	6,142	27,579
Saline.....	4	4	8	1,399	1,084	2,483	17,157
Stark.....	--	1	1	--	659	659	W
Vermilion.....	1	--	1	32	--	32	238
Williamson.....	4	4	8	2,098	1,986	4,084	26,009
Undistributed ¹	--	--	--	--	--	--	63,657
Total ²	27	36	63	29,444	28,957	58,402	318,878

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

¹ Includes value indicated by symbol W.

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

Coke.—Production of coke in 1971 was 2.144 million tons, a decrease of nearly 9 percent from the 2.356 million tons produced in 1970. There were only four operating plants at yearend, one less than in 1970 (General Motors Corp.'s Waukegan plant in Lake County discontinued production in February). Ninety-eight percent of the coke distributed by the producing companies was used in their own blast furnaces. Illinois coke plants carbonized nearly 3.4 million tons of coal, of which about 43 percent came from Illinois, 34 percent from Kentucky, 21 percent from

West Virginia, and 1 percent each from Pennsylvania and Virginia.

About 189,000 tons of coke breeze was recovered at the producing plants, a decrease of more than 8 percent from 1970. Other byproducts of coke-oven operations in the State included coke-oven gas, ammonia, tar, crude light oil, and light-oil derivatives.

Peat.—Illinois produced 72,823 short tons of peat in 1971, over 15 percent more than the 62,990 short tons produced in 1970. Production was reported by seven companies from Cook, Kane, Lake, and Whiteside Counties.

Table 6.—Shipments of bituminous coal for consumption in Illinois by district of origin and consumer use

(Thousand short tons)

	District of origin ¹								Total	
	1	3 and 6	4	7 and 8	9	10	11	15		19
1967:										
Electric utilities.....	--	--	--	17	2,121	26,825	534	--	--	29,497
Coke and gas plants.....	--	110	--	1,871	--	1,468	--	--	--	3,449
Retail dealers.....	--	5	12	1,342	847	1,831	37	--	--	4,074
All others.....	--	52	--	553	182	8,386	517	--	--	9,690
Total.....	--	167	12	3,783	3,150	38,510	1,088	--	--	46,710
1968:										
Electric utilities.....	--	12	127	12	1,885	25,539	646	--	--	28,221
Coke and gas plants.....	--	196	--	1,673	--	1,200	--	--	--	3,069
Retail dealers.....	--	--	11	1,231	665	1,362	43	--	--	3,312
All others.....	--	41	--	484	258	7,618	462	--	--	8,863
Total.....	--	249	138	3,400	2,808	35,719	1,151	--	--	43,465
1969:										
Electric utilities.....	--	4	--	--	3,063	26,622	656	--	48	30,393
Coke and gas plants.....	--	99	--	2,076	--	1,538	--	--	--	3,713
Retail dealers.....	--	--	14	1,287	587	1,141	48	--	--	3,077
All others.....	22	45	--	356	254	7,102	282	--	--	8,061
Total.....	22	148	14	3,719	3,904	36,403	986	--	48	45,244
1970:										
Electric utilities.....	--	--	--	1	2,175	25,688	514	--	1,075	29,453
Coke and gas plants.....	--	1	--	2,069	--	1,618	--	--	--	3,688
Retail dealers.....	--	--	5	1,329	237	1,015	2	3	--	2,591
All others.....	13	29	--	447	188	5,657	245	--	--	6,579
Total.....	13	30	5	3,846	2,600	33,978	761	3	1,075	42,311
1971:										
Electric utilities.....	--	--	--	43	1,431	22,204	W	--	W	27,930
Coke and gas plants.....	W	--	--	1,847	--	1,424	--	--	W	3,347
Retail dealers.....	--	--	4	1,082	59	723	W	--	W	1,871
All others.....	W	2	--	687	92	4,189	W	--	W	5,141
Total.....	27	2	4	3,659	1,582	28,540	825	--	3,650	38,289

W Withheld to avoid disclosing individual company confidential data.

¹ States or portion of States represented by each district are as follows: District 1—Maryland, eastern Pennsylvania, and eastern West Virginia; 3 and 6—northern West Virginia; 4—Ohio; 7 and 8—eastern Kentucky, Virginia, southern West Virginia, and north-central Tennessee; 9—western Kentucky; 10—Illinois; 11—Indiana; 14—Arkansas and Oklahoma; 15—Kansas, Missouri, and Oklahoma; 19—Idaho and Wyoming; 22—Montana.

² Includes shipments from Districts 14, 15, 19, and 22.

Sales totaling 71,823 short tons increased more than 13 percent over the 1970 sales. Humus peat was sold in bulk form; moss and reed-sedge peat were sold in bulk and packaged forms. Eighty-five percent of all sales were in packaged forms. The majority of the peat was used for general soil improvement; a small amount was used for potting soils.

Illinois continued to rank second in output of peat in the United States, accounting for 12 percent of the Nation's total.

Petroleum, Natural Gas, and Natural Gas Liquids.—Crude petroleum production declined for the ninth consecutive year. Output decreased 10.7 percent in quantity and 4.5 percent in value. The value of crude petroleum production provided 19.4

percent of the total State mineral output value. According to the American Petroleum Institute (API), reserves of crude oil were 208,763,000 barrels on December 31, 1971, a decrease of 19,917,000 barrels from the previous year.

API reported the completion of 564 wells in 1971; 252 were producing oil wells, 16 were gas wells, 159 were dry holes in proven fields, and 137 were unsuccessful wildcats. The total footage drilled in new wells was 1,201,755—833,335 was in development completions and 368,420 was in exploratory completions.

Proved reserves of natural gas on December 31, 1971, were 498,953 million cubic feet, according to the American Gas

Association (AGA), an increase of 83,359 million cubic feet over the AGA 1970 estimate.

Proved recoverable reserves of natural gas liquids totaled 942,000 barrels on December 31, 1971, according to the American Gas Association (AGA), a decline of 193,000 barrels from that of 1970.

NONMETALS

Cement.—Portland and masonry cements were produced by three companies in 1971—Marquette Cement Manufacturing Co. at its Oglesby plant, La Salle County; the Medusa Portland Cement Co. at its Dixon plant, Lee County; and the Missouri Port-

land Cement Co. at its Joppa plant, Massac County. Portland cement shipments decreased 5 percent in quantity but increased 3 percent in value. Shipments of masonry cement increased 3 percent in quantity and nearly 25 percent in value. Average mill value of portland cement was \$3.43 per barrel; average mill value of masonry cement was \$4.48 per barrel.

Ninety-eight percent of the portland cement shipped was type I and II (general use and moderate heat); the remainder was type III (high-early-strength) white and waterproof cement. Portland and masonry cement consumed in the State totaled 20,816,000 376-pound barrels and

Table 7.—Crude oil production, by county

(Thousand 42-gallon barrels and thousand dollars)

County	1970		1971	
	Quantity	Value ¹	Quantity	Value ¹
Adams.....	3	\$10	4	\$14
Bond.....	68	221	54	187
Brown.....	1	3	4	14
Champaign.....	1	3	(²)	1
Christian.....	452	1,467	418	1,450
Clark ³	499	1,620	442	1,534
Clay.....	2,168	7,037	1,821	6,319
Clinton.....	743	2,412	708	2,457
Coles.....	342	1,110	303	1,051
Crawford.....	2,010	6,524	1,979	6,367
Cumberland.....	(³)	(³)	(³)	(³)
De Witt.....	192	623	180	625
Douglas.....	50	162	38	132
Edgar.....	95	308	103	357
Edwards.....	732	2,376	538	2,040
Efingham.....	452	1,467	356	1,235
Fayette.....	4,780	15,515	4,677	16,229
Franklin.....	956	3,103	773	2,682
Gallatin.....	333	2,704	742	2,575
Hamilton.....	1,639	5,320	1,399	4,854
Jasper.....	1,058	3,434	825	2,363
Jefferson.....	1,133	3,677	1,096	3,303
Lawrence.....	5,230	16,975	4,545	15,771
McDonough.....	39	127	42	146
Macon.....	9	29	7	24
Macoupin.....	3	10	(²)	(²)
Madison.....	121	393	121	420
Marion.....	3,584	11,633	3,542	12,291
Montgomery.....	1	3	1	3
Moultrie.....	4	13	3	10
Perry.....	19	62	17	59
Randolph.....	118	383	110	382
Richland.....	1,716	5,570	1,340	4,650
St. Clair.....	115	373	82	285
Saline.....	556	1,805	545	1,891
Sangamon.....	201	652	145	503
Shelby.....	43	139	40	139
Wabash.....	1,770	5,745	1,671	5,798
Washington.....	760	2,467	682	2,367
Wayne.....	4,861	15,778	4,149	14,397
White.....	6,232	20,228	5,370	18,634
Williamson.....	158	513	162	562
Total.....	43,747	141,994	39,084	135,621

¹ Revised.

¹ County values calculated by using State average value per barrel: \$3.25 for 1970; and \$3.47 for 1971.

² Less than ½ unit.

³ Production of Cumberland County included with Clark County because actual source of production cannot be identified.

Source: Illinois Geological Survey (quantities).

Table 8.—Oil and gas well drilling completions, by county, in 1971

County	Proved field wells ¹			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Adams	1	--	--	--	--	--	1	675
Bond	1	1	1	--	--	3	6	4,276
Christian	21	--	9	2	--	12	44	80,346
Clark	3	--	--	1	--	2	6	7,147
Clay	41	--	16	1	--	4	62	180,750
Clinton	3	--	5	--	--	6	14	18,871
Coles	4	3	4	1	--	1	13	23,869
Crawford	22	2	4	--	--	--	28	41,618
Cumberland	--	--	--	--	--	2	2	5,252
Douglas	1	--	3	1	--	1	6	10,268
Edgar	6	3	3	--	1	2	15	7,540
Edwards	--	--	4	2	--	1	7	22,814
Effingham	1	--	--	--	--	2	3	6,841
Fayette	6	--	1	--	--	1	8	8,522
Ford	--	--	--	--	--	1	1	600
Franklin	2	--	4	--	--	--	7	37,123
Gallatin	--	--	11	--	--	--	11	23,752
Hamilton	1	--	4	--	--	--	5	13,190
Jackson	--	--	--	--	--	4	4	9,308
Jasper	15	--	1	1	--	--	19	50,026
Jefferson	2	--	3	--	--	5	10	28,655
Lawrence	23	--	7	--	--	--	30	43,153
Logan	--	--	--	--	--	1	1	1,572
McLean	--	--	--	--	--	3	3	2,764
Mason	1	--	--	--	--	--	1	2,155
Macoupin	--	1	1	--	--	1	3	1,408
Madison	--	--	2	--	--	3	5	7,752
Marion	9	--	6	1	--	5	21	40,326
Perry	2	--	4	1	--	3	10	12,622
Pike	--	--	--	--	--	1	1	412
Pope	--	--	--	--	--	1	1	3,802
Randolph	--	--	--	--	1	2	3	5,655
Richland	12	--	7	1	--	5	25	75,462
St. Clair	--	--	--	--	--	5	5	8,181
Saline	--	2	2	--	--	2	6	15,238
Sangamon	16	--	16	6	--	9	47	82,158
Schuyler	--	--	1	--	--	--	1	525
Shelby	--	--	--	--	--	2	2	3,615
Vermilion	--	--	--	--	--	1	1	1,957
Wabash	7	--	4	--	--	3	14	31,935
Washington	4	--	8	1	--	11	24	42,047
Wayne	15	--	13	4	--	5	37	111,662
White	9	--	11	--	--	5	25	69,705
Williamson	--	--	4	1	2	13	20	56,166
Total	223	12	159	24	4	137	564	1,201,755

¹ Development wells as defined by American Petroleum Institute.
Source: American Petroleum Institute.

760,000 280-pound barrels, respectively. Portland cement was consumed for ready-mix concrete (76 percent), concrete products (8 percent), building materials (9 percent), contractors (7 percent), and other miscellaneous customers. Raw materials used in making portland cement included 2,075,000 tons of limestone, 68,000 tons of gypsum, and 435,000 tons of clay, shale, sand, and iron-bearing materials. About 225.4 million kilowatt-hours of electricity was used in the manufacturing process.

Marquette Cement Manufacturing Co. was replacing eight old kilns at its Oglesby plant with one 15-foot by 17-foot by 520-foot kiln with an annual capacity increase of 150,000 barrels. Completion was scheduled for yearend 1972.

Medusa Portland Cement Co., Div. of Medusa Corp., installed a new glass bag dust collector at its plant in Dixon to supplement the electrostatic precipitator.

Clays.—Total production of fire clay and miscellaneous clay and shale increased 2 percent in quantity but decreased more than 17 percent in value in 1971. Production of fuller's earth decreased in both quantity and value.

Production of clay and shale was reported from 16 counties. Fire clay was produced by four companies (three fewer than in 1970) in Grundy, La Salle, McDonough, and Scott Counties.

Fluorspar.—Shipments of finished fluorspar totaled 138,051 tons valued at \$9,882,936, a decrease of 6.9 percent in quantity but an increase of 14.4 percent in

value compared with that of 1970. The State, however, continued to be the Nation's leading producer of fluorspar, supplying 51 percent of the output.

Table 9.—Portland cement salient statistics
(Thousand 376-pound barrels and thousand dollars)

	1970	1971
Number of active plants.....	1	3
Rated clinker capacity, Dec. 31.....	9,999	9,958
Production.....	7,400	8,046
Shipments from mills: Quantity.....	7,946	7,578
Value.....	\$25,252	\$25,975
Stocks at mills, Dec. 31.....	1,996	673

¹ Revised.

² One plant ceased operation in September 1970.

Acid-grade fluorspar accounted for 41 percent of the Illinois shipments, and metallurgical and chemical grades accounted for the other 59 percent. Entire output of finished fluorspar in Illinois in 1971 was credited to Hardin County, although some crude material was mined in Pope County.

The Minerva Oil Co. and the Ozark-Mahoning Co. continued to be the principal operators in the State. Development programs that these companies have undertaken included the following:²

At Rosiclare, Ozark-Mahoning Co. finished substantial surface installations. A deep shaft, scheduled to be completed in mid-1972, was being sunk to develop a newly discovered vein ore body. A heavy-media plant has been purchased and will be erected at the mine site for treating low-grade ore.

A new production shaft was completed by Ozark-Mahoning Co. at the site of its heavy-media mill in the Cave in Rock area. This shaft was sunk on a 30-inch bore hole at the existing mine workings and will be sunk an additional 170 feet to the sub-Rosiclare level. Production from their M. F. Oxford No. 7 mine started in May 1971, at a rate of 600 tons per day. This mine is the first in the district to use closed-circuit television, enabling the hoistman to operate the underground feeder and jaw crusher system. Skip loading is fully automatic.

The Minerva Oil Co. was completing surface installations at its Spivey development, north of Cave in Rock, and preparing to deepen the former 300-foot Green shaft to the 670-foot level. At its No. 1 mine, the Minerva Oil Co. continued to sink truck inclines to open up the Levias and Fredonia levels below the old Renault

workings. A part of the Crystal mill was rehabilitated late in 1971 so that its heavy-media plant could process low-grade ores from resumed operations using narrow diesel equipment in the North Victory and Deardorff lease. Both are shallow-adit, room-and-pillar mines.

In Rosiclare, the Kentucky Fluorspar Co. continued to operate the former Alcoa flotation mill on custom ore of the district, as well as on ore from its Humphrey mine near Mexico, Ky. The Humphrey mine, however, was closed and plugged in October; according to the operator, this was done because of the highly siliceous nature of the ore.

Gem Stones.—Small quantities of gem materials, consisting of glacial agates, fluorite, and other mineral specimens, continued to be collected in 1971. Estimated total value of the materials in 1971 increased over the 1970 estimate, but gem stones continued to contribute only a very minor amount of the State's total mineral value.

Iron Oxide Pigments.—Three plants, operating in Adams, Kane, and St. Clair Counties, produced finished (natural and manufactured) iron oxide pigments in 1970. Among producing States, Illinois continued to rank second to Pennsylvania.

Lime.—Marblehead Lime Co. and Standard Lime & Refractories Co. produced lime in Adams and Cook Counties for steel furnaces, water purification, sewage treatment, and other uses. Output declined 4 percent and was 9 percent below the 1969 record. The lime was consumed in Indiana, Illinois, Iowa, and other States. Total consumption of lime in Illinois was 970,619 tons.

Perlite.—Crude perlite mined outside the State was expanded by five companies with plants in Cook, DeKalb, Lake, and Will Counties. Production of the expanded product increased 3.8 percent in quantity and 19.6 percent in value. Principal uses were for roof insulation and for concrete aggregate, accounting for 69 percent and 12 percent, respectively. Other uses included plaster aggregate, filter aid, low-temperature insulation, masonry and cavity-fill insulation, and horticultural aggregates. Illinois continued to lead the country in production of expanded perlite and also in the quantity that producers used and sold.

² Montgomery, Gill. Fluorspar. Min. Eng., v. 24, No. 1, January 1972, pp. 40-41.

Sand and Gravel.—Illinois ranked third in the Nation in both quantity and value of sand and gravel produced. Production increased 3.3 percent, but value declined 1.3 percent. Counties from which over a million tons was produced in 1971 were Cook, Du Page, Grundy, Kane, Lake, LaSalle, McLean, McHenry, Madison, Peoria, Tazewell, Will, and Winnebago.

Of the total sand and gravel produced, over 49 percent was used as paving material, 34 percent as building material, and the remainder as industrial sands, railroad ballast, and fill. The average value of the total sand and gravel produced was \$1.31 per ton.

Stone.—Illinois reached a new record high in stone production in 1971, exceeding the previous record of 55.9 million short tons established in 1968 by more than 6 million short tons. It continued to

rank second only to Pennsylvania in total tonnage of stone produced in the United States.

Compared with 1970, the production of crushed stone increased from 55.8 million short tons to 62 million short tons valued at \$86.4 million and \$106.1 million, respectively. Limestone and dolomite, which accounted for most of the State's stone production, rose from 55.7 to 57.4 million short tons in quantity and \$86.4 million to \$94.1 million, representing increases of nearly 3 percent and 9 percent, respectively, over those of the previous year. About 59 percent of the limestone and dolomite production was used for dense-graded road base stone, concrete aggregate, and bituminous aggregate.

Major producing counties, each with production of over 1 million short tons, were Adams, Clark, Cook, Hardin, John-

Table 10.—Sand and gravel sold or used by producers, by class of operation and use

(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Blast.....	168	\$898	95	\$318
Building.....	6,281	6,993	7,810	8,330
Fill.....	W	W	2,398	1,965
Foundry.....	57	W	W	W
Glass ¹	2,224	5,661	1,382	4,242
Molding.....	1,109	4,303	307	3,036
Paving.....	8,969	9,345	8,499	10,199
Other uses ²	3,319	7,951	819	1,643
Total³.....	22,130	35,152	21,812	29,732
Gravel:				
Building.....	7,580	8,370	7,642	9,081
Fill.....	1,403	1,050	1,255	1,068
Paving.....	12,307	15,127	13,377	18,229
Miscellaneous.....	22	103	360	364
Other uses ⁴	67	81	382	433
Total³.....	21,378	24,732	23,016	29,175
Government-and-contractor operations:				
Sand:				
Building.....	-	-	5	5
Paving.....	2	2	81	79
Total.....	2	2	86	84
Gravel:				
Building.....	7	5	16	21
Fill.....	-	-	27	37
Paving.....	408	264	408	349
Total³.....	415	269	450	406
Total sand and gravel³.....	43,926	60,155	45,364	59,397

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

¹Includes ground glass (1970), and unground glass.

²Includes abrasives, chemicals, enamel (1970), engine, fill, grinding and polishing, and other sand.

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

⁴Includes railroad ballast.

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

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Bond	5	296	\$309	6	W	W
Boone	8	162	133	3	W	W
Bureau	15	935	825	10	579	\$613
Carroll	4	W	W	1	14	19
Champaign	6	664	745	8	701	779
Clark	4	267	305	5	W	W
Coles	3	326	434	3	W	W
Cook	7	1,170	1,498	8	2,024	2,697
Cumberland	1	176	205	--	--	--
De Kalb	4	346	356	4	374	W
De Witt	4	276	373	4	W	W
Du Page	3	W	W	6	1,372	2,091
Effingham	1	W	W	--	5	17
Ford	6	262	334	4	W	W
Fulton	8	601	696	8	650	866
Gallatin	2	W	W	2	260	273
Hamilton	--	--	--	--	2	3
Jasper	--	--	--	1	15	19
Johnson	1	33	23	1	25	3
Kane	14	5,917	5,830	14	5,314	6,354
Kendall	3	W	W	3	494	480
Lake	6	1,300	1,070	10	2,042	1,574
La Salle	16	4,604	15,833	13	2,882	7,871
Lawrence	6	325	298	4	459	468
McDonough	--	--	--	1	30	3
McHenry	20	6,377	6,690	25	7,208	7,984
McLean	16	984	1,256	6	W	W
Macon	7	556	564	4	502	553
Madison	4	622	726	7	1,091	739
Massac	5	121	101	3	W	W
Mercer	1	W	W	1	4	4
Morgan	1	4	2	--	W	W
Pope	2	10	6	1	5	(¹)
Pulaski	3	W	W	4	11	7
Rock Island	5	894	687	4	909	696
Sangamon	4	787	1,060	5	839	898
Stephenson	2	91	108	3	W	W
Tazewell	12	1,189	1,831	9	1,426	2,243
Union	2	24	19	1	17	12
Vermilion	7	322	245	7	274	232
White	4	W	W	4	942	831
Will	9	3,380	4,205	9	3,052	4,607
Winnebago	9	1,201	1,180	11	1,111	1,103
Undistributed ²	70	9,707	12,203	68	10,732	15,410
Total ³	310	43,926	60,155	291	45,364	59,397

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

¹ Less than ½ unit.

² Includes Adams, Alexander, Brown, Clinton, Crawford, Edwards (1970), Fayette, Grundy, Henry, Iroquois, Jackson, Jo Daviess, Kankakee, Lee, Livingston, Logan, Marshall, Mason, Moultrie, Ogle, Peoria, Pike, Putnam, Randolph, St. Clair (1970) Schuyler, Scott, Shelby, Stark, Wabash, Whiteside, and Woodford Counties, and some sand and gravel that cannot be assigned to specific counties.

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

son, Kane, Kankakee, La Salle, Lee, Livingston, Randolph, Rock Island, St. Clair, Vermilion, and Will.

Dimension stone, which represented only a very small part of the total stone production in the State, was produced in Kane and McHenry Counties.

Production of sandstone (ganister) in Alexander County was discontinued.

Tripoli (Amorphous Silica).—Crude material was recovered from underground mines in Alexander County by Illinois Minerals Co. near Elco, and Tammsco Div. (Lowe's Inc.) near Tamms. The production of crude material increased 13.4 percent in quantity and 10.2 percent in value.

Output of prepared material increased 12.3 percent in quantity and 11.4 percent in value. Prepared material was used for abrasives, filler, and other purposes. Of the few States that produce tripoli, Illinois ranked first in production and second in value.

Vermiculite.—Crude vermiculite mined outside the State was processed by the W. R. Grace & Co. (Construction Products Div.) at its plant in Cook County; Mica Pellets, Inc., at its plant in De Kalb County; and International Vermiculite Co. at its plant in Macoupin County. The amount of exfoliated vermiculite sold or

used in 1971 decreased slightly from the previous year but increased more than 12 percent in value over that of 1970. Uses were for insulation, aggregate in plaster and concrete, horticulture, and other purposes.

Table 12.—Limestone and dolomite sold or used by producers, by use
(Thousand short tons and thousand dollars)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Dimension total	13	\$126	4	\$60
Crushed and broken:				
Bituminous aggregate	6,894	11,138	7,376	12,745
Concrete aggregate	9,250	14,755	9,155	14,989
Dense graded road base stone	15,910	23,409	17,191	26,129
Macadam aggregate	4,799	7,741	3,189	5,378
Surface treatment aggregate	4,491	6,744	5,871	9,481
Unspecified construction aggregate and roadstone	2,329	3,616	2,836	4,712
Agricultural limestone	4,000	6,271	4,113	6,643
Asphalt filler	397	1,264	W	W
Cement	2,213	1,977	2,219	2,380
Fill	48	52	11	20
Flux	929	1,317	758	1,105
Railroad ballast	647	954	752	1,157
Riprap and jetty stone	712	949	637	919
Other ²	3,063	6,041	3,237	8,338
Total ³	55,683	86,230	57,346	93,997
Grand total ³	55,695	86,356	57,350	94,058

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

¹ Includes agricultural limestone and poultry grit.

² Includes stone for chemical uses, lime manufacture, stone sand, whitening and other fillers; 1970 data also includes stone used in mine dusting, poultry grit, terrazzo and disinfectant; 1971 data also includes stone used in building products and roofing aggregate.

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

Table 13.—Crushed stone sold and used by producers, by county
(Thousand short tons and thousand dollars)

County	1970		1971	
	Quantity	Value	Quantity	Value
Adams	911	\$1,905	1,097	\$3,074
Alexander	1	3	W	W
Boone	317	W	W	W
Calhoun	W	W	35	W
Carroll	386	443	322	388
Clark	W	1,159	1,018	1,845
Greene	W	W	340	W
Hancock	430	687	219	362
Hardin	2,344	3,007	1,811	2,650
Henderson	278	458	299	507
Jersey	117	199	120	211
Jo Daviess	441	478	282	315
Kane	1,006	1,688	1,157	1,987
La Salle	1,051	1,083	4,569	11,615
Lee	1,348	1,483	1,085	1,390
Livingston	2,526	4,208	2,465	4,215
Massac	W	144	W	690
Montgomery	1,217	1,935	W	W
Ogle	540	713	752	1,100
Pike	564	901	671	1,112
Randolph	1,558	2,718	1,428	3,079
St. Clair	2,956	4,716	2,694	3,858
Sangamon	W	W	26	39
Scott	W	W	325	571
Stephenson	640	662	711	812
Will	3,956	5,938	4,549	6,889
Winnebago	505	851	728	1,150
Undistributed ¹	32,674	50,998	35,288	58,226
Total ²	55,763	86,377	61,991	106,084

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

¹ Includes stone produced in the following counties: Brown, Christian, Clay, Clinton, Coles, Cook, Crawford (1971), Cumberland (1971), De Kalb, Douglas (1971), Du Page, Fayette, Grundy (1971), Henry, Jackson, Johnson, Kankakee, Kendall, Knox, Lake (1971), Logan, McDonough, McHenry, Macoupin, Madison, Marion, Mason (1971), Menard, Mercer, Monroe, Moultrie (1971), Peoria, Pulaski, Rock Island, Schuyler, Shelby, Union, Vermilion, Warren, Washington, and Whiteside.

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

METALS

Lead and Zinc.—Production of 1,238 short tons of lead and 12,706 short tons of zinc, in terms of recoverable metal, represented decreases of 19.1 percent and 24.4 percent, respectively, from the 1970 figures. In terms of total value, lead production decreased 28.6 percent and zinc production decreased 20.5 percent.

Average weighted annual prices used to calculate values of lead and zinc in table 1 were 13.8 cents and 16.1 cents per pound, respectively. These averages compare with 15.619 cents per pound for lead and 15.319 cents per pound for zinc in 1970.

In northern Illinois (Jo Daviess County), Eagle-Picher Industries, Inc., operated the Bautsch, Blackjack, and Gray mines; the Rehm-Bauer mine was abandoned as of February 1970. In southern Illinois (Hardin County), the Minerva Oil

Co., Ozark-Mahoning Co., and the Kentucky Fluorspar Co. recovered lead and zinc as byproducts of fluorspar operations.

Two zinc smelters closed down during the year. These were the East St. Louis (also known as the Sauget) plant of the American Zinc Co. and the Depue plant of New Jersey Zinc Co.

Pig Iron and Steel.—About 6.5 million tons of pig iron, valued at \$446.5 million, was shipped from Illinois blast furnaces or was consumed by the producing companies. This output represented a decrease of 12 percent from 1970 production. Pig iron was produced by five companies operating blast furnaces in Granite City and South Chicago.

According to the American Iron and Steel Institute, Illinois produced 10.9 million short tons of steel in 1971, compared with 11.8 million short tons in 1970.

Table 14.—Mine production (recoverable) of lead and zinc

	1969	1970	1971
Mines producing: Lode.....		5	6
Material sold or treated (ore):.....			4
Fluorspar..... thousand short tons..	221	348	320
Zinc..... do.....	261	266	230
Production (recoverable):.....			
Quantity:			
Lead..... short tons..	791	1,532	1,238
Zinc..... do.....	13,765	16,797	12,706
Value:			
Lead..... thousands..	\$236	\$479	\$342
Zinc..... do.....	4,019	5,146	4,091
Total..... do.....	4,255	5,625	4,433

Table 15.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Marquette Cement Mfg. Co.	20 North Wacker Dr. Chicago, Ill. 60606	Portland and masonry, dry process.	La Salle.
Medusa Portland Cement Co.	Box 5668 Cleveland, Ohio 44101	do.....	Lee.
Missouri Portland Cement Co.	7751 Carondelet Ave. St. Louis, Mo. 63105	do.....	Massac.
Clays and shale:			
American Brick Co.....	6558 West Fullerton Ave. Chicago, Ill. 60635	Pit and plant.....	Cook.
Hydraulic-Press Brick Co. (Illinois Streater Div.)	705 Olive St. St. Louis, Mo. 63101	Pit.....	La Salle.
Illinois Brick Co.....	228 North La Salle St. Chicago, Ill. 60601	Pit.....	Livingston.
A. P. Green Refractories Co. (Div. of U.S. Gypsum Co.)	Box 64, Morris, Ill. 60450	do.....	Cook.
Marblehead Lime Co. (General Dynamics Corp.)	300 West Washington St. Chicago, Ill. 60606	do.....	Grundy.
Marquette Cement Mfg. Co.	20 North Wacker Dr. Chicago, Ill. 60606	do.....	La Salle.
Richards Brick Co.....	234 Springer Ave. Edwardsville, Ill. 62025	Pit.....	Do.
		Pit.....	Bond.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clays and shale—Continued			
Southern Clay Co., Inc. (Lowe's Inc.)	North Edward St. Cassopolis, Mich. 49031	Pit and plant	Pulaski.
Western Brick Co. (Div. of Illinois Brick Co.)	Box 591 Danville, Ill. 61832	do	Vermilion.
Coal (bituminous):			
Amax Coal Company, Div. of American Metal Climax, Inc.:	105 S. Meridian St. Indianapolis, Ind. 46225		
Sun Spot		Strip mine, cleaning plant.	Fulton.
Leahy		do	Perry.
Delta		do	Williamson.
Consolidation Coal Com- pany, Midwestern Div.	P.O. Box 218 Pinckneyville, Ill. 62274		
Hillsboro		Underground mine	Montgomery.
Norris		Strip mine, clean- ing plant.	Fulton.
Burning Star No. 2		do	Perry.
Burning Star No. 3		do	Randolph.
Eads Coal Co.	Box 73 Belle Rive, Ill. 62810	Strip mine	Jefferson.
Forsyth-Energy, Inc.	P.O. Box 488 Herrin, Ill. 62948	Strip mining, cleaning plant.	Williamson.
Freeman Coal Mining Corp.:	307 North Michigan Ave. Chicago, Ill. 60601		
Orient No. 5		Underground mine, cleaning plant.	Franklin.
Orient No. 3		do	Jefferson.
Orient No. 6		do	Do.
Crown		do	Montgomery
Orient No. 4		do	Williamson.
Inland Steel Co.:	30 West Monroe St. Chicago, Ill. 60603		
Inland		do	Jefferson.
Midland Coal Co., Div. of American Smelting and Refining Co.:	P.O. Box 8 Trivoli, Ill. 61569		
Allendale		Strip mine, cleaning plant.	Stark.
Mecco		do	Knox.
Edwards		do	Peoria.
Elm No. 1		do	Do.
Elm No. 2		do	Fulton.
Monterey Coal Co.	205 Oakland Ave. Carlinville, Ill. 62626	Underground mine, cleaning plant.	Macoupin.
Old Ben Coal Corp.:	10 South Riverside Plaza Chicago, Ill. 60606		
Old Ben No. 21		do	Franklin.
Old Ben No. 24		Underground mine	Do.
Old Ben No. 26		Underground mine, cleaning plant.	Do.
Peabody Coal Co.:	301 North Memorial Dr. St. Louis, Mo. 63102		
No. 10		do	Christian.
Eagle		Strip and under- ground mines, cleaning plant.	Gallatin.
Northern Illinois		Strip mine, cleaning plant.	Kankakee.
Midwest		Strip and under- ground mines, cleaning plant.	St. Clair.
River King		do	Do.
Will Scarlet		Strip mine, cleaning plant.	Williamson.
Sahara Coal Co., Inc.:	59 East Van Buren St. Chicago, Ill. 60605		
No. 5		Underground mine	Saline.
No. 6		Strip mine, cleaning plant.	Do.
No. 16		Underground mine	Do.
No. 20		do	Do.
No. 21		do	Do.
Southwestern Illinois Coal Corp.:	1514 Merchants Bank Bldg. Indianapolis, Ind. 46204		
Captain		Strip mine, cleaning plant.	Perry.
Streamline		do	Randolph.
The United Electric Coal Cos.:	307 North Michigan Ave. Chicago, Ill. 60601		
Cuba No. 9		do	Fulton.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Coal (bituminous)—Continued			
The United Electric Coal Cos.—Continued			
Buckheart No. 17	-----	Strip mine, cleaning plant.	Fulton.
Banner No. 27	-----	do	Peoria.
Fidelity No. 11	-----	do	Perry.
Zeigler Coal & Coke Co.:	208 South La Salle St. Chicago, Ill. 60604		
Murdock	-----	Underground mine, cleaning plant.	Douglas.
Spartan No. 2	-----	do	Randolph.
Zeigler No. 4	-----	do	Williamson.
Coke:			
Granite City Steel Co.	Box 367 Granite City, Ill. 62041	Coke ovens	Madison.
Interlake Steel Corp.	135th St. and Perry Ave. Chicago, Ill. 60627	do	Cook.
International Harvester Co.	401 North Michigan Ave. Chicago, Ill. 60611	do	Do.
Republic Steel Corp.	1629 Republic Bldg. Cleveland, Ohio 44101	do	Do.
Fluorspar:			
Minerva Company, Mining Div. Minerva Oil Co.:	Eldorado, Ill. 62930		
Crystal Group	-----	Underground mines.	Hardin.
Minerva No. 1	-----	Mill	Do.
	-----	Underground mine, mill.	Do.
Ozark-Mahoning Co.	Box 57 Rosiclare, Ill. 62982	Underground mines.	Do.
	-----	Mill	Do.
Iron and steel:			
Granite City Steel Co.	Box 365 Granite City Ill. 62040	Iron and steel furnaces.	Madison.
Interlake Steel Corp.	310 South Michigan Ave. Chicago, Ill. 60604	Iron furnaces	Cook.
Republic Steel Corp.	1629 Republic Bldg. Cleveland, Ohio 44101	Iron furnace and steel furnace.	Do.
United States Steel Corp.	3426 East 89th St. Chicago, Ill. 60617	Iron and steel furnaces.	Do.
Wisconsin Steel Division International Harvester Co.	410 North Michigan Ave. Chicago, Ill. 60611	do	Do.
Iron-oxide pigments: (Finished)			
George B. Smith Chemical Works, Inc.	Maple Park, Ill. 60151	Plant	Kane.
Lead and zinc:			
Eagle-Picher Industries, Inc.: Bautsch, Blackjack and Rehm-Bauer.	Box 1040 Galena, Ill. 61036	Underground mines, ore processed at Graham mill.	Jo Daviess.
Graham mill	-----		Do.
Minerva Company, Mining Div. Minerva Oil Co.:	Eldorado, Ill. 62930		
Minerva No. 1	-----	Underground mine, mill.	Hardin.
Ozark-Mahoning Co.	Box 57 Rosiclare, Ill. 62982	Underground mines.	Do.
	-----	Mill	Do.
Lime:			
Marblehead Lime Co.:	300 West Washington St. Chicago, Ill. 60606	Quicklime and hydrated lime, 3 shaft kilns.	Adams.
Marblehead Limekiln	-----		
Quincy Limekiln	-----	Quicklime, 1 calcimatic kiln.	Do.
South Chicago Limekiln.	-----	Quicklime and hydrated lime, 4 rotary kilns.	Cook.
Thornton Limekiln	-----	do	Do.
Standard Lime & Refractories Co. (Div. Martin Marietta Corp.)	Executive Plaza II Hunt Valley, Md. 21030	Quicklime, 3 rotary kilns.	Do.
Natural gas processing:			
U.S. Industrial Chemicals Co., Div. of National Distillers & Chem. Corp.	99 Park Ave. New York, N.Y. 10016		Douglas.
Peat:			
Anderson Peat Co. (Old Fort Industries, Inc.)	Morrison, Ill. 61270	Bog, processing plant.	Whiteside.
Markman Peat Co.	Route 3 Morrison, Ill. 61270	do	Do.
Expanded perlite:			
Filter Materials Corp.	124 North Buesching Rd. Lake Zurich, Ill. 60047	Processing plant	Lake.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Expanded perlite—Continued			
Johns-Manville Perlite Corp., Building Products Div.	22 East 40th St. New York, N.Y. 10016	Processing plant....	Will.
Mica Pellets, Inc.....	1008 Oak St. De Kalb, Ill. 60115	-----do-----	De Kalb.
National Gypsum Co.....	325 Delaware Ave. Buffalo, N.Y. 14202	-----do-----	Lake.
Silbrico Corp.....	6300 River Rd. La Grange, Ill. 60525	-----do-----	Cook.
Petroleum refineries:			
American Oil Co.....	910 South Michigan Ave. Chicago, Ill. 60680	-----do-----	Madison.
Clark Oil & Refining Co...	8530 West National Ave. Milwaukee, Wis. 53227	-----do-----	Cook, Madison.
Marathon Oil Co.....	539 South Main Findlay, Ohio 45840	-----do-----	Crawford.
Shell Oil Co.....	50 West 50th New York, N.Y. 10020	-----do-----	Madison.
Texaco Inc.....	135 East 42nd New York, N.Y. 10017	-----do-----	Lawrence, Will.
Union Oil Co. of California.	Union Oil Center Los Angeles, Calif. 90054	-----do-----	Cook.
Sand and gravel:			
Accorsi Sand & Gravel, Inc.	Box 365 Bartlett, Ill. 60103	Pit; portable plant..	Do.
Bellrose Silica Co.....	307 Central Life Bldg. Ottawa, Ill. 61350	-----do-----	La Salle.
Beverly Gravel Co. (Plote, Inc.)	2400 South Roselle Rd. Palatine, Ill. 60067	Pit; portable and stationary plants.	Kane.
Chain O Lakes Sand & Gravel Co., Evanston Fuel & Material Co.	2400 South Roselle Rd. Palatine, Ill. 60067	Pit; stationary plant.	McHenry.
Chicago Gravel Co.....	343 South Dearborn St. Chicago, Ill. 60604	Pits; stationary plants.	Cook, Will.
Concrete Materials Division, Martin Marietta Corp.	4096 1st Ave. NE Cedar Rapids, Iowa 52406	Pits; portable and stationary plants.	Ogle, Peoria, Tazewell, Woodford.
Elmhurst-Chicago Stone Co.	400 West 1st St. Elmhurst, Ill. 61026	Pits; stationary plants.	Du Page, Will.
Feltes Sand & Gravel Co., Inc.	Route 25 North Aurora, Ill. 60542	Pits; portable plants.	Kane.
Illinois-Wisconsin Sand & Gravel Co.	Eastern Ave. South Beloit, Ill. 61080	Pit; dredge; station- ary plant.	Winnebago.
McHenry Sand & Gravel Co., Inc.	920 North Front St. McHenry, Ill. 60050	Pits; portable plants.	McHenry.
Manley Sand Division Martin Marietta Corp.	920 North Front St. McHenry, Ill. 60050	Pits; portable plants.	McHenry.
Material Service Division General Dynamics Corp.	300 West Washington St. Chicago, Ill. 60606	Pits; stationary plants.	Cook, Grundy, Kane, McHenry, Will.
Meyer Aggregate.....	Box 56, Route 2 Algonquin, Ill. 60102	Pits; portable and stationary plants.	McHenry.
Meyer Aggregate West Division.	Box 56, Route 2 Algonquin, Ill. 60102	-----do-----	Kane, Kendall.
Moline Consumers Co.....	313 16th St. Moline, Ill. 61265	-----do-----	Bureau, La Salle, Rock Island.
Ottawa Silica Co.....	Box 577, Ottawa, Ill. 61350.	Pit; stationary plant.	La Salle.
Road Materials Corp., E. M. Melahn Construc- tion Co., Inc.	Box 205 East Dundee, Ill. 60118	Pits; stationary plants.	Kane, McHenry.
Rowe Construction Co., R. A. Cullinan & Son.	1523 West Market St. Bloomington, Ill. 61701	Pits; portable and stationary plants.	Livingston, McLean.
Edward Schneider.....	Route 3, Box 72 Elgin, Ill. 60120	-----do-----	Kane.
Thelen Sand & Gravel....	Route 3, Box 330 Antioch, Ill. 60002	Pit; portable and stationary plants.	Lake.
Urban Sand & Gravel Co..	Route 1 Champaign, Ill. 61820	Pits; dredges; portable plants.	Champaign, McLean.
Vulcan Materials Co., Midwest Division.	29 North Wacker Dr. Chicago, Ill. 60606	Pits; stationary plants.	Kane, Lake, McHenry.
Wedron Silica Co., Del Monte Properties Co.	135 South La Salle St. Chicago, Ill. 60603	Pit; stationary plant.	La Salle.
White County Sand & Gravel.	Maunie, Ill. 62861.....	-----do-----	White.
Smelters and refineries:			
American Zinc Co.....	20 South Fourth St. St. Louis, Mo. 63101	Zinc secondary plant.	Montgomery.
Apex Smelting Co.....	2537 Taylor St. Chicago, Ill. 60612	Zinc primary plants. Zinc secondary plant.	St. Clair. Cook.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Smelters and refineries—Continued			
Goldsmith Div. of National Lead Co.	900 West 18th St. Chicago, Ill. 60608	Lead secondary plant.	Cook.
Imperial Type Metal Co.	3400 Aramingo Ave. Philadelphia, Pa. 19134	-----do-----	Do.
National Lead Co.	111 Broadway New York, N.Y. 10006	-----do-----	Madison.
The New Jersey Zinc Co.	160 Front St. New York, N.Y. 10038	Zinc primary plant..	Bureau.
Sandoval Zinc Co.	3649 South Albany Ave. Chicago, Ill. 60632	Zinc secondary plant.	Marion.
Stone:			
Limestone and dolomite:			
Charleston Stone Co.	Box 230 Charleston, Ill. 61920	Quarries; stationary plant.	Coles.
Columbia Quarry Co.	1007 Washington Ave. St. Louis, Mo. 63101	Quarries; stationary plants. Underground mine; stationary plant.	Johnson, Massac, Pulaski, St. Clair. Monroe.
Conco-Western Stone Co.	111 North Spaulding St. Spring Valley, Ill. 61362	Quarry; portable plant.	Kane.
East St. Louis Stone Co.	523 Murphy Bldg. East St. Louis, Ill. 62201	Quarry; stationary plant.	St. Clair.
Elmhurst-Chicago Stone Co.	400 West 1st St. Elmhurst, Ill. 61026	-----do-----	Du Page.
D-P Indian Point Limestone Products, Inc.	Box 126 Mason City, Ill. 62664	-----do-----	Menard.
Industrial Chemicals Div., Allied Chemicals Corp.	Box 70 Morristown, N.J. 07960	-----do-----	Randolph.
General Dynamics Corp.	4226 Lawndale Ave. Lyons, Ill. 60534	Underground mine; stationary plant.	Adams.
Marblehead Lime Co., Material Service Division.	-----do-----	Quarries; stationary plants.	Cook, Vermilion, Will.
Lincoln Stone Quarry, Inc.	Box 69 Hillside, Ill. 60162	Quarry; stationary plant.	Will.
Manteno Limestone Co.	Box 509 Manteno, Ill. 60950	-----do-----	Kankakee.
Marquette Cement Mfg. Co.	20 North Wacker Dr. Chicago, Ill. 60606	-----do-----	La Salle.
Medusa Portland Cement Co.	Box 5668 Cleveland, Ohio 44101	-----do-----	Lee.
Lehigh Stone Corp. Div.	Box 669 Kankakee, Ill. 60901	Quarries; stationary plants.	Clark, Kankakee.
Midwest Stone Co.	Box 180, Anna, Ill. 62906...	Quarry; portable plant.	Union.
Mississippi Lime Co.	7 Alby St., Box 247 Alton, Ill. 62002	Underground mine; stationary plant.	Madison.
Missouri Portland Cement Co.	7751 Carondelet Ave. St. Louis, Mo. 63105	Quarry; stationary plant.	Hardin.
Moline Consumers Co.	313 16th St. Moline, Ill. 61265	Quarries; stationary portable plants.	Adams, Henry, Pike, Rock Island, Warren.
Pontiac Stone Co.	Route 3, Box 412 Pontiac, Ill. 61764	Quarry; stationary plant.	Livingston.
Rein, Schultz & Dahl, Inc.	6217 Nesbitt Rd. Madison, Wis. 53711	Quarries; portable plants.	Carroll, Jo Daviess, Stephenson, Whiteside.
River Sand & Stone Co., Inc. (Ryan Contracting Co., Inc.)	Box 5271, Lawndale Branch 5416 Boonville Hwy. Evansville, Ind. 47715	Quarry; under- ground mine; sta- tionary plant.	Hardin.
Rockford Blacktop Construction Co.	600 Boylston St. Loves Park, Ill. 61111	Quarries; portable plants.	Boone, Winnebago.
Southern Illinois Stone Co.	Box 38 Buncombe, Ill. 62912	Quarry; stationary plant.	Johnson.
Vulcan Materials Co., Midwest Division.	29 North Wacker Dr. Chicago, Ill. 60606	Quarries; stationary plants.	Cook, Will.
Recovered sulfur:			
The Anlin Company of Illinois.	Box 6554 Houston, Tex. 77005	Byproduct sulfur recovery.	Madison.
Union Oil Co. of Cali- fornia.	Box 239 Lemont, Ill. 60439	-----do-----	Cook.
Tripoli (amorphous silica):			
Illinois Minerals Co.	218 10th St. Cairo, Ill. 62914	Underground mine..	Alexander.
Tammseo Division (Lowe's Inc.)	North Edward St. Cassopolis, Mich. 49031	-----do-----	Do.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Exfoliated vermiculite:			
International Vermiculite Co.	1st and Mound Sts. Girard, Ill. 62640	Processing plant----	Macoupin.
Mica Pellets, Inc.-----	1008 Oak St. De Kalb, Ill. 60115	-----do-----	De Kalb.
Construction Products Div., W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	-----do-----	Cook.

The Mineral Industry of Indiana

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

By Brinton C. Brown ¹

Indiana ranked 25th in the United States in value of its mineral production which reached an alltime high of \$281.6 million in 1971, surpassing the previous record set in the preceding year by 10 percent. The combined value of seven nonmetallic minerals increased 14 percent above the 1970 value and accounted for 52 percent of the 1971 State mineral production value. Although the total value of each nonmetallic mineral was greater than in the preceding year, the quantities of clay and lime produced were slightly less. As a result of the 44-day nationwide coal miners strike, the quantity of coal produced was less than in 1970 but the total value increased because of higher coal prices. Petroleum production and value both declined in 1971, nevertheless, the combined value of the four mineral fuels produced in the State increased 6 percent above the

1970 value. Aluminum and iron and steel were produced in Indiana but no metallic minerals were mined in the State during 1971.

The State's mineral production value was divided as follows: Coal, 39 percent; crushed stone, 14 percent; sand and gravel, 10 percent; petroleum, 8 percent; dimension stone, 3 percent; portland and masonry cements, lime, gypsum, clay, peat, natural gas, and abrasives, the remainder.

Legislation and Government Programs.—Public concern for ecology and emphasis on preservation of the environment continued to have an effect on the mineral industry. During the year the 92d Congress conducted hearings on some 23 bills involving strip mining controls. The Sierra Club was committed to a fight to abolish coal strip mining in the United States.

¹ Mining engineer, Division of Nonmetallic Minerals.

Table 1.—Mineral production in Indiana ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement, portland.....thousand 376-pound barrels	12,432	\$41,810	W	W
Clays.....thousand short tons	1,335	2,139	1,324	2,304
Coal (bituminous).....do	22,263	102,371	21,396	110,796
Natural gas.....million cubic feet	153	36	537	132
Peat.....thousand short tons	W	W	50	W
Petroleum (crude).....thousand 42-gallon barrels	7,487	23,958	6,658	22,770
Sand and gravel.....thousand short tons	23,476	25,796	24,982	29,094
Stone.....do	25,818	45,215	26,233	48,218
Value of items that cannot be disclosed:				
Abrasives (whetstone), cement (masonry), fire clay (1971), gypsum, lime and values indicated by symbol W.....	XX	14,461	XX	68,251
Total.....	XX	255,786	XX	281,565
Total 1967 constant dollars.....	XX	228,800	XX	^p 244,624

^p Preliminary. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

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

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

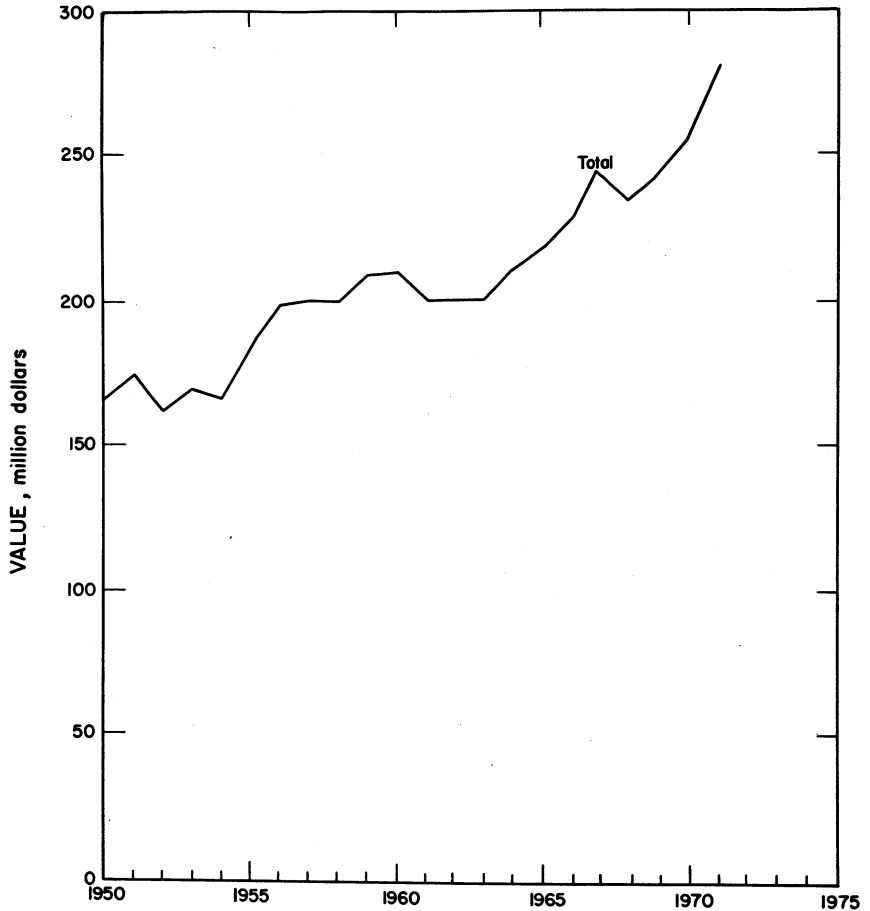


Figure 1.—Total value of mineral production in Indiana.

Table 2.—Value of mineral production in Indiana, by county ¹
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Adams.....	\$629	\$726	Stone, clays, sand and gravel.
Allen.....	3,259	3,871	Stone, sand and gravel, peat.
Bartholomew.....	731	840	Stone, sand and gravel.
Benton.....	W	W	Sand and gravel.
Blackford.....	W	W	Stone, sand and gravel, clays.
Boone.....	W	W	Sand and gravel.
Brown.....	W	W	Do.
Carroll.....	W	W	Stone, sand and gravel.
Cass.....	W	W	Cement, stone, sand and gravel, clays.
Clark.....	W	W	Cement, stone, clays, sand and gravel.
Clay.....	W	W	Coal, clays.
Clinton.....	11	W	Sand and gravel.
Crawford.....	W	W	Stone.
Daviess.....	W	55	Sand and gravel.
Dearborn.....	W	368	Do.
Decatur.....	W	W	Stone.
De Kalb.....	254	368	Sand and gravel.
Delaware.....	1,355	1,467	Stone, sand and gravel, peat.
Dubois.....	W	W	Clays, sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Indiana, by county¹—Continued

(Thousands)			
County	1970	1971	Minerals produced in 1971 in order of value
Elkhart	W	W	Sand and gravel, stone.
Fayette	W	W	Sand and gravel.
Fountain	W	W	Sand and gravel.
Franklin	\$604	\$829	Sand and gravel, coal, clays.
Fulton	W	W	Stone, sand and gravel, clays.
Gibson	W	W	Sand and gravel, peat.
Grant	W	W	Coal, sand and gravel.
Greene	W	W	Stone, sand and gravel, peat.
Hamilton	W	W	Coal, sand and gravel, clays.
Hancock	3,957	5,215	Sand and gravel, stone.
Harrison	W	W	Sand and gravel.
Hendricks	W	W	Sand and gravel, stone.
Henry	W	W	Sand and gravel.
Howard	W	W	Do.
Huntington	W	W	Stone, sand and gravel.
Jackson	W	W	Stone, sand and gravel, clays.
Jasper	385	499	Sand and gravel, clays.
Jay	W	W	Stone, sand and gravel.
Jefferson	W	W	Do.
Jennings	W	5	Sand and gravel.
Johnson	W	W	Stone, sand and gravel.
Knox	W	W	Sand and gravel.
Kosciusko	543	543	Do.
Lagrange	696	W	Sand and gravel, stone.
Lake	W	W	Do.
La Porte	W	W	Cement, lime, sand and gravel, clays.
Lawrence	W	W	Sand and gravel, stone.
Madison	13,834	16,833	Cement, stone, clays.
Marion	W	W	Stone, sand and gravel.
Marshall	3,240	W	Sand and gravel, stone.
Martin	W	W	Sand and gravel, stone, peat.
Miami	683	W	Gypsum, clays.
Monroe	683	721	Sand and gravel, stone.
Montgomery	6,169	W	Stone.
Morgan	W	W	Sand and gravel, clays.
Newton	W	W	Clays, sand and gravel, stone.
Noble	W	W	Stone.
Orange	242	331	Sand and gravel, stone.
Owen	W	W	Stone, abrasives.
Parke	851	857	Stone, sand and gravel.
Perry	523	846	Sand and gravel, clays, coal.
Pike	W	W	Stone, sand and gravel.
Porter	W	W	Coal, stone.
Posey	W	W	Clays.
Pulaski	W	W	Sand and gravel.
Putnam	W	W	Stone, clays.
Randolph	W	W	Cement, stone, sand and gravel.
Ripley	W	W	Stone, sand and gravel.
Rush	W	W	Stone.
St. Joseph	236	W	Stone, sand and gravel.
Scott	W	927	Sand and gravel, stone.
Shelby	W	W	Stone.
Spencer	W	W	Stone, sand and gravel.
Starke	W	W	Coal.
Steuben	W	W	Sand and gravel.
Sullivan	190	W	Sand and gravel, stone.
Switzerland	22,687	22,345	Coal, sand and gravel, stone.
Tippecanoe	W	W	Sand and gravel.
Union	W	W	Do.
Vermillion	21	8	Do.
Vigo	4,944	6,206	Coal, sand and gravel, clays.
Wabash	W	1,821	Sand and gravel, coal, stone.
Warren	340	W	Stone, sand and gravel.
Warrick	W	W	Sand and gravel, peat.
Washington	W	W	Coal, stone.
Wayne	W	W	Stone.
Wells	W	W	Sand and gravel, stone.
White	W	W	Stone, sand and gravel, peat.
Whitley	W	W	Stone.
Undistributed ²	78	W	Sand and gravel.
Total³	189,326	215,876	

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

¹ Data for petroleum and natural gas are not available on a county basis; however, value for these commodities are included with "Undistributed." Benton, Brown, Floyd, Ohio, Tipton and Vanderburgh Counties are not listed because no production was reported.

² Includes value for petroleum, natural gas and mineral production that is not assigned to specific counties plus values indicated by symbol W.

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

Table 3.—Indicators of Indiana business activity

	1970 ^a	1971 ^b	Change, percent
Employment and labor force, annual average:			
Total labor force.....thousands..	2,177.9	2,166.5	-0.5
Unemployment.....do.....	104.2	121.6	+16.7
Employment:			
Manufacturing.....do.....	710.2	679.3	-4.4
Construction.....do.....	79.8	74.4	-6.8
Mining.....do.....	7.0	6.6	-5.7
Transportation and public utilities.....do.....	102.2	99.4	-2.7
Wholesale and retail trade.....do.....	367.3	368.1	+0.2
Finance, insurance, and real estate.....do.....	76.2	76.5	+0.4
Services.....do.....	219.7	226.0	+2.9
Government.....do.....	286.4	280.9	-1.9
Personal income:			
Total.....millions..	\$19,679	\$20,952	+6.5
Per capita.....do.....	\$3,779	\$3,973	+5.1
Construction activity:			
Construction permits:			
Valuation of authorized nonresidential construction....millions..	\$198.6	\$255.5	+28.6
Number of private and public residential units authorized.....	23,953	35,099	+46.5
State highway commission contracts awarded.....millions..	\$150.0	\$151.0	+0.7
Portland cement shipments to and within Indiana thousand 376-pound barrels..	8,530	9,184	+7.7
Mineral production value.....millions..	\$255.8	\$281.6	+10.1

^a Preliminary. ^b Revised.

Sources: Area Trends in Employment and Unemployment; Employment and Earnings; Construction Review; Survey of Current Business; Streets and Roads; and U.S. Bureau of Mines.

Indiana legislators enacted the following bills into law during the 1971 General Assembly that amend the 1971 Indiana Code (IC) and may affect the mineral industry:

1. Senate Bill (S.B.) 345, P.L. 182, amends IC 1971, Title 13, by adding a new article (Art. 6) to permit any person, association, corporation, or government to sue to halt activities allegedly polluting, impairing, or destroying the environment and forces respondent to prove that the questioned activity is not contrary to the public welfare;

2. House Bill (H.B.) 1070, P.L. 180, amends IC 1971, 13-4-7-19, 21, regulating drilling of oil and gas wells to add new bond requirements, and govern the drilling, plugging, and abandonment of such wells;

3. H.B. 1168, P.L. 266 amends IC 1971, 18-6-4-2, 3, 12 concerning economic development and pollution control, by broadening the powers of a city's economic development commission to include the acquiring and leasing out of industrial facilities, on grounds of insufficient employment opportunities, diversification of industry, or industrial pollution control;

4. H.B. 1551, P.L. 174 amends IC 1971 by adding a new chapter (Ch. 5.5) prohibiting the sale and use of certain hard or nondegradable detergents, and reducing the allowable phosphate content of detergents to 12 percent by January 1, 1972,

and to 3 percent by January 1, 1973, and includes fines up to \$1,000 an incident;

5. S.B. 547, P.L. 358 amends IC 1971, 22-10-2-4, 22-10-3-7 thru 10, 12, 13, 22-10-7-6, 22-10-9-2, 22-10-10-4, 9, 11 to require filling of entrances to abandoned coal mines and makes other changes in the Mining Act of 1955 including certification of mine electricians;

6. H.B. 1202, P.L. 3, amends IC 1971, 1-2, by adding a new chapter (Ch. 9) to adopt limestone found and quarried in south and central Indiana from the geologic formation named Salem Limestone as the official stone of the State of Indiana;

7. H.B. 1317, P.L. 423, amends IC 1971, 32-5, by adding a new chapter (Ch. 11) establishing ownership in mineral interests when such have gone unused for 20 years or more;

8. H.B. 1344, P.L. 138, amends IC 1971, 9-8-6, by adding a new section (Sec. 36.5) to set decibel noise limits for motor vehicles varying with weight class and speed;

9. S.B. 500, P.L. 380, amends IC 1971, by adding a new chapter (Ch. 1.5) to 25-30, concerning regulation of dealers in valuable metals, and requires that records be kept on State Police forms and prescribes penalties for violations.

The following legislative bills were introduced but not enacted during the 1971 General Assembly: H.B. 1151, to establish a severance tax on coal at the rate of 0.5

percent of the mined value with receipts going to coal-producing counties; H.B. 1163, to establish a severance tax of 0.5 to 1 percent on petroleum and mineral products excluding sand and gravel; H.B. 1167 to create a commission to administer the land reclamation act and impose a severance tax on mining coal, clay, and shale to finance the commission. The commission would have the authority to stop strip mining deemed to be detrimental. The rate of the proposed severance tax would have been 10 cents a ton and fees would have been assessed for applications to mine and for acreage mined; H.B. 1141 to establish a use tax on coal and other fossil fuels by major consumers using 1,000 tons of coal or Btu equivalent with revenues dedicated to reclamation of strip-mined areas and to control of pollution from mining operations; and S.B. 327 authorizing the Department of Natural Resources to conduct geological investigations including exploratory drilling to evaluate mineral deposits on State-owned land and to issue permits for a fee of \$100 to people interested in making such investigations.

An interim legislative committee held a hearing to study mineral severance tax as a means to support the Indiana Geological Survey. In the past the Survey benefited from a petroleum severance tax but during the past 5 years the gas and oil output has declined 30 percent.

New rules were prepared by the Indiana Division of Forestry for final cuts and pit entrance roads at strip coal mines. Final cuts must be graded not to exceed $33\frac{1}{3}$ percent. If the final cut is to be filled with water, then the highwall and the slope opposite the highwall are to be graded not to exceed $33\frac{1}{3}$ percent above the water line. Pit entrance roads must be graded in accordance with the reclamation plan.

During 1971 the Division of Forestry issued permits for surface mining of 4,381 acres of land, of which 98 percent was for coal-strip mining and the remainder for clay and shale pits. The permits require reclamation of the mined land for the following uses: 664 acres forest land with a maximum of $33\frac{1}{3}$ percent grade; 3,078 acres of range land with a maximum of $33\frac{1}{3}$ percent grade; 626 acres of pasture land with a maximum grade of 25 percent; and 13 acres for other uses including land fill with a maximum grade of 8 percent.

After the governor refused to sign the

original sulfur dioxide control ordinance (APC-13) adopted by the Indiana Air Pollution Control Board in February, the Board revised the rules for controlling emissions with looser restrictions which would go into effect in 1975. Opponents to the revised ordinance claim that it would only apply to new coal burning powerplants larger than 300 megawatts and would not enable the State to meet the new standards established by the Environmental Protection Agency (EPA).

Fort Wayne received delivery of an \$800,000 gas turbine boiler for generating electric power but there was no gas available to operate it. So the city continued to operate the old inefficient coal-burning boilers which are a source of air pollution. The city also applied for a \$750,000 grant from the EPA to experiment with a boiler fuel comprised of coal and compressed solid waste to reduce sulfur dioxide emission.

A special appeals board appointed by the Mayor of Gary granted United States Steel Corp. a variance from the city's air quality ordinance and gave the company until July 1, 1972, to choose a process for controlling emissions from coke ovens.

The Indiana Stream Pollution Control Board ordered Lake Michigan area cities in Indiana to reduce the phosphate content of sewage by 80 percent before discharging effluent into waterways. The cities have until 1972 to comply. The ban on the sale of detergents containing more than 12 percent phosphates was moved by the Board from January 1 to July 1, 1972. A panel of three Federal judges denied an injunction sought by three major soap manufacturers trying to keep Indiana's new antiphosphate law from going into effect.

The Indiana Geological Survey issued the following publications of interest to the mineral industries during 1971: Preliminary Coal Maps 14 and 15 showing distribution, structure, and mined areas of coal in Perry and Daviess Counties, respectively; Bulletin 42-F, "Specialty Sand Resources of Indiana;" Bulletin 42-G, "Marl Resources of Indiana;" Bulletin 42-H, "Crushed Stone Aggregate Resources of Indiana;" and Bulletin 46, "Applied Geology of Industrial Limestone and Dolomite." The Muncie 1 by 2 degrees quadrangle map, the fifth in a series of eight that will cover Indiana and parts of adjacent States, was published in 1971.

The map appears in three versions: (1) A composite showing bedrock in pattern and unconsolidated material in color; (2) separate colored versions for bedrock; or (3) unconsolidated materials alone. The three remaining maps in the series (Fort Wayne, Cincinnati, and Louisville) are scheduled for publication in 1972.

Employment and Injuries.—In the mineral industries, 6,790 men worked 14,903,000 man-hours, compared with 7,005 men and 15,373,000 man-hours in 1970, a decrease of 3 percent. Employment increased 2 percent at nonmetal mines and 1 percent at coal mines but decreased 8 percent at stone quarries.

There were 388 lost-time injuries in the mineral industries, including three fatalities, compared with 362 injuries including five fatalities in 1970. There were no fatalities during the year in underground mines; however, two occurred in coal-strip mines and one at a stone quarry.

Indiana had 12 limestone quarries with crushing plants competing in the nationwide annual safety contest conducted by the Bureau of Mines in cooperation with the National Limestone Institute. Contestants who operated throughout 1971 without a disabling work injury were awarded Certificates of Achievement in Safety as follows: Class II, working 60,001 to 120,000 man-hours—Scott County Stone Co. Inc., Hardy quarry; Class III, working 20,001 to 60,000 man-hours—May Stone and Sand, Inc., Ardmore plant; Meshberger Stone,

Inc., Columbus quarry; Berry Materials Corp., North Vernon quarry; and DeBolt Concrete Co., Inc., Middleboro quarry; Class IV, working 10,001 to 20,000 man-hours—Cave Stone Inc., Norristown quarry; and Class V, working 10,000 man-hours or less—Kixmiller Brothers, Inc., Freelandville quarry.

Meshberger Stone, Inc., quarry at Columbus also received a Gold Bar Award from the National Crushed Stone Association Safety Contest for 8 consecutive years without a lost-time injury.

Western Indiana Aggregates, Inc., portable gravel plant at Lafayette was the winner of the National Sand and Gravel Association's safety contest Class D competition for plants producing from 170,000 to 224,999 tons. Certificates of Achievement in Safety were made to contestants who operated in 1971 without lost-time accidents as follows: Class B (550,000 to 1.5 million tons) Western Indiana Aggregates, Inc., Lafayette No. 1 Gravel Division plant; Class C (225,000 to 549,999 tons) Martin Marietta Corp's North Terre Haute plant, Clinton plant, and 86th Street Indianapolis plant; Western Indiana Aggregates, Inc., three subsidiary plants—Eagle Materials plant, Hanna Sand and Gravel plant, and Montezuma Gravel Div. plant; and Class F (less than 60,000 tons) Martin Marietta Corp.'s South Terre Haute plant. A special certificate was awarded to Interstate Sand and Gravel Co., Inc., for an 11-year accident-free record at its Neal gravel plant.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours		
					Fatal	Non-fatal	Frequency	Severity	
1970:									
Coal.....	2,412	274	660	5,140	2	211	41.44	4,051	
Peat.....	26	219	6	45	--	1	22.09	751	
Nonmetal.....	580	285	165	1,304	--	12	9.20	339	
Sand and gravel.....	891	249	222	1,881	2	20	11.70	8,173	
Stone.....	3,096	274	848	7,003	1	113	16.28	1,609	
Total.....	7,005	271	1,901	15,373	5	357	23.55	3,118	
1971: ^P									
Coal.....	2,555	259	662	5,207	2	223	43.21	4,093	
Nonmetal ¹	595	292	174	1,394	--	17	12.19	1,028	
Sand and gravel.....	885	239	211	1,855	--	22	11.86	593	
Stone.....	2,755	273	753	6,447	1	123	19.23	1,548	
Total.....	6,790	265	1,800	14,903	3	385	26.03	2,269	

^P Preliminary.

¹ Beginning in 1971, data concerning peat operations are included in the nonmetals industry.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Stone.—Hindustan Whetstone Co. fabricated whetstones from sandstone quarried near Orleans in Orange County. The quantity increased 67 percent, but the total value increased only 12 percent.

Cement.—Portland cement shipments increased and the value rose over 1970 figures. The quantity however was less than the 1967 record shipments. The average mill value of portland cement for all types was \$3.48 a barrel in Indiana, slightly below the \$3.52 average for the United States.

Four companies operated a total of 13 kilns at three dry-process and two wet-process plants, with a combined annual clinker-producing capacity of nearly 14 million barrels. Louisville Cement Co. was installing a new 13 by 15-foot-diameter by 500-foot-long kiln equipped with a glass bag dust collector at its Speed plant in Clark County that will increase annual capacity 1 million barrels and replace three smaller kilns. Completion was scheduled for early in 1973. The company was installing additional dust control equipment at the Logansport plant in Cass County. Universal Atlas Cement Division of United States Steel Corp. operated its portland cement plant at Gary in Lake County. The company also started its new calcium-aluminate refractory cement facility at Gary and shutdown the old calcium-aluminate cement plant. Lone Star Industries operated its plant at Greencastle in Putnam County, and Lehigh Portland Cement Co. produced cement at its Mitchell plant in Lawrence County.

About 92 percent of the portland cement shipped was Type I (general construction use) and Type II (moderately low heat and moderate degree of resistance to sulfate attack); 5 percent was Type III (high-early-strength); and the remainder was slag-pozzolan and expansive cement.

Ready-mix concrete producers were the primary customers of Indiana's portland cement, using 67 percent of the shipments. Concrete product manufacturers used 15 percent to make concrete blocks, concrete pipes and precast prestressed concrete, and other concrete products. Direct shipments to highway contractors amounted to 12 percent of the shipments. Building mate-

rials dealers received 5 percent of the cement and the remainder went to other contractors and for miscellaneous uses. The apparent consumption of portland cement in Indiana during 1971 was 9.2 million barrels. More than 4.8 million barrels of cement produced in Indiana was shipped to customers in nearby States; however, despite the abundance of Indiana's cement production, some Indiana customers received cement produced in other States. Shipments of cement were about 91 percent in bulk and the remainder in bags; about 92 percent of the cement was shipped by truck and the remainder by rail.

Masonry cement was produced at three of the five plants. Lehigh and Louisville Cement (Cass County) did not produce masonry cement. Shipments increased 19 percent in quantity and 26 percent in value. The average mill value of masonry cement increased 17 cents a barrel. Consumption of masonry cement in Indiana was 762,000 barrels in 1971.

Clays.—Combined clay and shale output declined slightly; however, the value increased nearly 8 percent above the 1970 value. Common clay and shale comprised most of the material sold or used, of which shale was the largest quantity. Shale was produced by 14 companies in 11 counties; and common clay was produced by 18 companies at 20 pits in 13 counties. The largest producers were Hydraulic-Press Brick Co. in Morgan County, Louisville Cement Co. in Cass and Clark Counties, Log Cabin Coal Co. in Clay County, and S. L. Turner Coal and Clay Co. Inc. in Parke County. These four companies accounted for 54 percent of the State's output. A small quantity of fire clay was produced by H.H. Bartlett from a stockpile in Dubois County, Log Cabin Coal Co. in Clay County, and Lorenz and Son in Porter County. In summary, 31 companies operated 36 clay and shale pits in 20 counties. About 66 percent of the clay was produced in four counties: Morgan, Clay, Clark, and Parke.

About 43 percent of all production was used to manufacture building bricks; 30 percent was used in making portland cement; and the remainder was used for lightweight aggregate, drain tile, sewer pipe, and filler. Fire clay was used in mak-

ing common, face, and refractory bricks and pottery. Competition from plastic drain tubing caused a decline in the use of clay drain tile. Brick sales were down because of a slowdown of building in Indiana.

Table 5.—Clays sold or used by producers, by kind
(Thousand short tons and thousand dollars)

Year	Fire clay		Miscellaneous clay		Total ¹	
	Quantity	Value	Quantity	Value	Quantity	Value
1967-----	247	\$420	1,242	\$1,706	1,489	\$2,126
1968-----	182	340	1,369	2,015	1,550	2,355
1969-----	166	314	1,317	1,950	1,483	2,264
1970-----	75	202	1,259	1,936	1,335	2,139
1971-----	* 1	* 5	1,324	2,303	1,325	2,308

¹ Data may not add to totals shown because of independent rounding.

² Includes a small quantity of kaolin.

Mineral Resources, Inc., of St. Louis, Mo. reopened an old shale pit east of Loo-gootee in Martin County to supply shale for Lehigh Portland Cement Co. at the Mitchell plant.

The Brownstown shale pit in Jackson County ceased operations in February 1971.

Gypsum.—Indiana ranked sixth in gypsum production in the Nation. Production of crude gypsum increased 8 percent and the value rose 13 percent above 1970 figures. 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 in Lake County on crude gypsum brought by water transportation from Michigan.

Calcined gypsum production and value both increased 7 percent. The major use for calcined gypsum was in manufacturing wallboard and plaster for the building industry. Production of Type-X gypsum wallboard, a special fire-retardant, was becoming increasingly more important. Crude gypsum and a mixture of gypsum and anhydrite were sold for use as cement retarder. Uncalcined gypsum was also sold as landplaster for agricultural use.

Lime.—Although output decreased 7 percent below the 1970 record, Indiana's lime production ranked 12th in the United States. Marblehead Lime Co. operated the only lime plant in the State at Buffington in Lake County producing quicklime. Limestone quarried in northern Michigan was transported by lake freighters to Buffington and processed in rotary kilns using bituminous coal for fuel.

Indiana ranked fifth in the Nation as a lime consumer, using 1,307,237 tons of lime. Although some lime produced in Indiana was shipped to customers in Illinois and Iowa, large quantities were shipped into the State from producers in Illinois, Ohio, and Missouri. Most of the quicklime was used by the steel industry; however, a small amount was used for soil stabilization and water purification.

Marblehead Lime Co. announced a \$12 million expansion program including the addition of two new kilns, bringing the total to five kilns. When the expansion is completed, the plant's annual capacity will increase from nearly 500,000 to more than 800,000 tons. With the new capacity the plant will rank as one of the world's largest.

Perlite.—Crude perlite, mined mostly in New Mexico, was expanded at six plants: 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 in Montgomery County; Airlite Processing Corp. near Scottsburg in Scott County; and Chemrock Corp. near Lafayette in Tippecanoe County. Federal Cement Products, Inc., did not expand perlite at its plant in Lake County during 1971. Expanded perlite production increased 39 percent and the value rose 22 percent above that in the preceding year. The principal uses for perlite expanded in Indiana were for plaster aggregate and as a filter aid. Smaller quantities were used for concrete aggregate and insulation.

Sand and Gravel.—Sand and gravel production increased 6 percent and the value rose 13 percent above 1970 figures. Sand and gravel was produced in 71 counties by

188 commercial operators, 24 county agencies, and one operation each by a Federal, State, and Municipal agency. Sand and gravel was processed at 113 stationary plants, 71 portable plants, and 24 dredging units. About 94 percent of the sand and gravel was processed in washing or screening plants. Of the total production, 58 percent was gravel.

Production ranged from 2,000 tons in one county to 3.2 million tons in another county. Only three commercial operations produced 1 million tons or more each; three, between 700,000 and 900,000 tons each; 24, between 200,000 and 500,000 tons each; 36, between 100,000 and 200,000 tons each; 57, between 25,000 and 100,000 tons each; and 65, less than 25,000 tons. Six individual operations produced 25 percent of the output while 158 operations accounted

for only 17 percent of the total output. American Aggregates Corp., Irving Materials, Inc., and Martin Marietta Corp. were the largest producers. Nearly 93 percent of the commercial sand and gravel was transported by truck; the remainder by rail and water transportation.

About 55 percent of Indiana's sand and gravel was used for paving roads; another 32 percent by the building industry; 9 percent for fill material; and the remainder for railroad ballast and ground and underground industrial uses such as molding and glass manufacturing.

American Aggregates Corp. found a limestone and dolomite deposit beneath its gravel deposit at the North Indianapolis operation. The company is now mining sand and gravel and quarrying stone from the same location.

Table 6.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	4,208	\$4,071	3,816	\$3,928
Fill.....	828	583	854	615
Paving.....	4,680	4,568	5,144	5,446
Other uses ¹	524	1,625	551	1,728
Total².....	10,240	10,848	10,366	11,719
Gravel:				
Building.....	3,390	4,577	3,843	5,227
Fill.....	1,481	1,038	1,182	935
Paving.....	7,381	8,740	7,666	9,782
Other uses ³	75	77	632	663
Total².....	12,326	14,432	13,324	16,607
Government-and-contractor operations:				
Sand:				
Paving.....	22	11	76	58
Fill.....	--	--	23	22
Other uses.....	1	1	--	--
Total².....	23	12	99	81
Gravel:				
Building.....	95	42	205	161
Fill.....	--	--	73	32
Paving.....	792	462	854	431
Other uses.....	--	--	60	62
Total².....	887	504	1,194	686
Total sand and gravel².....	23,476	25,796	24,982	29,094

¹ Includes engine, fire or furnace, glass, molding, railroad ballast, and other sands.

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

³ Includes miscellaneous (1971), railroad ballast, and other gravel.

Table 7.—Sand and gravel sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Allen	7	1,052	\$1,030	6	1,117	\$1,187
Bartholomew	--	--	--	--	60	60
Cass	2	101	91	2	W	W
Clinton	1	11	11	2	W	W
Dearborn	2	W	W	3	264	368
De Kalb	5	273	254	5	379	368
Delaware	3	W	W	2	375	337
Dubois	--	--	--	1	(¹)	1
Elkhart	18	546	569	19	486	563
Franklin	2	W	W	3	60	9
Fulton	2	W	W	2	W	163
Gibson	1	W	W	--	W	40
Greene	2	W	W	3	338	349
Hamilton	5	1,957	2,431	5	2,322	3,092
Harrison	3	W	W	3	373	W
Jackson	2	W	248	4	420	425
Jay	1	31	34	1	26	28
Jefferson	1	W	W	--	12	5
Jennings	--	--	--	2	4	(¹)
Knox	5	590	543	5	621	548
Kosciusko	7	815	695	4	763	W
Lagrange	9	285	215	6	W	W
Madison	6	539	640	4	633	758
Marion	4	2,651	3,240	5	W	W
Marshall	3	W	W	5	513	W
Miami	3	W	W	4	522	W
Montgomery	2	W	W	2	77	46
Morgan	4	427	335	4	W	W
Noble	6	295	239	7	379	327
Perry	1	24	17	1	11	11
Randolph	1	W	23	1	W	W
Rush	1	10	9	1	W	W
St. Joseph	4	W	W	7	937	925
Shelby	5	555	571	6	414	459
Steuben	4	189	185	7	328	375
Sullivan	3	W	115	3	117	W
Switzerland	2	W	W	1	1,016	W
Union	1	32	21	--	19	8
Vermillion	4	W	W	4	368	441
Vigo	5	874	865	5	W	W
Wabash	4	54	42	3	48	32
Warren	2	575	W	4	786	W
Wayne	7	602	661	5	545	497
Whitley	1	66	78	2	W	W
Undistributed ²	51	10,974	12,635	55	10,648	17,725
Total ³	202	23,476	25,796	214	24,982	29,094

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

¹ Less than 1/2 unit.

² Includes Adams, Benton (1971), Blackford (1971), Boone, Brown (1971), Carroll (1971), Clark, Daviess, Fayette, Fountain, Grant, Hancock, Hendricks, Henry, Howard, Huntington, Jasper, Johnson, Lake, La Porte, Owen, Parke, Porter, Posey, Putnam, Starke, Tippecanoe and Wells Counties (1971), and some sand and gravel that cannot be assigned to specific counties.

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

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 production and steel refining. In addition, slag was shipped from Illinois for processing in Indiana. Processed slag was used in making cement; marketed for mineral wool, roofing granules, concrete aggregate, and railroad ballast; or expanded for lightweight aggregate.

Stone.—Production of stone, comprising mostly crushed limestone and dolomite, in-

creased 2 percent in quantity and 7 percent in value. Stone was mined by 81 companies at 125 quarries in 53 counties. Ten companies mined 57 percent of the output at 34 quarries. Three quarries had an output exceeding 900,000 tons each; 10, between 500,000 and 900,000 tons each; 56, between 100,000 and 499,999 tons each; and 56 less than 100,000 tons each of which 36 were less than 25,000 tons. Ralph Rogers and Co., Inc., and Mulzer Crushed Stone Co. were the largest producers of crushed limestone. Ten companies mined

29,074 tons of marl at 12 quarries in Elkhart, Kosciusko, Lagrange, La Porte, Marshall, Noble, St. Joseph, and Steuben Counties. Three companies mined 5,138 tons of sandstone in Lawrence, Monroe, and Morgan Counties.

Principal uses of stone were as follows: 62 percent for road base and paving materials; 15 percent for concrete aggregate; 12 percent for manufacturing portland cement; 7 percent for agricultural uses; and the remainder for railroad ballast, riprap and jettystone, rough and dressed architectural dimension stone, and for miscellaneous chemical and industrial uses. Trucks transported 86 percent of the stone; the remainder was divided between railroad and waterway transportation.

Although the tonnage was small, the value of dimension stone was 20 percent of the total Indiana stone production. Indiana limestone has supplied more than half the United States dimension limestone market for nearly a century. In recent

years it lost steadily in its share of the construction market to other building materials such as precast concrete, glass, and metal. A slump in the building industry forced Indiana Limestone Co., Inc., the largest producer of dimension limestone, to go on a 4-day work week in 1971. Empire Stone Co., a long-time producer of Salem dimension limestone near Bloomington, ceased operations in 1971. Dimension limestone was produced by 14 companies at 20 quarries in Franklin, Lawrence, and Monroe Counties. Victor Oolitic Stone Co. and Indiana Limestone Co., Inc. were the largest producers in Monroe and Lawrence Counties. Dimension sandstone was produced at the High Bluff quarry in Morgan County. Production and value of dimension stone were slightly higher than in 1970.

Bloomington Crushed Stone Co., Inc. opened a crushed limestone quarry (Sieboldt Quarry) in Lawrence County mining from the Paoli and Ste. Genevieve forma-

Table 8.—Limestone and dolomite sold or used by producers, by use
(Thousand short tons and thousand dollars unless otherwise specified)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Dimension:				
Rough architectural..... thousand cubic feet..	1,895	\$3,118	2,769	\$4,429
Irregular shaped stone:			(1)	2
Rubble.....	4	92		
Other rough.....	7	27		
Dressed architectural:				
Cut..... thousand cubic feet..	2,460	3,132	345	2,837
House stone veneer..... do.....	458	977	420	851
Sawed..... do.....	558	2,035	W	W
Flagging..... do.....	W	14	33	W
Total (approximate).....	273	9,433	300	9,753
Crushed and broken:				
Bituminous aggregate.....	2,101	3,124	2,146	3,485
Concrete aggregate.....	3,433	4,789	3,766	5,814
Dense graded road base stone.....	6,953	9,586	7,842	11,590
Macadam aggregate.....	1,369	2,098	1,837	2,748
Surface treatment aggregate.....	2,802	3,989	1,214	1,862
Unspecified aggregate and roadstone.....	2,779	3,859	3,209	4,943
Agricultural limestone ³	1,980	3,422	1,845	3,270
Cement ⁴	2,561	2,315	3,016	2,695
Filter stone.....	4	5		
Flux.....	35	52	29	46
Railroad ballast.....	434	591	459	645
Riprap and jetty stone.....	136	454	248	767
Other ⁵	920	1,364	287	433
Total ⁶	25,508	35,597	25,899	38,298
Grand total.....	25,781	45,030	26,199	48,051

W Withheld to avoid disclosing individual company confidential data; included in "Total."

¹ Less than 1/2 unit; included in "Total."

² Data includes flagging for 1970.

³ Includes poultry grit and other soil conditioners.

⁴ Includes lime for 1970.

⁵ Includes stone used for asphalt filler, mine dusting, building products, and other unspecified uses; also, stone sand (1970) and fill (1971).

⁶ Data may not add to totals shown because of independent rounding.

Table 9.—Limestone and dolomite sold or used by producer, by county
(Thousand short tons and thousand dollars)

County	1970		1971		Type of stone produced in 1971
	Quantity	Value	Quantity	Value	
Adams	W	W	W	W	Crushed and broken.
Allen	1,474	\$2,229	W	W	Do.
Bartholomew	466	731	W	W	Do.
Blackford	W	W	W	W	Do.
Carroll	W	W	W	W	Do.
Cass	712	797	W	W	Do.
Clark	2,293	2,806	2,318	\$2,794	Do.
Crawford	W	W	W	W	Do.
Decatur	W	W	W	W	Do.
Delaware	W	W	W	W	Do.
Franklin	6	82	W	W	Dimension.
Grant	W	W	W	W	Crushed and broken.
Hamilton	948	1,526	1,269	2,123	Do.
Harrison	297	468	W	W	Do.
Howard	W	W	W	W	Do.
Huntington	W	W	W	W	Do.
Jasper	W	W	W	W	Do.
Jay	124	W	136	W	Do.
Jennings	W	W	W	W	Do.
Lawrence	2,329	6,943	2,495	6,849	Dimension and crushed and broken.
Madison	W	W	W	W	Crushed and broken.
Marion	--	--	W	W	Do.
Miami	36	W	51	W	Do.
Monroe	W	6,160	W	7,219	Dimension and crushed and broken.
Morgan	W	W	W	W	Crushed and broken.
Newton	W	W	W	W	Do.
Orange	586	813	648	923	Do.
Owen	W	W	W	W	Do.
Perry	W	W	W	W	Do.
Pike	--	--	W	W	Do.
Pulaski	W	W	W	W	Do.
Putnam	2,626	3,703	2,774	4,060	Do.
Randolph	213	W	W	W	Do.
Ripley	W	W	W	W	Do.
Rush	W	227	W	W	Do.
Scott	W	W	W	W	Do.
Shelby	W	W	W	W	Do.
Sullivan	14	32	15	40	Do.
Switzerland	60	W	--	--	
Vigo	--	--	W	W	Crushed and broken.
Wabash	180	298	W	W	Do.
Warrick	W	W	W	W	Do.
Washington	W	W	W	W	Do.
Wayne	150	W	W	W	Do.
Wells	W	W	W	W	Do.
White	W	W	W	W	Do.
Total	25,781	45,030	26,199	48,051	

W Withheld to avoid disclosing individual company confidential data; included in "Total."

Table 10.—Calcareous marl production

Year	Number of producers	Short tons	Value
1967	18	51,890	\$33,553
1968	13	35,828	28,311
1969	12	31,671	30,190
1970	12	23,208	23,436
1971	12	29,074	26,095

tions. Northern Indiana Stone Co. completed the first full year of operation of its Belshaw quarry in Lake County. Ryan, Inc., reopened an abandoned quarry near Georgetown, Washington County, and was crushing stone from the Harrodsburg Limestone formation. Paul Buchanan reopened a quarry near Wert in Jefferson County and produced crushed stone.

Franklin County Stone Co. and Henson Stone Co. each started small rubble-stone operations in Franklin County. Mr. Larry Evans of the Bedford Stone Service in Lawrence County purchased Limestone Veneers and the Carl Furst Co. The Evan's companies are producers and fabricators of Salem dimension limestone.

Poor economic conditions were attributed in the closing of several small dimension stone quarries including Judd Stone Service, Franklin County; Blue Ridge Quarries, Shelby County; Springs Valley Sandstone Co., Orange County; and St. Meinrad Archabbey quarry in Spencer County.

Baker Rockledge Products Co. installed equipment for production of high-magne-

sium dolomite for glass manufacture at its Portland plant in Jay County.

Sulfur.—American Oil Co. recovered by-product sulfur from crude petroleum by the Mathieson-Fluor process at the Whiting refinery in Lake County. The sales of elemental sulfur declined 6 percent in quantity but more significantly dropped 50 percent in value, reflecting the abundance of sulfur now recovered to comply with pollution control requirements.

Cities Service Oil Co. was installing facilities for removal of sulfur from refinery fuel gases with the capacity of recovering 50 tons a day of sulfur. The new equipment costing \$3.5 million consists of a sulfur recovery unit, an amine absorption system, and a distillate hydrotreater.

MINERAL FUELS

Coal (Bituminous).—Indiana's coal production, ranking seventh in the Nation,

decreased 4 percent because of the 44-day nationwide coal strike that ended November 14. However, the value increased 8 percent to \$5.18 a ton, as a result of an average price increase of 58 cents a ton for all coal mined in the State. The strip mine coal price increased to \$5.05 a ton and the price of underground coal rose to \$6.61 a ton. About 92 percent of the coal was produced at 34 strip mines by 23 companies in nine counties; the remainder was mined in four underground mines. About 33 percent of the coal production came from Warrick County; followed by Pike County, 21 percent; Sullivan County, 18 percent; Greene County, 12 percent; Vermillion and Clay Counties, 6 percent each; and the remainder from Fountain, Gibson, Parke, Spencer, and Vigo Counties. Peabody Coal Co. was the largest producer followed by Amax Coal Co. and Old Ben Coal, Inc.

Table 11.—Coal (bituminous) production in 1971, by county
(Excludes mines producing less than 1,000 short tons)

(Thousand short tons and thousand dollars)

County	Number of mines			Production			Value
	Under-ground	Strip	Total	Under-ground	Strip	Total	
Clay.....	--	6	6	--	1,192	1,192	\$6,913
Fountain.....	--	1	1	--	27	27	186
Gibson.....	1	--	1	907	--	907	W
Greene.....	--	4	4	--	2,462	2,462	12,433
Parke.....	--	1	1	--	11	11	38
Pike.....	1	9	10	62	4,466	4,528	24,703
Spencer.....	--	2	2	--	59	59	W
Sullivan.....	1	2	3	713	3,136	3,849	22,233
Vermillion.....	--	2	2	--	1,318	1,318	W
Vigo.....	1	--	1	33	--	33	W
Warrick.....	--	7	7	--	6,961	6,961	31,838
Undistributed.....	--	--	--	--	--	--	12,451
Total.....	4	34	38	1,765	19,632	21,397	110,795

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

Underground mine coal seams ranged in thickness from 71 to 81 inches, whereas the thickness of strip coal seams ranged from 24 to 134 inches. Overburden thickness at strip mines ranged from 18 to 150 feet.

Strip mine excavating equipment in operation during the year included 57 power shovels, 41 draglines, 40 front-end loaders, and one carryall scraper. The bucket capacities of the 98 power shovels and dragline excavators were reported as follows: 11, exceeding 50 cubic yards; 14, between 16 and 50 cubic yards; 23, between 6 and 15 cubic yards; and 50, less than 6 cubic yards. Shovels and draglines were powered as follows: 46 electric, 44 diesel, 5 diesel

electric, and 5 gasoline. All underground coal was mechanically loaded.

About 77 percent of Indiana's coal production was transported by rail or water, 11 percent by truck, and 12 percent was conveyed to mine-mouth electric power generating plants. About 11 percent of the coal was shipped by unit trains. During the year 16 coal preparation plants were active.

Consumption of coal in Indiana was 38,599,000 tons of which 42 percent came from Indiana's production; 23 percent from West Virginia and Virginia; 17 percent from western Kentucky; 14 percent from Illinois; and the remainder from

Pennsylvania, Montana, and Ohio. Electric utilities used 57 percent of the coal consumed in the State; coke and gas plants used 29 percent; and the remainder was consumed for other uses. Despite the necessity to purchase coal mined in other States to meet demand, 25 percent of Indiana's coal production was shipped to customers in the following States: Wisconsin, 8 percent; Illinois and Michigan, 4 percent each; Georgia and Florida, 3 percent each; Kentucky, 2 percent; and Minnesota, 1 percent. The small remainders went to Iowa and Tennessee and an increase in mine inventory.

Six new strip mines started operation in 1971. L.R. Chapman Construction Co. opened the Chapman No. 3 Mine in Pike County in September. Embry Coal Co. started in Warrick County in June. River Coal Co. opened the River Coal No. 2 Mine in Vermillion County in July. Delta Material Corp. commenced in Clay County in September. Prechtel and Vaal opened the Prechtel and Vaal No. 1 Mine in Spencer County and the Prechtel and Vaal No. 2 Mine in Pike County in December.

Three strip mines were abandoned during the year. J. and H. Strip, later known as Richardson Strip, located in Pike County was abandoned in July and the property was purchased by Thornberry Construction Co. Cornell No. 2 strip in Warrick County and Boehmann Strip in Spencer County were both abandoned in January. Two small underground mines were closed: R. & H. Mining Inc. mine in Pike County and Mount Pleasant Mining Co.'s mine in Vigo County.

Amax Coal Co. started development of a 2.5-million-ton-per-year strip mine west of Stevenson Station Road in Millersburg, Warrick County with production scheduled for late 1973 on the 6,000-acre site. The mine was expected to operate 15 to 20 years, mining both the Springfield Coal (V) and the Hymera Coal (VI) seams. The company was granted permission by the Indiana Natural Resources Commission to conduct a two-State underground operation with the mine entrance in Illinois. Coal mined in Gibson County will be hauled via a tunnel under the Wabash River for use at the Public Service Indiana powerplant under construction in Gibson County.

Three large stripping machines were under construction during the year. Pea-

body Coal Co. was erecting a 105-cubic-yard dragline at the Universal mine in southern Vermillion County. Old Ben Coal Corp. was building a 100-cubic-yard dragline at its Enos Northwest Field Pit. Amax Coal Co. was erecting a 150-cubic-yard dragline at its new operation near Millersburg in Warrick County.

Estimated recoverable Indiana coal reserves published by the Indiana Coal Association were 18.456 billion tons in 1972.

According to the Indiana Coal Association, member companies reclaimed 100,139 acres of mined land in Indiana as of June 30, 1971. The area afforested was 72,614 acres with 53,642,500 trees; 5,432 acres seeded ungraded; 11,022 acres graded and seeded; and 11,071 acres in lakes. Part of the revegetated area included 5,455 acres of State Forest; 14,753 acres of recreational area; and 3,225 acres for private homes.

Coke.—Indiana continued to be the second largest coke producer in the Nation. (Pennsylvania was still the No. 1 coke producer.) Output of coke produced at six plants decreased 12 percent because of the coal strike October 1 through November 14.

During the year 11,450,000 tons of coal were carbonized to produce 7,832,000 tons of coke, a yield of 68.37 percent. About 35 percent of the coking coal came from West Virginia; 22 percent from Kentucky; 21 percent from Illinois; 15 percent from Virginia; and 7 percent from Pennsylvania. No coking coal was produced in Indiana during the year. The value of coal carbonized was \$14.67 a ton or \$168,024,000.

Nearly 96 percent of the coke production was consumed by the steel industry for making pig iron and steel. The value of 7,489,000 tons of coke used in the blast furnaces and steel producing furnaces was \$166,963,000. Coke was produced by Inland Steel Co., United States Steel Corp., and Youngstown Sheet and Tube Co. in Lake County; Citizens Gas and Coke Utility in Marion County; Bethlehem Steel Corp. in Porter County; and Indiana Gas and Chemical Corp. in Vigo County.

In addition to the coke production, 746,000 tons of coke breeze was produced and used at agglomeration plants and for other industrial uses.

Inland Steel Co. completed construction of a battery of 51 coke ovens at the Indiana Harbor Works in East Chicago. Beth-

lehem Steel Corp.'s construction of a new coke gas desulfurization and sulfur recovery facility neared completion by yearend. When the facility is completed early in 1972, it will remove about 90 percent of the sulfur from the coke gas released from the two 82-oven coke oven batteries.

Citizens Gas and Coke Utility was spending \$1.1 million to control air pollution from its 163 coke ovens.

Peat.—Peat moss sales increased 47 percent in quantity and 23 percent in value. Although peat moss was the only material produced during the year, a small quantity of humus was sold from stocks. Nine companies produced peat moss from bogs in Allen, Delaware, Fulton, Grant, Marshall, Warren and Wells Counties. Milburn Peat Co. in Warren County was the largest producer. About 95 percent of the peat moss was sold for soil improvement; the remainder as an ingredient for potting soils, mixed fertilizers, packing flowers, and earthworm culture.

Petroleum and Natural Gas.—Production of crude petroleum in Indiana during 1971 declined 11 percent from that of the preceding year. The total amount produced from 4,394 wells was 6,657,745 barrels of oil, of which secondary recovery amounted to an estimated 3,503,000 barrels. Primary production decreased 13 per-

cent and secondary production declined 9 percent during the year. Although the price increased 22 cents a barrel to \$3.42, the total value was \$22,770,000, 5 percent below that in the preceding year.

The number of wells drilled in connection with gas storage operations more than doubled, and wells drilled for secondary recovery operations increased 20 percent; nevertheless, total drilling activity was less in 1971 than in 1970. Of the 382 wells drilled, 117 were exploratory, 83 for primary development, 119 for secondary recovery operations, and 63 in connection with gas storage operations. The total number of wells drilled decreased 8 percent and the total footage was 21 percent less than in 1970. The success ratio of exploratory drilling was 14.5 percent, with 14 oil wells—four in Knox County, three in Gibson County, two each in Daviess and Spencer Counties, and one each in Greene, Pike, and Posey Counties; three gas wells—one each in Gibson, Greene, and Lawrence Counties; and 100 dry holes. Four new oilfields, six new oil pools, one new gas pool, and three oil pool extensions were completed in Mississippian rocks; one new gas pool and one oil pool extension produced from Pennsylvanian strata; and one new gasfield produced from Devonian rocks.

Table 12.—Crude petroleum production in 1971, by major field

Name of field	Year discovered	Area, acres	Location, county	Number of wells		Production (barrels)
				Pro- ducing	Com- pleted	
Black River Consolidated.....	1950	700	Posey.....	NA	1	114, 834
Caborn Consolidated.....	1940	1, 870	...do.....	NA	0	114, 438
Coe, South.....	1961	440	Pike.....	NA	0	139, 151
Griffin Consolidated.....	1938	7, 470	Gibson, Posey.....	NA	7	1, 316, 595
Heusler Consolidated.....	1938	2, 220	Posey, Vanderburgh.....	NA	0	272, 788
Mt. Carmel Consolidated.....	1941	2, 160	Gibson, Knox.....	NA	8	133, 424
Mt. Vernon Consolidated.....	1941	2, 360	Posey.....	NA	1	236, 596
Plummer.....	1969	920	Greene.....	46	2	463, 819
Springfield Consolidated.....	1946	2, 640	Posey.....	NA	0	402, 296
Union-Bowman Consolidated (New).....	1941	15, 660	Gibson, Knox, Pike.....	NA	11	424, 247
Welborn Consolidated.....	1941	1, 830	Posey.....	NA	1	180, 320
Wheatonville Consolidated.....	1949	1, 700	Gibson.....	NA	6	171, 930
Undistributed.....	XX	XX	.....	---	56	2, 687, 307
Total.....	XX	XX		14, 394	293	6, 657, 745

NA Not available. XX Not applicable.

¹ Information provided by Division of Oil and Gas, Indiana Department of Natural Resources.

² Includes workovers without newly drilled footage.

Source: Petroleum Section, Indiana Geological Survey.

Table 13.—Oil and gas wells drilled in 1971 ¹

County	Proved field wells			Exploratory wells			Total	Footage
	Oil	Gas	Dry	Oil	Gas	Dry		
Clay	1	--	--	--	--	--	1	1,439
Daviess	2	1	--	2	--	23	28	26,782
Delaware	--	--	1	--	--	--	1	300
Dubois	--	--	--	--	--	2	2	1,595
Fulton	--	--	--	--	--	1	1	1,217
Gibson	21	--	10	3	1	12	47	64,467
Greene	4	--	--	1	1	8	14	11,947
Huntington	1	--	--	--	--	1	2	2,044
Jasper	2	--	--	--	--	1	1	1,203
Jay	7	--	--	--	--	--	2	2,214
Knox	--	--	4	4	--	--	9	24,37,992
Lawrence	--	--	--	--	1	--	1	120
Miami	--	--	--	--	--	1	1	1,004
Perry	--	--	--	--	--	1	1	662
Pike	6	--	2	1	--	5	14	15,074
Posey	11	--	10	1	--	10	32	61,079
Pulaski	--	--	--	--	--	1	1	2,900
Spencer	11	--	8	2	--	12	33	28,256
Steuben	--	--	--	--	--	4	4	16,931
Sullivan	2	--	3	--	--	4	9	10,290
Vanderburgh	7	--	--	--	--	1	8	11,094
Vermillion	--	--	--	--	--	1	1	1,467
Vigo	--	--	--	--	--	1	1	901
Wabash	3	--	--	--	--	2	5	4,939
Warrick	--	1	--	--	--	--	1	--
Total	² 78	²	³ 438	14	³	³ 100	³ 235	305,917

¹ Does not include service wells (water input, salt water disposal, water supply, or gas input wells). Also does not include wells drilled in connection with gas storage operations.

² Includes oil wells completed in secondary recovery projects.

³ Includes workovers without newly drilled footage.

⁴ Includes dry holes completed in secondary recovery projects.

Recent successful development of the Plummer Field, discovered in 1969, in Greene County encouraged additional exploration in that area of the State. In Daviess, Greene, and Knox Counties 48 exploratory wells were drilled resulting in four new fields, one new pool, and three extensions to existing pools. In these and nearby counties much of the exploratory effort was by shallow-test investigations aimed at locating Silurian reefs and oil entrapped in the overlying structures.

Results of primary development drilling were as follows: 44 oil wells; two gas wells; nine holes for saltwater disposals; and 28 dry holes. Drilling for secondary recovery resulted in 34 oil producers, 75 input, water supply, and salt water disposals well, and 10 dry holes.

Reported natural gas production increased 126 percent to 537 million cubic feet, valued at \$132,000.

Proved oil reserves at the end of 1971 amounted to 30,855,000 barrels, and the total liquid hydrocarbon reserve was 30,882,000 barrels.²

Nine petroleum refineries operated during the year with a total crude oil distillation capacity of 555,500 barrels³ per calendar day. In the spring of 1971, the Witco

Chemical Corp., Pioneer Products Division, shutdown its 8,000 barrel-per-day refinery. The capacities of the eight remaining refineries are given in barrels per calendar day as follows: American Oil Co., 264,000; Atlantic Richfield Co., 140,000; Cities Service Oil Co., 56,000; Mobil Oil Corp., 47,000 all in Lake County; Rock Island Refining Corp., 27,000 in Marion County; Indiana Farm Bureau Coop. Association, Inc., 12,500 in Posey County; Laketon Asphalt Refining, Inc., 6,000 in Wabash County; and Gladioux Refinery, Inc., 3,000 in Allen County.

American Oil Co. had a 40,000-barrel-per-day catalytic reforming facility under construction at the Whiting refinery during the year.

METALS

Aluminum.—The Aluminum Co. of America (Alcoa) produced aluminum in-

² American Gas Association, American Petroleum Institute, and Canadian Petroleum Association. Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas in the United States and Canada and United States Productive Capacity as of December 31, 1971. V. 26, May 1972, pp. 22 & 23.

³ U.S. Bureau of Mines, Petroleum Refineries in the United States and Puerto Rico. Mineral Industry Surveys, Jan. 1, 1972, 15 pp.

gots at the Warrick smelter in Evansville using alumina barged from Mobile, Ala., and Point Comfort, Tex. Production increased 12 percent in quantity and 14 percent in value despite curtailment of three potlines during the nationwide coal strike which ended November 14. Installation of the fifth and sixth potlines was completed in 1971, increasing the annual primary smelting capacity to 275,000 tons which equals the aluminum industry's largest domestic smelter. Alcoa's aluminum can recycling project at the Warrick operation continued to receive shipments from distant areas including cities in California and Texas. Construction was completed on the world's fastest multistand cold-rolling mill for light-gauge aluminum sheet production which is used mostly by the packaging industry.

Pig Iron and Steel.—Pig iron production from Indiana's 25 blast furnaces was 12,695,000 tons in 1971, a decrease of 5 percent. Although shipments of pig iron decreased 4 percent, the value rose to \$895.7 million, an increase of 2 percent above the 1970 value, reflecting an average price increase of \$4.51 a ton. Inland Steel Co., United States Steel Corp., and Youngstown Sheet and Tube Co. produced pig iron and steel in Lake County; and Bethlehem Steel Corp. produced iron and steel in Porter County.

Steel production in Indiana reported by the American Iron and Steel Institute was 17,307,000 tons; 7 percent less than the 1970 production. All four companies produced steel using basic oxygen furnaces (BOF) and all but Bethlehem Steel Corp. operated open-hearth furnaces. Steel was also produced from scrap in electric arc furnaces by Inland Steel Co.; Borg-Warner Corp. in Henry County; Continental Steel Corp. in Howard County; and Joslyne Manufacturing Supply Co. in Allen County.

Bethlehem Steel Corp. was erecting the largest blast furnace in the Western Hemisphere at its Burns Harbor plant. The new unit, with a daily capacity of more than 5,000 tons of pig iron, was scheduled for

full production by early 1972. The initial blast furnace, which went into production in December 1969, is now rated as the hemisphere's largest. The two units combined will produce in excess of 10,000 tons of pig iron a day and increase the annual capacity of the Burns Harbor operation from 2.0 to 4.3 million tons. The company has invested \$52 million in air and water pollution control equipment, and work in progress will increase the total expenditure to \$59 million by the end of 1972.

United States Steel Corp. curtailed operation of its Gary steel mills on August 1 because orders for steel lagged far behind stocks on hand. By yearend only half of the work force had been called back to operate some processing units.

United States Steel Corp. was constructing a second basic oxygen process (BOP) reducer with three vessels capable of turning out 70 heats a day with a capacity of about 220 tons a heat. Successful research by United States Steel Corp. improved the Q-BOP process, invented by Maxhütte of West Germany, and the existing BOP furnaces in Gary will be converted to 200-ton Q-BOP furnaces with the expected startup time late in 1972 as originally scheduled. This will be the first Q-BOP shop in the United States. The Q-BOP can produce a heat of quality steel in less time with higher yields and increased scrap-melting capability of as much as 20 percent as compared with BOP. Also under construction was the No. 13 blast furnace, scheduled for completion in 1972.

Inland Steel Co. started construction of a second BOF shop with the demolition of 11 open-hearth furnaces, which are 55 years old. When the BOF comes onstream in 1973, another 13 open-hearth furnaces are scheduled to be retired for lack of air pollution control equipment.

Other Metals.—Antimonial lead, bismuth, gold, lead, silver, and tellurium were recovered by United States Smelting Lead Refinery, Inc., subsidiary of United States Smelting, Refining, and Mining Co. at its electrolytic refinery in Lake County.

Table 14.—Principal producers 1

Commodity and company	Address	Type of activity	County
Abrasive stone: Hindostar Whetstone Co	Box 501, Bedford, Ind. 47421	Quarry; stationary plant	Orange
Cement:			
Lehigh Portland Cement Co.	Young Bldg., 718 Hamilton St. Allentown, Pa. 18105	Portland, dry process	Lawrence.
Lone Star Cement Corp.	2511 East 46th St., Suite K Indianapolis, Ind. 46205	Portland and masonry, wet process	Putnam.
Louisville Cement Co.	501 South 2nd St. Louisville, Ky. 40202	Portland and masonry, wet and dry process	Cass, Clark. Lake.
Universal Atlas Cement Div., United States Steel Corp.	600 Grant St. U.S. Steel Bldg. Pittsburgh, Pa. 15230	Portland and masonry, dry process	
Clays and shale:			
Adams Clay Products Co.	Box 32 Martinsville, Ind. 46151	Pits and plant	Morgan.
American Brick Co.	6558 West Fullerton Ave. Chicago, Ill. 60635	Pit and plant	Lake.
Arketex Ceramic Corp	Box 347, Brazil, Ind. 47834	Pit and plants	Vermillion.
Bloomfield Shale, Inc.	P.O. Box 272 Bloomfield, Ind. 47424	Pit and plant	Greene.
Bloomington Limestone Corp.	P.O. Box 849 Bloomington, Ind. 47401	Pit	Lawrence.
Colonial Brick Corp.	Box 365, Cayuga, Ind. 47928	Pits and plants	Vermillion.
Cornet Coal and Clay Co.	P.O. Box 11 Linton, Ind. 47441	Pit	Greene.
General Shale Co.	P.O. Box 96 Mooreville, Ind. 46158	Pit and plant	Morgan.
Huntingburg Brick Co.	710 Main St. Huntingburg, Ind. 47542	do	Dubois.
Hydraulic-Press Brick Co.	705 Olive St. St. Louis, Mo. 63101	do	Morgan.
Indiana Drain Tile, Inc.	Brooklyn, Ind. 46111	do	Do.
Inman Tile Co.	R. R. 4 Hartford City, Ind. 47848	do	Blackford.
Jackson Brick & Hollow Ware Co.	701 North Ewing St. Brownstown, Ind. 47920	do	Jackson.
The Krick-Tyndall Co., Sub. Hancock Brick & Tile Co.	Box 450, Findlay, Ohio 45840	do	Adams.
Lehigh Portland Cement Co.	Young Bldg., 718 Hamilton St. Allentown, Pa. 18106	Pit	Jackson.
Log Cabin Coal Co.	804 South Decatur St. Brazil, Ind. 47834	Pits	Clay.
Logan Clay Products Co.	501 South 2d St. Louisville, Ky. 40202	Pit and plant	Clay, Montgomery. Cass, Clark.
Louisville Cement Co.	Huntington, Ind. 46750	Pits	Huntington.
Majenica Tile Co.	Madison, Ind. 47260	do	Jackson.
Medora Brick Co.	Pierre LaCledre Center 7701 Forsyth Blvd. St. Louis, Mo. 63105	Pit	Marion.
Mineral Resources, Inc.	Box 337, Carbon, Ind. 47887	Pit	Parke.

See footnote at end of table.

Table 14.—Principal producers 1—Continued

Commodity and company	Address	Type of activity	County
Coal (bituminous):			
Ayrshire Coal Co., Div. of American Metal Climax, Inc.	430 Big Four Bldg. Indianapolis, Ind. 46225	Strip mine; cleaning plant.	Clay.
Chinook	-----	Strip mine	Pike.
Ayrcoe	-----	Strip mine; cleaning plant.	Sullivan.
Minnehaha	-----	Underground mine; cleaning plant.	Do.
Thunderbird	-----	Strip mine	Warrick.
Wright	-----	-----	Pike.
Chapman Coal Co.	-----	-----	-----
Cornell Excavating, Inc.	P. O. Box 55 Petersburg, Ind. 47567	-----	Warrick.
Enos Coal Corp., Old Ben Coal Corp.:	Route 4 Boonville, Ind. 47601	-----	-----
Enos	10 South Riverside Plaza Chicago, Ill. 60606	-----	-----
Blackfoot No. 5	-----	Strip mine; cleaning plant.	Pike.
J. R. Coal Corp.	Route 1, Chandler, Ind. 47610	-----	Do.
Kings Station Coal Corp.	10 South Riverside Plaza Chicago, Ill. 60606	Underground mine; cleaning plant.	Warrick.
Lemmons & Co., Inc.	635 South Second St. Boonville, Ind. 47601	Strip mine	Gibson.
Mount Pleasant Mining	Route 25, Box 19 Boonville, Ind. 47601	-----	Warrick.
Mulzer Crushed Stone Co.	Terre Haute, Ind. 48701	Underground mine; cleaning plant.	Vigo.
Parke Coal Co.	Box 248 Tell City, Ind. 47586	Strip mine	Spencer.
Peabody Coal Co.:	Box 236 Petersburg, Ind. 47567	-----	Pike.
Hawthorn.	301 North Memorial Dr. St. Louis, Mo. 63102	-----	-----
Latta	-----	Strip mine; cleaning plant.	Greene.
Universal	-----	Strip mine; coal cleaned at Miller plant.	Do.
Miller Preparation Plant	-----	Cleaning plant.	Vermillion.
Dugger	-----	Strip mine	Greene.
Lynnville	-----	Strip mine; coal cleaned at Miller plant.	Sullivan.
R & H Mining, Inc.	Route 1, Jasper, Ind. 47546	Strip mine; cleaning plant.	Warrick.
Squaw Creek Coal Co.	Box 111, Boonville, Ind. 47601	Underground mine	Pike.
Thornberry Construction Co., Inc.	Box 467, Madison, Ky. 42481	Strip mine; cleaning plant.	Warrick.
Coke:	-----	Strip mine	Pike.
Citizens Gas & Coke Utility	2020 North Meridian Indianapolis, Ind. 46209	Coke ovens	Marion.
Indiana Gas & Chemical Corp.	1841 Human St. Terre Haute, Ind. 47802	-----	Vigo.
Inland Steel Co.	3210 Wading St. East Chicago, Ind. 46312	-----	Lake.
United States Steel Corp.	Gary, Ind. 46400	-----	Do.
The Youngstown Sheet & Tube Co.	Box 900 Youngstown, Ohio 44501	-----	Do.

See footnote at end of table.

Table 14.—Principal producers 1.—Continued

Commodity and company	Address	Type of activity	County
Gypsum:			
National Gypsum Co.	825 Delaware Ave. Buffalo, N. Y. 14202	Underground mine; calcining plant.	Martin.
United States Gypsum Co.	101 South Wacker Dr. Chicago, Ill. 60606	Underground mine; 2 calcining plants.	Lake, Martin.
Iron and steel:			
Bethlehem Steel Corp., Burns Harbor Plant.	701 East 3rd St. Bethlehem, Pa. 18016	Iron blast furnace and basic oxygen steel furnace.	Porter.
Inland Steel Co.	8210 Watling St. East Chicago, Ind. 46312	Iron blast furnaces and open-hearth steel furnaces.	Lake.
United States Steel Corp., Gary Steel Works	Gary, Ind. 46740	do.	Do.
The Youngstown Sheet & Tube Co.	Box 900, Youngstown, Ohio 44501	do.	Do.
Lime: Marblehead Lime Co.	300 West Washington St. Chicago, Ill. 60606	Quicklime, 3 rotary kilns.	Do.
Peat:			
Glacier Peat Moss Corp.	Route 1 Jonesboro, Ind. 46938	Bog; processing plant.	Grant.
Herb Felger Peat Moss Co.	9912 Valentine Rd. Huntertown, Ind. 46748	do.	Allen.
Millburn Peat Co., Inc.	Box 297 Otterbein, Ind. 47970	do.	Warren.
Plant Organic Products Co.	Route 1 Gaston, Ind. 47372	do.	Delaware.
Expanded perlite:			
Airlite Processing Corp.	P. O. Scottsburg Vienna, Ind. 47170	Processing plant.	Scott.
Chemrock Corp.	End of Ohio St. Nashville, Tenn. 37208	do.	Tippecanoe.
Federal Cement Products, Inc.	24 Marble St. Hammond, Ind. 46320	do.	Lake.
National Gypsum Co.	825 Delaware Ave. Buffalo, N. Y. 14202	do.	Martin.
United States Gypsum Co.	01 South Wacker Dr. Chicago, Ill. 60606	do.	Lake, Martin.
Petroleum refineries:			
American Oil Co.	2400 New York Ave., Box 710 Whiting, Ind. 46394	do.	Lake.
Atlantic Richfield Co.	3500 Indianapolis Blvd. East Chicago, Ind. 46312	do.	Do.
Cities Service Oil Co.	5900 Cline Ave., B. 718 East Chicago, Ind. 46312	do.	Do.
Mobil Oil Corp.	3521 Indianapolis Blvd. East Chicago, Ind. 46312	do.	Do.
Rock Island Refining Corp.	P. O. Box 6800 Indianapolis, Ind. 46288	do.	Marion.
Roofing granules: H. B. Reed & Co., Inc.	6957 Kennedy Ave. Hammond, Ind. 46323	2 plants; produced from slag.	Lake.
Sand and gravel:			
Aggregate Service McMahan Constr. Co.	Box 378, Rochester, Ind. 47975	Pits; portable and stationary plants.	Marshall.
American Aggregates Corp.	Garst Ave. at Ave. B Greenville, Ohio 46881	Pits; stationary plants.	Hamilton, Marion, Wayne.

See footnote at end of table.

Table 14.—Principal producers 1.—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
Paul C. Brudi Stone & Gravel Co., Inc.	Box 2937, Fort Wayne, Ind. 46808	Pits; stationary plants.	Allen.
Concrete Materials Div., Martin Marietta Corp.	4096 First Ave., N.E., Cedar Rapids, Iowa 52406	Pits; portable and stationary plants.	Hamilton, Marion, Shelby, Vermillion, Vigo.
Connersville Gravel Co., Inc.	P. O. Box 426, Connersville, Ind. 47331	Pit; stationary plant.	Fayette.
Driftwood Gravel, Inc., Jefferson Corp.	Box 9, Columbus, Ind. 47201	do.	Johnson.
Fidler Sand & Gravel, Inc.	1700 Egbert Ave., Goshen, Ind. 46526	Pit; dredge; stationary plant.	Elkhart.
Hilltop Concrete Corp.	Box 11056, Cincinnati, Ohio 45211	Pit; stationary plant.	Switzerland.
Indiana Glass Sand Co.	Box 17, New Albany, Ind. 47150	Pit.	Harrison.
Interstate Sand & Gravel Co., Inc.	Box 38, Covington, Ind. 47932	Pit; stationary plant.	Warren.
Irving Bros. Gravel Co., Inc.	Box 83, Canton, Ind. 46932	do.	Grant.
Irving Materials, Inc., No. 2	Box 369, Greensfield, Ind. 46140	Pits; portable and stationary plants.	Hamilton, Henry.
Knox County Sand Co., Ralph Rogers & Co., Inc.	Box 389, Vincennes, Ind. 47591	Pit; stationary plant.	Knox.
May Stone & Sand, Inc.	Box 2997, Fort Wayne, Ind. 46809	Pits; stationary plants.	Allen.
Mid State Aggregate, Inc.	Box 27, Lafayette, Ind. 47902	do.	Boone, Tippecanoe.
Midwest Aggregates, Inc.	2018 S. South Anthonion, Fort Wayne, Ind. 46808	Pits; stationary plants; portable plant.	Allen, De Kalb, Whitley.
Myers Sand & Gravel Corp.	Box 212, Ellettsburg, Ind. 46015	Pit; stationary plant.	Madison.
Neal Gravel Co., Inc., Interstate Sand & Gravel Co., Inc.	Box 38, Covington, Ind. 47932	do.	Fountain.
Rieth-Riley Construction Co., Inc.	Box 566, Sturgis, Mich. 49091	Pits; portable plants.	De Kalb, Elkhart, St. Joseph.
S & G Excavating, Inc.	Route 21, Box 698, Terre Haute, Ind. 47801	Pit; stationary plant.	Vigo.
South Bend Sand & Gravel Corp.	3113 Lincoln Way, West South Bend, Ind. 46628	Pits; stationary plant.	St. Joseph.
Spray Sand & Gravel, Inc.	Route 4, Seymour, Ind. 47274	Pits; dredges; stationary plants.	Jackson.
Stonestreet Gravel Co., Inc.	R. F. N. 1, Angola, Ind. 46703	Pits; stationary plants.	Allen, Steuben.
Western Indiana Aggregates, Inc., Medusa Portland Cement Co.	500 North 6th Street, Lafayette, Ind. 47901		
Anderson Gravel Division			
Eagle Materials, Inc.		Pits; stationary plant.	Madison.
Hanna Sand & Gravel Co., Inc.		Dredge, stationary plant.	Laake.
Lafayette No. 1 Gravel Division		do.	La Porte.
Lafayette Portable Gravel Division		Pit; stationary plant.	Tippecanoe.
Leesburg Gravel Division		Pit; portable plant.	Do.
Montezuma Gravel Division		Pit; stationary plant.	Kosciusko.
South Bend Gravel Division		do.	Parke.
Nonferrous smelters and refineries:		do.	St. Joseph.
Aluminum Company of America	Newburgh, Ind. 47630	Aluminum smelter.	Warrick.
American Smelting & Refining Co.	2230 Indianapolis Blvd., Whiting, Ind. 46394	Lead secondary plant.	Laake.
National Lead Co., American Lead Plant.	Beech Grove, Ind. 46107	do.	Marion.
United States Smelting Lead Refinery, Inc.	5800 Kennedy Ave., East Chicago, Ind. 46312	Lead primary and secondary plant.	Laake.
Stone:			
Limestone and dolomite:			
American Aggregates Corp.	Garst Ave. at Avenue B, Greenville, Ohio 45881	Quarries; stationary plants.	Hamilton, Owen.

See footnote at end of table.

Table 14.—Principal producers 1—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Limestone and dolomite—Continued			
Baker Rockledge Products, Inc.	Box 902, Portland, Ind. 47371	Quarry	Randolph, Jay.
Berry Materials Corp.	Box 450, North Vernon, Ind. 47265	do	Jennings, Ripley.
Bloomington Crushed Stone Co., Inc.	Box 849, Bloomington, Ind. 47401	Quarries; stationary plants	Lawrence, Monroe, Newton.
Ralph Rogers & Co., Inc.	Box 250, Bloomington, Ind. 47401	Quarry; stationary plant	Monroe.
Bloomington Limestone Corp.	11 North Penn St.	Quarries; stationary plants	Clark, Madison, Marion, Putnam, Sullivan.
Concrete Materials Div., Martin Marietta Corp.	Indianapolis, Ind. 46204	Quarry	Randolph, Wayne.
DeBolt Concrete Co., Inc.	Box 438, Richmond, Ind. 47874	Quarry; stationary plant	Monroe, Putnam.
Empire Stone Co.	Box 788, Bloomington, Ind. 47401	Quarry; stationary plant	Cass, Putnam.
France Stone Co.	Box 1928, Toledo, Ohio 43603	Quarry; stationary plant	Monroe.
Independent Limestone Co.	Route 5, Box 395 Bloomington, Ind. 47401	Quarries, stationary plants	Lawrence, Monroe.
Indiana Limestone Co., Inc.	405 North 1st St. Bedford, Ind. 46421	do	Hamilton, Huntington,
Irving Bros. Gravel Co., Inc.	Route 3, Marton, Ind. 46952	do	Wells.
Erie Stone, Inc.	do	Quarry; stationary plant	Delaware.
Irving Bros. Stone & Gravel	do	do	Grant.
Pipe Creek Stone Co.	do	do	Lawrence.
Lehigh Portland Cement Co.	Young Bldg., 718 Hamilton St. Arlington, Ind. 47109	do	Putnam.
Lone Star Cement Corp.	2311 East 46th St., Suite K Indianapolis, Ind. 46208	Quarries; stationary plants	Cass, Clark.
Louisville Cement Co.	501 South Ind St. Louisville, Ky. 40202	do	Allen, Blackford, Delaware.
May Stone & Sand, Inc.	Box 2927, Fort Wayne, Ind. 46800	do	Allen.
Midwest Aggregates Corp., Old Fort Industries, Inc.	2013 S. Anthony Blvd. Fort Wayne, Ind. 46803	Quarry; stationary plant	Lawrence.
Mitchell Crushed Stone Co., Inc., Ralph Rogers & Co., Inc.	Box 849 Bloomington, Ind. 47401	do	Lawrence.
Muizer Crushed Stone Co.	Box 248, Tell City, Ind. 47586	Quarries; underground mine; stationary plants	Crawford, Perry.
Muncie Stone and Lime Co.	Box 2525, Muncie, Ind. 47302	Quarry	Delaware.
Newton County Stone Co., Inc., Ralph Rogers & Co., Inc.	Box 147, Kentland, Ind. 47951	Quarry; stationary plant	Newton.
Reed Co., Inc.	Box 64, Bloomington, Ind. 47401	do	Monroe.
Vice Quality Stone Co.	Box 668, Bloomington, Ind. 47401	do	Lawrence, Monroe.
Western Indiana Aggregates, Inc., Medusa Portland Cement Co., Franksville Stone Division.	500 North 6th St. Lafayette, Ind. 47901	do	Pulaski.
Wooley Stone Co., Inc.	Box 40, Bloomington, Ind. 47401	do	Monroe.
Marl			
Vernon M. Kaufman	Route 1, Topeka, Ind. 46571	Pit	Noble.
Miller Marl	Middlebury, Ind. 46540	Pit	LaGrange.
Willis Sprecher	do	Pit	Do.
Taylor and Son	Route 1, Orland, Ind. 46776	Pit	Steuben.
Sandstone			
High Bluff Quarry	Route 3, Box 267 Mooreville, Ind. 46158	Quarry; finishing plant	Morgan.
Indiana Sandstone Co., Inc.	Box 501, Bedford, Ind. 47421	do	Lawrence.
Springs Valley Sandstone Co.	Route 1 West Baden Springs, Ind. 47469	do	Lawrence, Martin.
Sulfur (recovered): American Oil Co.	910 South Michigan Ave. Chicago, Ill. 60680	Mathieson-Fluor Process	Lake.

¹ Data regarding producers of natural gas and petroleum not available.

The Mineral Industry of Iowa

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

By Brinton C. Brown ¹

Mineral production value in Iowa reached another alltime high of \$127.8 million in 1971, surpassing the record set in 1970 by \$6.9 million. Although output of most mineral commodities remained about the same as in 1970, with the exception of decreases in sand and gravel and clays, substantial price increases for virtually every commodity boosted the combined mineral output value by nearly 6 percent.

Nonmetallic minerals dominated the State's total mineral production with 96 percent of the value; mineral fuels comprised the remainder. Iowa's mineral pro-

duction value was divided as follows: Cement, 39 percent; stone, 35 percent; sand and gravel, 16 percent; coal, 4 percent; gypsum, 4 percent; clays, 1 percent; lime, peat, and fire clay, 1 percent. Bituminous coal was the primary mineral fuel produced. No petroleum has been produced since 1963; however, one exploration well was drilled in Monroe County. The dry hole was 1,567 feet deep. During the year 74 drilling permits were issued: Four for oil tests, 10 for gas storage wells, and 60 for stratigraphic tests.

¹ Mining engineer, Division of Nonmetallic Minerals.

Table 1.—Mineral production in Iowa ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland.....thousand 376-pound barrels..	12,744	\$45,432	12,726	\$47,925
Masonry.....thousand 280-pound barrels..	520	1,758	473	1,719
Clays.....thousand short tons..	1,181	1,823	² 1,028	1,702
Coal (bituminous).....do.....	987	4,059	989	4,609
Gypsum.....do.....	1,136	4,223	1,154	4,460
Sand and gravel.....do.....	21,058	20,642	18,279	20,530
Stone.....do.....	25,305	41,119	³ 25,389	44,977
Value of items that cannot be disclosed: Gem stones, lime, and peat.....	XX	1,766	XX	1,899
Total.....	XX	120,822	XX	127,821
Total 1967 constant dollars.....	XX	108,075	XX	^p 111,051

^p Preliminary. XX Not applicable.

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

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

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

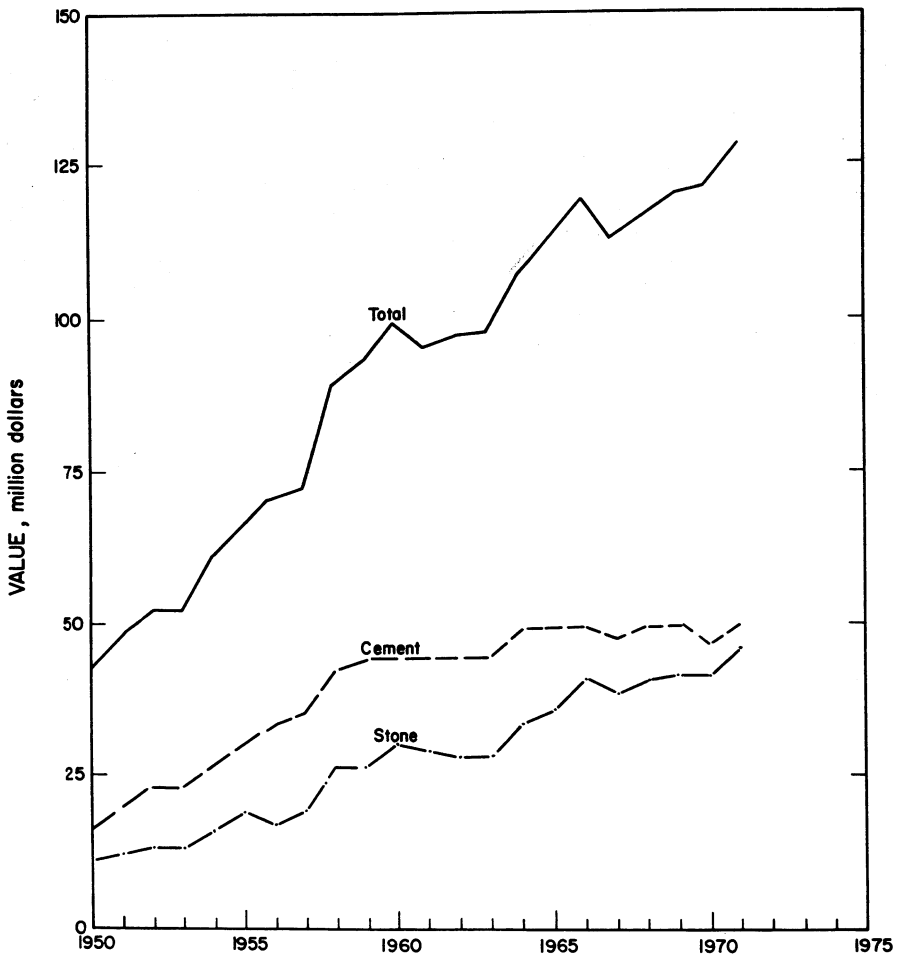


Figure 1.—Value of cement, stone, and total value of mineral production in Iowa.

Table 2.—Value of mineral production in Iowa, by county 1
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Adair	W	W	Stone.
Adams	W	W	Do.
Allamakee	W	W	Stone, sand and gravel.
Appanoose	W	W	Stone, clays.
Audubon	\$200	W	Sand and gravel.
Benton	W	\$165	Sand and gravel, stone.
Black Hawk	W	W	Stone, sand and gravel.
Boone	W	W	Sand and gravel, clays.
Bremer	279	314	Stone, sand and gravel.
Buchanan	W	W	Do.
Buena Vista	102	33	Sand and gravel.
Butler	W	W	Stone, sand and gravel.
Calhoun	W	54	Sand and gravel.
Carroll	301	223	Do.
Cass	W	W	Stone.
Cedar	W	W	Do.
Cerro Gordo	28,334	23,734	Cement, stone, sand and gravel, clays, lime.
Cherokee	497	W	Sand and gravel.
Chickasaw	W	W	Stone, sand and gravel.
Clarke	W	W	Stone.
Clay	232	W	Sand and gravel.
Clayton	951	657	Sand and gravel, stone.
Clinton	W	W	Stone, sand and gravel.
Crawford	W	W	Sand and gravel.
Dallas	562	346	Sand and gravel, clays, stone.
Decatur	W	W	Stone.
Delaware	W	206	Stone, sand and gravel.
Des Moines	1,722	2,424	Stone, gypsum, sand and gravel.
Dickinson	354	276	Sand and gravel.
Dubuque	859	W	Stone, sand and gravel.
Emmet	208	147	Sand and gravel.
Fayette	988	915	Stone, sand and gravel.
Floyd	344	501	Stone, sand and gravel, clays.
Franklin	W	228	Sand and gravel, clays, stone.
Fremont	W	W	Stone, sand and gravel.
Greene	326	W	Sand and gravel.
Grundy	W	W	Stone, sand and gravel.
Guthrie	172	113	Sand and gravel.
Hamilton	W	W	Stone, sand and gravel.
Hancock	W	W	Sand and gravel, stone.
Hardin	W	W	Stone, sand and gravel.
Harrison	915	714	Do.
Henry	W	139	Sand and gravel, stone.
Howard	180	W	Stone, sand and gravel.
Humboldt	W	1,367	Do.
Ida	W	W	Sand and gravel.
Iowa	W	W	Do.
Jackson	W	W	Stone, sand and gravel.
Jasper	W	W	Sand and gravel, stone.
Jefferson	W	166	Stone, sand and gravel.
Johnson	1,550	W	Do.
Jones	662	W	Do.
Keokuk	W	W	Stone, clays.
Kossuth	296	129	Sand and gravel.
Lee	375	543	Stone, sand and gravel.
Linn	3,253	W	Do.
Louisa	W	W	Stone.
Lucas	686	932	Coal.
Lyon	315	156	Sand and gravel.
Madison	W	W	Stone, clays.
Mahaska	1,782	2,416	Coal, stone, sand and gravel, clays.
Marion	W	1,543	Coal, stone, sand and gravel.
Marshall	W	W	Stone, sand and gravel.
Mills	W	W	Do.
Mitchell	W	659	Do.
Monona	187	413	Sand and gravel.
Monroe	1,094	W	Coal.
Montgomery	W	W	Stone, sand and gravel.
Muscatine	W	W	Do.
O'Brien	W	W	Sand and gravel.
Osceola	101	W	Do.
Page	381	241	Do.
Palo Alto	W	W	Stone, sand and gravel.
Plymouth	250	431	Sand and gravel.
Pocahontas	571	499	Do.
Polk	W	W	Stone, sand and gravel.
Pottawattamie	16,053	17,001	Cement, sand and gravel, clays.
Poweshiek	W	W	Stone, sand and gravel.
Sac	W	W	Stone.
Scott	691	435	Sand and gravel.
	14,557	14,919	Cement, stone, lime, clays, sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Iowa, by county ¹—Continued
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Shelby	W	W	Sand and gravel.
Sioux	\$885	\$762	Do.
Story	1,107	1,125	Sand and gravel, stone, clays.
Tama	W	W	Sand and gravel.
Taylor	W	W	Stone.
Union	W	W	Do.
Van Buren	808	831	Stone, coal, sand and gravel.
Wapello	W	477	Sand and gravel, coal, stone, clays.
Warren	W	W	Sand and gravel, clays.
Washington	W	W	Stone.
Wayne	W	W	
Webster	4,670	4,909	Gypsum, stone, sand and gravel, clays.
Winnebago	W	W	Peat, sand and gravel.
Winneshiek	W	W	Stone, sand and gravel.
Woodbury	370	W	Sand and gravel, clays.
Worth	765	824	Stone, sand and gravel, peat.
Wright	271	W	Sand and gravel.
Undistributed ²	31,561	40,347	
Total	120,822	³ 127,821	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
¹ Davis and Ringgold Counties are not listed because no production was reported.

² Includes gem stones, some sand and gravel, and stone that cannot be assigned to specific counties, and values indicated by symbol W.

³ Data does not add to total shown because of independent rounding.

Table 3.—Indicators of Iowa business activity

	1970 ^r	1971 ^p	Change, percent	
Employment and labor force, annual average:				
Total labor force	thousands	1,245.8	1,257.5	+0.9
Unemployment	do	44.1	51.1	+15.9
Employment:				
Manufacturing	do	215.5	206.6	-4.1
Construction	do	40.6	38.7	-4.7
Mining	do	3.0	2.9	-3.3
Transportation and public utilities	do	51.1	51.5	+0.8
Finance, insurance, and real estate	do	41.0	41.6	+1.5
Wholesale and retail trade	do	209.2	212.0	+1.3
Services	do	146.7	151.8	+3.5
Government	do	175.7	178.3	+1.5
Personal income:				
Total	millions	\$10,418	\$11,053	+6.1
Per capita	do	\$3,681	\$3,876	+5.3
Construction activity:				
Valuation of nonresidential construction	millions	\$105.2	\$134.6	+27.9
New housing units authorized	do	11,074	13,165	+18.9
State highway commission contracts awarded	millions	\$126.3	\$155.4	+23.0
Portland cement shipments to and within Iowa	thousand 376-pound barrels	8,488	8,593	+1.2
Mineral production value	millions	\$120.8	\$127.8	+5.8

^p Preliminary. ^r Revised.

Sources: Survey of Current Business, Construction Review, Iowa State Highway Commission, Farm Income Situation, Employment and Earnings Annual Report on the Labor Force, and Bureau of Mines.

The Federal Power Commission allowed Northern Natural Gas Co. to abandon the Vincent underground natural gas storage field and related facilities in Humboldt, Webster, and Wright Counties, and to terminate testing at the facility. The company said the Jordan, lower Franconia and Mt. Simon-Eau Clair Formations could not be developed as storage facilities.

Duane Arnold Energy Center, Iowa's first nuclear powerplant, was under construction in Linn County. This \$168 million

project of Iowa Electric Light and Power Co. (along with smaller participation by Corn Belt Co-operative and Central Iowa Power Co-operative) scheduled operation of the first 550-megawatt unit for December 1973.

Although Iowa's coal mines were not shut down by the nationwide coal miners' strike in 1971, some purchasers of out-of-State coal, including the University of Iowa, faced a fuel shortage.

Legislation and Government Programs.

—Public concern for ecology and emphasis on preservation of the environment continued to have an effect on the mineral industry. During the year the 92d Congress conducted hearings on some 23 bills involving strip mining controls.

In August the Iowa Natural Resources Council and the Iowa Water Pollution Commission approved construction of a \$9 million heat-diffuser pipe in the Mississippi River by the Quad-Cities Nuclear Power Plant. However, the Iowa Conservation Commission was unwilling to grant a permit to install the cooling-water system in September on the grounds that warmed condensing water from the plant might adversely affect the river's ecology. Some 1,467 million gallons of water a day would be drawn from the river for cooling purposes and returned heated by 23° F through ducts in two large diffuser pipes buried under the riverbed. This would cause the temperature of the Mississippi to rise about 5° F, but the heat would dissipate to about 1° F warmer than normal some 30 miles downstream. The Quad-Cities 1,618-megawatt powerplant at Cordova, Ill., about 20 miles upstream from Davenport, has been under construction since 1966 by Commonwealth Edison Co. and Iowa-Illinois Gas & Electric Co. Unit No. 1 was ready for operation in October, and Unit No. 2 in December. Each unit would displace about 250,000 tons of coal in a single month and release no combustion byproducts into the atmosphere. Because of the delay in obtaining the cooling system permit, the \$200 million plant was idle at yearend while a committee of the Iowa Water Pollution Control Commission was working on a compromise plan.

In 1971 the 64th General Assembly of Iowa passed House File 522, an act relating to the regulation of the manufacture, sale, transportation, storage, possession, and use of explosive materials. The act requires a license to do any or all of the above items commercially for an annual fee of \$60. In order to use explosives, a person must also obtain a permit from the local police or sheriff. The regulations include strict requirements on the storage of explosives.

A bill passed by the Iowa Senate providing for a new Department of Environmen-

tal Quality to control air and water pollution and solid waste disposal was being debated in the Iowa House at yearend.

The Iowa Air Pollution Control Commission adopted new rules relating to odors, "fugitive dust," and sulfur emissions, and voted to extend the deadline for control of sulfur emissions by 1 year. The revised regulations specify that no more than 6 pounds of sulfur dioxide per million Btu can be emitted after January 1, 1974, and no more than 5 pounds after January 1, 1975. The Commission advocated legislation to boost the maximum fine for violating State clean-air laws from \$200 to \$1,000 a day. (California adopted a \$6,000 a day fine in 1969.)

Midwest Rock Products, Inc. received approval of the Iowa Natural Resources Council to expand its operations west of Atlantic despite protests from 20 residents. Landowners voiced strong opposition to Northern Natural Gas Co.'s proposal for natural gas storage under 32,000 acres of land in Dallas County. Landowners fear that the gas storage would inhibit population growth, lower property values, endanger residents from possible leakage, increase insurance rates, and interfere with farm operations. They pointed to a gas explosion that destroyed a home last year at nearby Redfield.

The Iowa Geological Survey was making a feasibility study of using old stone quarries for sanitary land fills, and of the hazards of ground water pollution. During the year the Survey issued the following publications: (1) List of Publications of the Iowa Geological Survey; (2) Water Resources of Southeast Iowa, Water Atlas No. 4; (3) Geology and Ground-Water Resources of Cerro Gordo County, Iowa, Water Supply Bulletin No. 9; (4) Geology and Ground-Water Resources of Linn County, Iowa, Water Supply Bull. No. 10; (5) Mineral Resources Map of Iowa; (6) Stratigraphy of the Upper Devonian Shell Rock Formation of North-Central Iowa, Report of Investigations No. 10; (7) Bedrock Topographic Map of East-Central Iowa; (8) Bedrock Topographic Map of Southeast Iowa; (9) Report of Preliminary Interpretation of Aeromagnetic Survey of Southern Iowa; (10) The Maquoketa Formation (Upper Ordovician) in Iowa, Misc. Map Series No. 1; (11) Optimal Well

Plugging Procedures, Public Information Circular (PIC) No. 1; and (12) Résumé of Oil Exploration and Potential in Iowa, PIC No. 2.

In June 1971 the Environmental Protection Agency made a solid waste research grant to the Metallurgy Division of the Atomic Energy Commission's Ames Laboratory to conduct investigations on the re-

moval of copper, tin, and chromium from automotive scrap.

Employment and Injuries.—In the mineral industries 4,860 men worked 9,630,000 man-hours, compared with 4,231 men and 9,283,000 man-hours in 1970. There were 223 lost-time injuries in the mineral industries, including five fatalities, compared with 196 injuries and one fatality in 1970.

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

Year and industry	Average men working daily	Days active	Man-days worked (thou-sands)	Man-hours worked (thou-sands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Fre-quency	Severity
1970:								
Coal and peat.....	169	261	44	378	--	10	26.42	716
Nonmetal.....	504	263	132	1,067	--	43	40.31	680
Sand and gravel.....	1,092	197	215	1,998	--	44	22.02	1,269
Stone.....	2,466	272	672	5,840	1	99	17.12	1,597
Total.....	4,231	251	1,063	9,283	1	196	21.22	1,385
1971: ^p								
Coal.....	170	251	42	366	1	11	32.82	1,7223
Nonmetal ¹	470	251	119	954	--	51	53.45	728
Sand and gravel.....	1,270	195	248	2,316	1	45	19.86	2,846
Stone.....	2,950	234	692	5,995	3	111	19.02	5,682
Total ²	4,860	226	1,100	9,630	5	218	23.16	4,947

^p Preliminary.

¹ Beginning in 1971, data concerning peat operations are included in the nonmetals industry on a continuing basis.

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

Schildberg Construction Co., Inc. quarry in Greenfield and Raid Quarries Corp's Glasgow Plant at Burlington won top safety honors in the 1971 National Limestone Institute Safety Competition in Class I division (120,001 man-hours or more) and Class IV division (10,001 to 20,000 man-hours) respectively. Iowa had 15 plants competing in the nationwide annual contest conducted by the Bureau of Mines in cooperation with the National Limestone Institute. Certificates of Achievements in Safety were made to contestants who operated throughout 1971 without a disabling work injury. The following limestone producers also received Certificates of Achievement in Safety: Class III, working 20,001 to 60,000 man-hours—Fort Dodge Limestone Co., Fort Dodge quarry; Heckman-Reynolds, Inc., Floyd quarry; Kuhlman Construction Co., Colesburg quarry; Lee Crawford Quarry Co., Cedar Rapids quarry; and Cooney Construction Co., Waukon quarry; Class IV, working 10,001 to 20,000 man-hours—C. D. Hess and Son

Rock Materials Co., Melcher quarry; Class V, working 10,000 man-hours or less—Tenchau Limestone Co., Grand Mound quarry.

Martin Marietta's Earlham quarry in Madison County was the winner of the National Crushed Stone Association Safety Contest, Group V Division (less than 30,000 man-hours), and also received the Green Bar award for 10 consecutive years without a lost-time injury. Martin Marietta's Day stripping unit and Mercer stripping crew, both portable units, were Gold Bar winners, each with 7 consecutive years injury-free. Martin Marietta's sand and gravel plants dominated the National Sand and Gravel Association's safety contest, winning in the following divisions: Class B (550,000 to 1.5 million tons), West Des Moines plant; Class C (225,000 to 549,999 tons), Cedar Rapids plant; Class D (170,000 to 224,999 tons), Waterloo plant; Class E (60,000 to 169,999 tons), Eddyville plant, Marshalltown plant, and Portable Plant No. 41; and Class F (less than 60,000 tons), Portable Plant No. 42.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Production and shipments of portland cement were about the same in quantity as in 1970; however, the value increased 5 percent. The average mill value of portland cement for all types was \$3.77 per barrel in Iowa, slightly above the \$3.52 average for the United States, and 21 cents per barrel higher than the 1970 average for the State.

Five companies operated a total of 19 kilns at three wet process and two dry process plants with a combined annual clinker producing capacity of 14.5 million barrels. Northwestern States Portland Cement Co. completed installation of an electrostatic precipitator on a clay dryer at its plant near Mason City, Cerro Gordo County. Lehigh Portland Cement Co. was installing additional air pollution control equipment at its Mason City plant. Penn-Dixie Cement Corp. started operating a new 12-foot by 36-foot finish grinding mill at its plant near Des Moines, Polk County. The company completed its air pollution abatement program at this plant in 1971. Marquette Cement Manufacturing Co. produced cement near West Des Moines in Polk County; and Dewey Portland Cement Co., Division of Martin Marietta Corp., operated a cement plant near Buffalo in Scott County.

About 96 percent of the portland cement shipped was Type I (general construction use) and Type II (moderately low heat and moderate degree of resistance to sulfate attack); the remainder was Type III (high-early-strength) and expansive cement.

Disposition of portland cement shipments was as follows: 54 percent for ready-mix concrete, 28 percent for concrete products, 4 percent to building material dealers, 13 percent for highway contractors, and 1 percent for other contractors, government agencies, and miscellaneous customers. Consumption of portland cement in Iowa was 8.6 million barrels. More than 4 million barrels of cement produced in Iowa was shipped to customers in nearby States. Despite the abundance of Iowa's cement production, some Iowa customers received cement produced in other States. About 94 percent of the cement was shipped in bulk and the remainder in

bags. About 75 percent of the cement was shipped by truck, 24 percent by rail, and 1 percent by barge.

Masonry cement shipments decreased 9 percent in quantity and 2 percent in value. The average mill value of masonry cement increased to \$3.63 per barrel, up 25 cents per barrel from the 1970 average for the State. Penn-Dixie and Lehigh did not produce masonry cement. Consumption of masonry cement in Iowa was 180,000 barrels.

Clays.—Production of clays decreased 13 percent in quantity and 7 percent in value. There was a decline in the use of clay drain tile because of competition from plastic drain tubing. Fourteen companies operated 22 opencut clay and shale mines in 15 counties. Cerro Gordo County was the largest producer, followed by Appanoose and Polk Counties, each with production exceeding 100,000 tons. Common clay, amounting to 56 percent of the total output, was produced at 10 mines in eight counties, with more than half of the output from Cerro Gordo County. Shale, accounting for 33 percent of the total production, was produced at seven mines in six counties. Undifferentiated clays and shales were mined in three counties. A small quantity of fire clay was produced in Boone County.

About 42 percent of all production was used in manufacturing portland cement, 22 percent to make building brick, 14 percent for making drain tile, 12 percent for lightweight aggregates, 10 percent for manufacturing sewer pipe, and a very small quantity for refractory mortar.

Nelson Coal Co.'s mine at What Cheer in Keokuk County was acquired by Can-Tex Industries, Brick and Tile Div. of Harsco Corp.

During the year operators stripped 23 acres for clay production and rehabilitated 19 acres of land for other use.

Gem Stones.—Small quantities of gem stones and mineral specimens were collected by rockhounds and amateur collectors.

Gypsum.—Iowa dropped from third to fourth largest producer of crude gypsum in the United States despite a slight increase in output and a 6-percent increase in value. Gypsum was mined by United

States Gypsum Co. at an underground mine near Sperry in Des Moines County, and by United States Gypsum Co., National Gypsum Co., Georgia-Pacific Corp., and Celotex Corp. at four open-cut mines near Fort Dodge in Webster County.

Calcined gypsum production and value both increased 11 percent above that of 1970. Natural gas was used at all five calcining plants, operating a total of 22 kettles, four hydrocal digestors, and six board machines. The major use for calcined gypsum was in manufacturing wallboard, lath, and sheathing for the building industry. Smaller quantities were used for basecoat plasters, mill-mixed basecoats, veneer plaster, gaging and molding plasters, and prepared finishes. Production of Type-X gypsum wallboard, a special fire retardant, was becoming increasingly more important. Calcined gypsum was also sold for industrial uses in manufacturing plate glass and terra cotta items, dental and orthopedic plasters, industrial molding, art and casting plasters, and other nonbuilding uses. Uncalcined gypsum was sold in smaller quantities for portland cement retarder and for agricultural use.

During the year 41 acres of land were stripped for gypsum removal and 34 acres of land were rehabilitated.

Lime.—Output of quicklime and hydrated lime declined 25 percent and was 28 percent below the 1969 record. The value decreased 19 percent from the 1970 figure. Linwood Stone Products Co., Inc. was the State's only producer of quicklime and hydrated lime for commercial sale at its underground limestone mine and plant near Buffalo in Scott County. American Crystal Sugar Co. made hydrated lime for use in its sugar refinery at a lime plant at Mason City, Cerro Gordo County.

About 32 percent of the lime sold was used for water purification, 22 percent for flux in steel manufacturing, 19 percent for munitions, 10 percent for soil stabilization, and 17 percent for sugar refining, sewage treatment, and miscellaneous uses.

Customers in the State consumed 41 percent of Iowa's lime sold, which included

most of the hydrated lime. Shipments of quicklime were made to other States (with the percent of total in parentheses) as follows: Illinois (26), Wisconsin (20), Minnesota (6), Nebraska (6), and Michigan (1).

Perlite.—Crude perlite, mined mostly in New Mexico, was expanded at four gypsum plants near Fort Dodge in Webster County. Expanded perlite production declined 13 percent in quantity and value declined 12 percent below that of 1970. The principal use was in the manufacture of building plaster.

Sand and Gravel.—Iowa sand and gravel production decreased 13 percent in quantity below the 1970 record and 0.5 percent in value. Sand and gravel was produced in 81 counties by 123 commercial operators, and by two city and 41 county governments at 293 locations. Sand and gravel producers reported operating 108 stationary plants, 105 portable units, and 23 dredges. About 97 percent of the sand and gravel was processed in washing or screening plants. Of the total production, nearly 55 percent was gravel.

Only three commercial operations had production in the 300,000- to 800,000-ton range each; 10 had between 200,000 and 300,000 tons each; 26 had between 100,000 and 200,000 tons each; 160 had between 25,000 and 100,000 tons each; and 75 had less than 25,000 tons. More than 56 percent of the sand and gravel was produced by operators with less than 100,000 tons annual production. Nearly 99 percent of the commercial sand and gravel was transported by truck; the remainder by rail.

About 58 percent of Iowa's sand and gravel was used for paving, 24 percent by the building industry, and 1 percent for ground and unground industrial uses such as molding, sand blasting, and filtration. The remaining 16 percent was used for fill, railroad ballast, and miscellaneous construction uses.

During the year sand and gravel operators stripped 366 acres for mining operations and rehabilitated 383 acres of old workings.

Table 5.—Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Audubon	6	157	\$200	2	W	W
Benton	3	W	W	2	108	\$149
Black Hawk	9	522	539	8	434	522
Boone	9	481	461	2	W	W
Buena Vista	6	236	102	--	44	33
Butler	9	191	191	5	W	W
Calhoun	1	W	W	4	104	54
Carroll	6	341	301	3	250	223
Cerro Gordo	10	1,009	1,131	5	508	747
Cherokee	15	597	497	3	W	W
Chickasaw	1	W	W	1	16	16
Clay	8	420	282	1	W	W
Clayton	5	157	486	2	W	W
Clinton	4	191	257	6	145	171
Dallas	8	368	323	6	451	597
Decatur	1	16	24	--	--	--
Des Moines	2	W	W	1	198	193
Dickinson	7	412	354	4	347	276
Emmet	10	331	208	6	144	147
Fayette	8	124	156	5	102	127
Franklin	7	231	235	2	W	W
Fremont	2	W	W	1	W	W
Greene	9	532	326	4	W	W
Grundy	4	81	79	--	W	W
Guthrie	6	200	172	3	118	113
Hamilton	6	W	W	1	2	3
Hancock	8	324	217	6	363	317
Hardin	10	301	246	8	218	300
Henry	1	W	W	1	78	89
Howard	4	W	W	3	19	13
Humboldt	4	W	W	2	91	60
Ida	1	W	W	1	13	W
Jefferson	3	18	40	--	9	16
Johnson	3	W	W	1	356	502
Jones	6	67	79	3	30	39
Kossuth	12	534	296	2	156	129
Lee	4	W	W	1	124	101
Linn	6	450	545	4	W	W
Lyon	12	482	315	9	180	156
Marion	5	140	153	2	W	W
Marshall	3	343	236	2	W	W
Mills	1	W	W	2	90	110
Mitchell	3	W	W	2	33	37
Monona	4	221	187	3	235	413
Montgomery	--	--	--	--	18	48
Muscatine	7	540	589	8	489	558
O'Brien	4	197	101	--	W	W
Osceola	9	423	381	3	W	241
Palo Alto	4	287	250	4	407	431
Plymouth	10	732	571	4	452	499
Polk	11	1,896	2,649	7	1,914	2,711
Sac	13	679	691	2	328	435
Sioux	7	856	885	7	694	762
Story	16	756	756	3	W	W
Tama	3	192	176	2	W	W
Webster	14	413	273	8	253	205
Winnebago	3	W	W	2	234	199
Winneshiek	2	W	W	1	65	31
Woodbury	7	437	313	1	W	W
Worth	3	W	W	5	159	99
Wright	7	373	271	4	W	W
Undistributed ¹	46	3,740	4,039	99	8,250	8,609
Total ²	423	21,058	20,642	290	18,279	20,530

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

¹ Includes Allamakee, Bremer, Buchanan, Cass (1970), Crawford, Delaware, Dubuque, Floyd, Harrison, Iowa, Jackson, Jasper, Mahaska, Page, Pocahontas, Pottawattamie, Scott, Shelby, Van Buren, Wapello, and Warren Counties, and some sand and gravel that cannot be assigned to specific counties.² Data may not add to totals shown because of independent rounding.

Table 6.—Sand and gravel sold or used by producers, by class of operation and use

(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,069	\$3,405	3,021	\$3,652
Fill	971	724	W	W
Paving	3,186	3,553	2,929	3,674
Other uses ¹	1,214	1,417	1,970	2,291
Total ²	8,441	9,099	7,920	9,616
Gravel:				
Building	1,208	2,184	1,384	2,463
Paving	3,897	4,018	6,557	5,996
Other uses ³	2,787	2,031	1,092	1,140
Total ²	7,892	8,234	9,034	9,601
Government-and-contractor operations:				
Sand:				
Building	6	8	--	--
Paving	399	466	327	430
Other uses	2	1	48	54
Total ²	408	476	375	484
Gravel:				
Building	7	8	1	2
Fill	14	3	8	1
Paving	4,283	2,804	798	733
Other uses	13	19	143	93
Total ²	4,318	2,834	950	829
Total sand and gravel ²	21,058	20,642	18,279	20,530

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

¹ Includes blast, filtration, molding (1970), railroad ballast, and other sands.² Data may not add to totals shown because of independent rounding.³ Includes fill, railroad ballast, miscellaneous, and other gravel.

Stone.—Production of stone, comprising mostly limestone and a small quantity of dolomite, increased slightly in quantity in 1971; however, the value rose 9 percent. The average price for crushed and broken stone was \$1.77 a ton, up from \$1.61 in 1970. Stone was quarried in 64 of Iowa's 99 counties by 68 companies and five municipal highway departments at 287 quarries. Limestone was crushed at 274 quarries, including seven underground mines. Two operators produced dimension limestone at five quarries in Dubuque and Jones Counties. Four companies crushed dolomite from 12 quarries in five counties. Production exceeded 1 million tons in each of the following counties: Madison, Linn, Scott, and Cerro Gordo.

Principal uses of stone were 60 percent for road base and paving materials, 12 percent for concrete aggregates, 15 percent for manufacturing portland cement, 7 percent for agricultural purposes, and 6 percent for railroad ballast, riprap and jettystone, rough and dressed architectural dimension stone, and miscellaneous chemical and industrial uses. Trucks transported 94 percent of the stone, railroads 5 percent, and waterway transportation the remainder.

Operators stripped 309 acres to quarry stone and rehabilitated 275 acres of mined land. Although stone was quarried at 287 sites, some stone was crushed in portable plants which did not operate at the same location continuously during the year.

Table 7.—Limestone ¹ sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1970			1971			Type of stone produced in 1971
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value	
Allamakee.....	5	158	\$228	5	W	W	Crushed and broken.
Appanoose.....	3	319	594	5	W	W	Do.
Benton.....	1	W	W	1	10	\$16	Do.
Buchanan.....	9	213	299	10	275	424	Do.
Cerro Gordo.....	8	1,952	2,674	6	W	W	Do.
Clayton.....	26	320	465	17	109	161	Do.
Delaware.....	6	221	305	5	W	W	Do.
Des Moines.....	5	W	W	5	718	W	Do.
Dubuque.....	9	477	765	7	² 463	² 665	Dimension and crushed and broken.
Fayette.....	21	584	832	21	589	788	Crushed and broken.
Franklin.....	5	61	85	5	32	51	Do.
Grundy.....	1	40	W	1	W	W	Do.
Henry.....	1	W	49	1	60	50	Do.
Humboldt.....	5	792	1,184	5	937	1,307	Do.
Jackson.....	7	W	314	6	197	261	Do.
Jasper.....	1	W	W	1	86	W	Do.
Jefferson.....	2	W	W	2	83	150	Do.
Jones.....	11	335	533	8	W	W	Dimension and crushed and broken.
Lee.....	3	W	W	3	253	442	Crushed and broken.
Linn.....	10	1,829	2,703	33	2,004	3,570	Do.
Madison.....	9	1,925	3,376	9	2,223	4,312	Do.
Mills.....	2	W	W	2	205	W	Do.
Mitchell.....	9	244	367	7	398	623	Do.
Montgomery.....	2	W	W	2	451	W	Do.
Scott.....	8	2,085	2,807	3	1,896	2,558	Do.
Winneshiek.....	11	363	533	10	W	W	Do.
Worth.....	2	W	W	3	302	W	Do.
Undistributed ³	113	13,382	22,951	104	14,096	29,594	
Total ⁴	295	25,305	41,119	237	² 25,389	² 44,977	

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

¹ "Limestone" used generally to include dolomite.² To avoid disclosing individual company confidential data certain totals are incomplete, dimension stone being concealed.³ Includes Adair, Adams, Black Hawk, Bremer, Butler, Cass, Cedar, Chickasaw, Clarke, Clinton, Dallas, Decatur, Floyd, Fremont, Hamilton, Hancock, Hardin, Harrison, Howard, Johnson, Keokuk, Louisa, Mahaska, Marion, Marshall, Muscatine, Page, Pocahontas, Pottawattamie, Poweshiek, Story, Tama (1970), Taylor, Union, Van Buren, Wapello, Washington, Wayne (1970) and Webster Counties and production for which no county breakdown is available.⁴ Data may not add to totals shown because of independent rounding.

Table 8.—Limestone and dolomite sold or used by producers, by use
(Thousand short tons and thousand dollars unless otherwise specified)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Dimension:				
Irregular shaped stone.....	3	\$38	(¹)	\$12
Rubble.....	8	W	W	W
Cut stone..... thousand cubic feet..	4	27	3	35
Sawed stone..... do.....	W	W	5	101
Construction.....	W	W	1	12
Flagging.....				
Total ² (approximate thousand short tons)...	11	284	W	W
Crushed and broken:				
Bituminous aggregate.....	1,638	2,829	1,877	3,330
Concrete aggregate.....	3,210	6,279	3,156	6,947
Dense graded road base stone.....	5,046	7,966	5,044	8,710
Macadam aggregate.....	(¹)	(¹)	60	102
Surface treatment aggregate.....	6,645	10,171	6,834	11,670
Unspecified aggregate and roadstone.....	1,669	2,389	1,324	2,215
Agricultural limestone.....	1,855	3,401	1,762	3,439
Cement.....	3,574	4,196	3,684	4,974
Riprap and jetty stone.....	197	336	254	492
Other ³	1,460	3,266	1,392	3,095
Total ⁴	25,293	40,835	25,389	44,977

W Withheld to avoid disclosing individual company confidential data; included with dimension total.

¹ Less than 1/2 unit.

² Includes rough architectural stone (1970) and house stone veneer.

³ Includes stone used for asphalt filler and other fillers or extenders, flux, lime, poultry grit, railroad ballast, and other unspecified uses; also refractory stone, roofing aggregate and stone sand (1971 only).

⁴ Data may not add to totals shown because of independent rounding.

MINERAL FUELS

Coal (Bituminous).—Combined production of coal from underground and strip mine operations was about the same as in 1970, however, the value increased 13 percent. The average price for all coal mined in the State increased from \$4.11 a ton to \$4.66. The strip mine coal price rose 38 cents a ton to \$4.55 and the price of underground coal increased 78 cents a ton to \$4.81.

Nearly 58 percent of the coal was produced at 11 strip mines operated by eight companies in five counties. The remainder was produced at two underground mines in two counties. However, the New Gladstone Coal Co. closed its underground mine in Appanoose County in April 1971 with very small production for the year.

Underground coal seams ranged in thickness from 60 to 68 inches, whereas the thickness of strip coal seams ranged from 36 to 72 inches. Overburden thickness at strip mines ranged from 6 to 65 feet.

Strip mining equipment in operation during the year included 10 power shovels, 14 draglines, 14 front end loaders, and two scrapers. Bucket capacity of excavating equipment was less than 5 cubic yards each, except for two dragline excavators

with a capacity in the 6- to 15-cubic-yard range. Shovels and draglines were equipped with diesel engines except for one shovel powered by a gasoline engine. All underground coal was mechanically loaded except in the small mine that closed.

Electric utilities received 95 percent of Iowa's coal shipments; the remainder was sold to customers in the State for other uses. Nearly 50 percent of Iowa's coal production was transported by rail, and the remainder by trucks. Of the 5,222,000 tons of coal shipped from other States for Iowa's consumption in 1971, 77 percent was supplied from Illinois mines.

During the year operators stripped 77 acres for coal removal and rehabilitated 47 acres of mined land.

Peat.—Production of peat increased 38 percent, and the value rose 25 percent. Eli Colby Co. mined peat moss near Lake Mills in Winnebago County and processed it in their plant at Hanlontown. Colby Pioneer Peat Co. mined reed-sedge near Joice in Worth County and processed it in their plant, also located in Hanlontown. Nearly 52 percent of the material was sold in bulk, and the remainder packaged. About 92 percent of the peat was sold for

Table 9.—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	Total	Under-ground	Strip	Total	
Lucas	1	--	1	172	--	172	\$932
Mahaska	--	5	5	--	290	290	1,282
Marion	--	3	3	--	191	191	917
Monroe	1	1	2	246	36	282	W
Van Buren	--	1	1	--	18	18	W
Wapello	--	1	1	--	36	36	160
Undistributed ¹	--	--	--	--	--	--	1,318
Total	2	11	13	418	571	989	4,609

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

¹ Includes values indicated by symbol W.

soil improvement, and the remainder for packing flowers, plants, and shrubs, and as an ingredient for potting soils.

METALS

Ferrous alloys.—Kemco Division of Foote Mineral Co., the sole producer of ferroalloys in the State, operated an electric arc furnace at its Keokuk plant, producing ferrosilicon and silvery pig iron. A major new facility for final processing of silvery pig

iron was completed during the year, and new raw and finished material handling equipment was ordered at yearend. Silvery pig iron is a premium form of silicon additive used in foundries and steel mills because of its magnetic qualities, uniformity of size, and superior silicon recoveries. When ground to a fine mesh, it is utilized as media in the heavy media separation process for beneficiation of ores.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Dewey Portland Cement Co. Div.	Box 4288, 802 Kahl Bldg.	Portland and masonry, wet process	Scott.
Martin Marietta Corp.	Davenport, Iowa 52808	Portland and masonry, dry process	Cerro Gordo.
Lehigh Portland Cement Co.	Young Bldg., 718 Hamilton St. Allentown, Pa. 18105	Portland and masonry, wet process	Polk.
Marquette Cement Mfg. Co.	20 N. Wacker Dr. Chicago, Ill. 60606	Portland and masonry, dry process	Cerro Gordo.
Northwestern States Portland Cement Co.	Box 1008, 12-2nd St., NE Mason City, Iowa 50401	Portland, wet process	Polk.
Penn-Dixie Cement Corp.	Box 152, Nazareth, Pa. 18064	Pit and plant	Cerro Gordo, Dallas, Keokuk, Mahaska, Polk, Wapello,
Clays and shales: Balfour Brick Co.	Sergeant Bluff, Iowa 51064	6 pits and plants	Appanoose.
Cap-It ex Industries, Brick and Tile Division, Harsco Corp.	Box 586 Ottumwa, Iowa 52501	-----do.-----	-----do.-----
Carter-Waters Corp.	2440 Fenway Kansas City, Mo. 64100	Pit	Scott.
Dewey Portland Cement Co. Div.	Box 4288, 802 Kahl Bldg. Davenport, Iowa 52808	Pit and plant	Webster.
Martin Marietta Corp.	1818 Commerce Tower Kansas City, Mo. 64105	-----do.-----	Do.
W. S. Dickey Clay Mfg. Co.	1230 E. First Ave. South Fort Dodge, Iowa 50501	Pit	Cerro Gordo.
Kalo Brick & Tile Co.	Young Bldg., 718 Hamilton St. Allentown, Pa. 18105	Pit	Do.
Lehigh Portland Cement Co.	Box 1008, 12-2nd St., NE Mason City, Iowa 50401	Pit and plant	Floyd, Franklin, Dallas.
Northwestern States Portland Cement Co.	Rockford, Iowa 50468	-----do.-----	-----do.-----
Rockford Brick & Tile Co.	Sheffield, Iowa 50475	Strip mine	Marion.
Sheffield Brick & Tile Co.	209 Benson Bldg. Sioux City, Iowa 51102	Underground mine	Lucas.
United Brick & Tile Co. of Iowa	Route 2, Knoxville, Iowa 51088	Strip mine	Mahaska.
Coal (bituminous): Beard Coal Co.	Route 3, Chariton, Iowa 50049	Underground mine	Monroe.
Big Ben Coal Co.	Box 265, Bussey, Iowa 50044	Two strip mines	Mahaska, Marion.
Jude Coal Co.	Route 2, Melrose, Iowa 52569	Electric furnace	Marion. Lee.
Lovilia Coal Co.	Box 16, Oskaloosa, Iowa 52577	Open pit mine, and calcining and board plants	Webster.
Mich Coal Co.	Harvey, Iowa 50119	-----do.-----	Do.
Weldon Coal Co.	320 Concert St. Keokuk, Iowa 52632	-----do.-----	Do.
Ferroalloys: Foote Mineral Co.	1500 N. Dale Mabry Tampa, Fla. 33607	-----do.-----	Do.
Gypsum: The Celotex Corp.	P.O. Box 811 Portland, Ore. 97204	Underground mine, and calcining and board plant	Des Moines.
Georgia-Pacific Corp., Gypsum Division.	325 Delaware Ave. Buffalo, N.Y. 14202	Quicklime, shaft kiln	Cerro Gordo.
National Gypsum Co.	101 S. Wacker Dr. Chicago, Ill. 60606	Quicklime and hydrated lime, three rotary kilns	Scott.
United States Gypsum Co.			
Lime: American Crystal Sugar Co.	Boston Bldg. Denver, Colo. 80201		
Linwood Stone Products Co., Inc.	Route 2 Davenport, Iowa 52804		

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Peat: Eli Colby Co.....	Box 248 Lake Mills, Iowa 50450	Bog.....	Winnebago.
Colby Pioneer Peat Co.....	Box 8, Hanlontown, Iowa 50444.....	Processing plant.....	Worth.
Expanded perlite: The Celotex Corp.....	1500 N. Dale Mabry Tampa, Fla. 33607	Bog; processing plant.....	Do.
Georgia-Pacific Corp., Gypsum Division.	P.O. Box 811 Portland, Ore. 97204	Processing plant.....	Webster.
National Gypsum Co.....	325 Delaware Ave. Buffalo, N. Y. 14202	do.....	Do.
United States Gypsum Co.....	101 S. Wacker Dr. Chicago, Ill. 60606	do.....	Do.
Sand and gravel:			
Acme Fuel & Material Co. (W. G. Block Co.)	Box 34 Muscatine, Iowa 52761	Dredges; stationary plants.....	Muscatine.
K. H. Buttler.....	Box 204 State St. Guthrie Center, Iowa 50115	Pits; portable plants.....	Dallas, Guthrie.
Clear Lake Materials Corp.....	Box 105 Clear Lake, Iowa 50428	Stationary plant.....	Cerro Gordo.
Concrete Materials Div., Martin Marietta Corp.	4096 First Ave., NE Cedar Rapids, Iowa 52401	Pits, underground mine; portable and stationary plants.....	Black Hawk, Clayton, Linn, Mahaska, Marshall, Polk, Wapello, Worth, Various.
Concrete Sand & Materials Co.....	Box 288, Spencer, Iowa 51301.....	Pits; stationary plants.....	Dickinson.
Coom Valley Gravel Co. (E. W. Hallelt).	1108-30th St., SE Des Moines, Iowa 50817	Pit; stationary plant.....	Polk.
Elmer Dole Co.....	Irvington, Iowa 50850.....	Pits; portable plants.....	Kossuth.
L. G. Everist, Inc.....	302 Paulton Bldg. Sioux Falls, South Dakota 57102	Pit; stationary plant.....	Sioux.
G. A. Finley, Inc.....	Harian, Iowa 51537.....	Pits; portable and stationary plants.....	Audubon, Crawford, Dallas, Pottawattamie, Sac, Shelby.
Hallett Construction Co.....	Box 13 Boone, Iowa 50086	do.....	Boone, Cherokee, Decatur, Franklin, Fremont, Iowa, Marshall, Osceola, Page, Polk, Sac, Story, Winnebago.
Higman Sand & Gravel Co.....	Akron, Iowa 51001.....	Pit; stationary plant.....	Plymouth.
Hogan Construction Co.....	Rock Rapids, Iowa 51246.....	Pits; portable plants.....	Dickinson, Lyon, Plymouth.
Hyman Construction Co., Inc.....	Box 146 Sioux Center, Iowa 51250	Pits; portable and stationary plants.....	Ida, Lyon, Osceola, Sioux.
Ronald Kenyon Construction Co.....	1211 Grand Ave. West Des Moines, Iowa 50265	do.....	Dallas, Polk.
LaHarv Construction Co.....	Box 173 Forest City, Iowa 50436	do.....	Hancock, Winnebago.
Maudlin Construction Co.....	Box 134 Webster City, Iowa 50595	do.....	Various.
Peters Construction Co.....	5225 E. University Des Moines, Iowa 50817	do.....	Monona, Polk.
Pound Construction Co., Inc.....	Box 217, Scranton, Iowa 51462.....	do.....	Carroll, Greene, Webster.
Raid Quarries Corp.....	Farmers & Merchants Bank Bldg. Box 1085 Burlington, Iowa 52601	do.....	Des Moines, Henry, Lee.
Stevens Sand & Gravel Co., Inc.....	Route 4, Iowa City, Iowa 52240.....	Dredge; portable plant.....	Johnson.
Van Dusseldorp Sand & Gravel, Inc..	Box 156, Colfax, Iowa 50054.....	Dredges; stationary plants.....	Jasper.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
Welp & McCarten, Inc.	522 S. 22nd St. Fort Dodge, Iowa 50501	Pits; portable plants	Cerro Gordo, Hancock, Howard, Webster.
West Des Moines Sand Co.	Box 98 West Des Moines, Iowa 50265	Pit; stationary plant	Polk.
White Materials Corp.	SE 36th & Carlisle Road Des Moines, Iowa 50817	Dredge; stationary plant	Do.
Stone: Limestone and dolomite:			
B. L. Anderson, Inc.	327 Guaranty Bldg. Cedar Rapids, Iowa 52400	Quarries; portable plants	Linn, Jones.
Concrete Materials Div. Martin Marietta Corp.	4096 First Ave. NE Cedar Rapids, Iowa 52401	Quarries; portable and stationary plants.	Black Hawk, Bremer, Johnson, Hancock, Linn, Madison, Marshall, Tama, Worth, Various
DeWees Potthoff Stone Co.	Box 39, Marion, Iowa 52302	Quarries; portable plants	Cedar, Jackson, Jones, Linn.
Dewey Portland Cement Co. Div. Martin Marietta Corp.	Box 4258, 802 Kahl Bldg. Davenport, Iowa 52800	Quarry; stationary plant	Scott.
Douds Stone, Inc.	611 Church St., Box 187 Ottumwa, Iowa 52501	Quarries; underground mine; portable and stationary plants.	Van Buren, Wapello.
Gendler Stone Products Co.	1075 Polk Blvd. Des Moines, Iowa 50311	Quarries; portable plants	Dallas, Madison, Page, Taylor.
Kaaser Construction Co.	3111 Ingersol Des Moines, Iowa 50312	---do---	Des Moines, Fremont, Jasper, Keokuk, Mahaska, Marion, Mills, Mont- gomery, Poweshiek, Washington.
Lehigh Portland Cement Co.	Young Bldg., 718 Hamilton St. Allentown, Pa. 18104	Quarry; stationary plant	Cerro Gordo.
Linwood Stone Products Co., Inc. (McCarthy Improvement Co.).	Route 2 Davenport, Iowa 52805	Underground mine and stationary plant.	Scott.
Lowe & Eschman Construction Co.	Box 267, Marion, Iowa 52302	Quarries; portable plants	Clinton.
Marquette Cement Mfg. Co.	20 N. Wacker Dr. Chicago, Ill. 60606	Quarry; stationary plant	Madison.
Paul Niemann Construction Co. Northwestern States Portland Cement Co.	Box 38, Sumner, Iowa 50674 Box 1008, 12-2nd St., NE Mason City, Iowa 50401	Quarries; portable plants	Bremer, Buchanan, Butler, Fayette. Cerro Gordo.
P. & M Stone Co., Inc.	Box 569, Humboldt, Iowa 50548	Quarries; portable plants	Cerro Gordo, Humboldt.
Penn-Dixie Cement Corp.	Box 152, Nazareth, Pa. 18064	Quarry; stationary plant	Madison.
Raid Quarries Corp.	217 Farmers & Merchants Bank Bldg., Box 1085 Burlington, Iowa 52601	Quarries; portable and stationary plants.	Des Moines, Jefferson, Lee, Van Buren.
The River Products Co.	220 Savings & Loan Bldg. Iowa City, Iowa 52240	Quarries, underground mines; portable and stationary plants.	Johnson, Louisa, Washington.
E. I. Sargent Quarries, Inc.	2525 W. Euclid St. Des Moines, Iowa 50810	Quarries; portable plants	Clarke, Decatur, Madison.
Schildberg Construction Co., Inc.	Box 368 Greenfield, Iowa 50849	---do---	Adair, Adams, Cass, Madison, Union, Pottawattamie.
Weaver Construction Co.	Box 817 Iowa Falls, Iowa 50126	Quarries; portable and stationary plants.	Cerro Gordo, Franklin, Hamilton, Hardin, Story.
Welp & McCarten, Inc.	522 S. 22nd St. Fort Dodge, Iowa 50501	---do---	Black Hawk, Howard, Humboldt, Webster, Worth.

The Mineral Industry of Kansas

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

By Bernadette Michalski ¹ and Lawrence L. Brady ²

Kansas mineral production was valued at \$589.4 million in 1971, increasing by 0.9 percent from \$584 million in 1970. Increases in value are generally attributed to price rises rather than to expansion in volume. The principal mineral commodities, in order of descending value, were petroleum, natural gas, natural gas liquids, helium, cement, stone, and salt. Mineral fuels and related products comprised about 85 percent of the total value, while nonmetals contributed the remaining 15 percent.

For the first time since 1877 Kansas produced no metallic minerals. Low-grade ore, low ore prices, and pollution control costs have contributed to the termination of zinc-lead operations. A total of 2.9 million tons of zinc concentrate and 690,000 tons of lead concentrate was recovered from the Kansas subsurface during nearly a century of mining operations in the State.

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Table 1.—Mineral production in Kansas ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland.....thousand 376-pound barrels	9,197	\$28,177	9,208	\$29,961
Masonry.....thousand 280-pound barrels	328	1,029	355	1,232
Clays.....thousand short tons	² 713	² 946	879	1,151
Coal (bituminous).....do	1,627	9,102	1,151	6,579
Helium:				
High-purity.....million cubic feet	354	8,137	342	7,182
Crude.....do	³ 2,550	³ 30,600	³ 2,510	30,120
Lead (recoverable content of ores, etc.).....short tons	80	25	—	—
Lime.....thousand short tons	6	W	8	W
Natural gas.....million cubic feet	899,955	125,994	885,144	127,267
Natural gas liquids:				
Natural gasoline and cycle products				
.....thousand 42-gallon barrels	6,549	14,617	5,387	12,253
LP gases.....do	20,814	30,597	23,215	39,001
Petroleum (crude).....do	84,853	277,469	78,532	276,433
Salt.....thousand short tons	1,230	18,206	1,240	18,712
Sand and gravel.....do	12,968	12,351	11,862	11,351
Stone.....do	15,161	22,406	⁵ 14,908	23,697
Zinc (recoverable content of ores, etc.).....short tons	1,186	364	—	—
Value of items that cannot be disclosed: Clays (fire) (1970), gypsum, pumice, salt (brine), and values indicated by symbol W	XX	3,969	XX	4,505
Total.....	XX	⁴ 583,989	XX	589,444
Total 1967 constant dollars.....	XX	522,378	XX	⁴ 512,109

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

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

² Excludes fire clay included with "Value of items that cannot be disclosed."

³ Helium measured at 14.7 psi absolute at 70 degrees Fahrenheit.

⁴ Excludes salt in brine included with "Value of items that cannot be disclosed."

⁵ Excludes quantity of dimension stone.

Table 2.—Value of mineral production in Kansas, by county

(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Allen	\$11,519	\$7,641	Cement, stone, clays, natural gas.
Anderson	983	143	Stone.
Atchison	393	W	Do.
Barber	7,784	6,953	Natural gas, petroleum, gypsum, natural gas liquids, sand and gravel.
Barton	19,766	18,887	Petroleum, salt, sand and gravel, natural gas, clays.
Bourbon	W	W	Stone.
Brown	W	W	
Butler	13,053	12,885	Petroleum, stone, sand and gravel.
Chase	W	126	Stone, sand and gravel.
Chautauqua	1,989	W	Stone, natural gas.
Cherokee	7,129	4,323	Coal, clays, stone, sand and gravel.
Cheyenne	W	W	Sand and gravel.
Clark	1,404	965	Natural gas, petroleum, sand and gravel.
Clay	198	W	Sand and gravel, stone.
Cloud	W	W	Clays, sand and gravel.
Coffey	W	W	Stone.
Comanche	1,536	1,407	Petroleum, natural gas, sand and gravel.
Cowley	8,364	7,237	Petroleum, sand and gravel, stone, natural gas.
Crawford	2,810	2,629	Coal, clays, stone.
Decatur	2,191	2,248	Petroleum, sand and gravel.
Dickinson	740	687	Stone, sand and gravel, petroleum.
Doniphan	613	657	Stone, sand and gravel.
Douglas	272	W	Sand and gravel.
Edwards	1,637	2,594	Stone, natural gas, petroleum, sand and gravel.
Elk	1,695	W	Natural gas, sand and gravel.
Ellis	24,535	23,944	Petroleum, sand and gravel, stone.
Ellsworth	19,447	25,365	Natural gas liquids, petroleum, salt, clays, sand and gravel, pumice, natural gas.
Finney	12,494	5,401	Petroleum, natural gas liquids, sand and gravel.
Ford	420	431	Natural gas liquids, sand and gravel, petroleum, natural gas.
Franklin	1,242	W	Stone, clays, sand and gravel.
Geary	W	W	Stone, sand and gravel.
Gove	W	1,182	Petroleum, sand and gravel.
Graham	12,813	13,239	Do.
Grant	36,782	15,057	Natural gas liquids, petroleum, sand and gravel.
Gray	W	W	Sand and gravel.
Greeley	W	W	
Greenwood	7,210	W	Petroleum, natural gas.
Hamilton	2,698	1,235	Natural gas, sand and gravel, petroleum.
Harper	5,086	4,088	Petroleum, natural gas liquids, natural gas, sand and gravel.
Harvey	2,658	W	Petroleum, natural gas liquids.
Haskell	20,448	13,170	Helium, petroleum, natural gas, sand and gravel.
Hodgeman	W	4,123	Petroleum, sand and gravel.
Jackson	W	80	Stone, sand and gravel.
Jefferson	867	W	Stone.
Jewell	W	W	Do.
Johnson	2,339	W	Stone, sand and gravel.
Kearny	18,297	714	Petroleum, natural gas liquids, sand and gravel, natural gas.
Kingman	14,329	10,896	Petroleum, natural gas liquids, natural gas, sand and gravel, stone.
Kiowa	5,795	3,159	Petroleum, natural gas, sand and gravel.
Labette	390	406	Stone.
Lane	123	215	Petroleum, sand and gravel.
Leavenworth	W	W	Stone, sand and gravel.
Lincoln	W	W	Stone, sand and gravel, pumice.
Linn	W	293	Stone.
Logan	16	241	Petroleum, sand and gravel.
Lyon	1,092	927	Petroleum, stone, sand and gravel.
McPherson	5,897	5,846	Petroleum, natural gas, clays, stone, sand and gravel, pumice.
Marion	3,061	2,114	Petroleum, stone, natural gas, sand and gravel.
Marshall	W	W	Gypsum, sand and gravel, stone.
Meade	4,415	4,213	Natural gas, petroleum, sand and gravel.
Miami	552	81	Stone.
Mitchell	W	1	Sand and gravel.
Montgomery	5,643	6,445	Cement, stone, clays.
Morris	992	1,098	Petroleum, stone, sand and gravel.
Morton	22,525	20,098	Petroleum, helium, natural gas liquids, natural gas.
Nemaha	85	W	Sand and gravel, stone.
Neosho	W	10,369	Cement, stone, sand and gravel.
Ness	8,216	9,451	Petroleum, sand and gravel.
Norton	1,634	1,464	Petroleum, sand and gravel, pumice.
Osage	W	30	Stone.
Osborne	W	148	Petroleum, sand and gravel.
Ottawa	74	W	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Kansas, by county—Continued
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Pawnee	\$3,806	\$4,010	Petroleum, natural gas, sand and gravel.
Phillips	6,550	7,022	Petroleum, sand and gravel.
Pottawatomie	W	W	Stone, sand and gravel.
Pratt	4,908	3,918	Petroleum, natural gas, sand and gravel.
Rawlins	2,206	W	Petroleum, sand and gravel.
Reno	16,385	16,563	Salt, petroleum, sand and gravel, natural gas.
Republic	W	W	Stone, sand and gravel.
Rice	† 27,298	25,934	Petroleum, helium, salt, sand and gravel, natural gas.
Riley	983	998	Stone, petroleum, sand and gravel.
Rooks	13,525	W	Petroleum, sand and gravel.
Rush	6,706	6,486	Petroleum, helium, natural gas.
Russell	22,374	21,649	Petroleum, sand and gravel.
Saline	1,593	W	Do.
Scott	† 7,083	3,588	Helium, natural gas liquids, petroleum, sand and gravel, natural gas.
Sedgwick	10,761	10,321	Petroleum, salt, natural gas liquids, sand and gravel.
Seward	† 30,508	27,394	Helium, natural gas liquids, petroleum, natural gas, sand and gravel.
Shawnee	1,941	W	Stone, sand and gravel.
Sheridan	2,233	2,186	Petroleum, sand and gravel.
Sherman	278	294	Lime, sand and gravel, petroleum, stone.
Smith	W	W	Stone, sand and gravel.
Stafford	12,142	11,910	Petroleum, natural gas, sand and gravel.
Stanton	5,567	87	Petroleum, natural gas.
Stevens	26,103	3,656	Do.
Sumner	5,955	6,404	Petroleum, natural gas, sand and gravel.
Thomas	W	106	Sand and gravel, petroleum.
Trego	5,315	3,731	Petroleum, sand and gravel.
Wabaunsee	1,021	1,642	Petroleum.
Wallace	W	W	Sand and gravel.
Washington	W	W	Sand and gravel, stone.
Wichita	65	W	Sand and gravel, petroleum.
Wilson	5,164	5,553	Cement, stone, clays.
Woodson	2,974	W	Stone.
Wyandotte	9,977	10,769	*Cement, sand and gravel, stone.
Undistributed ¹	24,314	160,311	
Total ²	† \$583,989	\$589,444	

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

¹ Includes sand and gravel, petroleum, stone, and natural gas which cannot be assigned to specific counties and values indicated by symbol W.

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

Table 3.—Indicators of Kansas business activity

	1970 ^r	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force.....	thousands.. 884.1	882.6	-0.2
Unemployment.....	do... 43.4	50.9	+17.3
Total nonagricultural employment.....	do... 677.0	668.8	-1.2
Construction.....	do... 32.0	30.4	-5.0
Mining.....	do... 11.0	10.1	-8.2
Manufacturing.....	do... 134.5	128.5	-4.5
Other wage and salary.....	do... 499.5	499.8	+1
Personal income:			
Total.....	millions.. \$3,598	\$9,234	+7.4
Per capita.....	\$3,825	\$4,090	+6.9
Construction activity:			
Building permits, total private nonresidential.....	millions.. \$87.1	\$116.0	+33.2
Total residential construction units.....	9,906	12,827	+29.5
Cement shipments to and within Kansas.....	thousand 376-pound barrels.. 5,127	5,229	+2.0
Mineral production value.....	millions.. † \$584.0	\$589.4	+0.9

^p Preliminary. ^r Revised.

Sources: Survey of Current Business; Construction Review; Employment and Earnings; Area Trends in Employment; and the U.S. Bureau of Mines.

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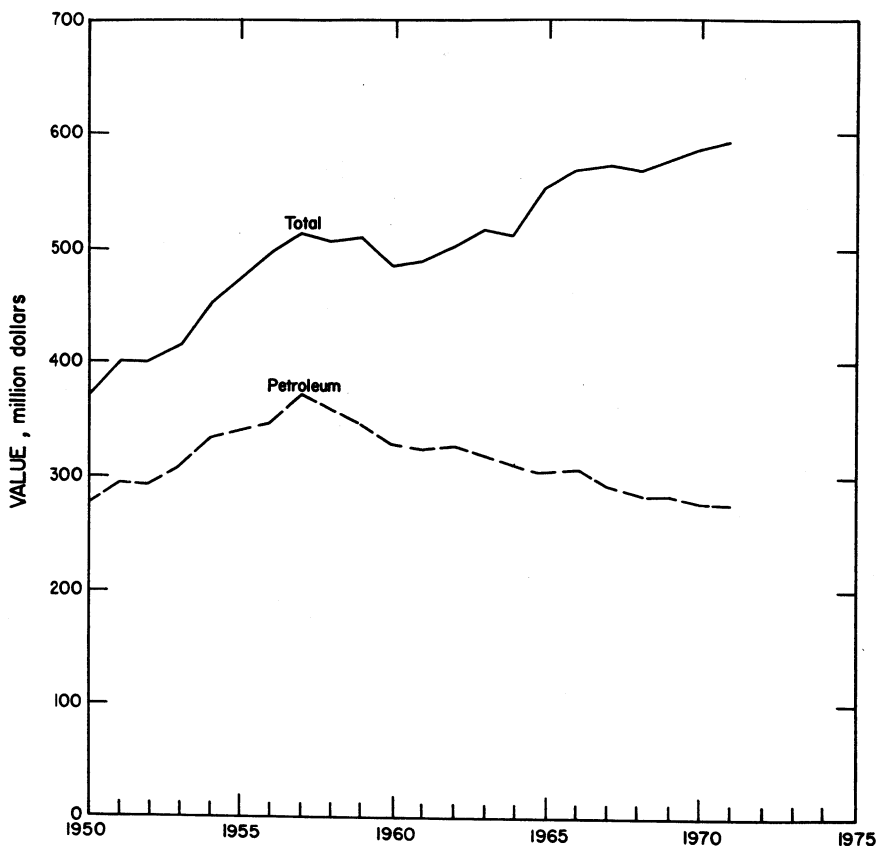


Figure 1.—Value of petroleum, and total value of mineral production in Kansas.

Trends and Developments.—Contracts awarded for highway construction by the Kansas Highway Commission reached a record total of \$101.4 million in 1971. This exceeds the previous record year of 1963 by \$17 million. Contract work performed totaled \$80.4 million. There were 58 miles of new 4-lane highway, 64 miles of new 2-lane highway, 193 miles of new asphaltic overlay on older routes, and 64 bridges placed during the year. Maintenance resurfacing of 1,729 miles of state highways was also completed in 1971.

Location and design studies on 316 miles of highway were either completed or in progress for Kansas highways in 1971.

With the highway contract total setting a record high in 1971 and an increase projected for 1972, the mineral products

playing a vital part in the construction industry should show a marked production increase in the near future.

The Kansas Power and Light Co. has successfully tested a limestone scrubber system on a 125,000-kilowatt power unit at the company's Lawrence station. As a result, a similar system was installed in a new 430,000-kilowatt power unit at the station. Limestone is injected as a fine powder into the boiler along with the finely ground coal. The gases and particulate material moving from the boiler pass through the scrubber assembly that is designed to remove particulate material (fly ash) and sulfur gases derived from the coal. Sulfur dioxide gas reacts with the calcined limestone, forming a calcium sulfate. This material, plus the coal ash and un-

reacted lime, is then deposited in a settling basin. Limestone used at the Kansas Power and Light Co. plant is provided by Hamm Quarries, Inc., from the Platts-mouth Limestone deposit near Lawrence.

A scrubber system of slightly different design is planned for the new La Cygne powerplant in Linn County. This 820,000-kilowatt station, under construction by Kansas Gas and Electric Co. and Kansas City Power and Light Co., will be a totally coal-burning facility. The La Cygne facility will inject finely ground limestone as a slurry outside the boiler in a separate system. Approximately 400,000 to 600,000 tons of limestone a year will be used at the La Cygne powerplant. Bates County Rock, Inc., of Butler, Mo., tentatively has the contract to deliver this rock, and both the Bethany Falls and Winterset Limestone will be utilized.

Employment.—The Employment Security Division of the Kansas Department of Labor reports the total mining employment as 10,100 persons, down from the 11,000 persons reported for 1970.

The Workman's Compensation Commission reported 620 injuries and four fatalities in the mineral industry (including petroleum and natural gas) in 1971.

Legislation & Government Programs.—The Kansas Mined Land Board in 1971 set the slope standards on reclaimed land, thus bringing to final defined form the Mined Land Conservation and Reclamation Act. Initial regulation of the coal mining and reclamation law went into effect in January 1969, and final definition of the slopes was set in December 1971.

Numerous research projects of interest to the mineral industry are being conducted by the State Geological Survey of Kansas. Studies are being conducted on Kansas bentonite, coal, utilization of fly ash, and use of Kansas minerals as fillers in various products such as casting resins. Use of the computer in studying various geological problems is continuing and new electronic scanning techniques are being applied to permeability and porosity studies of carbonate rocks. Various geochemical studies and evaluation of environmental problems add important data for solution of problems directly related to different phases of the mineral industry. Basic geological mapping conducted by a cooperative of the State Geological Survey of Kansas and U.S.

Geological Survey in conjunction with ground-water studies adds important areal information for mineral producers. Geophysical studies of small areas having economic mineral potential have also been initiated by the State Geological Survey of Kansas using both gravity and magnetic studies.

The Mined Land Redevelopment Office funded by the Ozarks Regional Commission and the State Geological Survey of Kansas in Girard has been instrumental in the reclamation of the older strip mined areas in southeastern Kansas. Approximately 4,000 acres of land mined prior to enactment of the Coal Mined Land Reclamation Law (January 1969) have been reclaimed. However, more than 45,000 acres of mined land remains to be reclaimed.

A study on the utilization of fly ash on coal strip mine land was continued in Crawford County. The study involved the U.S. Bureau of Mines, State Geological Survey of Kansas, Kansas State University, and the Kansas Power and Light Co.

Cooperative research continued between the Atomic Energy Commission and the State Geological Survey on the proposed location of the Atomic Energy Commission Radioactive Waste Repository Site in Kansas. Eight different areas in the State were investigated as potential sites for the repository. Criteria for selection of the eight preliminary sites were (1) a general knowledge of the area, (2) at least 150 feet of salt at a depth less than 2,000 feet, and (3) a minimum of oil and gas development. Based on information obtained at these eight locations, further work will be conducted on the select sites.

Drilling and Exploration.—During 1971 a total of 2,349 oil and gas wells were drilled in Kansas. Of these, 1,608 were production wells and 741 were exploratory wells, and 1,211 resulted in oil or gas recovery and 1,138 were dry. Drilling activity resulted in 1,099 new oil wells and 112 new gas wells.

Total footage attributable to oil and gas drilling activity was 7,186,379 feet, of which 4,438,375 feet was production and 2,748,004 feet was exploration. Total footage declined 416,434 feet in 1971. Ness County was foremost in total footage drilled with 572,716 feet.

Linn, Ness, Graham, Barton, and Butler

Counties accounted for 26 percent of the wells drilled. Footage drilled in these counties totaled 1,594,351 feet, an average of 2,618 feet per well. Linn County re-

ported a total of 192 wells drilled in 1971. All but one were production wells. Linn County drilling activity resulted in 188 new oil wells and one gas well.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Coal.....	238	282	67	489	--	19	38.86	579
Metal.....	25	259	6	52	--	--	--	--
Nonmetal.....	338	262	219	1,738	--	60	34.52	658
Sand and gravel.....	663	220	146	1,301	--	22	16.91	561
Stone.....	1,530	271	415	3,442	--	51	14.82	415
Total ¹	3,294	259	854	7,021	--	152	21.65	511
1971:^P								
Coal.....	255	266	67	499	1	18	38.09	12,569
Metal.....	--	--	--	--	--	--	--	--
Nonmetal.....	555	250	139	1,087	--	36	33.11	1,092
Sand and gravel.....	535	237	127	1,133	1	17	15.89	5,519
Stone.....	1,735	259	449	3,789	--	33	8.71	288
Total ¹	3,080	254	783	6,508	2	104	16.29	2,274

^P Preliminary.

¹ Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Carbon Black.—The Columbian Carbon Co., a subsidiary of Cities Service Oil Co. and sole producer of carbon black in Kansas, continued production at its Hickok plant in Grant County.

Carbon black was consumed in the manufacture of tires at the Topeka plant of the Goodyear Tire and Rubber Co.

Coal.—Production was reported at 1.2 million tons in 1971, a 4.8-million-ton decrease in output compared with that of the previous year. The 29-percent decline in coal production resulted from the 6-week labor strike coupled with the rise in production cost in the face of increasing overburden-to-coal ratio. Production is obtained entirely from strip mining operations conducted largely in Cherokee and Crawford Counties.

Helium.—As of yearend six helium extraction plants were in operation in Kansas. Of these, Cities Service Helix, Inc. (Ulysses),³ National Helium Corp. (Liberal), and Northern Helix Co. (Bushton) extracted crude helium primarily for long-term storage. Alamo Chemical Co., Gardner Cryogenics Inc. (Elkhart), Kansas Refined Helium Co. (Otis), and Cities

Service Cryogenics, Inc. (Scott City),⁴ produce high-purity helium for independent sale to commercial (non-Federal) customers. Crude helium production in 1971 was reported at 2,510 million cubic feet valued at \$30.1 million, down from the previous year's totals of 2,550 million cubic feet valued at \$30.6 million.

High-purity helium production totaled 342 million cubic feet valued at \$7.2 million, down from 354 million cubic feet valued at \$8.1 million.

On January 26, 1971, the Department of Interior invoked the termination provisions of contracts under which the Bureau of Mines purchased helium for long-term conservation storage. Under the termination notices the United States was to cease the purchase of helium at 8:00 a.m., March 28, 1971. However, on March 27 the U.S. District Court for the District of Kansas in an action brought by three of the contractors, Cities Service Helix, Inc., National Helium Co., and Phillips Petroleum Co., issued an order which, in effect, re-

³ Cities Service Helix, Inc., also purifies crude helium piped from Cities Service Cryogenics, Inc., plant at Scott City, Kans.

⁴ Crude helium is piped to Cities Service Helix, Inc., plant at Ulysses for purification.

Table 5.—Natural gasoline and LP gases produced in 1971
(42-gallon barrels)

Company	Location		Natural gasoline	Butane	Propane	LP gases	Total
	Nearest town	County					
Alamo Chemical Co.	Elkhart	Morton	535,282	--	--	--	535,282
Anadarko Production Co.	Liberal	Seward	62,130	--	65,499	--	127,629
Cities Service Helex, Inc.	Ulysses	Morton	103,641	--	58,716	--	162,357
Cities Service Oil Co.	Scott City	Grant	--	--	--	3,571,900	3,571,900
	Cheney	Scott	--	--	--	1,783,472	1,783,472
	Midway	Kingman	--	--	--	626,000	626,000
	Wichita	do	--	--	--	268,100	268,100
	Wilburton	Sedwick	367,900	419,100	385,400	107,100	1,172,400
	Lekin	Morton	--	--	--	--	107,100
Kans. Refined Helium Co.	Otis	Kearny	120,118	--	--	--	120,118
Kathol Natural Gas, Inc.	St. John	Real	14,984	17,846	16,550	--	44,984
Mesa Petroleum Co.	Hickok	Ulysses	405,872	480,846	420,543	--	49,932
Mobil Oil Corp.	Harper	Grant	236,890	1,571	114,006	386,890	1,307,261
National Helium Corp.	Liberal	do	242,039	109,375	236,589	--	788,867
Northern Gas Products Co.	Burton	Seward	919,573	94,044	1,341,737	--	588,023
Northern Natural Gas Co.	Holcomb	Funney	823,379	2,083,794	6,739,406	--	2,355,414
	Sublette	Seward	225,777	--	--	--	10,916,226
Amoco Production Co.	Ulysses	do	583,983	1,117,570	883,051	--	2,584,604
	do	do	399,257	48,148	126,700	--	574,105
Peoples Natural Gas Division	Burton	Harvey	33,805	--	--	--	33,805
	Johnson City	Stanton	4,027	--	--	--	4,027
Skelly Oil Co.	Medicine Lodge	Barber	25,375	22,026	44,255	15,231	15,231
	Minneapolis	Ford	26,674	25,504	45,831	1,377	98,083
							98,059

Source: Kansas State Corporation Commission.

¹ Includes 2,314,647 barrels of ethane.

quired the United States to continue the purchase of helium from the three contractors pending further order of the court. The order was affirmed on appeal on the ground that the requirements of the National Environmental Policy Act had not been complied with. As of year-end 1971, the Department was in the process of formulating an environmental impact statement in furtherance of an evaluation of the environmental consequences of termination of the contracts. A fourth contractor, Northern Helix Co., filed a suit in the Court of Claims contending that failure of the government to make payments under its contract for an extended period of time constituted a material breach of the contract. A decision by the Court of Claims held that the government's failure to pay constituted a material breach. The issue as to damages is yet to be litigated. Pursuant to an interim storage contract, the Bureau of Mines is accepting for storage helium delivered by this contractor.

Natural Gas.—Production totaled 885 billion cubic feet in 1971, representing a 14.8-billion-cubic-foot decline from the record production level of the previous year. Value of natural gas was \$127.3 million, an increase of about 1 percent compared with the value reported for 1970 record production.

Proved recoverable reserves of natural gas as of December 31, 1971, according to the American Gas Association, totaled 12.5 trillion cubic feet. Although additional reserves of 100.4 billion cubic feet were reported during the year, total reserves de-

clined by 6.0 percent from the proved reserve level reported for 1970.

Natural Gas Liquids.—Natural gas liquids production was reported at 28.6 million barrels in 1971, about 1.2 million barrels over the previous year's production level. Included in the 1971 figure were 23.2 million barrels of liquefied petroleum gases and ethane averaging \$1.68 per barrel, and 5.4 million barrels of natural gasoline and cycle products averaging \$2.27 per barrel.

Proved recoverable reserves of natural gas liquids decreased from 294.1 million barrels in 1970 to 276.6 million barrels in 1971, a 6-percent decline, as based on data released by the American Gas Association.

Petroleum.—Crude oil production declined for the fifth consecutive year. Output in 1971 ran 7.4 percent below the previous year's level. In spite of this decline petroleum remains the most important Kansas mineral product.

The decline in crude oil production was accompanied by a continuing decrease in proved crude oil reserves. The estimated proved crude oil reserves for Kansas as of December 31, 1971, was 501,552 thousand barrels, a 7-percent or a 37,753-thousand-barrel decline from the previous year's level. New field discoveries and new reservoir discoveries in old fields amounted to 39,545 thousand barrels in 1971.

Refineries.—Eleven refineries operated in Kansas at the close of 1971. These refineries processed a total of 132.4 million barrels of crude oil. Of this total, 75 million barrels was local crude, 55.4 million barrels was obtained from other States, and 2 million barrels was imported from Canada.

Table 6.—Crude oil production, indicated demand, and stocks in 1971, by month
(Thousand 42-gallon barrels)

Month	Production	Indicated demand	End-of-month stocks originating within Kansas
January.....	6,532	6,511	7,308
February.....	5,676	5,750	7,234
March.....	7,135	7,153	7,216
April.....	6,711	6,394	7,533
May.....	6,627	5,450	8,710
June.....	6,680	7,245	8,145
July.....	6,636	6,906	7,375
August.....	6,680	7,118	7,437
September.....	6,425	6,968	6,894
October.....	6,486	6,640	6,740
November.....	6,386	5,803	7,323
December.....	6,558	6,115	7,766
Total:			
1971.....	78,532	78,053	XX
1970.....	84,853	84,153	XX

XX Not applicable.

Table 7.—Crude petroleum production by field ¹
(Thousand 42-gallon barrels)

Field ²	1970	1971	Cumulative to Dec. 31, 1971
Bemis-Shutts	2,623	2,590	211,670
Chase-Silica	1,780	1,600	246,368
El Dorado	1,736	1,500	276,076
Hall-Gurney	2,734	2,480	120,863
Kraft-Prusa	1,332	3,200	116,962
Trapp	2,033	1,930	202,344
Other fields ³	72,615	65,232	NA
Total	84,853	78,532	NA

NA Not available.

¹ Fields with annual production in excess of 1 million barrels.

² Breakdown for individual fields from the Oil and Gas Journal.

³ Bureau of Mines figures.

Table 8.—Oil and gas well drilling completions, by county

County	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Allen	21	--	6	--	--	--	27	23,130
Anderson	6	1	--	--	--	1	8	6,536
Barber	--	4	6	--	1	9	21	95,256
Barton	35	--	36	5	--	17	93	314,770
Bourbon	--	--	1	--	--	--	1	833
Butler	41	--	31	3	--	14	89	241,044
Chase	--	--	1	--	--	--	1	947
Chautauqua	23	--	14	--	--	3	40	65,151
Clark	--	--	1	--	--	2	3	16,793
Coffey	47	--	10	1	--	5	63	84,148
Comanche	9	2	--	--	--	9	20	104,361
Cowley	25	1	19	4	--	21	70	205,103
Crawford	1	--	1	--	--	--	2	640
Decatur	12	--	6	5	--	5	23	102,033
Dickinson	--	--	1	--	--	--	1	2,590
Douglas	4	2	--	--	--	--	4	3,339
Edwards	8	4	4	--	1	5	20	82,179
Elk	25	5	12	--	--	9	51	94,007
Ellis	24	--	26	7	--	19	76	273,244
Ellsworth	25	--	13	2	--	16	56	163,469
Finney	8	--	2	5	--	4	19	92,966
Ford	--	1	1	2	--	4	8	39,048
Franklin	3	--	1	--	--	1	5	4,032
Gove	11	--	9	3	--	18	41	169,279
Graham	25	--	27	10	--	43	105	405,602
Grant	--	24	1	--	--	--	25	74,564
Greeley	--	1	--	--	--	--	1	2,340
Greenwood	46	--	21	1	--	7	75	160,665
Hamilton	--	11	--	--	--	1	12	33,597
Harper	4	1	5	2	--	8	20	90,371
Harvey	10	1	6	3	--	9	29	90,453
Haskell	--	2	1	1	--	--	4	19,097
Hodgeman	11	--	11	3	--	27	52	239,108
Johnson	2	1	--	--	--	--	3	2,034
Kearny	--	1	--	--	--	3	4	15,121
Kingman	4	3	--	2	--	16	27	108,946
Kiowa	2	1	6	--	--	3	12	55,834
Labette	4	--	--	--	--	--	4	1,880
Lane	188	--	2	3	--	6	12	55,121
Linn	--	1	2	--	--	1	192	60,219
Logan	2	--	1	--	--	2	5	24,400
Lyon	4	--	3	--	--	4	11	25,687
McPherson	9	2	6	3	1	6	27	79,851
Marion	11	--	2	--	--	9	22	55,719
Marshall	--	--	--	--	--	14	14	22,955
Meade	5	5	6	--	1	3	20	115,900
Miami	4	1	7	--	--	1	13	6,808
Mitchell	--	--	--	--	--	1	1	515
Montgomery	29	1	13	--	--	1	44	44,097
Morris	1	--	--	--	--	--	1	3,100
Morton	3	--	3	--	--	2	8	41,209
Nemaha	--	--	--	--	--	2	2	1,913
Neosho	5	--	1	--	--	--	6	3,773

See footnote at end of table.

Table 8.—Oil and gas well drilling completions, by county—Continued

County	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Ness.....	38	--	31	19	--	42	130	572,716
Norton.....	4	--	3	2	--	6	15	54,832
Osage.....	--	--	--	--	--	1	1	354
Pawnee.....	13	3	14	6	2	18	56	223,942
Phillips.....	15	--	4	5	--	5	29	100,792
Pottawatomie.....	1	--	--	--	--	11	13	26,597
Pratt.....	3	1	5	1	--	4	14	60,492
Rawlins.....	11	--	13	1	--	5	30	126,236
Reno.....	5	--	6	1	--	5	17	56,288
Rice.....	29	--	14	3	--	9	55	182,738
Riley.....	--	--	--	--	--	2	2	2,000
Rooks.....	25	--	18	4	--	14	61	218,217
Rush.....	9	6	14	4	1	15	49	185,863
Russell.....	24	--	14	2	--	11	51	155,099
Saline.....	1	--	1	--	--	3	5	15,307
Scott.....	--	--	3	1	--	1	3	14,457
Sedgwick.....	1	--	1	--	--	11	15	52,445
Seward.....	6	4	11	--	4	7	32	186,672
Sheridan.....	1	--	1	--	--	18	20	77,362
Sherman.....	--	--	--	--	--	1	1	5,240
Smith.....	--	--	--	--	--	4	4	16,720
Stafford.....	28	2	25	6	1	16	78	297,637
Stanton.....	--	1	1	--	--	2	4	16,289
Stevens.....	--	7	3	--	--	2	12	51,886
Sumner.....	20	3	13	3	2	31	72	262,477
Thomas.....	--	--	--	--	--	4	4	18,822
Trego.....	4	--	8	6	--	12	30	119,232
Wilson.....	3	--	2	--	--	1	6	4,813
Woodson.....	29	--	10	--	--	3	42	44,522
Total.....	968	98	542	131	14	596	2,349	7,186,379

Source: American Petroleum Institute.

NONMETALS

Total value of nonmetals produced in 1971 was approximately \$90.6 million compared with \$87.1 million in the previous year. Portland cement production constituted about a third of the total nonmetal production value for the State. Other leading commodities, by value of output, are stone, salt, and sand and gravel. The combined output of the above-mentioned commodities constituted 92.4 percent of the value of nonmetallic mineral production in Kansas for 1971. The remainder was derived from production of clay and shale, masonry cement, gypsum, lime, perlite, and pumice.

Cement.—Although total operating plants were reduced from six to five by close of 1970, portland cement production increased by 0.1 percent in 1971. Production increases at most existing facilities were attributable to expansion and modernization activities.

Clays.—Production of clay and shale during 1971 increased 23 percent by volume and 21.7 percent by value compared with the previous year's production. Of a total output of 879,426 tons, more than a third

or 295,495 tons was consumed in cement manufacture; 225,335 tons was consumed in building brick manufacture; and the remainder was consumed in the manufacture of sewer pipe, heavy clay products, lightweight aggregates, tile, stoneware and pottery.

Table 9.—Portland cement salient statistics

(Thousand 376-pound barrels and thousand dollars)

	1970	1971
Number of active plants ¹	6	5
Rated clinker capacity, Dec. 31.....	11,659	11,793
Production.....	8,973	9,570
Shipments from mills:		
Quantity.....	9,197	9,208
Value.....	\$23,177	\$29,961
Stocks at mills, Dec. 31.....	1,120	1,124

¹ One plant ceased operations at end of 1970.

Gypsum.—Two gypsum mines are presently in operation in Kansas. The National Gypsum Co. has a mine near Sun City in Barber County and transports crushed gypsum to their plant at Medicine Lodge for processing. National Gypsum mines its gypsum from the Blaine Formation of the Lower Permian strata. In Marshall County, the Bestwall Div. of the

Georgia-Pacific Corp. mines gypsum from the Easley Creek Shale (Lower Permian) at a stratigraphic position much lower than the Barber County gypsum beds.

Lime.—Great Western Sugar Co. is the lone lime producer in Kansas. Lime produced in Sherman County is used entirely in sugar processing by Great Western Sugar Co. at its Goodland, Kans., beet sugar plant.

Perlite.—Lite-Weight Products Inc., of Kansas City processes raw perlite mined outside of Kansas into a variety of products including lawn and garden fertilizer, perlite plaster, concrete aggregate, cryogenic insulation, and a variety of expanded perlite.

Pumice.—Mining of pumice (volcanic ash) continued in Ellsworth, Lincoln, McPherson, and Norton Counties during the year. The pumice was processed for absorbants and dusting compounds by the Wyandotte B.A.S.F. Corp. Two companies plus the State Highway Commission utilize the volcanic ash for road construction. The expected development of molded door and building panels by Pearl-lite, Inc., of Mankato utilizing volcanic ash and urethane was discontinued during the year.

Salt.—Production of salt increased 1 percent in volume and 3 percent in value over 1970 production. Salt was produced in five Kansas counties: Barton, Ellsworth, Reno, Rice, and Sedgwick. The entire production of Kansas salt is from the Hutchinson Salt Member of the Wellington Formation (Lower Permian). Five salt mines produced salt by evaporative methods from brine wells, while the remaining

three mines obtained rock salt by underground mining.

The American Salt Corp. has added a \$3.5 million addition to its plant at Lyons, Kans. When completed, the expansion will add 550 tons per day of evaporated salt to the plant's output, more than doubling that company's present production of evaporated salt.

Sand and Gravel.—Total sand and gravel production decreased 8.5 percent in volume and 8.1 percent in value. There were 226 sand and gravel operations in 80 counties in the State. Of the total volume of production, 51 percent of the sand and gravel was used for paving purposes while 36 percent was used for building construction.

Leading counties in sand and gravel production were those counties in which large cities were located. Based on total volume produced, the leading counties were Wyandotte, Sedgwick, Shawnee, Johnson, and Reno.

Stone.—Stone production showed a 1-percent decrease in volume but a 6-percent increase in value over 1970 production. With 96 percent of the total stone output being crushed limestone, trends toward increased construction should result in future increases in stone production. Increased uses of limestone in pollution abatement should also aid total stone production in the future. Besides the crushed limestone, the stone production includes chat mainly from tailings piles in the old Tri-State mining district, crushed quartzite and sandstone, and dimension limestone and sandstone.

Table 10.—Evaporated and rock salt sold or used by producers

(Thousand short tons and thousand dollars)

Year	Evaporated salt		Rock salt	
	Quantity	Value	Quantity	Value
1967	521	\$12,085	548	\$2,601
1968	556	12,875	572	2,644
1969	623	13,810	648	3,230
1970	670	15,178	560	3,028
1971	676	15,847	564	2,865

Table 11.—Sand and gravel sold or used by producers, by class of operation and use

(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand				
Building.....	4,089	\$4,076	3,923	\$4,098
Engine.....	16	24	--	--
Fill.....	935	523	960	551
Paving.....	3,141	3,184	3,408	3,314
Other uses ¹	583	493	181	217
Total ².....	8,765	8,305	8,472	8,180
Gravel:				
Building.....	207	241	179	293
Fill.....	38	40	76	75
Paving.....	1,183	1,267	1,094	1,160
Railroad ballast.....	--	--	10	11
Miscellaneous.....	--	--	207	247
Other uses ³	264	766	18	25
Total ².....	1,692	2,314	1,583	1,810
Government-and-contractor operations:				
Sand:				
Building.....	--	--	13	14
Fill.....	2	1	33	26
Paving.....	1,009	683	816	695
Total.....	1,011	684	862	735
Gravel:				
Building.....	--	--	105	60
Fill.....	--	--	38	39
Paving.....	1,499	1,049	765	518
Other uses.....	--	--	37	10
Total ².....	1,499	1,049	945	626
Total sand and gravel ².....	12,968	12,351	11,862	11,351

¹ Includes blast (1970), filtration (1970), molding (1970), railroad ballast, and other sands.² Data may not add to totals shown because of independent rounding.³ Includes miscellaneous (1970), railroad ballast (1970), and other gravel (1970).

Table 12.—Sand and gravel sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Barton.....	3	257	\$260	6	229	W
Butler.....	1	W	W	1	3	\$6
Chase.....	2	W	W	2	13	9
Cherokee.....	--	--	--	1	78	18
Cheyenne.....	3	W	W	3	102	W
Clark.....	1	32	24	1	34	16
Clay.....	1	102	W	2	191	W
Cloud.....	1	139	W	1	W	W
Comanche.....	1	52	35	1	51	51
Cowley.....	6	280	268	6	291	262
Decatur.....	2	W	W	1	2	1
Dickinson.....	1	W	99	1	W	W
Doniphan.....	1	2	1	1	1	1
Douglas.....	1	171	180	2	218	W
Edwards.....	1	W	22	1	30	19
Elk.....	1	53	W	1	12	4
Ellis.....	8	385	351	5	237	193
Ellsworth.....	1	30	22	2	17	17
Finney.....	3	W	298	2	W	W
Franklin.....	--	--	--	1	4	3
Gove.....	3	35	W	4	W	W
Graham.....	2	W	W	1	20	10
Greenwood.....	1	84	63	--	--	--
Hamilton.....	1	W	W	1	19	10
Harper.....	1	W	W	2	73	W
Haskell.....	3	W	W	4	96	72
Hodgeman.....	1	W	W	1	89	45
Jackson.....	1	W	31	4	46	17
Jewell.....	1	7	3	--	--	--
Johnson.....	1	535	W	2	529	W
Kearney.....	2	W	W	3	70	W
Lane.....	--	--	--	1	36	18
Leavenworth.....	1	11	25	1	18	35
Lincoln.....	--	--	--	1	13	13
Linn.....	1	7	5	--	--	--
Logan.....	3	21	16	2	18	22
Lyon.....	3	93	133	4	W	W
McPherson.....	2	W	W	1	23	34
Marshall.....	5	165	220	6	124	W
Meade.....	1	W	W	1	20	13
Morris.....	1	W	W	1	25	34
Nemaha.....	2	10	20	4	W	105
Neosho.....	--	--	--	1	76	W
Ness.....	2	W	W	1	19	24
Norton.....	2	W	W	2	40	43
Osborne.....	2	W	W	1	30	30
Ottawa.....	1	55	74	1	W	W
Pawnee.....	3	90	81	5	84	W
Phillips.....	2	W	W	4	86	101
Pottawatomie.....	2	60	43	3	W	W
Rawlins.....	3	23	25	3	W	W
Reno.....	8	440	347	9	397	280
Republic.....	2	W	W	2	113	W
Rice.....	3	169	111	4	141	96
Russell.....	2	W	W	2	60	59
Saline.....	2	W	W	3	235	W
Scott.....	1	23	21	1	30	22
Sedgwick.....	14	2,433	1,806	13	1,707	1,330
Shawnee.....	5	526	417	5	543	424
Sheridan.....	2	W	W	3	47	32
Sherman.....	4	104	132	3	56	72
Smith.....	2	W	W	1	21	5
Stevens.....	1	W	4	--	--	--
Thomas.....	3	W	58	4	65	75
Trego.....	5	91	76	5	94	74
Wabaunsee.....	1	3	1	--	--	--
Wallace.....	2	W	W	--	--	--
Wallace.....	3	69	58	6	W	W
Wyandotte.....	6	2,774	3,004	11	2,321	2,662
Undistributed ¹	32	3,626	4,014	47	2,960	4,987
Total ²	189	12,968	12,351	226	11,862	11,351

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

¹ Includes Barber, Ford, Geary, Grant, Gray, Greeley (1970), Kingman, Kiowa, Marion, Mitchell, Pratt, Riley, Rooks, Seward, Stafford, Sumner, Washington, and some sand and gravel not assigned to specific counties.

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

Table 13.—Stone sold or used by producers, by kind
(Thousand short tons and thousand dollars)

Kind of stone	1970		1971	
	Quantity	Value	Quantity	Value
Dimension stone total ¹	21	\$445	W	\$507
Crushed and broken:				
Limestone.....	14,552	21,176	14,349	22,227
Undistributed ²	587	785	558	963
Total ³	15,140	21,961	14,908	23,190
Grand total ³	15,161	22,406	14,908	23,697

¹ To avoid disclosing individual company confidential data, dimension limestone and sandstone are combined.

² Includes sandstone, quartzite, and other stone.

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

Table 14.—Stone sold or used by producers, by use
(Thousand short tons and thousand dollars)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Crushed and broken:				
Bituminous aggregate.....	1,521	\$2,510	1,684	\$2,721
Concrete aggregate.....	2,580	4,590	2,661	4,869
Dense graded road base stone.....	2,594	3,746	3,033	4,824
Macadam aggregate.....	414	616	356	559
Surface treatment aggregate.....	2,371	3,408	1,817	2,845
Unspecified aggregate & roadstone.....	849	1,095	706	963
Agricultural limestone.....	861	1,274	629	947
Cement.....	2,845	3,408	3,471	4,386
Railroad ballast.....	66	109	W	W
Riprap and jetty stone.....	849	943	313	630
Other ¹	188	262	169	278
Other stone ²	--	--	69	168
Total.....	³ 15,140	21,961	14,908	23,190

¹ Includes filter stone, whiting, stone sand, railroad ballast (1971), asphalt filler, and other uses in small quantities.

² Includes data for chat, quartzite and sandstone.

³ Data does not add to total shown because of independent rounding.

Table 15.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ash Grove Cement Co.---	1000 Tenmain Center Kansas City, Mo. 64105	Plant and quarry---	Neosho.
General Portland Cement Co.	2800 Republic Bank Tower Dallas, Tex. 75201	-----do-----	Wilson.
Lone Star Cement Corp.---	2511 East 46th St., Suite 472	-----do-----	Wyandotte.
The Monarch Cement Co.	Indianapolis, Ind. 46205	-----do-----	Allen.
Universal Atlas Cement, Div. of U.S. Steel Corp.	Humboldt, Kans. 66748 600 Grant Street U.S. Steel Bldg. Pittsburgh, Pa. 15230	-----do-----	Montgomery.
Clays:			
Acme Brick Co.-----	Box 425 Fort Worth, Tex. 76101	Mine and plant.---	Cherokee and Ellsworth.
Ash Grove Cement Co.---	1000 Tenmain Center Kansas City, Mo. 64105	-----do-----	Neosho.
Buildex, Inc.-----	Box 62299 Pittsburg, Kans. 66762	-----do-----	Franklin and Ellsworth.
Cloud Ceramics.-----	Box 417 Concordia, Kans. 66901	-----do-----	Cloud.
W.S. Dickey Clay Manu- facturing Co.	1818 Commerce Tower Kansas City, Mo. 64105	-----do-----	Cherokee and Crawford.
Excelsior Clay Products, Inc.	342 North Waco Wichita, Kans. 67202	-----do-----	Wilson.
General Portland Cement Co.	Box 479 Fredonia, Kans. 66736	-----do-----	Do.
Humboldt Shale Mining Co.	Box 185 Humboldt, Kans. 66748	Mine-----	Allen.
Kansas Brick & Tile Co., Inc.	Box 126 Hoisington, Kans. 67544	Mine and plant.---	Barton.
The Monarch Cement Co.	Humboldt, Kans. 66748	-----do-----	Allen.
Universal Atlas Cement Co., Div. of U.S. Steel Corp.	Box 2969 Pittsburgh, Pa. 15230	-----do-----	Montgomery.
Wilkinsons, Inc.-----	Rt. 1 Weir, Kans. 66781	Mine-----	Cherokee.
Coal:			
The Clemens Coal Co.-----	Box 62299 Pittsburg, Kans. 66762	Strip mine-----	Crawford.
Pittsburg & Midway Coal Mining Co.	Tenmain Center Kansas City, Mo. 64105	-----do-----	Cherokee.
Wilkinsons, Inc.-----	Rt. 1 Weir, Kans. 66781	-----do-----	Do.
Gypsum:			
Georgia-Pacific Corp., Gypsum Div.	900 Southwest 5th Portland, Oreg. 97204	Quarry and plant.---	Marshall.
National Gypsum Co.-----	325 Delaware Ave. Buffalo, N.Y. 14202	-----do-----	Barber.
Lime: The Great Western Sugar Co.	Box 5308 Denver, Colo. 80217	Plant-----	Sherman.
Pumice:			
Ernest Hanzlicek-----	Wilson, Kans. 67490	Mine-----	Lincoln.
Stan Orr Construction Co.--	P.O. Box 417 McPherson, Kans. 67460	-----do-----	Ellsworth.
Wyandotte Chemicals Corp.	1609 Biddle Ave. Wyandotte, Mich. 48192	Mine and plant.---	Norton.
Salt:			
American Salt Corp.-----	3142 Broadway Kansas City, Mo. 64111	Wells and under- ground.	Rice.
Barton Salt Co.-----	P.O. Box 1403 Hutchinson, Kans. 67501	Wells-----	Reno.
Carey Salt Co.-----	1800 Carey Blvd. Hutchinson, Kans. 67501	Well and under- ground.	Do.
Cargill, Inc.-----	Cargill Bldg. Minneapolis, Minn. 55402	Wells-----	Barton.
Independent Salt Company	Box 36 Kanopolis, Kans. 67454	Underground.-----	Ellsworth.
Morton Salt Co.-----	110 North Wacker Drive Chicago, Ill. 60606	Wells-----	Reno.
Vulcan Materials Co., Chemicals Div.	Box 545 Wichita, Kans. 67201	Brine wells-----	Sedgwick.
Sand and gravel:			
John H. Alsop Sand Co.---	Belleville, Kans. 66935	Stationary-----	Clay and Republic.
American Sand Co.-----	4600 Speaker Rd. Kansas City, Kans. 66106	Dredge-----	Wyandotte.
Consumers Sand Co.-----	924 West Railroad Street Topeka, Kans. 66088	Portable and 2 dredges.	Shawnee.
Holliday Sand & Gravel Co.	6811 West 63rd Street Overland Park, Kans. 66202	Stationary and portable.	Wyandotte, Johnson, Douglas.
Peck-Woolf Sand & Material Co.	7301 Kaw Dr. Kansas City, Kans. 66111	Dredge-----	Wyandotte.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
Salina Sand Co., Inc.-----	Mentor, Kans. 67465-----	Stationary-----	Saline.
San Ore Constr. Co., Inc.-----	Box 417 McPherson, Kans. 67460	Portable-----	Sherman and Ellis.
Superior Sand Co., Inc.-----	6500 West 21st, Route 7 Wichita, Kans. 67212	Dredge-----	Sedgwick.
Stone:			
Ash Grove Cement Co.-----	1000 Tenmain Center Kansas City, Mo. 64105	Quarry-----	Johnson and Neosho.
General Portland Cement Co.	2300 Republic Bank Tower Dallas, Tex. 75201	-----do-----	Wilson.
Hallett Construction Co.---	Crosby, Minn. 56441-----	-----do-----	McPherson and Rice.
N.R. Hamm Quarry, Inc.---	Box 17 Perry, Kans. 66073	-----do-----	Jefferson, Leaven- worth, Shawnee, Dickenson, Jack- son, Marion, Morris, Nemaha, Pottawatomie, Smith, Washing- ton.
Holland Quarries-----	9131 Noland Rd. Lenexa, Kans. 66215	-----do-----	Johnson.
Ideal Cement Co.-----	420 Ideal Cement Bldg. Denver, Colo. 80202	-----do-----	Jewell.
Lone Star Cement Corp.---	2511 East 46th St., Suite "K" Indianapolis, Ind. 46205	-----do-----	Wyandotte.
Midwest Minerals, Inc.---	Box 7 Girard, Kans. 66743	-----do-----	Various.
The Monarch Cement Co.---	Humboldt, Kans. 66748---	-----do-----	Allen.
Reno Construction Co.---	Box 4278 Overland Park, Kans. 66204	-----do-----	Johnson.
Thompson-Strauss Quarries.	7000 Holiday Dr. Kansas City, Kans. 66106	-----do-----	Wyandotte.
West-Lake Quarry & Material Co.	Rt. 1, Box 206 Taussig Rd. Bridgeton, Mo. 64302	-----do-----	Doniphan.
Helium:			
Alamo Chemical Co., Gardner Cryogenics, Inc.	Elkhart, Kans. 67950-----	Plant-----	Morton.
Cities Service Cryogenics, Inc.	Scott City, Kans. 67871---	-----do-----	Scott.
Cities Service Helix, Inc.---	Ulysses, Kans. 67880-----	-----do-----	Haskell.
Kansas Refined Helium Co.	Osita, Kans. 67565-----	-----do-----	Rush.
National Helium Corp.	Liberal, Kans. 67901-----	-----do-----	Seward.
Northern Helix Co.-----	Bushton, Kans. 67427-----	-----do-----	Rice.
Petroleum operators:			
Amoco Production Co.-----	Box 591 Tulsa, Okla. 74100	-----do-----	Various.
Cities Service Oil Co.-----	Tulsa, Okla. 74100-----	-----do-----	Do.
Continental Oil Co.-----	New York, N.Y. 10000-----	-----do-----	Do.
Derby Refining Co.-----	Wichita, Kans. 67200-----	-----do-----	Sedgwick.
National Cooperative Refinery Association.	McPherson, Kans. 67460---	-----do-----	Various.
Skelly Oil Co.-----	Tulsa, Okla. 74100-----	-----do-----	Do.
Texaco, Inc.-----	New York, N.Y. 10000-----	-----do-----	Do.
Petroleum refineries:			
American Petrofina Co. of Texas.	El Dorado, Kans. 67042---	Refinery-----	Butler.
Apeco Oil Corp.-----	Arkansas City, Kans. 67005-	-----do-----	Cowley.
CRA, Inc.-----	Coffeyville, Kans. 67337---	-----do-----	Montgomery.
	Philipsburg, Kans. 67661---	-----do-----	Phillips.
Derby Refining Co.-----	Wichita, Kans. 67200-----	-----do-----	Sedgwick.
Mid-American Refining Co., Inc.	Chanute, Kans. 66720-----	-----do-----	Neosho.
Mobil Oil Corp.-----	Augusta, Kans. 67010-----	-----do-----	Butler.
National Cooperative Refinery Association.	McPherson, Kans. 67460---	-----do-----	McPherson.
Phillips Petroleum Co.---	Kansas City, Kans. 66100---	-----do-----	Wyandotte.
Skelly Oil Co.-----	El Dorado, Kans. 67042---	-----do-----	Butler.
Southwestern Pallet	Scott City, Kans. 67871---	-----do-----	Scott.
Natural gas purchasers:			
Cities Service Gas Co.-----	Okla. City, Okla. 73100---	-----do-----	Various.
Colorado Interstate Gas Co.	Colorado Springs, Colo. 80900	-----do-----	Do.
Kansas-Nebraska Natural Gas Co.	Hastings, Nebr. 68901---	-----do-----	Do.
Northern Natural Gas Co.	Omaha, Nebr. 68100-----	-----do-----	Do.
Panhandle Eastern Pipeline Co.	Houston, Tex. 77000-----	-----do-----	Do.

The Mineral Industry of Kentucky

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

By H. L. Riley¹ and Preston McGrain²

The value of mineral production in Kentucky increased 9 percent above that of 1970, reaching a record high of \$926 million. In 1971, coal production accounted for 84 percent of this value. Kentucky ranked first in the United States in the production of bituminous coal with 22 percent of the national total. One hundred-nineteen million tons of bituminous coal valued at \$775 million was mined.

Government Programs.—The U.S. Geological Survey with the cooperation of the Kentucky Geological Survey continued to map the areal geology of the State on 7.5-minute quadrangle maps. A total of all or parts of 399 quadrangles have been published.

The Kentucky Geological Survey published six reports on geology and mineral resources.³

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³ Davis, R. W., T. W. Lambert, and A. J. Hansen, Jr. Water in the Economy of the Jackson Purchase Region of Kentucky. Kentucky Geol. Survey, Ser. 10, Spec. Pub. 20, 1971, 33 pp.

Dever, G. R., Jr. Oil and Gas Exploration Map, Bullitt County, Kentucky. Kentucky Geol. Survey, Ser. 10, scale 1:24,000, 1971.

McGrain, Preston. Economic Geology of Marshall County, Kentucky. Kentucky Geol. Survey, Ser. 10, County Rept. 5, 1970, 33 pp.

Geologic Mapping Provides Key to Environmental and Natural Resource Development in Kentucky. Kentucky Geol. Survey Ser. 10, 1971, 12 pp.

Mull, D. S., R. V. Cushman, and T. W. Lambert. Public and Industrial Water Supplies of Kentucky, 1968-69. Kentucky Geol. Survey, Ser. 10, Inf. Circ. 20, 1971, 107 pp.

Whitesides, D. V. Yields and Specific Capacities of Bedrock Wells in Kentucky. Kentucky Geol. Survey Ser. 10, Inf. Circ. 21, 1971, 18 pp.

Table 1.—Mineral production in Kentucky¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ².....thousand short tons..	1,020	\$1,793	956	\$1,377
Coal (bituminous).....do.....	125,305	711,163	119,339	774,735
Natural gas.....million cubic feet..	77,892	19,161	72,723	18,253
Petroleum (crude).....thousand 42-gallon barrels..	11,575	36,461	10,692	35,925
Sand and gravel.....thousand short tons..	8,760	10,474	8,202	11,061
Stone.....do.....	29,310	³ 45,208	³ 32,513	³ 52,296
Zinc.....short tons..	4,189	1,233	5,268	1,696
Value of items that cannot be disclosed: Ball clay, cement, fluor-spar, lime (1971), and natural gas liquids.....	XX	21,922	XX	30,542
Total.....	XX	847,465	XX	925,885
Total 1967 constant dollars.....	XX	758,057	XX	^p 804,409

^p Preliminary. NA Not available. XX Not applicable.

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

² Excludes ball clay, included with "Value of items that cannot be disclosed."

³ Excludes quartzite, included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Kentucky, by county ¹
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value ²
Adair	W	W	Petroleum, stone.
Allen	W	W	Stone, petroleum.
Anderson	W	W	Stone.
Ballard	\$10	(³)	Sand and gravel.
Barren	326	W	Stone, petroleum.
Bath	12	W	Do.
Bell	16,352	\$23,102	Coal, petroleum.
Boone	621	W	Sand and gravel, stone.
Bourbon	W	W	Do.
Boyd	W	1,155	Coal, clays, petroleum.
Boyle	W	W	Stone.
Breathitt	16,870	25,249	Coal, petroleum.
Breckinridge	W	508	Stone, petroleum, sand and gravel.
Bullitt	W	W	Stone, clays.
Butler	W	1,815	Coal, stone, petroleum.
Caldwell	W	W	Stone.
Calloway	61	202	Sand and gravel.
Carlisle	18	2	Do.
Carrroll	W	W	Do.
Carter	W	2,308	Coal, stone, clays.
Casey	W	382	Stone, petroleum.
Christian	W	2,962	Stone, coal, petroleum, clays.
Clay	3,478	5,035	Coal, petroleum.
Clinton	W	W	Coal, stone, petroleum.
Crittenden	W	W	Fluorspar, stone.
Cumberland	W	W	Petroleum, stone.
Daviess	W	10,111	Coal, petroleum, sand and gravel.
Edmonson	W	W	Coal, stone, petroleum.
Elliott	110	W	Petroleum, coal.
Estill	W	W	Petroleum, stone.
Fayette	W	W	Stone.
Fleming	W	W	Do.
Floyd	W	27,951	Coal, petroleum, sand and gravel.
Franklin	795	W	Stone.
Fulton	W	137	Sand and gravel.
Gallatin	W	W	Do.
Garrard	W	165	Stone.
Graves	W	W	Clays, sand and gravel.
Grayson	W	W	Stone.
Green	W	W	Stone, petroleum.
Greenup	W	358	Clays, stone, petroleum, sand and gravel.
Hancock	W	962	Coal, clays, petroleum.
Hardin	1,250	1,244	Stone.
Harlan	71,795	81,808	Coal, stone.
Harrison	W	W	Stone.
Hart	W	W	Stone, sand and gravel, petroleum.
Henderson	W	6,099	Petroleum, sand and gravel, coal.
Henry	W	W	Stone.
Hickman	W	(³)	Sand and gravel.
Hopkins	64,355	70,323	Coal, petroleum, sand and gravel.
Jackson	W	W	Coal, stone.
Jefferson	W	W	Cement, sand and gravel, stone, clays.
Jessamine	W	W	Stone, clays.
Johnson	12,239	15,249	Coal, petroleum.
Knott	22,697	25,487	Do.
Knox	4,878	8,859	Do.
Laurel	W	3,303	Coal, stone, petroleum.
Lawrence	2,461	2,530	Coal, petroleum.
Lee	W	6,112	Petroleum, stone, coal.
Leslie	17,666	12,776	Coal, petroleum.
Letcher	W	W	Coal, stone, petroleum.
Livingston	8,467	10,460	Stone, zinc, sand and gravel.
Logan	W	W	Stone, petroleum.
Lyon	5	W	Do.
McCracken	W	W	Sand and gravel.
McCreary	W	5,343	Coal, petroleum.
McLean	2,208	W	Do.
Madison	W	W	Stone.
Magoffin	W	5,341	Coal, petroleum.
Marion	W	238	Stone, petroleum.
Marshall	15	1,389	Stone, sand and gravel.
Martin	8,231	12,062	Coal, sand and gravel, petroleum.
Mason	W	W	Sand and gravel.
Meade	W	W	Stone.
Menifee	W	W	Do.
Mercer	W	W	Do.
Metcalfe	W	W	Petroleum, stone.
Monroe	W	308	Stone, petroleum.
Montgomery	105	172	Stone.
Morgan	W	4,960	Coal, stone, clays, petroleum.

See footnotes at end of table.

Table 2.—Value of mineral production in Kentucky, by county 1—Continued
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value ²
Muhlenberg	\$101,445	\$103,239	Coal, petroleum, stone.
Nelson	W	W	Stone.
Nicholas	W	W	Do.
Ohio	W	28,395	Coal, stone, petroleum.
Oldham	839	1,217	Stone.
Owsley	2	W	Coal, petroleum.
Pendleton	W	W	Lime, stone.
Perry	54,668	48,923	Coal, petroleum.
Pike	W	W	Coal, stone, petroleum.
Powell	W	W	Stone, petroleum, clays.
Pulaski	W	4,181	Coal, stone, petroleum.
Rockcastle	W	W	Stone, coal.
Rowan	W	W	Stone, clays.
Russell	1	(³)	Petroleum.
Scott	W	W	Stone.
Shelby	W	34	Do.
Simpson	W	W	Stone, petroleum.
Taylor	W	W	Do.
Todd	W	W	Do.
Trigg	W	W	Stone.
Trimble	W	W	Sand and gravel.
Union	W	21,460	Coal, petroleum, sand and gravel.
Warren	991	1,399	Stone, petroleum.
Washington	W	W	Stone.
Wayne	W	W	Stone, coal, petroleum.
Webster	8,157	8,384	Coal, petroleum.
Whitley	W	6,369	Coal, clays, petroleum.
Wolfe	259	481	Stone, petroleum, coal.
Undistributed ⁴	426,073	325,283	
Total	847,465	825,885	

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

¹ The following counties are not listed because no production was reported: Bracken, Campbell, Clark, Grant, Kenton, Laru, Lewis, Lincoln, Owen, Robertson, Spencer, and Woodford.

² Excludes natural gas and natural gas liquids; included with "Undistributed."

³ Less than ½ unit.

⁴ Includes natural gas, natural gas liquids, and values indicated by symbol W.

⁵ Data may not add to total shown because of independent rounding.

Trends and Developments.—Personal per capita income increased 7 percent. Although Kentucky ranks 44th in per capita income, it is sixth in the 12-state southeastern region. Service employment increased 1 percent. Value of mineral pro-

duction increased 9 percent, primarily due to the increased coal value. Electrical energy sales, other than to the Atomic Energy Commission, increased 6 percent.

Kentucky Utilities Co. (KU) placed the 427,000-kilowatt No. 3 unit at the E. W.

Table 3.—Indicators of Kentucky business activity

	1970	1971 ^p	Change, percent	
Employment and labor force, annual average:				
Total nonagricultural employment	thousands	914	934	+2.2
Mining	do	28	31	+10.7
Contract construction	do	49	46	-6.1
Service	do	137	139	+1.5
Government	do	174	180	+3.4
Manufacturing	do	251	254	+1.2
Personal income:				
Total	millions	\$9,901	\$10,792	+9.0
Per capita	do	\$3,071	\$3,288	+7.1
New business incorporations	do	3,747	4,200	+12.1
Construction activity:				
Housing units—private and public:				
Number	do	17,660	24,211	+37.1
Value of nonresidential construction	millions	\$128	\$105	-18.0
Mineral production value	do	\$847	\$926	+9.3
Electrical energy sales (sales to AEC excluded)	million kilowatt-hours	14,902	15,826	+6.2

^p Preliminary. ^r Revised.

Sources: Kentucky Department of Labor, Division of Research and Statistics; Survey of Current Business; Kentucky Economic Outlook, Kentucky Department of Labor; Construction Review; U.S. Bureau of Mines.

Brown powerplant in commercial operation. The construction cost was approximately \$58 million. This raises KU's electric generating capacity to 1,215,000 kilowatts. KU announced additional plans for a \$50 million construction program including air pollution equipment and erection of transmission lines and substations.

The Kentucky Rural Electric Cooperative Corp. has under construction a \$100 million

coal-fired electric generating plant near Maysville, in Mason County.

Duke Power Co., Charlotte, N. C., acquired Belcoal Co., including coal leases in Bell and Knox Counties. The transaction reportedly involved Duke Power Co. stock valued at just over \$3.6 million and was designed to assure coal supplies for the utility's coal-fired electric generating plants.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Coal.....	25,915	201	5,207	41,714	88	1,883	47.25	14,571
Metal.....	33	232	9	74	--	7	94.12	417
Nonmetal.....	305	216	66	533	--	16	30.01	962
Sand and gravel.....	363	272	99	860	--	25	29.09	575
Stone.....	2,079	242	504	4,234	1	111	26.45	2,529
Total ¹	28,695	205	5,885	47,416	89	2,042	44.94	13,067
1971: ^p								
Coal.....	25,300	202	5,130	42,997	43	1,990	47.26	7,979
Metal.....	25	326	8	63	--	8	127.85	3,308
Nonmetal.....	530	236	125	1,002	--	54	53.92	1,262
Sand and gravel.....	375	268	101	904	1	21	24.33	7,050
Stone.....	2,255	260	585	5,006	1	195	39.16	2,183
Total ¹	28,520	209	5,948	49,971	45	2,268	46.27	7,241

^p Preliminary.

¹ Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal deliveries to the Tennessee Valley Authority's (TVA) steam electric generating plants during TVA's 1971 fiscal year included 22.4 million tons from western Kentucky and 4.6 million tons from eastern Kentucky.

National Steel Corp. acquired the coal lands and coal leases owned by Evans Industries and its associated companies in eastern Kentucky. The acquisition approximately doubles the quantity of National Steel Corp.'s holdings in this area. The company now controls almost 130,000 acres of land containing high-grade metallurgical coal and low-sulfur steam coal in eastern Kentucky. The acquisition included Beaver Creek Consolidated Coal Co., Inc., and the new Stinson coal preparation plant in Knott County.

The State Strip Mining and Reclamation Division of the Kentucky Department of

Natural Resources reported 23,000 acres of coal-bearing lands were strip mined in Kentucky, compared with 13,000 acres in 1969.

Coal (Bituminous).—Production of coal decreased 5 percent, and its value increased 9 percent compared with 1970 data. Coal production was 119 million tons valued at \$775 million for an average value of \$6.49 per ton compared with \$5.68 per ton in 1970. Bituminous coal was produced at 1,745 mines in 42 counties compared with 1,721 mines in 38 counties in 1970. Muhlenberg and Pike Counties produced 23.3 and 20.1 million tons of coal, respectively.

In eastern Kentucky, 1,625 mines in 30 counties produced 71.6 million tons of coal valued at \$7.60 per ton, compared with 1,623 mines in 28 counties that produced 72.5 million tons valued at \$6.73 per ton in 1970. Pike County's production was the

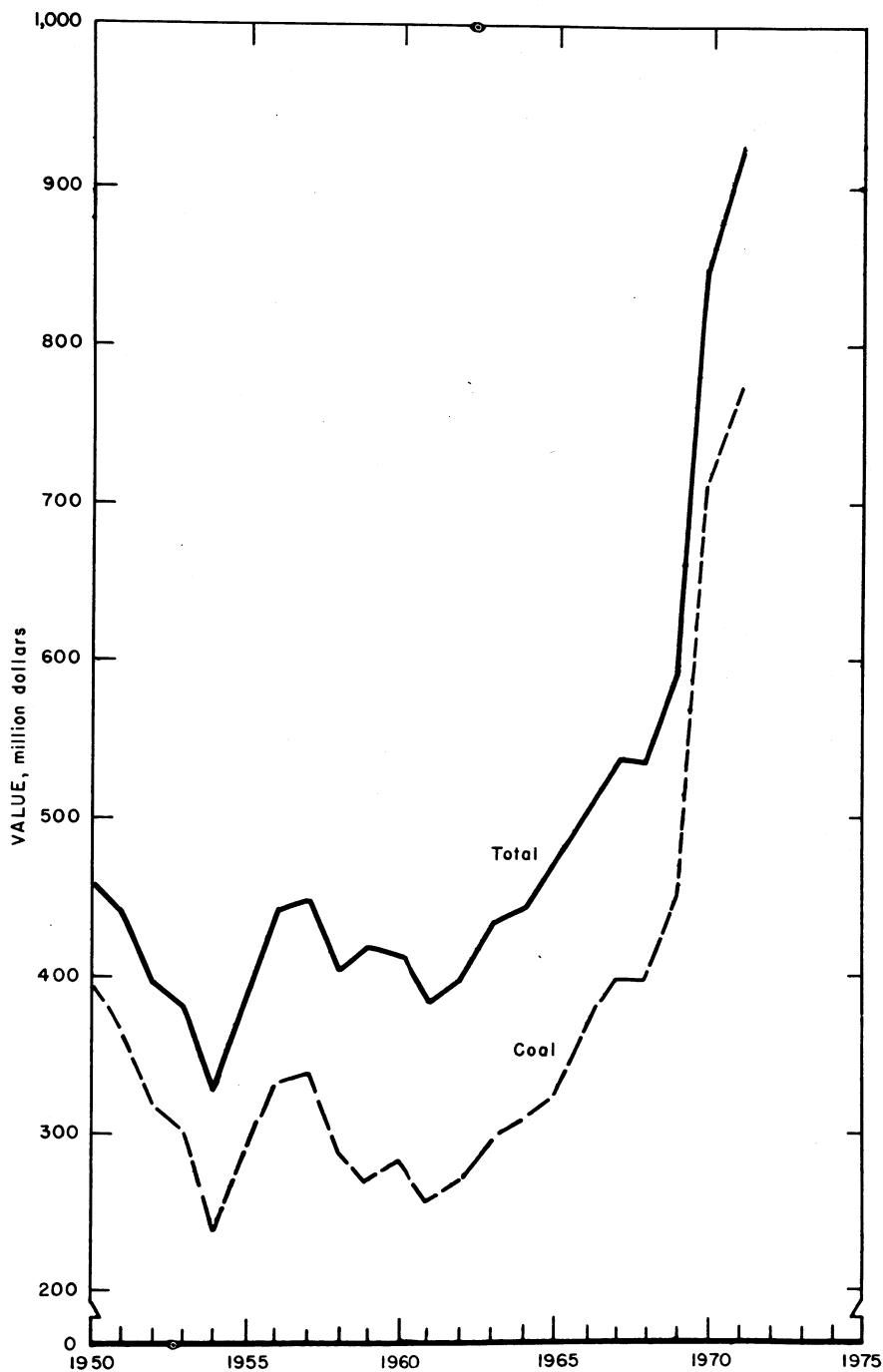


Figure 1.—Value of coal and total value of mineral production in Kentucky.

largest of all eastern Kentucky counties. Eight hundred and forty underground mines produced 37.4 million tons or 52 percent of the coal mined in eastern Kentucky. Strip-mined coal was 25.0 million tons or 35 percent of the total coal produced. Auger-mined coal was 13 percent of the total.

Of the total coal produced in eastern Kentucky, 31 percent was crushed, and 27 percent was cleaned at 32 coal-cleaning plants. Shipments were 92 percent by rail

and the balance by truck. Unit trains carried 16 percent of the coal produced.

In the western Kentucky coalfield, 120 mines in 12 counties produced 47.8 million tons of coal valued at \$4.88 per ton compared with 98 mines in 10 counties, which mined 52.8 million tons valued at \$4.22 per ton in 1970. Eighty-five strip mines, produced about 67 percent of the coal, and 27 underground mines, 33 percent. Auger mining produced less than 1/2 of 1 percent. Of the total coal produced in the western

Table 5.—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	
Eastern:									
Bell.....	20	31	22	73	545	2,676	457	3,678	\$23,102
Boyd.....	---	5	2	7	---	157	13	170	1,090
Breathitt.....	2	21	18	41	26	2,526	1,321	3,873	25,195
Carter.....	---	11	3	14	---	223	34	257	1,234
Clay.....	17	20	11	48	147	474	185	806	5,015
Clinton.....	1	1	---	2	32	257	---	289	W
Elliott.....	---	3	---	3	---	11	---	11	W
Floyd.....	138	15	10	163	2,478	1,582	410	4,470	27,846
Harlan.....	77	36	30	143	6,861	1,079	789	8,729	81,530
Jackson.....	---	4	1	5	---	18	2	20	W
Johnson.....	21	13	4	38	228	2,298	230	2,756	14,560
Knott.....	59	28	14	101	2,166	1,142	499	3,807	25,463
Knox.....	14	50	6	70	40	1,216	59	1,315	8,849
Laurel.....	---	22	2	24	---	470	4	474	3,112
Lawrence.....	---	10	7	17	---	260	74	334	1,975
Lee.....	1	2	---	3	20	11	---	31	W
Leslie.....	15	17	8	40	1,140	549	166	1,855	12,769
Letcher.....	101	55	24	180	3,420	1,752	918	6,090	53,804
McCreary.....	7	3	---	10	574	133	---	707	5,336
Magoffin.....	---	9	3	12	---	806	53	859	4,548
Martin.....	6	11	5	22	1,118	614	155	1,887	11,970
Morgan.....	---	6	---	6	---	449	---	449	4,301
Owsley.....	---	1	---	1	---	28	---	28	W
Perry.....	39	51	22	112	2,851	2,732	1,576	7,159	48,349
Pike.....	309	64	50	423	15,494	2,532	2,060	20,086	172,329
Pulaski.....	2	4	2	8	6	347	26	379	2,626
Rockcastle.....	---	2	---	2	---	6	---	6	W
Wayne.....	---	1	---	1	---	11	---	11	W
Whitley.....	11	30	11	52	208	609	201	1,018	6,309
Wolfe.....	---	2	2	4	---	13	3	16	W
Undistributed ¹	---	---	---	---	---	---	---	---	2,648
Total.....	840	528	257	1,625	37,354	24,981	9,235	71,570	543,960
Western:									
Butler.....	2	3	---	5	64	161	---	225	1,258
Christian.....	---	8	---	8	---	166	---	166	954
Daviess.....	---	1	---	1	---	1,094	---	1,094	W
Edmonson.....	---	2	---	2	---	353	---	353	W
Hancock.....	---	1	---	1	---	73	---	73	W
Henderson.....	2	---	---	2	62	---	---	62	344
Hopkins.....	10	30	5	45	6,250	5,650	130	12,030	67,539
McLean.....	---	3	---	3	---	544	---	544	W
Muhlenberg.....	5	21	3	29	4,058	19,223	40	23,321	101,539
Ohio.....	1	14	---	15	1,432	4,438	---	5,870	25,834
Union.....	6	---	---	6	2,947	---	---	2,947	15,954
Webster.....	1	2	---	3	1,050	84	---	1,134	6,197
Undistributed ¹	---	---	---	---	---	---	---	---	11,155
Total.....	27	85	8	120	15,863	31,786	170	47,819	230,774
Grand total.....	867	613	265	1,745	53,217	56,767	9,405	119,389	774,734

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

¹ Includes value represented by symbol W.

Kentucky coalfield, 72 percent was crushed, and 36 percent was cleaned at 18 cleaning plants. Coal shipments were 81 percent by rail and water. Sixteen percent of shipments were reported to be by unit train, the same percentage as reported from the eastern Kentucky coalfield. Sixteen percent of production was used in mine-mouth steam

electric generating plants. All coal was sold on the open market. All reported production was mechanically loaded.

Natural Gas.—Marketable production of natural gas decreased from 77,892 million cubic feet valued at \$19,161,000 in 1970 to 72,723 million cubic feet valued at \$18,253,000 in 1971. Marketable production

Table 6.—Crude petroleum production, by county
(Thousand 42-gallon barrels and thousand dollars)

County	1970	1971
Adair	276	368
Allen	47	39
Barren	10	12
Bath	4	3
Bell	(¹)	(¹)
Boyd	2	1
Breathitt	22	16
Breckinridge	13	13
Butler	54	47
Casey	15	9
Christian	175	173
Clay	9	6
Clinton	29	27
Cumberland	24	24
Daviess	968	887
Edmonson	(¹)	1
Elliott	35	32
Estill	231	189
Floyd	30	27
Green	71	63
Greenup	2	1
Hancock	72	72
Hart	15	15
Henderson	1,731	1,443
Hopkins	791	828
Johnson	277	205
Knott	8	7
Knox	2	3
Laurel	2	2
Lawrence	236	180
Lee	1,486	1,622
Leslie	2	2
Letcher	284	226
Logan	3	1
McCreary	(¹)	2
McLean	585	551
Magoffin	286	236
Marion	-	(¹)
Martin	10	11
Metcalfe	85	71
Monroe	22	19
Morgan	1	3
Muhlenberg	346	300
Ohio	385	329
Owsley	1	1
Perry	199	171
Pike	29	28
Powell	33	33
Pulaski	2	1
Russell	(¹)	(¹)
Simpson	(¹)	(¹)
Taylor	(¹)	(¹)
Todd	-	1
Union	1,905	1,631
Warren	22	20
Wayne	8	8
Webster	687	651
Whitley	11	9
Wolfe	16	55
Total	211,575	10,692
Value	\$36,461	\$35,925

¹ Less than ½ unit.

² Data may not add to total shown because of independent rounding.

Sources: Quantity—Kentucky Geological Survey. Value—Bureau of Mines.

Table 7.—Oil and gas well drilling completions in 1971, by county

County	Proved field wells ¹			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Adair.....	52	1	17	7	--	19	96	148,075
Allen.....	7	--	5	1	--	8	21	6,198
Barren.....	2	--	5	2	--	3	12	5,195
Boyd.....	--	3	1	--	--	--	4	12,113
Breathitt.....	--	2	3	--	--	--	5	8,752
Breckinridge.....	--	--	3	--	--	1	4	1,423
Butler.....	1	--	1	--	--	1	3	1,522
Carlisle.....	--	--	--	--	--	1	1	702
Casey.....	--	1	3	1	--	4	8	3,524
Christian.....	2	1	6	--	--	3	12	7,653
Clay.....	--	3	2	--	--	--	5	6,422
Clinton.....	3	--	2	1	--	2	8	7,726
Cumberland.....	6	--	10	1	--	9	26	18,892
Davies.....	12	1	16	--	--	9	38	49,176
Edmonson.....	--	--	--	--	--	1	1	1,848
Elliott.....	1	--	2	--	--	--	3	2,010
Estill.....	2	--	--	--	--	1	3	2,855
Floyd.....	--	5	3	--	--	--	8	21,068
Garrard.....	--	--	--	--	--	2	2	2,491
Green.....	6	--	--	--	1	2	9	4,738
Hancock.....	4	--	11	--	--	14	29	22,668
Hardin.....	--	1	1	--	--	6	8	9,586
Hart.....	2	--	--	--	--	4	6	6,681
Henderson.....	1	--	5	--	--	4	10	24,523
Hopkins.....	8	15	15	1	4	15	58	126,322
Johnson.....	--	3	2	--	--	2	7	17,566
Knott.....	--	5	2	--	--	--	7	13,951
Knox.....	1	1	2	--	1	3	8	13,786
Larue.....	--	--	--	--	--	1	1	545
Lawrence.....	5	7	1	--	--	2	15	39,610
Lee.....	13	--	--	--	--	--	13	15,305
Leslie.....	--	3	2	--	--	--	5	11,178
Letcher.....	--	12	2	--	1	2	17	57,878
Logan.....	--	--	--	--	--	1	1	1,692
McCreary.....	--	--	--	1	--	3	4	4,778
McLean.....	7	--	4	1	1	2	15	22,602
Madison.....	--	--	--	--	--	1	1	1,424
Magoffin.....	1	1	--	--	--	--	2	1,641
Marion.....	4	--	--	1	--	--	5	656
Martin.....	--	11	2	--	--	--	13	34,121
Meade.....	--	2	--	--	--	--	2	947
Metcalfe.....	3	--	4	--	--	9	16	6,872
Monroe.....	13	--	12	--	--	1	26	11,816
Morgan.....	1	1	--	1	--	--	3	12,783
Muhlenberg.....	15	2	17	2	--	7	43	31,018
Ohio.....	9	3	24	1	2	16	55	49,191
Perry.....	2	23	3	--	2	--	30	92,415
Pike.....	1	15	2	1	--	1	20	77,480
Powell.....	1	--	--	--	--	--	1	939
Russell.....	--	--	--	1	--	1	2	2,303
Simpson.....	4	--	3	--	--	1	8	4,911
Union.....	5	--	9	--	--	--	14	25,454
Warren.....	1	--	2	--	--	1	4	3,123
Wayne.....	--	--	2	--	--	--	2	546
Webster.....	17	--	7	--	--	4	28	63,188
Whitley.....	--	1	--	--	--	--	1	1,000
Wolfe.....	9	1	2	--	--	--	12	14,737
Total.....	221	123	215	23	12	167	761	1,137,624

¹ Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

decreased 7 percent, and total value decreased 5 percent. The average wellhead value in 1970 was 24.6 cents, and in 1971, 25.1 cents per million cubic feet. The number of gas wells producing at yearend was reported to be 7,413 wells.

Natural Gas Liquids.—The quantity and value of natural gasoline and cycle products

decreased 38 and 42 percent, respectively. Production of liquified petroleum gases (LPG) and ethane decreased 8 percent; value increased 18 percent.

Petroleum.—Crude oil production overall has decreased since 1959, the record year. Crude oil production in 1971 declined to 10,692,000, 42-gallon barrels valued at

\$35,925,000, a reduction of 8 percent in volume and 2 percent in value from the previous year.

The number of oil wells producing at yearend was 14,657. The crude production by county is listed in table 6. The number of oil and gas wells and the footage drilled are shown in table 7. A total of 221 proved field oil wells and 123 proved field gas wells were drilled during 1971.

NONMETALS

Nonmetals provided 9 percent of the total value of mineral production in Kentucky in 1971.

Cement.—Kosmos Portland Cement Co., subsidiary of The Flintkote Co., operated in Jefferson County; it is the State's only cement plant. Most of the cement shipped was used by contractors as ready-mix concrete products and other masonry building materials. Raw materials used in making portland cement included limestone, clay, gypsum, and iron-bearing materials.

Portland cement consumed in the State totaled 5,762,000 barrels of 376-pounds each. Masonry cement consumption was 694,000 barrels of 280-pound each.

Clays.—Three companies mined ball clay from seven open pits in Graves County. These companies mined, processed, and packaged or shipped bulk ball clay to manufacturers of pottery ware, floor and

wall tile, paper fillers, refractory saggars, and refractory mortars, and firebrick.

Fire Clay.—Twelve companies produced 113,000 tons of fire clay valued at \$533,000 from Greenup, Carter, Rowan, Morgan, and Graves Counties. Most of the clay was used to manufacture firebrick and other refractories.

Common Clay and Shale.—Eight hundred and forty-three thousand tons of common clay and shale valued at \$844,000 was mined by 17 companies from 23 open pit mines in 12 counties. Production decreased 2 percent, and value decreased 11 percent. Most of the clay and shale was used in the manufacture of building brick and heavy clay products such as sewer pipe, lightweight aggregates, and cement.

Fluorspar.—Three mines produced fluorspar in Crittenden County. Most of the fluorspar produced was used in the manufacture of hydrofluoric acid.

Exploratory drilling has been done by a joint venture of several companies controlling 11,000 acres of mineral leases in Caldwell, Crittenden, Livingston, and Lyon Counties.

Graphite (Artificial).—Graphite was manufactured in Fulton County for use in manufacturing anodes and electrodes.

Lime.—Black River Mining Co. constructed a new plant at Carntown, in Pendleton County, and produced quicklime for

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

(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Ballard.....	1	19	\$10	1	6	(1)
Boone.....	3	578	621	4	850	\$965
Breckinridge.....	1	48	47	1	55	52
Calloway.....	2	51	61	2	76	202
Carlisle.....	1	35	18	1	24	2
Fulton.....	--	W	W	2	84	137
Graves.....	1	75	38	--	W	W
Hickman.....	--	W	W	1	7	(1)
Jefferson.....	4	2,502	2,764	3	2,004	3,087
Lyon.....	1	10	5	--	--	--
Marshall.....	1	30	15	1	5	(1)
Martin.....	1	36	53	--	W	W
Union.....	--	W	W	1	24	26
Various.....	--	--	--	--	24	24
Undistributed ²	23	5,376	6,844	26	5,042	6,566
Total ³	39	8,760	10,474	43	8,202	11,061

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

¹ Less than 1/2 unit.

² Includes Carroll (1970), Daviess, Floyd, Gallatin, Greenup (1971), Hart, Henderson, Livingston, McCracken, Mason, and Trimble Counties.

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

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

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	3,516	\$4,409	3,564	\$5,027
Fill.....	942	813	971	873
Paving.....	2,332	2,691	1,784	2,303
Other uses ¹	W	W	78	817
Total ²	W	W	6,397	8,520
Gravel:				
Building.....	578	806	820	1,271
Fill.....	39	39	18	20
Paving.....	1,032	1,454	782	1,197
Railroad ballast.....	30	51	—	—
Other uses ³	W	W	15	16
Total ²	W	W	1,634	2,503
Government-and-contractor operations:				
Sand: Fill.....				
	--	--	24	24
Gravel:				
Fill.....	1	(⁴)	2	1
Building.....	238	101	145	13
Total.....	239	101	147	14
Total sand and gravel ²	8,760	10,474	8,202	11,061

W Withheld to avoid disclosing individual company confidential data; included with "Total sand and gravel."

¹ Includes blast, engine (1970), foundry, railroad ballast, fire or furnace and other sands.

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

³ Includes miscellaneous and other gravel.

⁴ Less than ½ unit.

use in steel furnaces and for water purification. The lime was consumed in Ohio, Kentucky, and other States.

Perlite.—Crude perlite mined in the western States was expanded at plants in Boone and Campbell Counties for use in industrial board, soil conditioning, and building plaster. Shipments and value were substantially the same as those in 1970.

Sand and Gravel.—Commercial and government contracted sand and gravel was mined by 38 operators at 43 operations in 22 counties. A total of 6,421,000 tons of sand valued at \$8,544,000 and 1,781,000 tons of gravel valued at \$2,517,000 was mined. Total production of sand and gravel decreased 6 percent; total value increased 6 percent. End uses were primarily building and paving. Transportation of commercial production was 83 percent by truck, 13 percent by waterway, 2 percent by rail; the balance of 2 percent was not reported.

Stone.—Crushed limestone production increased 7 percent; and the value increased 13 percent. Seventy-seven producers, including one federal and two county agencies, mined and crushed limestone at 125 quar-

ries and underground mines. Of the total stone produced, 70 percent was used for concrete and roads, 6 percent for aglime, and 24 percent for other uses. Shipments of crushed stone were 82 percent by truck, 12 percent by waterway, and 4 percent by railroad; 2 percent was not reported.

Quartzite was mined and crushed near Smithland in Livingston County for use in the manufacture of ferrosilicon.

Vermiculite.—Crude vermiculite mined in other States was exfoliated at plants in Boone and Campbell Counties. Shipments increased 12.5 percent, and value increased 19 percent. The product was used for loose fill insulation, in horticulture, in lightweight concrete, and as plaster aggregate.

METALS

The value of metallic ores was less than ½ of 1 percent of total value of mineral production.

Aluminum-Primary.—The National Southwire Aluminum Co. smelted alumina at a plant near Hawesville. Production and value approximately doubled.

Table 10.—Crushed limestone sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Barren	1	173	\$294	1	W	W
Bath	1	--	--	1	144	W
Bourbon	1	177	W	--	--	--
Carter	4	1,267	1,944	4	571	\$890
Casey	1	W	W	1	195	352
Christian	3	1,124	1,519	3	1,019	1,426
Franklin	3	765	795	2	W	W
Garrard	1	88	W	1	97	165
Grayson	1	228	W	1	W	W
Hardin	5	763	1,250	5	800	1,244
Hart	1	W	W	1	198	W
Jackson	2	75	W	2	W	W
Jefferson	4	1,443	2,150	5	1,828	3,049
Livingston	3	W	W	7	4,447	6,307
Marion	2	W	W	1	118	238
Marshall	--	--	--	3	694	1,389
Menifee	1	W	W	1	143	W
Monroe	1	W	228	1	W	244
Montgomery	1	W	105	1	119	173
Morgan	4	378	610	4	360	630
Oldham	3	544	839	4	806	1,217
Trigg	1	W	W	1	201	W
Warren	4	639	921	4	809	1,332
Wolfe	1	105	157	1	W	W
Undistributed ¹	70	21,492	34,396	70	18,807	32,313
Total	118	29,261	45,208	125	31,358	50,969

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

¹ Includes Adair, Allen, Anderson, Boyle, Breckinridge, Bullitt, Butler, Caldwell, Clinton, Crittenden, Cumberland, Edmonson, Estill, Fayette, Fleming, Green, Greenup, Harlan, Harrison, Henry, Jessamine, Laurel, Lee, Letcher, Logan, Madison, Meade, Mercer, Metcalfe, Muhlenberg, Nelson, Nicholas, Ohio, Pendleton, Pike, Powell, Pulaski, Rockcastle, Rowan, Scott, Simpson, Taylor, Todd, Washington, and Wayne Counties.

² Data may not add to total shown because of independent rounding.

Table 11.—Crushed limestone sold or used by producers, by use
(Thousand short tons and thousand dollars)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Bituminous aggregate	2,771	\$4,436	3,417	\$5,887
Concrete aggregate	2,566	3,791	4,398	7,237
Dense-graded road base stone	12,432	19,932	8,427	13,625
Macadam aggregate	1,389	2,054	1,168	2,046
Surface treatment aggregate	1,064	1,707	1,419	2,436
Unspecified aggregate and roadstone	1,847	2,762	3,090	5,031
Agricultural limestone	1,883	3,303	1,779	3,046
Railroad ballast	404	560	312	425
Riprap and jetty stone	2,994	3,618	3,409	4,677
Other uses ¹	1,912	3,045	3,938	6,506
Total ²	29,261	45,208	31,358	50,969

¹ Includes stone sand, cement, fill, mine dusting, building products, other uses not listed or unspecified, also, ferrosilicon acid neutralizers and lime (1970), and flux (1971).

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

Ferroalloys.—Ferroalloy shipments increased 25 percent, and the value increased 30 percent. The ferroalloys were used primarily in steel manufacture.

Pig Iron.—Production of pig iron declined 5 percent, and total value increased 9

percent. Armco Steel Corp. produced basic and foundry pig iron at its Ashland plant.

Zinc.—Production of zinc sulfide increased 26 percent. The zinc concentrates were shipped to smelters at Bartlesville, Okla., and Amarillo, Tex.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum, primary:			
National-Southwire Aluminum Co.	P.O. Box M Hawesville, Ky. 42348	Smelter	Hancock.
Cement, masonry and portland:			
Kosmos Portland Cement Co., Div. of The Flintkote Co.	Dixie Highway Kosmosdale, Ky. 40272	Plant	Jefferson.
Clays:			
Ball:			
Bell City Pottery	Route 1 Farmington, Ky. 42040	Open pit mine and plant.	Graves.
Kentucky-Tennessee Clay Co.	Box 77 Mayfield, Ky. 42066	3 open pit mines and plant.	Do.
Old Hickory Clay Co.	Box 271 Paducah, Ky. 42351	2 open pit mines	Do.
Fire:			
Ford Burchett Clay Co.	Olive Hill, Ky. 41164	Open pit mine	Carter.
Burge & Fultz Clay Co.	Route 2 Olive Hill, Ky. 41164	do	Do.
General Refractories Co.	1520 Locust St. Philadelphia, Pa. 19102	4 open pit mines and plant.	Carter and Rowan.
M. A. McCoy & Son	Oak Hill, Ohio 45656	2 open pit mines	Greenup.
Miscellaneous:			
American Olean Tile Co.	Lewisport, Ky. 42351	Open pit mine and plant.	Hancock.
General Shale Products Co.	Johnson City, Tenn. 37601	do	Jefferson.
Harsco Corp.	4th & Washington St. Cannelton, Ind. 47520	2 open pit mines	Hancock.
Kosmos Portland Cement Co., Div. of The Flintkote Co.	Dixie Highway Kosmosdale, Ky. 40272	Open pit mine	Jefferson.
Martin Marietta, Kenlite Div.	129 River Road Louisville, Ky. 40202	Open pit mine and plant.	Bullitt.
Owensboro Brick & Tile Co.	Ewing Road Owensboro, Ky. 42302	do	Hancock.
Coal:			
Ayrshire Coal Co.	105 S. Meridan St. Indianapolis, Ind. 46225	1 strip mine	Muhlenberg.
Beth-Elkhorn Corp.	701 E. Third St. Bethlehem, Pa. 18016	3 underground mines.	Letcher and Pike.
Gibraltar Coal Co.	150 S. Meridan St. Indianapolis, Ind. 46225	Strip mine	Muhlenberg.
Island Creek Coal Co.	Wheelwright, Ky. 41669	5 underground mines.	Floyd.
Do.	444 S. Main St. Madisonville, Ky. 42431	8 underground mines.	Hopkins, Muhlenberg, Union.
Do.	Holden, W. Va. 25625	3 underground mines.	Pike.
Peabody Coal Co.	301 N. Memorial Dr. St. Louis, Mo. 63102	2 underground and 6 strip mines.	Muhlenberg and Ohio.
Pittsburgh and Midway Coal Min- ing Co.	Ten Main Center Kansas City, Mo. 64105	2 underground and 2 strip mines.	Hopkins and Muhlenberg.
United States Steel Corp.	525 William Penn Place Pittsburgh, Pa. 15230	3 underground and 1 auger mine.	Harlan.
Coke:			
Chemical Coke Co.	Dawson Springs, Ky. 42408	Plant	Hopkins.
Hooker Chemical Co.	Box 33 South Shore, Ky. 41175	do	Greenup.
Semet-Solvay Div. of Allied Chemi- cal Corp.	40 Rector St. New York, N.Y. 10006	do	Boyd.
Ferroalloys: Airco Alloys and Carbide	Box 217 Calvert City, Ky. 42029	do	Marshall.
Fluorspar:			
Calvert City Chemical Co.	Box 305 Calvert City, Ky. 42029	Underground mine and mill.	Crittenden and Livingston.
Minerva Oil Co.	Eldorado, Ill. 62930	Underground mine.	Crittenden.
Kentucky Fluorspar Co.	Marion, Ky. 42064	Underground mine and mill.	Do.
Graphite, artificial:			
Carborundum Co.	Hickman, Ky. 42050	Plant	Fulton.
Iron, pig:			
Armco Steel Corp.	Middletown, Ohio 45042	do	Boyd.
Natural gas:			
Processors:			
Columbia Hydrocarbon Corp.	South Shore, Ky. 41175	Processing plant	Greenup.
Kentucky Hydrocarbon Corp.	Box 128 Langley, Ky. 41645	do	Floyd.
Kentucky-West Virginia Gas Co.	Allen, Ky. 41601	do	Do.
Tennessee Gas Pipeline Co.	Box 7 Greensburg, Ky. 42743	do	Green.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Natural gas—Continued			
Producers:			
Inland Gas Co.....	340 17th St. Ashland, Ky. 41101	Natural gas wells.	Variouis.
Kentucky-West Virginia Gas Co.....	Second National Bank Bldg. Ashland, Ky. 41101	.....do.....	Do.
Petroleum Exploration Co.....	Leeco Road Leeco, Ky. 41313	.....do.....	Do.
Texas Gas Transmission Co.....	Owensboro, Ky. 42301	.....do.....	Do.
United Fuel Gas Co.....	Box 1273 Charleston, W. Va. 25325	.....do.....	Do.
Perlite, expanded:			
Grefco, Inc.....	Box 35 Florence, Ky. 41042	Plant.....	Boone.
W. R. Grace & Co.....	62 Whittemore Ave. Cambridge, Mass. 02140	.....do.....	Campbell.
Petroleum:			
Producers:			
Ashland Oil Refining Co.....	1409 Winchester Ave. Ashland, Ky. 41101	Crude oil wells...	Variouis.
Har-Ken Oil Co.....	Box 616 Owensboro, Ky. 42301	.....do.....	Do.
Humble Oil and Refining Co.....	2010 W. Ohio St. Evansville, Ind. 47712	.....do.....	Do.
Sinclair Oil and Gas Co.....	300 Fidelity National Bank Bldg. Oklahoma City, Okla. 73102	.....do.....	Do.
Sun Oil Co.....	Box 5026, Lawnsdale Evansville, Ind. 47715	.....do.....	Do.
Refineries:			
Ashland Oil and Refining Co.....	1409 Winchester Ave. Ashland, Ky. 41101	Refinery.....	Boyd.
Kentucky Oil and Refining Co.....	Box 325 Betsy Layne, Ky. 41605	.....do.....	Floyd.
Louisville Refining Co.....	1300 S. Western Parkway Louisville, Ky. 40212	.....do.....	Jefferson.
The Somerset Refinery, Inc.....	520 Monticello St. Somerset, Ky. 42501	.....do.....	Pulaski.
Sand and gravel:			
Evansville Materials, Inc.....	624 NW. Riverside Dr. Evansville, Ind. 47708	Dredge.....	Henderson.
Ingram Materials, Inc.....	Box 1049 4304 Harding Road Nashville, Tenn.	.....do.....	Livingston.
Nugent Sand Co.....	Box 6072 Louisville, Ky. 40206	.....do.....	Jefferson.
Ohio River Sand Co., Inc.....	129 River Road Louisville, Ky. 40206	.....do.....	Do.
Standard Materials Corp.....	11 N. Penn St. Indianapolis, Ind. 46204	Open pit mine and plant.	Trimble.
Stone:			
Limestone, crushed:			
Ken-mor Stone, Inc.....	Box 482 Georgetown, Ky. 40324	5 quarries and plants.	Carter, Morgan, Rowan.
Kentucky Stone Co., Subsidiary of Koppers Co.....	400 Sherburn Lane Louisville, Ky. 40207	5 underground mines, 7 quarries and plants.	Variouis.
Martin Marietta Corp., Apple Stone Div.....	4096 First Ave., N.E. Cedar Rapids, Iowa 52406	5 quarries and plants.	Boone and Jefferson.
Reed Crushed Stone Co., Inc.....	Box 35 Gilbertsville, Ky. 42044	1 quarry and plant.	Livingston.
Three Rivers Rock Co.....	Box 218 Smithland, Ky. 42081	.....do.....	Do.
Vulcan Materials Co.....	Box 7 Knoxville, Tenn. 37901	3 quarries and plants.	Fayette and Jefferson.
Quartzite:			
Industrial Minerals Co., Inc.....	Salem, Ky. 42078.....	1 quarry and plant.	Livingston.
Vermiculite, exfoliated:			
W. R. Grace & Co.....	62 Whittemore Ave. Cambridge, Mass. 02140	Plant.....	Campbell.

The Mineral Industry of Louisiana

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

By David A. Carleton ¹ and Leo H. Hough ²

Louisiana mineral output continued to increase as the value of mineral production amounted to \$5,553 million, up 8.8 percent from the previous year. Because of abundant supplies of petroleum and natural gas, the State maintained its second-place ranking in domestic mineral production value. The mineral fuels (crude petroleum, natural gas, and natural gas liquids) provided 96 percent of the total value of mineral production.

According to the American Petroleum Institute (API), reserves of crude petroleum declined for the first time since 1940 to a total of 5,399 million barrels at year-end 1971. Additions to reserves by finding new fields, field extensions, and upward revisions of known reservoirs were not able to keep pace with withdrawals. The net reduction in proved reserves was 311 mil-

lion barrels, a 5.5-percent decline. Following the trend established in 1969, proved reserves of natural gas and natural gas liquids both declined for the third consecutive year. Characteristically, the net loss in reserves was shared about equally between nonassociated and associated dissolved natural gas reservoirs.

Trends and Developments.—The Louisiana Petroleum Council reported that petroleum revenues yield one-half of the State's income. In the 12 years preceding 1968, income from oil and gas operations increased about 7 percent annually. During 1968-70 the increase in income was only 2 percent annually and in 1971 about 1 percent.

¹ Petroleum specialist, Division of Fossil Fuels.

² State Geologist, Louisiana Geological Survey, Baton Rouge, La.

Table 1.—Mineral production in Louisiana ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays..... thousand short tons.....	1,080	\$1,575	1,073	\$1,606
Lime..... do.....	1,025	12,811	960	17,625
Natural gas..... million cubic feet.....	7,788,276	1,503,137	8,081,907	1,632,545
Natural gas liquids:				
Natural gasoline and cycle products				
LP gases..... thousand 42-gallon barrels.....	56,526	174,632	54,424	173,425
Petroleum (crude)..... do.....	80,385	138,262	90,271	166,099
Salt..... do.....	906,907	3,061,558	935,243	3,359,710
Sand and gravel..... thousand short tons.....	13,584	64,854	13,352	67,950
Stone..... do.....	18,155	22,363	19,228	24,492
Sulfur (Frasch process)..... do.....	r 9,183	r 11,945	r 9,688	r 14,139
Sulfur (Frasch process)..... thousand long tons.....	3,618	89,489	3,681	W
Value of items that cannot be disclosed: Cement, gypsum, miscellaneous stone and value indicated by symbol W.....	XX	21,695	XX	95,418
Total.....	XX	5,102,321	XX	5,553,009
Total 1967 constant dollars.....	XX	4,564,026	XX	p 4,824,454

^p Preliminary. ^r Revised. W Withheld to avoid disclosing individual company confidential data; included with "value of items that cannot be disclosed." XX Not applicable.

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

² Excludes certain stone; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Louisiana, by parish

(Thousands)

Parish	1970	1971	Minerals produced in 1971 in order of value
Acadia.....	\$106,904	\$117,495	Natural gas, natural gas liquids, petroleum.
Allen.....	6,764	7,207	Petroleum, natural gas, natural gas liquids, sand and gravel.
Ascension.....	43,501	46,369	Natural gas liquids, petroleum, salt, natural gas.
Assumption.....	29,651	29,847	Natural gas, petroleum, natural gas liquids.
Avoyelles.....	4,420	5,810	Petroleum, natural gas liquids, natural gas, sand and gravel.
Beauregard.....	8,554	8,872	Petroleum, natural gas, sand and gravel, natural gas liquids.
Bienville.....	12,393	W	Natural gas, petroleum, sand and gravel, clays.
Bossier.....	19,502	19,701	Natural gas, petroleum, natural gas liquids, sand and gravel.
Caddo.....	24,222	W	Petroleum, natural gas, natural gas liquids, clays, sand and gravel.
Calcasieu.....	66,168	63,506	Petroleum, natural gas, natural gas liquids, lime, salt, sand and gravel.
Caldwell.....	3,088	3,946	Natural gas, petroleum.
Cameron.....	289,105	312,357	Natural gas, petroleum, natural gas liquids, salt, shell.
Catahoula.....	10,949	11,309	Petroleum, sand and gravel, natural gas.
Claiborne.....	25,011	33,527	Petroleum, natural gas, natural gas liquids, sand and gravel.
Concordia.....	23,894	W	Petroleum, natural gas, natural gas liquids.
De Soto.....	8,516	9,265	Natural gas, petroleum, sand and gravel.
East Baton Rouge.....	16,074	21,616	Lime, cement, petroleum, sand and gravel, natural gas, clays.
East Carroll.....	7	24	Natural gas, sand and gravel.
East Feliciana.....	W		
Evangeline.....	9,829	10,340	Petroleum, natural gas, natural gas liquids, sand and gravel.
Franklin.....	2,108	2,397	Petroleum, natural gas.
Grant.....	845	2,753	Petroleum, sand and gravel.
Iberia.....	216,385	298,230	Petroleum, natural gas, salt, natural gas liquids.
Iberville.....	61,881	67,260	Petroleum, salt, natural gas, natural gas liquids, sand and gravel.
Jackson.....	1,815	1,577	Natural gas, petroleum, sand and gravel.
Jefferson.....	231,773	357,755	Petroleum, natural gas, sulfur, natural gas liquids, salt, sand and gravel.
Jefferson Davis.....	53,796	54,077	Natural gas, petroleum, natural gas liquids, sand and gravel.
Lafayette.....	20,887	19,578	Do.
Lafourche.....	515,299	470,507	Petroleum, natural gas, sulfur, natural gas liquids.
La Salle.....	25,075	23,840	Petroleum, natural gas, sand and gravel.
Lincoln.....	19,659	W	Natural gas liquids, natural gas, petroleum, sand and gravel, clays.
Livingston.....	512	W	Sand and gravel.
Madison.....	1,205	1,142	Natural gas.
Morehouse.....	1,907	10,011	Natural gas, petroleum.
Natchitoches.....	27,814	35,200	Petroleum, natural gas, natural gas liquids, sand and gravel, clays.
Orleans.....	18,188	19,440	Cement, shell, lime, petroleum, natural gas, sand and gravel.
Ouachita.....	6,461	W	Petroleum, natural gas, sand and gravel, natural gas liquids.
Plaquemines.....	1,244,997	1,258,074	Petroleum, natural gas, sulfur, natural gas liquids, salt, sand and gravel.
Pointe Coupee.....	31,162	29,427	Petroleum, natural gas, natural gas liquids, clays.
Rapides.....	7,003	7,804	Petroleum, sand and gravel, natural gas, clays.
Red River.....	3,498	456	Sand and gravel, petroleum.
Richland.....	18,434	22,518	Petroleum, natural gas liquids, natural gas.
Sabine.....	1,356	1,014	Petroleum, sand and gravel, natural gas.
St. Bernard.....	30,270	50,692	Natural gas liquids, natural gas, petroleum, sand and gravel, clays.
St. Charles.....	90,370	85,898	Petroleum, natural gas, natural gas liquids.
St. Helena.....	W	W	Sand and gravel, clays.
St. James.....	9,345	11,127	Petroleum, natural gas, natural gas liquids.
St. John the Baptist.....	6,930	7,755	Petroleum, natural gas.
St. Landry.....	48,233	42,582	Natural gas, petroleum, natural gas liquids.
St. Martin.....	88,137	89,672	Petroleum, natural gas, salt, natural gas liquids, sand and gravel, clays.
St. Mary.....	473,513	536,844	Petroleum, natural gas, natural gas liquids, salt, shell, lime, sand and gravel.
St. Tammany.....	6,463	8,192	Shell, sand and gravel, natural gas, petroleum, clays.
Tangipahoa.....	2,276	3,158	Sand and gravel, petroleum, clays.
Tensas.....	8,463	4,202	Petroleum, natural gas, natural gas liquids.
Terrebonne.....	756,968	874,853	Petroleum, natural gas, natural gas liquids, sulfur, salt.
Union.....	8,583	1,702	Natural gas, petroleum, sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Louisiana, by parish—Continued
(Thousands)

Parish	1970	1971	Minerals produced in 1971 in order of value
Vermilion.....	\$311,444	\$312,090	Natural gas, petroleum, natural gas liquids, sand and gravel.
Vernon.....	308	507	Sand and gravel.
Washington.....	1,365	1,540	Do.
Webster.....	30,138	28,817	Natural gas, natural gas liquids, petroleum, sand and gravel.
West Baton Rouge.....	2,603	W	Petroleum, natural gas, clays.
West Carroll.....	40	W	Natural gas.
West Feliciana.....	W	W	Sand and gravel.
Winn.....	3,156	3,083	Petroleum, stone, gypsum, natural gas.
Undistributed.....	12,949	2106,044	
Total ²	5,102,321	5,553,009	

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

¹ Includes some natural gas liquids that cannot be assigned to specific parishes and values indicated by symbol W.

² Includes some petroleum that cannot be assigned to specific parishes and values indicated by symbol W.

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

Table 3.—Indicators of Louisiana business activity

	1970 ^a	1971 ^b	Change, percent	
Employment and labor force, annual average:				
Total labor force.....	thousands..	1,314.8	1,327.9	+1.0
Unemployment.....	do.....	62.6	70.6	+12.8
Employment:				
Contract construction.....	do.....	73.8	75.2	+1.9
Mining.....	do.....	50.7	50.4	-.6
Manufacturing.....	do.....	175.4	173.1	-1.3
Total all industries ¹	do.....	741.7	750.0	+1.1
Personal income:				
Total.....	millions..	\$11,130	\$11,957	+7.4
Per capita.....		\$3,054	\$3,248	+6.4
Construction activity:				
Number of new housing units authorized.....		19,343	36,346	+87.9
Valuation of nonresidential construction.....	millions..	\$244.6	\$136.3	-44.3
Cement shipments to and within Louisiana.....	thousand 376-pound barrels..	10,118	11,591	+14.6
Mineral production value.....	millions..	\$5,102.3	\$5,553.0	+8.8

^a Preliminary. ^b Revised.

¹ Transportation and public utilities; wholesale and retail trade; finance, insurance, and real estate; services; and government included.

Sources: Employment and Earnings; Survey of Current Business; Construction Review; Area Trends in Employment and Unemployment; and the U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Metal.....	1,236	365	451	3,609	1	17	4.99	1,908
Nonmetal.....	2,010	287	576	4,657	6	97	22.12	8,224
Sand and gravel.....	1,155	240	277	2,534	1	54	21.70	3,079
Stone.....	565	319	180	1,663	--	49	29.47	1,132
Total ¹	4,966	299	1,485	12,463	8	217	18.05	4,403
1971: ^a								
Metal.....	1,160	365	424	3,391	--	22	6.49	408
Nonmetal.....	1,190	285	339	2,700	--	87	32.23	1,117
Sand and gravel.....	1,220	245	299	2,741	1	55	20.43	3,925
Stone.....	525	348	182	1,624	--	56	34.48	746
Total ¹	4,095	304	1,245	10,456	1	220	21.14	1,566

^a Preliminary.

¹ Data may not add to totals shown because of independent rounding.

The sharply increased gas prices approved by the Federal Power Commission for new gas committed to the interstate market from the gulf coast hopefully will encourage the search for new supplies to alleviate the growing shortage. Many companies, particularly chemical companies, were faced with shortages, higher fuel costs, and higher costs for such chemicals as ammonia and methanol produced from natural gas.

According to the Louisiana Commerce and Industry Department, industrial and

manufacturing investment totaled \$668.8 million in 1971, up 10 percent from 1970. Heaviest investment was in petroleum refining and petrochemicals, which together accounted for \$383.4 million, or 57 percent of the 1971 total. Major projects included the \$127 million spent by Enjay Chemical Co. for expansion at Baton Rouge, a \$16.4 million new styrene plant at Donaldsonville, expansion and improvements at the Humble Oil and Refining Co., Baton Rouge refinery costing \$57 million, and in-

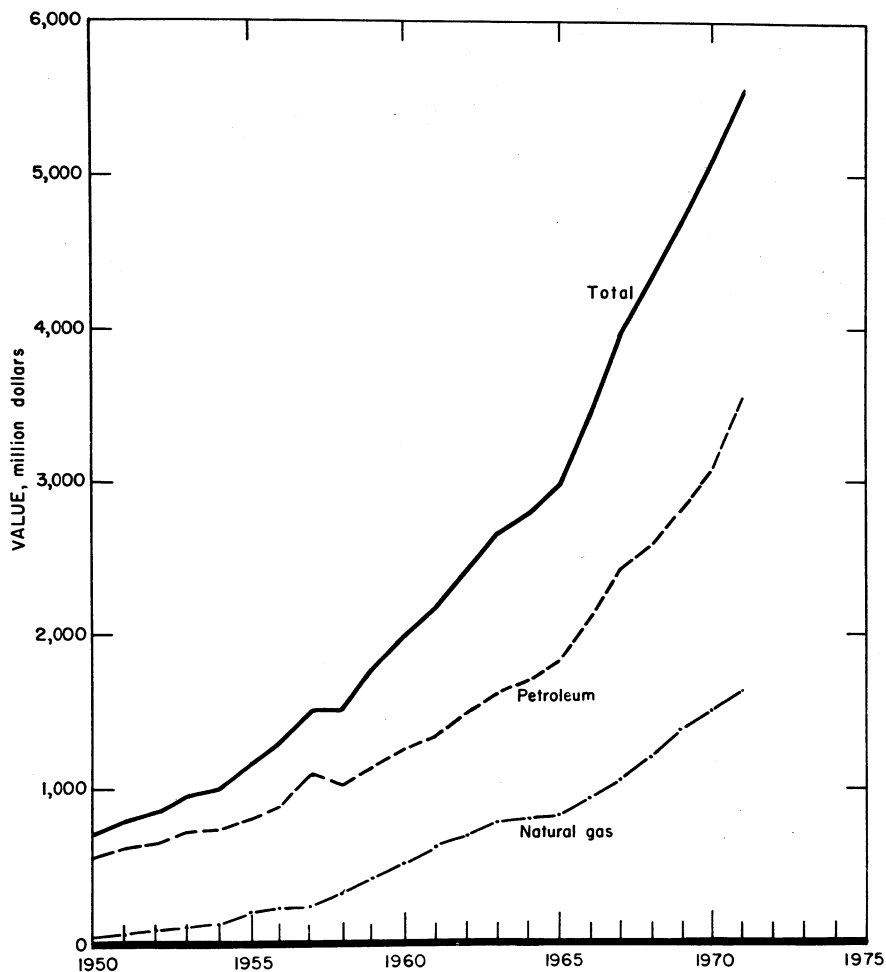


Figure 1.—Value of petroleum, natural gas, and total value of mineral production in Louisiana.

vestments of \$13 million in new units at Fortier by American Cyanamid Co.

A study by the Louisiana Wildlife and Fisheries Commission revealed that there was no evidence of damage to marine life as a result of the Chevron Oil Co. production platform fire 30 miles offshore in Main Pass Block 41 field in February 1970. Although mud and water in the area were investigated in a cartwheel fashion, this study was not considered to be completely conclusive. The fire produced a slick that at one time covered 120 square miles. The Commission continued its investigation of the 1971 oil spill of Shell Oil Co.

The offshore oil well fire touched off on December 1, 1970, by an unexplained explosion was brought under control in April 1971. This Shell Oil Co. fire in Bay Marchand south of New Orleans was allowed to burn in order to minimize water pollution. Two other well fires occurred during the year. One was a gas well which caught fire in Tigre Lagoon field of lower Vermilion Parish and caused the drowning of one man. The blazing stopped on August 3 when the well spouted salt water. The other fire began October 16, 1971, at the Amoco Production Co. offshore platform in Block 215 in the Eugene Island area 125 miles southeast of New Orleans. By the end of November, the fire had been reduced to a gas flame from three wells. The oil well fire was brought under control earlier in the month. Until all wells were closed off, they were allowed to burn in order to reduce the pollution effects.

Five companies were fined for failing to have subsurface safety devices in their offshore wells as required by Federal safety regulations. Chevron Oil Co., Continental Oil Co., Humble Oil & Refining Co., Shell Oil Co., and Union Oil Co. of California paid fines totaling about \$1.9 million.

Legislation and Government Programs.—The Louisiana Tidelands case has been pending in the Supreme Court for 25 years. The court ruled in 1969 that Louisiana's seaward boundary extended only 3 miles from the coastline. Hearings were in progress to determine the exact location of the 3-mile line. Proceeds from oil and gas leases amounting to more than \$1 billion have been impounded in an escrow account. The Department of Justice filed a motion with the Supreme Court for a sup-

plemental decree to the 1969 order calling for the distribution of the escrow account based on the most distant offshore boundary that Louisiana could claim under the 1969 order. Louisiana asked to have the court deny the motion or allow the State more time to respond to it. The State claims it has uncovered new evidence that shows its coastline to be much farther seaward. In December, the Supreme Court released the impounded funds to the Federal Treasury for general purpose use prior to the determination of the Federal-State boundary. The ruling could expand the area under operational control of the U.S. Geological Survey while reducing that of the Louisiana Department of Conservation.

Following public hearings during December, the Louisiana Air Control Commission adopted minimum standards set by the Federal Government in keeping with the Clean Air Act of 1970. An officer of the Commission did not believe it possible to bring some of the polluting industries into compliance within the 3-year time limit set by the act. However, it was the Commission's plan to concentrate on the big polluters by requesting them to submit schedules for standard conformance.

Rollins-Purle, Inc., a subsidiary of Rollins International, Inc., began operations at its \$1.6 million industrial pollution control plant in Baton Rouge. The facility has the capacity to handle daily 250,000 gallons of heavy industrial wastes produced in the Louisiana region by a wide range of industries including chemicals, petroleum, metal and metal processing, stone, clay, glass, paper, electric power, and others.

The States of Texas and Louisiana contended over the Sabine River portion of their common boundary (approximately 200 miles long). Louisiana claimed its boundary is the western bank of the river; Texas maintained the boundary is in the middle of the river. At stake is ownership of resources primarily oil and gas reserves, valued at approximately \$10 million. A special master was appointed by the Supreme Court to hold hearings on the dispute, which originated in a suit filed in 1969 by the State of Texas.

At the request of a special committee to probe the gas shortage situation in Louisiana, Governor McKeithen named a "negotiating committee" that was organized into

two task forces. One planned to make application to the Federal Power Commission to obtain a certificate of necessity so some of the interstate shipments may be diverted to Louisiana for household, industrial, and commercial use. The second

task force planned to examine the possibility of organizing a quasi-official corporation to engage in the intrastate gas business. Since mid-1971, all State leases provide for State royalties to be taken in cash or in kind (natural gas).

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The value of mineral fuel production totaled \$5,332 million in 1971. This was a 9-percent increase over that of 1970 and represented 96 percent of the entire mineral production of Louisiana.

*Leasing Activity.*³—The Louisiana State Mineral Board continued its policy of having monthly lease sales of State lands in 1971. During the year the petroleum industry paid \$12.5 million in bonus payments for 130,163 acres, an average of \$96.03 per acre. This was a gain to the State of over \$4 million compared with 1970. During that year 104,542 acres were leased for \$8.28 million, an average of \$79.20. The highest bid was made by Atlantic Richfield Co. for part of South Pass Block 60. Their bid was \$31.7 million, or \$18,005 per acre.

At the Federal Government drainage sale in October 1971, the petroleum industry submitted 33 bids on 13 tracts. Eleven leases were awarded with payments totaling \$96.5 million and averaging \$2,285 per acre.

Onshore leasing was active owing to the large amounts of acreage leased along the Cretaceous trend from Beauregard Parish to St. Tammany Parish.

During the year the Federal Government announced the lease sale of 78 tracts covering 366,000 acres. Prior to the December 21 sale date, the sale was contested in the Federal courts by environmentalists who contended that the environmental impact statement prepared by the Department of the Interior did not adequately consider all alternative sources of energy other than the lease sale of tracts in the Outer Continental Shelf. On December 20, in accordance with the court order, the sealed bids were impounded for 30 days awaiting an appeal. The Appellate Court refused to lift the injunction, and the bids were returned unopened. In early 1972 the Department of the Interior submitted an

amended impact statement but later decided not to appeal to a higher court and canceled the sale.

Aztec Oil and Gas Co. has agreed to purchase varying interests in 62,500 gross acres offshore from a group headed by Burmah Oil Exploration Inc. The purchase includes 15 percent of nine leases totaling 45,000 acres and interests ranging from 11 to 20 percent of another five leases totaling 17,500 acres. The Burmah Oil group acquired 11 of the tracts at the December 1970 Federal lease sale and three at the July 1970 Federal lease sale.

Exploration, Development, and Reserves.—According to the American Petroleum Institute, 2,935 wells were drilled in Louisiana, including the offshore zone 4 area through 1971. Footage drilled was 23.6 million feet, an average of 8,056 feet per well. Onshore drilling accounted for 2,134 wells and 16 million feet of hole. Offshore drilling accounted for 801 wells and 8.4 million feet of hole, an average depth of 10,475 feet per well.

Exploratory drilling accounted for a total of 802 wells—535 onshore and 267 offshore. Of the onshore exploratory wells, 30 were completed to produce oil, 47 were completed as gas producers, and 458 wells, or 86 percent, were dry. Of the offshore exploratory wells, 13 were completed to produce oil, 25 were gas productive, and 229 wells or 86 percent were dry. Proved field well drilling accounted for 2,133 wells, of which 1,599 or 75 percent were onshore. Of the onshore proved field wells, 758 were oil productive, 390 were gas productive, and 451, or 28 percent, were dry holes. Of the 534 proved field wells drilled offshore, 245 were completed to produce oil, 159 were gas productive, and 130, or 24 percent, were dry holes.

In north Louisiana, which covers 26 par-

³ American Association of Petroleum Geologists Bulletin. V. 56, No. 7, July 1972, pp. 1295-1302.

Table 5.—Oil and gas well drilling completions, by parish

Parish	Proved field wells			Exploratory			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Acadia.....	9	9	18	1	--	18	55	589,088
Allen.....	1	--	1	--	--	5	7	56,095
Ascension.....	2	1	2	--	--	--	5	36,225
Assumption.....	1	6	6	--	--	4	17	221,441
Avoyelles.....	1	--	4	--	--	6	11	85,293
Beauregard.....	2	1	4	1	--	13	21	210,117
Bienville.....	--	27	7	--	--	1	35	315,013
Bossier.....	62	4	9	1	--	7	83	136,542
Caddo.....	186	4	19	--	--	6	215	476,978
Calcasieu.....	19	7	21	2	2	16	67	509,487
Caldwell.....	--	8	9	--	1	17	35	103,966
Cameron.....	13	13	21	2	5	24	78	864,502
Catahoula.....	11	--	21	1	1	27	61	293,795
Claiborne.....	10	4	5	1	3	4	27	249,765
Concordia.....	9	--	31	3	--	30	73	474,090
De Soto.....	4	14	12	1	1	1	33	135,947
East Baton Rouge.....	1	--	1	--	--	2	4	40,984
East Carroll.....	--	--	--	--	--	2	2	14,777
Evangeline.....	2	1	4	--	--	8	15	144,485
Franklin.....	2	--	1	--	--	--	3	11,030
Grant.....	5	--	1	--	--	5	11	36,251
Iberia.....	16	12	16	2	2	6	54	473,107
Iberville.....	14	2	3	2	1	17	39	406,749
Jackson.....	--	2	2	--	--	4	8	75,853
Jefferson.....	22	8	5	--	--	10	45	468,736
Jefferson Davis.....	6	2	10	--	3	16	37	364,384
Lafayette.....	1	6	2	2	1	8	20	238,210
Lafourche.....	54	9	17	1	2	16	99	909,347
La Salle.....	55	4	42	1	--	10	112	316,100
Lincoln.....	1	--	1	--	3	2	7	53,113
Livingston.....	--	--	--	--	--	2	2	20,386
Madison.....	1	--	--	--	--	1	2	9,034
Morehouse.....	--	59	2	--	--	2	63	155,247
Natchitoches.....	--	--	3	--	--	3	6	37,105
Orleans.....	1	--	--	--	1	1	3	26,570
Ouachita.....	--	55	2	--	--	2	59	150,942
Plaquemines.....	50	11	13	1	2	22	99	919,216
Pointe Coupee.....	5	--	3	1	1	3	13	150,636
Rapides.....	5	--	17	1	--	4	27	186,827
Red River.....	8	--	2	--	--	6	16	53,126
Richland.....	2	5	24	--	--	1	32	73,621
Sabine.....	3	--	4	--	--	2	9	27,311
St. Bernard.....	--	--	1	--	--	8	9	91,410
St. Charles.....	15	6	3	--	1	4	29	300,019
St. Helena.....	--	--	--	--	--	2	2	23,927
St. James.....	2	3	3	--	--	1	9	97,427
St. John the Baptist.....	2	--	--	--	--	5	7	74,897
St. Landry.....	4	3	9	--	--	2	13	167,132
St. Martin.....	27	7	12	1	4	13	64	692,850
St. Mary.....	42	14	11	1	4	7	79	855,430
St. Tammany.....	--	--	--	--	--	4	4	51,215
Tensas.....	1	--	1	--	--	3	5	37,365
Terrebonne.....	53	33	24	3	4	19	136	1,538,919
Union.....	--	39	--	--	--	8	47	159,959
Vermilion.....	4	9	8	1	4	30	56	767,449
Vernon.....	--	--	1	--	--	1	2	23,032
Webster.....	1	2	3	--	--	1	7	59,520
West Baton Rouge.....	2	--	3	--	--	4	9	90,427
Winn.....	21	--	7	--	1	12	41	101,623
Offshore.....	245	159	130	13	25	229	801	8,390,854
Total.....	1,003	549	531	43	72	687	2,935	23,644,946

ishes, a total of 922 wells were drilled, 21 percent more than the 763 wells drilled in 1970. Exploration drilling increased from 151 wells in 1970 to 175 in 1971. Of this total, 18 (10.3 percent) were completed successfully. Exploratory drilling for the Wilcox Formation accounted for 59 percent of the total. None of the discoveries, which included eight new-field wells, nine outpost extensions, and one shallow-pool

well, appeared to add substantially to the reserves.

Onshore in the remaining 39 parishes in southern Louisiana, 1,142 wells were drilled, totaling 11.7 million feet. The 782 development wells included 376 oil producers, 163 gas wells, and 243 dry holes. Of the 360 exploration wells, 22 were oil producers, 37 were gas producers, and 301

were dry wells (success ratio of 16 per cent).

Important new-field discoveries were made in Jefferson Davis Parish, Terrebonne Parish, Vermilion Parish, and Iberia Parish. The Iberia Parish find (North Bayou Pigeon field) was completed in a Miocene formation at 13,697 feet and had an initial production of 516 barrels of oil per day. Important development wells were drilled in the following parishes: St. Mary, Jefferson Davis, Evangeline, Terrebonne, and Point Coupee. The St. Mary Parish well was completed at South Atchafalaya Bay field in an Miocene formation at 17,075 feet and had an initial production of 1,428 barrels of oil and 2,180,000 cubic feet of natural gas.

Offshore, 801 wells were drilled, for a total of 8.4 million feet. Of the 534 development wells drilled offshore, 245 were oil wells, 159 were gas wells, and 130 were dry holes, for a success ratio of 76 per cent. Only 13 oil wells and 25 gas wells of the 267 exploration wells were successful (14 percent successful).

Important new-field discoveries included a 6,350-thousand-cubic-foot-per-day gas well at Main Pass Block 107. A discovery at Breton Sound Block 33 was significant in that it represents one of the few commercial discoveries in the high-pressure section in eastern Louisiana.

Geophysical activity in north Louisiana increased from 118 crew-weeks in 1970 to 264 crew-weeks in 1971. Natchitoches, with 63 crew-weeks, was the most active parish. Winn Parish with 39.5, Claiborne Parish with 31.5, and Grant Parish with 31 were the other leaders. Increased activity in Winn and Grant Parishes indicates a renewal of interest in the area. The Lower Cretaceous formations in central Louisiana continued to receive the most activity.

In south Louisiana onshore gravity meter crew-weeks decreased from 67 to 44,

according to the American Association of Petroleum Geologists (AAPG). Overall geophysical activity rose, however, as seismic crew-weeks increased 5 percent to 782 crew-weeks. Offshore seismic activity declined 24 percent. Total activity in south Louisiana offshore and onshore was 1,050 crew-weeks, a 5-percent reduction from the previous year.

According to the API, proved reserves of crude oil declined for the first time, after several decades of uninterrupted annual growth. Proved reserves of 5,399 million barrels reflect a net reduction of 311 million barrels. Most of the net reduction occurred in south Louisiana, including the offshore areas. Natural gas reserves declined for the third year. At yearend, gas reserves were 78.6 trillion cubic feet. Natural gas liquids reserves also declined for the third year, to 2,467 million barrels at yearend. Louisiana's share of total U.S. reserves at yearend 1971 was crude oil—14.2 percent, natural gas liquids—33.8 percent, and natural gas—28.2 percent.

Carbon Black.—After falling below the 1-billion-pound level in 1970 (982 million pounds), production recovered in 1971, reaching 1,079 million pounds for a 9.9-percent increase. Louisiana continued to rank second after Texas, accounting for 35.8 percent of the national total. Essentially all of the output was furnace black; only insignificant quantities of channel black are produced.

As the Nation's leading producer of carbon black from natural gas, Louisiana consumed 26.0 billion cubic feet of natural gas and 151 million gallons of liquid hydrocarbons. The total value of production was \$78.2 million for an average value of \$0.0725 per pound.

At yearend, the State's nine plants had a capacity of 3,832,374 pounds per day, 35.1 percent of the country's total. Most of the

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

Commodity	Proved reserves Dec. 31, 1970	Changes in proved reserves due to extensions and discoveries in 1971	Proved reserves Dec. 31, 1971 (production deducted)	Changes from 1970 (percent)
Crude oil.....thousand barrels..	5,710,320	488,411	5,399,000	-5.5
Natural gas liquids.....do.....	2,566,980	150,286	2,467,880	-3.9
Natural gas.....million cubic feet..	82,956,688	3,783,282	78,625,854	-5.2

Source: American Petroleum Institute and American Gas Association.

increase during the year came from the three plants in St. Mary's Parish, where output rose 11.1 percent to 622.4 million pounds.

Table 7.—Carbon black production and value

(Million pounds and million dollars)

Year	Quantity	Value
1967-----	923	\$61.1
1968-----	1,031	70.4
1969-----	1,046	70.8
1970-----	982	70.6
1971-----	1,079	78.2

Natural Gas.—Marketed gas production was 8,082 billion cubic feet, a 3.8-percent increase from 1970. Louisiana ranked second in marketed production nationwide and accounted for 35.9 percent of the U.S. total.

Governor McKeithen, in April, named a "negotiating committee" to seek ways to improve the natural gas supply situation in the State. The new committee was formed to negotiate with agencies and officials of the Federal and State Governments, representatives of the oil and gas industry, including pipeline companies, and the Louisiana congressional delegation to find ways of obtaining more adequate supplies of natural gas for the State of Louisiana.

The Federal Power Commission authorized Mid-Louisiana Gas Co., a subsidiary of Houston Natural Gas Corp., to develop underground natural gas storage at the abandoned Hester gasfield in St. James Parish. Maximum reservoir volume will be 20.4 billion cubic feet, and development costs are projected at \$5.5 million.

Several of the natural gas pipeline companies have made advance payments for

first call on gas reserves recently discovered or expected to be discovered in exploration programs. This action illustrates the gas supply problems faced by the gas transmission companies and is expected to encourage exploration and development of new gas reserves.

An investigation into the accusation that the gulf coast of Louisiana has a large number of shut-in gas wells proved that the numbers were very minor. In general most of the shut-in wells are at locations or situations which make it unfeasible to connect the wells to a pipeline outlet.

After many years of controversy, the Federal Power Commission finally set new higher ceiling prices on natural gas at the wellhead in southern Louisiana. The decision, which raised prices \$0.03 to \$0.06 per thousand cubic feet (Mcf) across the board, is expected to provide incentives for increased exploration drilling. The settlement places the following ceiling prices on all interstate sales of gas produced in Louisiana:

(1) Old gas (contracts dated prior to October 1, 1968)—The price will be \$0.22375 per Mcf onshore and \$0.2135 in the Federal domain offshore where the State tax does not apply. This compares with \$0.185 for pre-1961 gas and \$0.195 for gas contracted from January 1, 1961, through September 30, 1968.

(2) New gas (contracts dated on or after October 1, 1968)—The price will be \$0.26 per Mcf for both onshore and offshore. The settlement eliminates price distinctions between oil well gas and gas well gas and, for the future, ends the distinction between onshore and offshore gas.

Natural Gas Liquids.—Production again ranked second nationwide and set a new record for Louisiana. According to the an-

Table 8.—Natural gas data

(Million cubic feet)

Year	Withdrawals ¹			Disposition			
	From gas wells	From oil wells	Total	Marketed production ²	Value at wells (thousands)	Repressuring	Vented and wasted ³
1967-----	5,070,825	1,016,600	6,087,425	5,716,857	\$1,057,619	208,719	161,849
1968-----	5,623,961	1,153,555	6,777,516	6,416,015	1,212,627	195,062	166,439
1969-----	6,305,897	1,255,130	7,561,027	7,227,826	1,387,743	174,349	158,852
1970-----	6,811,334	1,264,823	8,076,157	7,788,276	1,503,137	133,792	154,089
1971-----	7,011,666	1,306,885	8,318,551	8,081,907	1,632,645	133,080	103,564

¹ Marketed production plus quantities used in repressuring, vented, and wasted.

² Comprises gas sold or consumed by producers, including losses in transmission, amounts added to storage, and increases in pipelines.

³ Partly estimated. Includes direct waste on producing properties and residue blown to the air.

nual Oil and Gas Journal Survey,⁴ there were 136 gas processing plants in the State at yearend 1971. Total natural gas throughput capacity for these plants was 24,453 million cubic feet per day (MMcfd), one-third of the U.S. total. Plants in Louisiana processed an average of 20,918 MMcfd, equivalent to 86 percent of throughput capacity.

Natural gasoline and cycle products were recovered at 131 gasoline and cycling plants and six fractionators. The refrigerated absorption process was used in 56 percent of the plants, and the absorption method was used in 24 percent of the plants. Production of natural gasoline and cycle products decreased 3.7 percent, while the unit value increased 3.2 percent to \$3.19 per 42-gallon barrel. Production of liquefied petroleum from natural gas processing plants increased 12.3 percent and unit value increased 7.0 percent, resulting in an increase of 20.1 percent in total value for this commodity from the previous year. Production in 1971 accounted for 22 percent of the country's total, compared with 20 percent in 1970.

The 5.6-percent increase in plant throughput capacity from 23,163 MMcfd to 24,453 MMcfd resulted from the building of new plants and the additions to others. A new plant owned by Louisiana Land and Exploration Co. was built at Pointe au Chien in Terrebonne Parish. It is operated by La Gloria Oil and Gas Co. and has a capacity of 125 MMcfd. The plant, completed in October 1971, can extract 60 to 65 percent of the ethane, 90 percent of the propane, and essentially all of the

heavier liquids. The raw-make mixture is sent to the Wanda Petroleum Co. fractionator at Napoleonville where it is separated into various finished products. A major expansion project was undertaken by Mobil Oil Corp. at its Cow Island plant in Vermilion Parish. The addition includes 125 MMcfd of throughput capacity. All products are fractionated at the company's Riverside plant in Ascension Parish.

Petroleum.—Crude oil production in 1971 amounted to 935.2 million barrels, representing a 3.1-percent increase over the 906.9 barrels produced in 1970.

During June, the Conservation Department, which regulates and operates oil production allowable programs, announced upward revisions in the Louisiana oil production allowable formula or depth bracket schedule. The new formula attempts to relate drilling costs to a return on investment with the object of encouraging drilling and exploration, particularly deep wells and offshore wells.

To keep production of Louisiana crude in line with the market demand, the allowable was lowered in August from 75 percent to 73 percent of the new depth bracket schedule which went into effect on July 1. The allowable was further dropped to 70 percent for October and again to 69 percent in November.

A formal study by the Louisiana Department of Conservation found that only 35 of the State's 1,389 fields are capable of producing significant quantities of oil over

⁴ Oil and Gas Journal. 1972 Survey of Gas-Processing Plants. V. 70. No. 28, July 10, 1972, p. 98.

Table 9.—Crude oil production, indicated demand, and stocks in 1971, by month
(Thousand 42-gallon barrels)

Month	Production	Indicated demand	End of month stocks originating within State
January.....	79,839	80,705	37,664
February.....	73,632	73,367	37,929
March.....	80,271	82,207	35,993
April.....	78,817	77,876	36,934
May.....	81,140	77,513	40,561
June.....	78,750	80,725	38,586
July.....	80,526	82,094	37,018
August.....	81,831	80,872	37,977
September.....	72,785	73,903	36,859
October.....	77,566	77,983	36,442
November.....	73,855	73,712	36,585
December.....	76,231	79,788	33,028
Total:			
1971.....	935,243	940,745	XX
1970.....	906,907	903,608	XX

XX Not applicable.

Table 10.—Number of producing oil wells and average production per well per day

Year	Approximate number of producing wells, Dec. 31	Average production per well per day ¹ (barrels)
1967	30,670	69.2
1968	30,266	74.0
1969	29,393	78.7
1970	² 26,341	94.3
1971	² 24,991	102.5

¹ Based upon number of wells producing Dec. 31.² Does not include Federal leases entirely in Zone 4.

current production rates. Of these, nine fields account for over one-half of the total excess. According to the study only a few fields would be able to produce at the depth bracket allowable rate of 100 percent. At the 69 percent market demand factor, Louisiana's allowable was expected to produce 1,896,428 barrels with the bulk coming from three districts, LaFayette, Houma, and New Orleans. The Department, based on April 1971 estimates, credits these three districts with a maximum allowable capacity of 2,030,238 barrels per

day. Accordingly, the spare producing capacity was about 200,000 to 300,000 barrels per day. Earlier in the year API reported that only 34 of the country's principal oil-fields had spare capacity of as much as 5,000 barrels per day and that 16 of these were in Louisiana.

A State study of productive capacity of crude oil reservoirs indicates an annual capacity of 2,211 million barrels per day as of April 1, 1971, a decrease of 360,000 barrels per day since the previous study in January 1970. The latest survey was made during a period when the depth-bracket allowable was 75 percent. The previous study was made during a period when the allowable was 46 percent. Estimates of productive capacity should have been much better during the more recent period when industry was more aware of the ability of their wells at the higher rate. The report indicates that the present rate of production in the State could be increased by 161,000 barrels per day at 100 percent of depth-bracket allowable. Production with

Table 11.—Production of crude petroleum by district and selected fields (Thousand 42-gallon barrels)

District and field ¹	1970 ²	1971	District and field ¹	1970 ²	1971
Gulf coast onshore:³			Gulf coast offshore:³		
Avery Island.....	(4)	3,400	Bay Marchand Block 2.....	32,407	30,806
Bay de Chene.....	(4)	6,643	Eugene Island Block 126.....	5,589	5,621
Bay Ste. Elaine.....	7,642	7,775	Grand Isle Block 16.....	20,721	21,681
Bayou Salle.....	7,298	5,293	Grand Isle Block 43.....	21,018	22,776
Black Bay West.....	(4)	9,892	Grand Isle Block 47.....	4,676	4,271
Caillou Island.....	37,673	31,828	Main Pass Block 35.....	4,216	3,504
Cote Blanche Bay West.....	10,533	15,658	Main Pass Block 41.....	22,751	18,469
Cote Blanche Island.....	7,867	8,797	Main Pass Block 69.....	11,322	12,775
Delta Farms.....	1,893	1,278	Ship Shoal Block 208.....	13,301	10,038
Garden Island Bay.....	18,816	16,096	South Pass Block 24.....	22,685	20,330
Golden Meadow.....	3,452	2,738	South Pass Block 27.....	22,440	21,425
Grand Bay.....	5,805	6,680	Timbalier South Block		
Hackberry East.....	2,629	2,226	135.....	18,384	13,573
Hackberry West.....	3,935	3,760	Timbalier Bay.....	35,443	30,988
Iowa.....	886	876	West Delta Block 30.....	23,854	26,390
Jennings.....	672	292	West Delta Block 73.....	17,251	15,987
Lafitte.....	11,936	10,877	Other fields.....	136,190	156,666
Lake Barre.....	8,741	7,592	Total.....	412,248	415,305
Lake Pelto.....	5,032	4,891	Northern:		
Lake Salvador.....	(4)	4,380	Black Lake.....	5,942	(4)
Lake Washington.....	12,651	10,913	Caddo-Pine Island.....	3,586	3,500
Leeville.....	4,345	4,343	Delhi.....	4,771	5,870
Paradis.....	4,888	1,898	Haynesville.....	3,065	2,730
Quarantine Bay.....	9,813	7,117	Homer.....	343	383
Romere Pass.....	(4)	3,759	Lake St. John.....	1,210	1,170
Venice.....	5,694	5,475	Rodessa.....	740	900
Vinton.....	2,104	2,299	Other fields.....	27,782	30,916
Weeks Island.....	9,445	10,183	Total.....	47,439	45,416
West Bay.....	9,810	9,563	Grand total.....	906,907	*935,243
Other fields.....	253,660	267,999			
Total.....	447,220	474,521			

¹ Breakdown for individual fields from the Oil and Gas Journal.² Data not comparable with that published in 1970 due to change in source.³ Some fields include onshore and offshore production.⁴ Included in "Other fields."⁵ Data does not add to total shown because of independent rounding.

an unrestricted allowable (no productive controls) would be 320,000 barrels per day above present rates. These data exclude federally controlled leases in the offshore Zone 4.

In accordance with a December 1970 order, the U.S. Geological Survey calculated maximum efficient rates (MER) of recovery for all wells in the undisputed Federal waters offshore Louisiana and Texas. The orders were issued in an effort to increase production and to help restrain the increases in oil prices. By February production rose by about 49,000 barrels per day. The full effect of the MER order will be greater when the leases involved in the offshore boundary dispute are transferred to Federal jurisdiction. It has been estimated that after the transfer, Gulf of Mexico crude oil output could be increased by 300,000 barrels per day.

Pennzoil Offshore Gas Operations will apparently be the first of the companies to go into production on acreage acquired at the Federal lease sale in December 1970. The company plans to place four platforms, each of which will accommodate 18 wells, on its new leases.

The State's largest tertiary oil recovery program began in 1971 at the Bellevue field in Bossier Parish. Getty Oil Co. and some independent operators have combined to heat the oil that is left in the sand formation, causing it to be less viscous. Getty has more than 80 wells, whereas the others have a total of seven wells.

Refineries.—At yearend there were 18 refineries in operation (including the essentially completed Alliance refinery at Myrtle Grove), having a total throughput capacity of 1,481,600 barrels per calendar day. Crude runs to stills increases 14.5 percent to 493.0 million barrels (about 1,350,700 barrels per day), compared with 430.5 million barrels in 1970.

Principal among the refinery construction projects was the Alliance refinery at Myrtle Grove by Gulf Oil Corp. At yearend the plant was under test production. Built as the world's largest "grassroots" refinery, the plant has a 155,000-barrel-per-calendar-day capacity. The capacities, in barrels per day, for major processing units are as follows: Fluid catalytic cracker, 69,800; catalytic reformer, 36,400; alkylation unit, 28,000; and coker, 15,500. The refinery will produce motor gasoline (about

100,000 barrels per day), jet fuel, No. 2 fuel oil, propane, petro-chemicals, coke, and others. About 90 percent of the prime fuels produced will be shipped via a new 144-mile, 20-inch pipeline from the Alliance plant to Collins, Miss. Here the products will be injected into the Colonial pipeline system for delivery to markets in the Southeast and Middle Atlantic States. The feedstock will come to the refinery in a 37-mile, 18-inch pipeline from the company's Bay Marchand pumping facility. The crude will average 32° API gravity and 0.3 percent sulfur content.

Refinery construction continued both to expand capacity and to eliminate obsolescence. Continental Oil Co. increased the capacity of its Westlake refinery by adding 10,500 barrels per day of distillation capacity. Furthermore, catalytic cracking and catalytic reforming capacities were increased by 5,000 barrels per day and 2,000 barrels per day, respectively. Tenneco Oil Co. increased the throughput capacity of its Chalmette refinery by 3,000 barrels per day, and the Bayou State Oil Corp. increased the capacity of its Hosston refinery by 730 barrels per day.

Anticipating greater runs of sour crude oil and more stringent pollution control regulations, the Humble Oil and Refining Co. launched a \$5.1 million sulfur recovery project at its 434,000-barrel-per-day Baton Rouge refinery, the country's largest. The company was to spend \$3.7 million for recovery plant and \$1.4 million for attendant facilities. The new equipment will be able to recover about 170 tons of sulfur per day.

Murphy Oil Corp. announced a \$25 million program to modify and expand its refineries at Meraux, La., and Superior, Wisc. New units at Meraux will include a 65,000-barrel-per-day crude oil distillation unit, an 18,000-barrel-per-day naphtha desulfurizer, and a 16,000-barrel-per-day continuous regenerative platformer.

Petrochemicals.—Louisiana is expected to outstrip Tennessee as the South's leading State in the chemical industry. Several factors contributing to Louisiana's chemical industry expansion are its abundant petroleum and natural gas resources and an excellent waterborne transportation system which connects chemical centers along the Mississippi River and gulf coast with the American midcontinent.

Olin Corp. commenced construction of a petrochemical complex in Lake Charles to produce materials for urethane foams and coatings. The new complex, which will take 2 years to complete, will produce 90 million pounds of tolylene diisocyanate annually and will include facilities for the manufacture of toluene diamine and dinitrotoluene. Uniroyal, Inc., announced its plans to construct a multimillion-dollar plant at Geismar, La., that will make chemicals used in the rubber industry. Completion is scheduled for 1972.

Expansion at the ethylenamines plant of Union Carbide Corp. at Taft, La., has increased the capacity to 35,500 tons per year. Melamine Chemicals, Inc., has put its new 70-million-pound-per-year melamine plant onstream at Donaldsonville. The new unit will produce a product of 99.8 percent purity.

The \$44 million, 100-acre Georgia-Pacific Corp. chemical complex at Plaquemine, La., was successfully started up 2½ years after preliminary engineering plans were completed. It will produce 100 million gallons per year of methanol using a low-pressure process, 200 million pounds per year of phenol, and 120 million pounds per year of acetone.

Expansion of the PPG Industries' solvent capacity at its Lake Charles plant was continuing on schedule at the end of 1971, with startup slated for January 1972. The expansion will give the Lake Charles facility a combined capacity for perchloroethylene and trichloroethylene solvents of some 500 million pounds per year, making it the world's largest plant for the production of these two solvents.

Early in the year BASF Wyandotte Corp. announced plans to build a polyether polyols unit at its Geismar complex. The new unit will have an initial capacity of 100 million pounds per year.

Enjay Chemical Co.'s Baton Rouge chemical plant is undergoing a \$127 million expansion program with completion expected by 1973. The project is designed to substantially increase ethylene, propylene, and butadiene production.

The Foster Grant Co. completed a new 500-million-pound-per-year styrene plant at Baton Rouge. The plant ranks as one of the largest styrene production facilities in the world. The plant will be used to make

polystyrene, other thermoplastics, and synthetic rubber.

NONMETALS

Value of nonmetals production decreased \$4 million to \$221 million and was 4 percent of total value of mineral production in the State. The decrease in value was the third year of decline from the record \$289 million in 1968.

Barite.—Crude barite is not mined in Louisiana. However, one plant in Calcasieu Parish and three plants in Orleans Parish crushed and ground barite ore. Ore mined both domestically and abroad was shipped to Louisiana for processing. Ore processed in 1971 totaled 507,023 short tons, up 1 percent from 1970, and was valued at \$12.2 million, unchanged from 1970. Virtually all the barite is used as a weight additive in well drilling muds.

Cement.—After 3 years of decline, shipments of portland and masonry cement increased 15 percent during 1971. Portland cement was produced at three plants, of which two also produced masonry cement. About 83 percent of the portland cement shipped was type I and II (general use and moderate heat); the remainder was type III (high-early-strength) and oil-well cement. Portland and masonry cement consumed in the State totaled 11,591,000 376-pound barrels and 430,000 280-pound barrels, respectively. Portland cement was consumed for ready-mix concrete (41 percent), for concrete products (18 percent), for building materials (2 percent), by contractors (37 percent) and the remainder by other miscellaneous customers. Raw materials used in making portland cement included oyster shells, limestone, sand, gypsum, and iron-bearing materials. All the plants used natural gas in their kilns.

Leading producing companies were Ideal Cement Co., Lone Star Cement Corp., and Louisiana Cement Div. of OKC Corp.

Clays.—Output of common clay and undifferentiated clay and shale decreased slightly to 1.07 million tons. Average unit value was \$1.50 per ton. Twelve companies operated 14 pits in 13 parishes. Principal producing parishes in descending order of production were Pointe Coupee, St. Bernard, and West Baton Rouge. Clay output was consumed in the manufacture of lightweight aggregate, cement, and heavy building brick.

Gypsum.—Crude gypsum was mined in Winn Parish, and output increased 15 percent. The entire output was used as a retarder in portland cement. Unit price was only slightly higher than in 1970. Gypsum was calcined by National Gypsum Co. at its Jefferson Parish plant and United States Gypsum Co. at its Orleans Parish plant. Output was used in the manufacture of wallboard. Calcined gypsum production increased 27 percent, and unit value was about 29 percent higher than in 1970.

Fertilizer Materials.—In order to operate its phosphoric acid plant at Uncle Sam, La., more nearly at capacity, Freeport Mineral Co. entered an agreement with Brewster Phosphates, a recently announced partnership of American Cyanamid Co. and Kerr-McGee Corp. Under the new arrangement, Freeport will use half of the plant capacity to process phosphate rock furnished by Brewster Phosphates from American Cyanamid Co.'s Florida mine. The plant, opened in 1968, is the largest of its kind in the world. It has a design capacity of 1.1 million tons per year of 54 percent phosphoric acid.

Lime.—Production decreased 6 percent while average unit value increased 47 percent. Olin Corp. produced hydrated lime (calcium hydroxide) at its Lake Charles plant. Allied Chemical Corp. produced quicklime (calcium oxide) at its Baton Rouge facilities. United States Gypsum Co. in Orleans Parish and Pelican State Lime Division of Radcliff Materials, Inc., in St. Mary Parish produced both quicklime and hydrated lime. Lime output was consumed principally at chemical plants, aluminum smelters, and water purifications facilities. There is some concern as to future fuel supplies and as to particulate emission standards that may be promulgated for the industry. Producers believe they can bring their operations into complete compliance

with air quality standards by September 1974.

Perlite.—Although not mined in Louisiana, perlite was expanded by two plants—Zonolite Division of W. R. Grace & Co., in Orleans Parish and Filter-Media Co. of Louisiana, Inc., in St. John the Baptist Parish. The latter is one of the principal producers of filter materials. A substantially larger amount of perlite was expanded in 1971 than in the previous year. Principal uses were for filter aids and in concrete aggregate. Other uses included horticultural aggregate, plaster aggregate, and low-temperature insulation.

Salt.—Louisiana ranked first in salt production (sold or used by producers) and provided 30.3 percent of domestic output. State production increased 1.7 percent to 13.35 million short tons, valued at \$67.95 million. The average unit value was \$5.09 per ton, a 6.7-percent increase over that in 1970. There was a 2.0-percent increase in evaporated salt production, rock salt production increased 3.8 percent, and brine production decreased 5.8 percent. Average unit values in dollars per short ton were evaporated salt—\$34.18, rock salt—\$5.69, and brine—\$3.51. Thirteen companies mined salt at 16 operations in 10 parishes. Ten operations produced brine, three operations produced evaporated and rock salt, and two operations produced rock salt only.

Sand and Gravel.—Production was 19.2 million short tons, a 6-percent increase from the previous year. Average unit value increased slightly to \$1.27 per short ton. There was a total of 76 operations reported in 40 of the State's 64 parishes. Leading parishes in descending rank of production were Tangipahoa, Washington, Jefferson, and East Baton Rouge. These four parishes produced 41 percent of the State's output of sand and gravel. Com-

Table 12.—Salt sold or used by producers
(Thousand short tons and thousand dollars)

Year	Evaporated salt		Rock salt		Brine		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1967.....	301	\$7,619	4,183	\$22,131	5,101	\$18,733	9,585	\$48,483
1968.....	293	7,183	4,793	26,556	5,822	20,115	10,908	53,854
1969.....	277	7,598	5,237	29,160	6,921	24,344	12,435	61,102
1970.....	270	7,888	5,581	32,459	7,733	24,507	13,584	64,854
1971.....	275	9,399	5,794	32,976	7,283	25,574	13,352	167,950

¹ Data does not add to total shown because of independent rounding.

mercial operations accounted for 98 percent of sand and gravel production.

Sand production of 7,687,000 short tons was slightly more than 1970 production. Unit value also increased slightly, to \$1.14 per ton. Principal uses of produced sand were building (70.1 percent) and paving (28.8 percent). The remaining 1.1 percent was used as blast sand, glass sand, and engine sand.

Gravel production of 11,541,000 short tons was 8.0 percent higher than in 1970. Average unit value was \$1.36 per ton, up \$0.03 from 1970. Principal uses for produced gravel were building (66.6 percent), and paving (33.3 percent).

Stone.—Action taken by the Louisiana Wild Life and Fisheries Commission is ex-

pected to yield about \$15 million in additional royalties in the next 15 years. The Commission granted to several companies the right to dredge for and remove shells from the bottom of Lake Ponchartrain and Lake Maurepas until May 1984. The current leases terminate in May 1974. Companies involved are Ayers Materials Co. Inc., Radcliff Materials, Inc., and Louisiana Materials Co. The clam and oyster shells are used for calcining into lime and cement and for highway metaling.

Sulfur.—Louisiana continued as the leading Frasch sulfur producing State. The six plants produced 3,616,000 long tons in 1971, essentially unchanged from 3,636,000 long tons produced in 1970. The share of total U.S. Frasch sulfur mined in Louisi-

Table 13.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total ¹	
	Quantity	Value	Quantity	Value	Quantity	Value
1967.....	20,216	\$27,346	96	\$96	20,312	\$27,442
1968.....	20,208	26,354	203	150	20,411	26,504
1969.....	17,715	21,278	416	616	18,131	21,895
1970.....	17,746	21,527	410	836	18,155	22,363
1971.....	18,823	23,861	405	631	19,228	24,492

¹ Data may not add to totals shown because of independent rounding.

Table 14.—Sand and gravel sold or used by producers, by class of operation and use

(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	5,015	\$5,258	5,628	\$6,104
Paving.....	2,049	2,084	1,696	1,934
Other uses ¹	202	452	201	458
Total ².....	7,266	7,794	7,526	8,497
Gravel:				
Building.....	6,805	8,926	7,448	10,157
Paving.....	3,667	4,796	3,846	5,205
Other uses ³	9	12	3	2
Total ².....	10,480	13,733	11,297	15,362
Government-and-contractor operations:				
Sand:				
Building.....	173	346	161	246
Paving.....	26	52	--	--
Total ².....	199	399	161	246
Gravel:				
Building.....	169	338	244	386
Paving.....	42	100	--	--
Total ².....	210	438	244	386
Total sand and gravel ².....	18,155	22,363	19,228	24,492

¹ Includes blast, glass, fill, and engine sand (1970).

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

³ Includes miscellaneous and other gravel.

ana also remained essentially unchanged, 51.5 percent in 1971 compared to 51.3 in 1970. Prospects for Louisiana's Frasch sulfur operations are not especially bright. Current prices are relatively low and could become even lower as many industries are beginning to recover more sulfur in their environmental cleanliness efforts.

During the year there was a 14-percent decrease in the production of recovered sulfur; however, Humble Oil and Refining Co. began construction of a sulfur recovery plant at its Baton Rouge refinery. The new plant is designed to produce 170 tons per day of elemental sulfur and will include spare capacity to handle additional anticipated requirements. The recovery plant and attendant facilities will cost about \$5.1 million.

Table 15.—Sulfur produced and shipped from Frasch mines

(Thousand long tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value ¹
1967-----	4,059	4,233	\$139,739
1968-----	4,255	4,074	162,664
1969-----	3,857	3,999	108,299
1970-----	3,636	3,618	89,489
1971-----	3,616	3,681	W

W Withheld to avoid disclosing individual company confidential data.

¹ F.o.b. mine plant.

In December the Jefferson Lake Sulphur Co., already working under a hardship because of Canadian competition and world surplus supplies because of sulfur extraction required by more stringent environmental regulations, announced the closure of its plant in Plaquemines Parish. The decisive blow came when the plant was advised by its natural gas supplier that gas for the plant would be reduced 50 percent in accordance with FPC rules.

Vermiculite.—This mineral was not mined in Louisiana; however, exfoliated vermiculite was produced by Zonolite Division of W.R. Grace & Co. in Orleans. Production increased 12 percent from the previous year, and average unit value was 5 percent higher. The principal use of exfoliated vermiculite was as an admixture in concrete aggregate. Other uses included loose fill insulation, soil conditioner, and plaster aggregate.

METALS

Aluminum.—Bauxite received from out-of-State sources is processed into alumina at the Gramercy and Baton Rouge plants of Kaiser Aluminum and Chemical Corp. (Kaiser) and at the Burnside plant of Ormet Corp. Only the Chalmette plant of Kaiser and the Lake Charles plants of Consolidated Aluminum Corp. produced aluminum. Although aluminum production declined 2 percent during 1971, the State advanced its ranking to fourth in the Nation.

Kaiser became the free world's largest producer of aluminum fluoride with the startup of the \$5 million expansion which doubled the capacity of its Gramercy plant to 60,000 tons per year. The new plant incorporates the same process as the initial plant; that is, sulfuric acid is reacted with fluorspar to produce hydrogen fluoride gas which in turn is reacted with the alumina trihydrate to make aluminum fluoride. Kaiser also announced during the year that its production of synthetic cryolite from fluosilicic acid at its Chalmette plant will be increased from a current 30,000 tons per year to 50,000 tons per year by 1972.

Iron and Steel.—Midland-Ross Corp. began construction of a facility at Taft, La., to produce metalized pellets. The plant will cost about \$30 million and will be able to produce 800,000 tons per year. Construction will be in three stages beginning with the dock facilities and then the two 400,000-ton-per-day production units. Production of pellets to be used in electric furnace steel-making will begin with the completion of the first unit in early 1973.

Extensive air and water pollution controls systems are being incorporated into the plant, which will be designed so that expansion can be conducted easily. Numerous foundries along the Mississippi River near the plant (30 miles upstream from New Orleans) offer a sizable potential market. Some of the output will be exported.

Nickel.—American Metal Climax, Inc. (Amx) purchased the Port Nickel refinery at Braithwaite, La. Built by the Cuban American Nickel Co. in 1959 to process nickel-cobalt sulfide concentrates from Cuba, the plant was closed after 9 months of operation when supplies were cut off following Cuban nationalization of U.S.

owned mines. Since then it has been maintained on a standby basis. Originally the plant refined 50,000 tons per year of a nickel-cobalt sulfide slurry. With modifications the plant will be able to process 54,000 tons per year of a matte imported from Botswana in southern Africa and consisting of 42 percent nickel, 3 percent copper, and 0.4 percent cobalt. Nickel will be produced as powder, briquets, and

eventually cathodes. Copper will be produced as powder, briquets, and wire bar. Cobalt will be produced as metal and oxide powders and metal briquets.

Amax has reached an agreement with Bamangwato Concessions, Ltd., to toll-refine approximately 44,000 short tons annually of nickel-copper-cobalt when the plant is completed, scheduled for the first quarter of 1974.

Table 16.—Principal producers and processors of minerals

Commodity and company	Address	Type of activity	Parish
Aluminum:			
Kaiser Aluminum & Chemical Corp.	P.O. Box 1600 Chalmette, La. 70043	Reduction plant...	St. Bernard.
Consolidated Aluminum Corp.	P.O. Box LL Lake Charles, La. 70601	...do.....	Calcasieu.
Barite:			
Dresser Minerals	P.O. Box 6504 Houston, Tex. 77005	Grinding plant...	Orleans and Calcasieu.
Milchem, Inc.	P.O. Box 22111 Houston, Tex. 77027	...do.....	Orleans.
National Lead Co.	Box 1675 Houston, Tex. 77001	...do.....	Do.
Carbon black:			
Ashland Chemical Co.	P.O. Box 1503 Houston, Tex. 77005	Furnace plant....	St. Mary.
Cabot Corp.	125 High St. Boston, Mass. 02110	...do.....	St. Mary and Evangeline.
Columbian Carbon Co.	380 Madison Ave. New York, N.Y. 10017	...do.....	Ouachita, Avoyelles, St. Mary, Calcasieu.
Continental Carbon Co.	P.O. Box 22085 Houston, Tex. 77027	...do.....	Calcasieu.
Sid Richardson Carbon & Gasoline Co.	1200 Ft. Worth National Bank Bldg. Fort Worth, Tex. 76102	...do.....	West Baton Rouge.
Thermatomic Carbon Co.	245 Park Ave. New York, N.Y. 10017	...do.....	Ouachita.
Cement:			
Ideal Cement Co., Div. Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	Plant.....	East Baton Rouge.
Lone Star Cement Corp.	P.O. Box 47327 Dallas, Tex. 75247	...do.....	Orleans.
Louisiana Cement Co., Div. OKC Corp.	14900 Intracoastal Dr. New Orleans, La. 70129	...do.....	Do.
Clays:			
Acme Brick Co.	Box 425 Ft. Worth, Tex. 76101	Mine and plant...	East Baton Rouge.
Athens Caddo Brick Co.	Box 70 Athens, Tex. 75751	...do.....	Caddo.
Big River Industries, Inc.	Box 66377 Baton Rouge, La. 70806	...do.....	Pointe Coupee.
Hammond Baton Rouge Brick Co.	Box 329 Hammond, La. 70401	...do.....	Tangipahoa.
Ideal Cement Co., Div. Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	...do.....	West Baton Rouge.
Kentwood Brick & Tile Manufacturing Co., Inc.	Drawer F Kentwood, La. 70444	...do.....	St. Helena.
Louisiana Cement Co., Div. of OKC Corp.	14900 Intracoastal Dr. New Orleans, La. 71029	...do.....	St. Bernard.
Louisiana Lightweight Aggregate Co., Div. of Texas Industries, Inc.	8100 Carpenter Freeway Dallas, Tex. 75247	...do.....	Rapides.
Gypsum:			
National Gypsum Co.	325 Delaware Ave. Buffalo, N.Y. 14202	Calcining plant...	Jefferson.
United States Gypsum Co.	101 South Wacker Dr. Chicago, Ill. 60606	...do.....	Orleans.
Winn Rock, Inc.	P.O. Box 790 Winnfield, La. 71483	Quarry and plant.	Winn.
Lime:			
Allied Chemical Corp.	P.O. Box 70 Morristown, N.J. 07960	...do.....	East Baton Rouge.
Olin Corp.	P.O. Box 2896 Lake Charles, La. 70601	...do.....	Calcasieu.
Pelican State Lime Div. of Radcliff Materials, Inc.	P.O. Box 1637 Morgan City, La. 70380	...do.....	St. Mary.
United States Gypsum Co.	101 South Wacker Dr. Chicago, Ill. 60606	...do.....	Orleans.

Table 16.—Principal producers and processors of minerals—Continued

Commodity and company	Address	Type of activity	Parish
Natural gas and petroleum: ¹			
Salt:			
Allied Chemical Corp., Industrial Chemical Div.	Box 70 Morristown, N.J. 07960	Brine wells	Iberville.
The Carey Salt Co.	1800 Carey Blvd. Hutchinson, Kans. 67501	Underground mine.	St. Mary.
Cargill, Inc.	Cargill Building Minneapolis, Minn. 55402	.....do.....	Do.
Diamond Crystal Salt Co., Jefferson Island Div.	916 Riverside Ave. St. Clair, Mich. 48079	.....do.....	Iberia.
The Dow Chemical Co.	Midland, Mich. 48640	Brine wells	Iberville.
Freeport Sulphur Co.	Box 61520 New Orleans, La. 70160	.....do.....	Plaquemines, Jefferson, Terrebonne.
Gordy Salt Co., Inc.	Box 638 New Iberia, La. 70560	.....do.....	St. Martin.
International Salt Co., Avery Mine & Refinery.	Clarks Summit, Pa. 18411	Underground mine.	Iberia.
Kaiser Aluminum & Chemical Corp.	900 17th St., N.W. Washington, D.C. 20006	Brine wells	Ascension.
Morton Salt Co.	110 North Wacker Dr. Chicago, Ill. 60606	Underground mine.	Iberia.
Olin Corp.	Box 991 Little Rock, Ark. 72203	Brine wells	Cameron.
PPG Industries, Inc., Industrial Chemical Div.	Box 1000 Lake Charles, La. 70604	.....do.....	Calcasieu.
Wyandotte Chemicals Corp.	1609 Biddle Ave. Wyandotte, Mich. 48192	.....do.....	Ascension.
Sand and gravel:			
Braswell Sand & Gravel Co., Inc.	Box 798 Minden, La. 71055	Stationary	Webster.
Gifford-Hill & Co., Inc.	Box 47127 Dallas, Tex. 75247	Stationary and dredge.	Jefferson, Davis, Webster, Tangipahoa.
Jahncke Service, Inc.	814 Howard Ave. New Orleans, La. 70113	Dredge	St. Tammany.
Louisiana Industries, Inc.	Box 5472 Alexandria, La. 71301	.....do.....	Ouachita, Rapides, Washington.
Ouachita Gravel Co., Inc.	Box 1241 Monroe, La. 71201	Stationary	Ouachita.
Rebel Sand & Gravel Co.	Rt. 2, Box 386E Denham Springs, La. 70726	.....do.....	St. Helena.
Red Stick Gravel Co.	Box 847 Baton Rouge, La. 70821	.....do.....	East Baton Rouge.
Standard Gravel Co., Inc.	Rt. 4, Box 17 Franklinton, La. 70438	.....do.....	Washington.
Trinity Concrete Products	Box 47524 Dallas, Tex. 75247	Stationary and dredge.	Beauregard.
Shell:			
Ayers Materials Co., Inc.	P.O. Box 382 Harvey, La. 70058	Dredge	St. Tammany.
W. T. Burton Industries, Inc.	P.O. Box 100 Sulphur, La. 70663	.....do.....	Cameron.
Ideal Cement Co., Div. Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	.....do.....	St. Mary.
Jahncke Service Co., Inc.	814 Howard Ave. New Orleans, La. 70113	.....do.....	St. Tammany.
Lake Charles Dredging & Towing Co.	Lafayette, La. 70501	.....do.....	St. Mary.
Louisiana Materials Co.	P.O. Box 8214 New Orleans, La. 70122	.....do.....	St. Tammany.
Radcliff Materials, Inc.	P.O. Drawer 946 Mobile, Ala. 36601	.....do.....	Orleans.
Stone: Winn Rock, Inc.	P.O. Box 790 Winnfield, La. 71483	Quarry and plant.	Winn.
Sulfur, native:			
Freeport Sulphur Co.	161 East 42d St. New York, N.Y. 10017	Frasch process	Jefferson, Plaquemines, Terrebonne.
Texas Gulf Sulphur Co.	200 Park Ave. New York, N.Y. 10017	.....do.....	Lafourche.
Sulfur, recovered:			
Shell Oil Co.	Box 60673 New Orleans, La. 71060	Secondary recovery.	St. Charles.
Stauffer Chemical Co.	299 Park Ave. New York, N.Y. 10017	.....do.....	East Baton Rouge.
Vermiculite: W. R. Grace & Co., Zonolite Div.	62 Whittemore Ave. Cambridge, Mass. 02140	Exfoliating plant.	Orleans.

¹ 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 Geological Survey of Maine, for collecting information on all minerals except fuels.

By Frank B. Fulkerson ¹

The value of mineral production in Maine totaled \$21.9 million, a decrease of 8 percent from the record high established in 1970. Copper, zinc, silver, sand and gravel, and dimension stone production decreased, and feldspar mines were inactive. Increased values were recorded for cement, crushed stone, and peat.

There was continued exploration activity for metallic mineral deposits in the State. International Paper Co. was engaged in an evaluation program involving company-owned land, including geochemical and geophysical investigations at a prospect near Square Lake in northeastern Maine. At the end of 1971, Hanna Mining Co. and Basic, Inc., both of Cleveland, announced an agreement for a joint exploration and metallurgical testing program in-

volving the nickel-copper deposit near Union, studied by Knox Mining Co. since the middle 1960's. Exploration crews representing mineral divisions of several large petroleum companies were active in the Moosehead Lake area and other parts of northern Maine.

The \$200 million atomic powerplant being built at Wiscasset by Maine Yankee Atomic Power Co. was more than 90 percent complete at the end of 1971.

The State Geological Survey continued its program of mapping, publication, and service to other State agencies. The coastal mapping program was increased with six quadrangle mapping field parties studying bedrock geology.

¹ Industry economist, Division of Nonmetallic Minerals.

Table 1.—Mineral production in Maine ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ².....thousand short tons..	41	\$55	42	\$56
Copper.....short tons..	2,703	3,120	2,510	2,610
Gem stones.....	NA	35	NA	40
Peat.....thousand short tons..	W	W	2	W
Sand and gravel.....do..	12,971	6,888	8,292	5,881
Silver.....thousand troy ounces..	63	112	41	64
Stone.....thousand short tons..	W	W	1,133	2,913
Zinc.....short tons..	9,114	2,792	5,850	1,884
Value of items that cannot be disclosed:				
Beryllium concentrate (1970), cement (portland and masonry), feldspar (1970), fire clay (1970), kaolin (1971), peat, and value indicated by symbol W.....	XX	10,778	XX	8,450
Total	XX	23,780	XX	21,898
Total 1967 constant dollars.....	XX	21,721	XX	19,025

² Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

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

² Excludes certain clay; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Maine, by county
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Androscoggin	\$885	\$877	Sand and gravel, clays.
Aroostook	633	417	Sand and gravel.
Cumberland	2,472	2,202	Stone, sand and gravel, clays.
Franklin	W	207	Sand and gravel.
Hancock	6,345	4,927	Copper, zinc, sand and gravel, silver, peat, clays, stone.
Kennebec	1,086	1,584	Sand and gravel, stone.
Knox	W	W	Cement, stone, sand and gravel.
Lincoln	W	W	Sand and gravel.
Oxford	223	W	Do.
Penobscot	725	453	Do.
Piscataquis	W	W	Stone, sand and gravel.
Sagadahoc	W	W	Sand and gravel.
Somerset	W	W	Do.
Waldo	W	W	
Washington	W	W	Sand and gravel, peat.
York	W	W	Sand and gravel.
Undistributed ¹	11,410	11,231	
Total	² 23,780	21,898	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
¹ Includes value of gem stones and sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.
² Data may not add to total shown because of independent rounding.

Table 3.—Indicators of Maine business activity

	1970	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force..... thousands..	405.7	411.6	+1.4
Unemployment..... percent of work force..	5.7	7.8	+36.8
Employment:			
Manufacturing..... thousands..	110.0	103.2	-6.2
Durable goods..... do.....	33.0	31.0	-6.1
Nondurable goods..... do.....	77.0	72.2	-6.2
Nonmanufacturing..... do.....	221.6	225.3	+1.7
Personal income:			
Total..... millions..	\$3,235	\$3,249	+4
Per capita.....	\$3,251	\$3,419	+5.2
Portland cement shipments to and within Maine			
..... thousand 376-pound barrels..	1,094	1,210	+10.6
Mineral production value..... thousands..	\$23,780	\$21,898	-7.9

^p Preliminary.

Sources: New England Economic Indicators; Survey of Current Business; U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Metal and peat	101	255	26	206	1	15	77.52	32,189
Nonmetal	56	183	10	82	--	3	36.61	708
Sand and gravel	695	193	134	1,201	--	21	17.49	329
Stone	195	308	60	495	--	5	10.11	75
Total ¹	1,047	220	231	1,984	1	44	22.69	3,597
1971:^p								
Metal	75	279	21	167	--	6	35.90	1,322
Nonmetal ²	75	179	13	106	--	8	75.57	2,645
Sand and gravel	780	189	147	1,267	--	13	10.26	249
Stone	320	290	93	750	2	24	34.66	16,501
Total	1,250	220	274	2,290	2	51	23.14	5,761

^p Preliminary.

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

² Beginning in 1971, data concerning peat operations are included in the nonmetals industry on a continuing basis.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Martin Marietta Corp., Eastern Division, completed a new \$18 million cement plant at Thomaston to replace the existing plant at the same site. Production from the new plant, which has an annual capacity of 2.5 million barrels, was begun in July. The old 2-million-barrel production unit was shut down in October and was to be dismantled. The new facility has an outdoor rotary kiln 520 feet long and between 14 and 17 feet in diameter. The kiln replaces two smaller kilns housed inside the old plant buildings. The kiln discharges clinker into an 8- by 50-foot cooler. Total cost of dust suppression equipment at the new cement plant was nearly \$3 million. The plant is equipped with a central baghouse to remove dust from kiln exhaust gases. Also, 26 smaller bag-type collectors are placed at other locations throughout the plant where dust is generated. Water pollution is not a problem, since no water flows off the premises. About 33 million gallons of water are recycled in the plant's water system each month. Another 6 million gallons escape as water vapor.

The Thomaston facility continued to be the only cement plant in New England. Both finished portland and masonry cements were produced. Portland cements in regular production included Types I-II (general use) and Type III (high early strength). The quantity shipped in 1971 was nearly the same as in 1970, but the value of shipments increased owing to higher unit prices. The principal market area was Maine, New Hampshire, and eastern Massachusetts. Consumers of portland cement were ready-mixed concrete companies, concrete products manufacturers, and building materials dealers. Most of the product was shipped in bulk. The company maintained a distribution terminal at Wilmington, Mass., which has a daily capacity of 25,000 barrels. New pressure-flow rail cars transport cement from Thomaston to the terminal.

Total apparent consumption of portland cement in Maine during 1971 was 1,210,000 barrels compared with 1,094,000 barrels in 1970. Consumption of masonry cement was 77,000 barrels.

Clays.—Production of common clay for

brick manufacture was reported from three pits in Cumberland and two pits in Androscoggin County. Output of clay was virtually unchanged from that of 1970. Besides brick sales in Maine, producers shipped brick to Massachusetts. A small quantity of kaolin was recovered at a property in Hancock County and used in making pottery. Leading clay producers were Lachance Bros. Brick Co. and Morin Brick Co.

Feldspar.—No production was reported from the feldspar mine and grinding mill near West Paris in Oxford County. Bell Minerals Co. sold the properties in March to Aldrich Realty Co. of South Paris.

Gem Stones.—The State legislature officially named tourmaline as Maine's state mineral. Many fine specimens of green and pink tourmaline have been collected from quarries in Oxford, Androscoggin, and Sagadahoc Counties. The Maine tourmaline is often very clear, and some of the crystals have been of record size.² The value of gem stone production was about the same as in previous years.

Peat.—Sales of moss peat increased over those of 1970. The principal producers were Acadia Peat Corp., Penobscot, and International Peat Moss Co., Inc., Jonesport. The peat was processed, packaged, and sold mainly for general soil improvement. Other uses included potting soils and packing material for flowers.

Perlite.—Crude perlite from Colorado was expanded in a rotary kiln at the Chemrock Corp's Thomaston plant. The expanded product was sold for use principally as a filter media.

Sand and Gravel.—The production of sand and gravel dropped to 8.3 million tons, 36 percent below that of 1970. The Maine Highway Commission, the State's largest producer, reported a substantial decrease in output.

More than one-half of Maine's sand and gravel production was provided by operations in Androscoggin, Aroostook, Cumberland, Kennebec, and Penobscot Counties. Production in excess of 1 million tons was reported in Cumberland and Kennebec Counties. Average value of sand and gravel production increased from 53 cents per ton in 1970 to 71 cents per ton in 1971.

²Lapidary Journal. Maine Adopts State Mineral. V. 25, No. 4, July 1971, p. 571.

New construction was begun on two new lanes on Interstate 95 between Alton and the Canadian border at Houlton. The first contracts awarded called for work between

Alton and Howland in Penobscot County. Other projects along Maine highways included work on the interstate system in the Portland area.

Table 5.—Sand and gravel sold or used by producers, by class of operation and use

(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building.....	489	\$388	592	\$594
Fill.....	280	127	412	240
Paving.....	452	438	670	690
Other uses ¹	396	437	81	76
Total ²	1,617	1,391	1,755	1,600
Gravel:				
Construction:				
Building.....	420	191	575	710
Fill.....	204	125	161	108
Paving.....	978	1,263	960	1,341
Other uses ³	394	328	416	450
Total ²	1,996	1,908	2,111	2,609
Government-and-contractor operations:				
Sand:				
Building.....	--	--	1	2
Fill.....	200	48	26	6
Paving.....	425	155	1,472	614
Other uses.....	32	9	35	10
Total ²	657	212	1,534	632
Gravel:				
Building.....	12	3	23	20
Fill.....	198	46	34	10
Paving.....	8,481	3,325	2,836	1,010
Other uses.....	10	2	--	--
Total ²	8,702	3,376	2,893	1,040
Total sand and gravel ²	12,971	6,888	8,292	5,881

¹ Includes engine and other sands.

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

³ Includes miscellaneous, other, and railroad ballast gravel.

Stone.—Crushed stone production (limestone and granite) increased 9 percent in quantity and 12 percent in value, owing mainly to greater demand in cement production and for concrete and bituminous aggregate. Sizable tonnages of crushed limestone also were used for soil improvement, poultry feed and in paper manufacturing. Knox County continued as the leading limestone producing county, followed by Cumberland and Kennebec Counties; output of granite was reported in Cumberland County. Martin Marietta Corp. replaced old crushing facilities at its Thomaston quarry. Other leading producers were Blue Rock Industries, Cook and Co., Inc., and Lime Products Corp.

The production of dimension stone decreased compared with the 1970 level. Lower output was recorded from the John Swenson Granite Co. quarry on Vinelhaven Island. Unfinished granite blocks weighing approximately 20 tons each were quarried and transported to the company's finishing plant in Concord, N.H. Dimension slate for flooring and other uses was produced by Portland-Monson Slate Co. Black slate mined underground near Monson is sawed and split to size at the local finishing mill and shipped to the company plant in New York, where the back is ground for smoothness and proper thickness. The front side is left as split for flooring surfaces. The company was starting a new shaft about 5 miles from its present mine.

METALS

Callahan Mining Co. expected to close its Cape Rosier zinc-copper mine and mill permanently in mid-1972 owing to depletion of ore reserves. The mine, which was the first base-metal mining operation of significance in the State since the turn of the century, began production in 1968 after the company spent \$4.5 million for exploration, development, and construction. Zinc-copper ore was produced both by open pit and underground methods. The flotation mill was among the first to use sea water for processing. After the company announced it would close the mine, the Goose Pond Reclamation Committee, consisting of four members from the nearby town of Brooksville, two state representatives, and one from the mining firm, was formed to make recommenda-

tions and oversee the reclamation of the pit area to be abandoned.

About 15 miles east of Cape Rosier, near the town of Blue Hill, Kerr American, Inc., was planning to begin production in late 1972 from the Black Hawk zinc-copper mine. This mine was first developed in the 1960's, but it never produced. In 1971 the company began driving an inclined entry to the underground workings and erecting a mill with a capacity of 1,000 tons per day. The expected cost of the Blue Hill project is \$5 million. A trackless mining method will be used. Broken ore will be loaded into dump trucks and brought to the surface for milling. Steps were being taken to preserve the ecology of the area in which the mine is located. The company applied to the Maine Environmental Improvement Commission for a license to discharge process water from the mill into a nearby stream.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Dragon Cement Co., Division of Martin Marietta Corp. ¹	5A Joyce Kilmer Ave. New Brunswick, N.J. 08901	Plant.....	Knox.
Clays:			
Dennis Brick Co., Inc.....	R. F.D. No. 1 33 Old Washington Rd. Auburn, Maine 04210	Pit.....	Androscoggin.
Lachance Bros. Brick Co.....	R.F.D. No. 2 Gorham, Maine 04038	Pit.....	Cumberland.
Fred S. Liberty & Sons, Inc....	R.F.D. No. 1, Gray, Maine 04039	Pit.....	Do.
Morin Brick Co.....	Danville, Maine 04223	Pit.....	Androscoggin.
Royal River Brick Co., Inc.....	Box 191, Gray, Maine 04039	Pit.....	Cumberland.
Peat:			
Acadia Peat Corp.....	Penobscot, Maine 04476.....	Bog.....	Hancock.
International Peat Moss Co., Inc.	430 Trapelo Rd. Belmont, Mass. 02178	Bog.....	Washington.
Perlite (expanded):			
Chemrock Corp.....	End of Osage Street Nashville, Tenn. 37208	Plant.....	Knox.
Sand and gravel:			
Blue Rock Industries.....	58 Main Street Westbrook, Maine 04092	Pit.....	Androscoggin, Cumberland.
Harry C. Crooker & Sons, Inc.	Brunswick, Maine 04011.....	Pit ²	Do.
Hamlin Sand & Gravel Co., Inc.	920 Riverside St. Portland, Maine 04103	Pit ³	Cumberland.
Lane Construction Co.....	965 E. Main St. Meriden, Conn. 06450	Pit.....	Penobscot.
Lewiston Crushed Stone Co., Inc.	South Ave. Lewiston, Maine 04240	Pit ²	Androscoggin.
Harold C. MacQuinn, Inc.....	Bar Harbor, Maine 04609.....	Pit.....	Hancock.
C.M. Page Co., Inc.....	234 Main St. Orono, Maine 04473	Pit.....	Penobscot.
Leroy S. Prout Sand & Gravel	Scarborough, Maine 04074.....	Pit.....	Cumberland.
Maynard W. Robinson & Sons	R.F.D. No. 2 Cumberland Center, Maine 04021	Pit.....	Do.
Frank Rossi & Sons, Inc.....	National Bank Bldg. Gardiner, Maine 04345	Pit.....	Various.
Warren Bros. Company.....	Fairfield, Maine 04937.....	Pit.....	Kennebec.

See footnotes at end of table.

Table 6.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone:			
Granite, dimension:			
Hocking Granite Industries Inc. ⁴	Saint George, Maine 04857-----	Quarry-----	Knox.
The John Swenson Granite Co. Inc.	North State St. Concord, N.H. 03301	.....do-----	York, Knox.
Granite, crushed:			
Cook and Co., Inc.-----	150 Causeway St. Boston, Mass. 02114	.....do-----	Cumberland.
Limestone, crushed:			
Blue Rock Industries-----	58 Main St. Cumberland Mills, Maine 04092	.....do-----	Kennebec.
Dragon Cement Co., Division of Martin Marietta Corp.	5A Joyce Kilmer Ave New Brunswick, N.J. 08901	.....do-----	Knox.
Lime Products Corp.-----	P.O. Box 357 Union, Maine 04862	.....do-----	Do.
Miscellaneous, crushed:			
Blue Rock Industries-----	58 Main St. Cumberland Mills, Maine 04092	.....do-----	Cumberland.
Slate, dimension:			
Portland-Monson Slate Co.	Middle Granville, N.Y. 12849----	Underground..	Piscataquis.
Zinc:			
Callahan Mining Corp. ⁵ -----	Harborside, Maine 04642-----	Pit and underground.	Hancock.

¹ Portland and masonry.² 2 pits.³ 3 pits.⁴ Also crushed.⁵ Also copper and silver.

The Mineral Industry of Maryland

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

By Charles L. Klingman ¹

Mineral production in Maryland reached a new high in 1971. Total valuation of the mineral production was nearly \$100 million, an increase of \$11.2 million over that of 1970. Stone continued to be the leading commodity, accounting for 35 percent of the total mineral value of the State. Stone production dropped to 15.9 million tons, 1 percent under the tonnage for 1970. The value of the stone, however, was \$34.8 million, an increase of 6 percent. The average unit value of stone increased 7 percent.

Sand and gravel contributed 23 percent of the State's mineral value in 1971. Production of sand and gravel totaled 12.8 million tons and was valued at \$23.2 million.

Portland and masonry cement contributed significantly to the State economy in 1971. There were substantial increases in both production and value of both types of cement.

There was a small increase in bituminous coal production and a 25-percent increase in the unit price of the coal. About 70 percent of the coal mines in Maryland are open-pit or strip mines. Such mines are coming progressively under legal controls to protect the environment.

Carroll County became the leading mineral-producing county of the State, followed in order by Baltimore, Frederick, Prince Georges, and Garrett Counties.

Employment and Injuries.—The total number of people employed by the mineral industries of Maryland decreased 11 percent in 1971, compared with the 1970 figures.

There was a total of 101 lost-time injuries during 1971 in the mineral industries of Maryland, compared with 152 such in-

¹ Physical scientist, Division of Nonmetallic Minerals.

Table 1.—Mineral production in Maryland ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ² thousand short tons..	³ 1,129	³ \$1,433	1,027	⁴ \$1,558
Coal (bituminous)..... do.....	1,615	8,083	1,644	10,274
Gem stones.....	NA	3	NA	8
Natural gas..... million cubic feet.....	813	202	214	52
Peat.....	4	47	3	39
Sand and gravel..... thousand short tons.....	12,951	20,434	12,842	23,201
Stone..... do.....	16,015	32,783	15,912	34,770
Value of items that cannot be disclosed:				
Selected clays, cement (portland and masonry), greensand marl, lime, potassium salts (1970), and talc and soapstone.....	XX	25,231	XX	29,527
Total.....	XX	88,216	XX	99,429
Total 1967 constant dollars.....	XX	78,909	XX	86,384

^p Preliminary. NA Not available. XX Not applicable.

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

² Excludes ball clay; included with "Value of items that cannot be disclosed."

³ Excludes fire clay; included with "Value of items that cannot be disclosed."

⁴ Excludes kaolin; included with "Value of item that cannot be disclosed."

Table 2.—Value of mineral production in Maryland, by counties ¹
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Allegany	W	\$3,184	Coal, stone, sand and gravel.
Anne Arundel.....	\$3,312	2,308	Sand and gravel, stone.
Baltimore ²	15,407	16,327	Stone, sand and gravel, clays.
Calvert.....	W	W	Sand and gravel, greensand marl.
Caroline.....	25	W	Sand and gravel.
Carroll.....	W	W	Cement, stone, clays.
Cecil.....	6,774	6,515	Stone, sand and gravel.
Charles.....	W	W	Sand and gravel.
Dorchester.....	91	W	Do.
Frederick.....	9,043	11,701	Cement, stone, clays, lime.
Garrett.....	6,657	9,430	Coal, stone, natural gas, peat.
Harford.....	2,302	2,171	Stone, sand and gravel, clays, talc.
Howard.....	W	W	Stone.
Kent.....	W	30	Clays, peat.
Montgomery.....	W	W	Stone.
Prince Georges.....	8,790	10,364	Sand and gravel, clays, stone.
St. Marys.....	W	W	Sand and gravel.
Somerset.....	W	W	Do.
Talbot.....	W	--	
Washington.....	W	W	Cement, stone, clays.
Wicomico.....	W	W	Sand and gravel.
Worcester.....	13	--	
Undistributed ³	35,802	37,402	
Total	88,216	⁴ 99,429	

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

¹ Queen Annes County is not listed because no production was reported.

² Includes Baltimore City.

³ Includes sand and gravel and stone (1971) that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

⁴ Data may not add to total shown because of independent rounding.

Table 3.—Indicators of Maryland business activity

	1970	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force..... thousands..	1,506.3	1,538.9	+2.2
Unemployment..... percent of labor force..	3.9	4.9	+25.6
Employment:			
Manufacturing..... thousands..	271.1	253.1	-6.6
Transportation and public utilities..... do..	81.0	79.8	-1.5
Trade..... do..	304.0	315.5	+3.8
Finance, insurance, and real estate..... do..	63.6	69.9	+1.9
Mining..... do..	1.9	2.0	+5.3
Contract construction..... do..	88.4	94.3	+6.7
Services..... do..	236.7	245.4	+3.7
Government..... do..	249.0	256.0	+2.8
Payroll-average weekly earnings: Manufacturing.....	\$136.34	\$143.71	+5.4
Personal income:			
Total..... millions..	\$16,789	\$18,055	+7.5
Per capita.....	\$4,264	\$4,514	+5.9
Construction activity: Cement shipments to and within Maryland thousand 376-pound barrels..	7,709	7,469	-3.1
Mineral production value..... thousands..	\$88,216	\$99,429	+12.7

^p Preliminary.

Sources: Employment and Earnings and Annual Report on the Labor Force; Survey of Current Business; Area Trends in Employment and Unemployment; and U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Coal & peat.....	342	196	67	541	1	5	11.10	11,529
Nonmetal.....	166	239	40	321	--	16	49.89	761
Sand and gravel.....	749	258	193	1,748	--	34	19.46	2,360
Stone.....	1,457	278	405	3,356	--	97	28.90	651
Total ¹	2,714	260	706	5,965	1	152	25.65	2,144
1971: ^p								
Coal.....	315	188	59	481	--	4	8.32	391
Nonmetal ²	125	237	29	235	--	6	25.55	319
Sand and gravel.....	730	259	189	1,699	--	50	29.43	553
Stone.....	1,255	274	343	2,873	--	41	14.27	612
Total ¹	2,425	256	621	5,287	--	101	19.10	560

^p Preliminary.¹ Data may add to totals shown because of independent rounding.² Beginning in 1971, data concerning peat operations are included in the nonmetals industry on a continuing basis.

juries in 1970. The overall frequency rate was 19.10 injuries per million man-hours of work performed, compared with 25.65 injuries in 1970. The number of man-days lost due to injuries out of each million man-hours worked (severity rate) was 560, compared with 2,144 in 1970.

Legislation and Government Programs.

—Construction continued in 1971 on the nuclear powerplant at Calvert Cliffs. The plant is scheduled by 1974 to generate 1,750 megawatts of power and will cost \$398 million. Because of various court orders, appeals, hearings, and reports, construction was delayed. In addition, Maryland has passed a law giving the State

control over all future sites of powerplants. This control was exercised at least once in rejecting a site for a powerplant in Charles County on the Potomac River across from Quantico.

A new coal-burning powerplant was approved by the State in northwest Montgomery County at the present site of the Pepco Dickerson station. There will be two 800-megawatt stations costing a total of \$364 million.

A memorandum of understanding between the State and the Bureau was drawn up to extend the existing statistical cooperative agreement between these two bodies until December 31, 1976.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Shipments of portland cement in 1971 increased 5 percent. Masonry cement shipments increased 18 percent. Portland cement was produced at three plants, one of which also produced masonry cement. One additional company produced only masonry cement. Average mill value of portland cement was \$3.33 per barrel, up 35 cents per barrel over the 1970 price. General-use and moderate-heat types of cement comprised 97 percent of the production; the remainder was Type III (high-early-strength) cement. Portland cement was consumed for ready-mixed concrete, concrete products, and building materials, by contractors and miscellaneous other customers. Raw materials used in making

portland cement included limestone, cement rock, clay and shale, sand, gypsum, and iron-bearing materials. Approximately 13 percent of the crushed stone production of Maryland went into the manufacture of portland cement. The plants used fuel oil and bituminous coal to fire the raw materials and to convert them into crude cement clinker.

The Lehigh portland cement plant at Union Bridge completed an extensive expansion program in November 1970, and thereby became the largest Lehigh plant in the Nation. This work raised the capacity of the plant from about 3.5 million barrels per year to nearly 5 million.²

² Pit and Quarry, Union Bridge Operation Now Lehigh's Largest. V. 64, No. 1, July 1971, pp. 111-116, 126.

Marquette Cement Manufacturing Co. at Hagerstown also completed a modernization program during 1971, increasing annual capacity to 2.5 million barrels in addition to improving efficiency and reducing dust discharges into the air.³

Clays.—Various types of clays were produced at 14 pits in seven counties during the year. Production decreased slightly, but the value of the clay increased 11 percent because of higher prices of the products. Common clay and shale were used primarily as raw material for making brick, tile, cement, and lightweight aggregate. Less than 2 percent of the production was in the form of the higher priced ball and fire clays and kaolin.

Diatomite.—Even though there was no commercial production of diatomite in Maryland in 1971, it was known that a 20-foot-thick bed of diatomite existed in Calvert, Prince Georges, and Charles Counties. The high amount of clay in the deposit, however, reduced the diatomite quality below that of western sources. There were plans for the Maryland Geological Survey and the U.S. Bureau of Mines to run cooperative bloating tests on several samples of diatomite to see if it has potential use as a lightweight aggregate.

Gem Stones.—Production of semiprecious stones was limited to small quantities collected by dealers and amateur collectors. The total value of such stones was estimated at \$8,000 in 1971.

Lime.—S. W. Barrick & Sons, Inc., and Le Gore Lime Co. produced lime in Frederick County for agriculture. Output declined 21 percent and was 50 percent below the 1965 record. The lime was consumed in Maryland, Virginia, Delaware, and Pennsylvania. Total consumption of lime in Maryland was 382,000 tons. The Le Gore Lime Co. went out of business July 1, 1971.

Marl, Greensand.—Kaylorite Corp. of Dunkirk, Calvert County, produced greensand marl for use as a soil conditioner, but production was stopped in 1971 owing to the death of the owner-operator. Only a minor amount of the marl was mined before the shutdown.

Perlite.—Relatively small amounts of perlite were expanded during 1971 by two plants in Prince Georges County and by one plant in Baltimore County. The product was used as a lightweight aggregate in

concrete and plaster. The average mill value of the perlite was \$80.50 per short ton.

Sand and Gravel.—The production of sand and gravel in Maryland was 1 percent less in tonnage but 14 percent higher in value in 1971 than in 1970. In value, sand and gravel was the third-ranking mineral activity of the State. Sand was 20 percent higher in value per ton and gravel was 9 percent higher than the 1970 values.

Sand and gravel were utilized in building, 60 percent; paving, 18 percent; and fill, 10 percent. The remainder went to miscellaneous uses.

The five major producing counties for sand and gravel in Maryland, in order of production follow: Prince Georges, Baltimore, Cecil, Anne Arundel, and Charles Counties.

Commercially valuable deposits of sand and gravel occur throughout most of the coastal plain of eastern Maryland, with the most valuable ones in the vicinity of Baltimore and Washington, D.C.

Commercial producers operated 45 stationary plants, nine portable plants, and one dredge in 1971. Only two Government-and-contractor operations were active during the year; one was stationary and one portable.

Stone.—Stone production, which included both crushed and dimension stone, decreased 1 percent in tonnage in 1971. The unit price of stone increased, however, so as to cause a 6-percent increase in finished product value and to allow stone to continue to be the leading mineral commodity in the State. In value, Baltimore County was by far the leading area for stone production, followed in order by Montgomery, Cecil, Frederick, and Howard Counties. About 90 percent of this stone was transported by truck to its point of usage.

Of the crushed stone 55 percent went to aggregates of all kinds, 13 percent to cement manufacture, 11 percent to roadbase stone, and the remaining 21 percent to miscellaneous uses such as building products, lime manufacturing, and riprap.

Dimension stone made up less than 1 percent of the total stone tonnage but amounted to about 4 percent of the value of all stone. The average unit value of di-

³ Pit and Quarry. Marquette Modernizes at Hagerstown. V. 64, No. 1, July 1971, pp. 88-95, 106.

**Table 5.—Sand and gravel sold or used by producers,
by class of operation and use**

(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	5,202	\$7,634	4,252	\$7,170
Fill.....	W	W	191	118
Paving.....	1,549	2,461	1,232	2,412
Other uses ¹	159	321	934	2,210
Total ²	6,910	10,416	6,608	11,911
Gravel:				
Building.....	3,694	7,153	3,402	6,713
Fill.....	W	W	1,090	1,115
Paving.....	1,337	2,120	986	1,588
Other uses ³	880	726	644	1,858
Total ²	5,911	9,999	6,122	11,273
Government-and-contractor operations:				
Sand: Fill.....	36	5		
Gravel: Paving.....	94	13	112	16
Total sand and gravel ²	12,951	20,434	12,842	23,201

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

¹ Includes ground, unground, and other sands.

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

³ Includes miscellaneous and other gravel (1971).

mension stone was more than five times that of crushed stone. About 80 percent of the dimension stone was used as flagging.

Of the total stone production, 62 percent was limestone, 23 percent traprock, 13 percent granite, and the remaining 2 percent was divided among sandstone, oystershell, quartzite, and marble.

Crushed and broken stone was produced by 57 quarries in 12 counties. Dimension stone was produced by nine quarries in four counties. Five of the quarries produced both crushed and dimension stone.

Talc and Soapstone.—Talc was mined and processed in Harford County. This commodity was used in the manufacture of toilet preparations and ceramics. It was also used in foundry facings.

Vermiculite (Exfoliated).—W. R. Grace & Co., Prince Georges County, processed vermiculite for use primarily in horticulture, loosefill insulation, and concrete aggregate.

MINERAL FUELS

Coal (Bituminous).—Bituminous coal was mined from five fields or basins in the extreme western mountainous portion of Maryland. About 83 percent of the production came from open-pit or strip mines, which were under strict regulation throughout the year. Efforts were made to obtain

State laws to prohibit all strip mining in the State.

State coal production in 1971, however, increased 2 percent to 1.6 million short tons. The average unit value of the coal increased to \$6.36 per ton, 25 percent greater than the 1970 price. These two factors combined to make the total value of the Maryland coal output \$10.3 million or 27 percent higher.

Of the 55 total mines in the State, 21 were in Allegany County and 34 in Garrett County. Ten of these mines were underground, six were auger-type mines, and 39 were open-pit mines.

Coke and Coal Chemicals.—Bethlehem Steel Corp. produced coke for its internal use at Sparrows Point. The vapors from the coal distillation produced 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.—There was a sharp reduction in natural gas produced from Maryland in 1971. Total production was only 214 million cubic feet, which was 26 percent of the 1970 production. The unit price of the gas was 2 percent less than the 1970 price. All natural gas was produced from three small fields in Gar-

rett County in the extreme western part of Maryland. A depleted gasfield, the Accident field, was being used as a gas storage reservoir.

No liquid petroleum has been found in Maryland, although three deep dry wells have been drilled in Wicomico and Worcester Counties in the southeastern quarter of the State. There are two oil refineries in operation near Baltimore.

Peat.—Production of peat in Maryland dropped in 1971 to 3,000 short tons valued at \$39,000. Peat was humus and reed-sedge and was sold in both bulk and packaged form for soil improvement.

METALS

Aluminum.—No bauxite or other aluminum ore was mined in Maryland, but there were two manufacturers of aluminum and aluminum products operating in

the State. The manufacturers were Eastalco Aluminum Co. of Frederick and Tomke Aluminum of Baltimore.

Copper.—No copper ore was mined in Maryland in 1971, although a large amount had been produced before 1918. Two copper refineries produced metal in Maryland, however, using imported ore. They were American Smelting and Refining Co. in Baltimore and Kennecott Copper Corp. of Hawkins Point, Anne Arundel County.

Iron and Steel.—There was no mining of iron ore in Maryland in 1971, but Bethlehem Steel Corp. of Sparrows Point produced pig iron, raw steel, and semifabricated steel products from imported ore.

Lead.—Lead, lead alloys, and products were produced by three plants in Baltimore. The plants utilized primary metals and scrap for raw materials.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Portland:			
Alpha Portland Cement Co.	15 South Third St. Easton, Pa. 18042	Plant.....	Frederick.
Lehigh Portland Cement Co.	718 Hamilton St. Allentown, Pa. 18101	....do.....	Carroll.
Portland and Masonry:			
Marquette Cement Mfg. Co.	20 North Wacker Dr. Chicago, Ill. 60606	....do.....	Washington.
Masonry:			
M.J. Grove Lime Co., Division of the Flintkote Co.	Lime Kiln, Md. 21763	....do.....	Frederick.
Clays:			
Arundel Corp.	501 St. Paul Pl. Baltimore, Md. 21202	Pit.....	Baltimore.
Capitol Clay Products Inc.	6600 Sheriff Rd., N.E. Washington, D.C. 20027	Pit.....	Prince Georges.
Victor Cushwa & Sons, Inc.	201 West Potomac St. Williamsport, Md. 21795	Pit.....	Washington.
Lehigh Portland Cement Co.	718 Hamilton St. Allentown, Pa. 18101	2 pits.....	Carroll.
Structural Components Corp.	7600 Pulaski Highway Baltimore, Md. 21237	Pit.....	Baltimore.
Coal:			
Buffalo Coal Co., Inc.	P.O. Box 275 Bayard, W. Va. 26707	3 strip; 1 auger.	Allegheny and Garrett.
Grafton Coal Co.	P.O. Box 188 Mountain Lake Park, Md. 21550	Strip.....	Garrett.
Moran Coal Co., Inc.	Drawer E Westernport, Md. 21562	5 strip.....	Do.
Shallmar Coal Co., Inc.	Bayard, W. Va. 26707	1 strip; 1 auger.	Do.
TG&C Coal Co., Inc.	Midlothian, Md. 21543	Strip.....	Allegheny.
Winner Bros. Coal Co., Inc.	243 Upper Consol Road Frostburg, Md. 21532	2 strip.....	Do.
Gypsum (calcined):			
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.
Finished iron oxide pigments (natural and manufactured):			
Mineral Pigments Corp.	Washington Blvd. Muirkirk, Md. 20705	....do.....	Prince Georges.
Lime:			
S.W. Barrick & Sons, Inc.	Woodboro, Md. 21798	....do.....	Frederick.
Le Gore Lime Co.	Le Gore, Md. 21761	....do.....	Do.

Table 6.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Peat:			
Garrett County Processing & Packaging Corp.	R.F.D. No. 1 Accident, Md. 21520	Bog-----	Garrett.
Maryland Peat & Humus Co.	90 Cricket Ave. Ardmore, Pa. 19003	Bog-----	Kent.
Perlite (expanded):			
Atlantic Perlite Co.	7950 New Hampshire Ave. Suite 6, Langley Park, Md. 20787	Plant-----	Prince Georges.
Petroleum refineries:			
American Oil Co.	Baltimore, Md. 21200	Refinery-----	Baltimore.
Chevron Asphalt Co.	do	do-----	Do.
Sand and gravel:			
Annapolis Sand & Gravel Co., Inc.	P.O. Box 322 Waldorf, Md. 20601	Pit-----	Anne Arundel.
Arundel Corp.	501 St. Paul Pl. Baltimore, Md. 21202	Pit-----	Do.
Bob's Sand Co.	Severn, Md. 21144	Pit-----	Do.
Harry T. Campbell Sons Co.	Baltimore, Md. 21225	2 pits-----	Baltimore.
Campbell Sand Co.	4911 Calvert Rd. College Park, Md. 20740	Pit-----	Prince Georges.
Charles County Sand & Gravel Co., Inc.	P.O. Box 322 Waldorf, Md. 20601	Pit-----	Charles.
Contee Sand & Gravel Co., Inc.	P.O. Box 460 Laurel, Md. 20810	Pit-----	Prince Georges.
Inland Materials, Inc.	5401 Kirby Rd. Clinton, Md. 20735	Pit-----	Do.
Lone Star Industries, Inc.	5001 West Broad St. Richmond, Va. 23226	Pit-----	Do.
Charles Meyer & Sons, Inc.	Route 1, Box 49 Lothian, Md. 20820	Pit-----	Anne Arundel.
Nottingham Properties, Inc.	102 West Pennsylvania Ave. Towson, Md. 21204	Pit-----	Baltimore.
Potomac Sand & Gravel Co.	3020 K. St., N.W. Washington, D.C. 20007	Dredge-----	Charles.
Silver Hill Sand & Gravel Co.	4714 St. Barnabas Rd., S.E. Washington, D.C. 20031	Pit-----	Prince Georges.
A.H. Smith Co.	Branchville, Md. 20721	Pit-----	Do.
York Building Products Co., Inc.	P.O. Box 1708 York, Pa. 17400	3 pits-----	Cecil.
Smelters:			
American Smelting & Refining Co.	120 Broadway New York, N.Y. 10005	Refinery-----	Baltimore.
Kennecott Copper Corp.	161 East 42d St. New York, N.Y. 10017	do-----	Anne Arundel.
Stone:			
Harry T. Campbell Sons Co.	Baltimore, Md. 21204	Underground mine and 2 quarries.	Baltimore.
Gatch Crushed Stone Co., Inc.	Box 589 Bel Air, Md. 21014	Quarry-----	Harford.
M.J. Grove Lime Co. Div. of Flintkote Co.	Frederick, Md. 21701	do-----	Frederick.
Lehigh Portland Cement Co.	718 Hamilton St. Allentown, Pa. 18101	do-----	Carroll.
Maryland Materials, Inc.	P.O. Box W North East, Md. 21901	do-----	Cecil.
Rockville Crushed Stone, Inc.	P.O. Box 407 Rockville, Md. 20850	do-----	Montgomery.
D.M. Stoltzfus & Sons, Inc.	Talmage, Pa. 17580	do-----	Cecil.
Nello L. Teer Co.	P. O. Box 1131 Durham, N.C. 27700	do-----	Howard.
Talc and Soapstone:			
Harford Talc Co.	P. O. Box 527 Bel Air, Md. 21014	do-----	Harford.
Vermiculite (exfoliated):			
W.R. Grace & Co., Zonolite Division	62 Whittemore Ave. Cambridge, Mass. 02140	Plant-----	Prince Georges.

The Mineral Industry of Massachusetts

By Robert A. Clifton¹

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

Massachusetts' mineral production valued at \$50.2 million in 1971 was slightly below that of 1970. Sand and gravel, and stone accounted for 93 percent of mineral production value. The quantity of sand and gravel, and stone produced decreased 3 percent, but the total value remained about the same.

Canadian oil finds in offshore areas similar to those off Cape Cod prompted the

State Legislature to pass, and the Governor to sign, a territorial waters bill in November extending the State's territorial waters to a 200-mile limit. The conflict with the Federal 12-mile limit and the Interior Department's right to issue leases is before the courts. Massachusetts now has a cooperative statistical agreement with the Bureau of Mines for the first time.

¹ Chemist, Division of Nonmetallic Minerals.

Table 1.—Mineral production in Massachusetts¹

Mineral	1970		P 1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays.....thousand short tons..	284	\$582	186	\$377
Gem stones.....	NA	2	NA	W
Peat.....thousand short tons..	W	W	2	32
Sand and gravel.....do.....	17,925	22,244	17,343	23,058
Stone.....do.....	8,136	24,349	7,816	23,582
Value of items that cannot be disclosed: Nonmetals and values indicated by symbol W.....	XX	3,183	XX	3,150
Total.....	XX	50,360	XX	50,199
Total 1967 constant dollars.....	XX	45,047	XX	P 43,613

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

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

Table 2.—Value of mineral production in Massachusetts, by counties
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Barnstable	\$604	\$611	Sand and gravel.
Berkshire	8,211	8,352	Stone, lime, sand and gravel.
Bristol	3,949	4,560	Sand and gravel, stone.
Dukes	W	W	Sand and gravel.
Essex	3,981	4,353	Stone, sand and gravel.
Franklin	1,521	1,632	Sand and gravel, stone.
Hampden	5,210	3,587	Stone, sand and gravel.
Hampshire	622	W	Sand and gravel, stone.
Middlesex	13,800	14,709	Stone, sand and gravel.
Nantucket	6	W	Sand and gravel.
Norfolk	5,667	5,499	Stone, sand and gravel, clays.
Plymouth	996	1,348	Sand and gravel, clays, stone.
Suffolk	821	666	Stone, sand and gravel.
Worcester	4,023	4,428	Sand and gravel, stone, peat.
Undistributed ¹	1,011	453	
Total ²	50,360	50,199	

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

¹ Includes gem stones, some sand and gravel (1970) that cannot be assigned to specific counties and values indicated by symbol W.

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

Table 3.—Indicators of Massachusetts business activity

	1970	^p 1971	Change, percent
Employment and labor force, annual average:			
Total labor force.....	2,584.7	2,606.5	+0.8
Unemployment.....	5.3	7.1	+34.0
Employment:			
Manufacturing.....	650.5	604.3	-7.1
Transportation and public utilities.....	117.8	118.2	+0.3
Finance, insurance, and real estate.....	129.5	129.0	-0.4
Services ¹	466.5	474.1	+1.6
Wholesale and retail trade.....	496.6	498.6	+0.4
Government.....	319.9	330.6	+3.3
Construction.....	100.1	100.3	+0.2
Personal income:			
Total.....	\$24,851	\$26,404	+6.2
Per capita.....	\$4,361	\$4,586	+5.2
Construction activity: Cement shipments to Massachusetts thousand 376-pound barrels..	7,198	7,167	-0.4
Mineral production value.....	\$50,360	\$50,199	-0.3

^p Preliminary.

¹ Includes mining employment.

Sources: New England Economic Indicators; Survey of Current Business; Employment and Earnings; and U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Nonmetal and peat.....	63	293	18	148	--	7	47.17	2,406
Sand and gravel.....	972	234	227	1,972	--	32	16.22	423
Stone.....	718	238	171	1,404	1	46	33.47	4,936
Total ¹	1,753	238	417	3,525	1	85	24.40	2,304
1971: ^p								
Nonmetal ²	75	270	20	158	--	16	101.07	6,967
Sand and gravel.....	915	251	229	1,952	--	31	15.88	469
Stone.....	870	250	218	1,779	--	45	25.29	683
Total ¹	1,855	252	467	3,889	--	92	23.65	831

^p Preliminary.

¹ Data may not add to totals shown because of independent rounding.

² Beginning in 1971, data concerning peat operations are included in the nonmetals industry on a continuing basis.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Clays.—Common clay and shale production had a rather sharp (35 percent) decline in both quantity and value. Norfolk County had the single largest producer, Masslite Co., whose tonnage and value of shale for lightweight aggregates outstripped the other producers. Plymouth County's Stiles and Hart Brick Co. and K-F Brick Co., Inc., had a combined clay-for-brick production that exceeded the production and value in Norfolk County.

Gypsum.—United States Gypsum Co., in Suffolk County, manufactured calcined gypsum products. There was no apparent change in volume from 1970.

Lime.—Pfizer, Inc., and Lee Lime Corp. produced lime in Berkshire County for paper and pulp, mason's lime, whiting, and other uses. Output decreased slightly and was below the 1969 record. The lime was consumed in Connecticut, Massachusetts, Maine, and other States. Lime consumption in Massachusetts was 61,000 tons.

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.—Total sand and gravel production in 1971 was at only 97 percent of 1970's production and increased 4 percent over its value. The \$23 million of sand and gravel produced accounted for 46 percent of the total mineral value in the State, making it the second leading mineral commodity produced. Gravel accounted for more than half of the 17.3 million tons of sand and gravel output. Eighty-six percent of the total tonnage was mined at commercial operations; Government-and-contractor operations produced the balance.

Commercial sand and gravel was produced in all counties in the State except Suffolk, in which production was all non-commercial. 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.—Despite the large reduction in dimension stone production and value, the industry managed to produce 96 percent of 1970's total tonnage and to receive 97 percent of that year's value. Dimension stone reached only 77 percent of the 1970 production tonnage and 65 percent of the value. Crushed and broken stone, however, reached 96 percent of the tonnage and had a 7-percent rise in value. The \$23.6 million received kept stone among the top two mineral values in the State and contributed 44 percent of the State's total mineral value.

Stone, quarried 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 percent of the total stone output in 1971.

Crushed basalt was produced in seven counties. Middlesex County led in value and in quantity. The value of crushed basalt accounted for 40 percent of the total value of stone. The crushed stone was used mainly for construction aggregate; other uses were riprap, railroad ballast, and filter stone.

Granite, sold as crushed and dimension stone, was quarried in four counties. Norfolk County led in value and quantity of granite produced. Granite was the second most important 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 and Middlesex Counties. The chief uses of crushed limestone in descending order were lime, construction aggregate, asphalt fill, whiting, poultry grit, agricultural limestone, filter stone, and flux stone.

Sandstone was produced by the McCormick Longmeadow Stone Co., Inc. in Hampden County as cut stone for architectural work.

Crushed miscellaneous stone was quarried in Bristol, Norfolk, and Worcester Counties.

Roofing Aggregate.—Output of rhyolite to make roofing granules increased slightly. The rhyolite is quarried in Norfolk County and for statistical purposes is classified as miscellaneous stone.

Vermiculite.—The quantity and value of the vermiculite processed in Massachusetts during 1971 increased over that of 1970. W. R. Grace & Co. in Hampshire County exfoliated vermiculite mined outside the

Table 5.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	2,907	\$3,871	3,145	\$4,462
Fill.....	540	234	567	255
Paving.....	2,602	2,799	2,316	2,787
Other uses ¹	912	1,733	881	1,857
Total ²	6,860	8,636	6,909	9,362
Gravel:				
Building.....	2,840	5,121	3,258	5,883
Fill.....	1,349	854	1,275	947
Paving.....	3,287	3,910	2,735	3,555
Miscellaneous.....	629	690	520	660
Other uses ³	339	562	240	466
Total ²	8,444	11,136	8,029	11,511
Government-and-contractor operations:				
Sand:				
Fill.....	168	36	176	38
Paving.....	615	357	644	386
Other uses.....	68	109	64	100
Total ²	852	502	885	524
Gravel:				
Building.....	71	176	74	184
Fill.....	2	3	16	16
Paving.....	1,626	1,650	1,428	1,458
Other uses.....	71	141	2	5
Total ²	1,768	1,969	1,519	1,662
Total sand and gravel ²	17,925	22,244	17,343	23,058

¹ Includes blast, molding, filtration, and other sands.

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

³ Includes railroad ballast gravel.

Table 6.—Stone sold or used by producers, by use
(Thousand short tons and thousand dollars)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Dimension stone, total.....	128	\$5,808	99	\$3,782
Crushed and broken stone:				
Bituminous aggregate.....	3,078	6,695	2,731	6,460
Concrete aggregate.....	741	1,470	773	1,706
Dense graded road base stone.....	573	1,085	422	654
Macadam aggregate.....	118	207	W	W
Surface treatment aggregate.....	47	133	61	147
Unspecified aggregate and roadstone.....	2,013	3,682	2,071	4,515
Filter stone.....	W	W	45	90
Railroad ballast.....	W	W	93	160
Riprap and jetty stone.....	W	W	139	W
Other ¹	1,439	5,269	1,381	6,068
Total ²	8,008	18,541	7,717	19,801
Grand total ²	8,136	24,349	7,816	23,582

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

¹ Data includes crushed and broken stone for poultry grit, lime manufacture, roofing aggregate, whitening, and asphalt fill; 1970 data also includes data for stone sand.

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

State. The material was used mainly as insulation; other uses in order of production were concrete aggregate, soil conditioning, and plaster.

METALS

Iron and Steel Scrap.—The State consumed 75,000 tons of iron and steel scrap in 1971, an 18-percent reduction from 1970. Plant recycle accounted for 43,000

tons, and the remaining 32,000 tons represented the market.

MINERAL FUELS

Peat.—Reed-sedge peat was mined by Sterling Peat Co. in Worcester County. In 1971, 2,000 tons were mined valued at \$32,000. The peat was used mainly by nurserymen, landscapers, and greenhouse owners.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Susquehanna Corp., K-F Brick Co., Inc.	River St. Middleboro, Mass. 02346	Pit.....	Plymouth.
Plainville Corp. Masslite Div.....	Box 1747, Cross St. Plainville, Mass. 02762	Pit.....	Norfolk.
The Stiles & Hart Brick Co.....	Box J., Bridgewater, Mass. 02324	Pit.....	Plymouth.
Gypsum, calcined:			
United States Gypsum Co.....	101 South Wacker Dr. Chicago, Ill. 60606	Plant.....	Suffolk.
Lime:			
Lee Lime Corp.....	Marble St., Lee, Mass. 01238..	.....do.....	Berkshire.
Pfizer, Inc.....	260 Columbia St. Adams, Mass. 01220	.....do.....	Do.
Peat:			
Sterling Peat Co.....	Sterling Junction, Mass. 01565	Bog.....	Worcester.
Perlite, expanded:			
United States Gypsum Co.....	101 South Wacker Dr. Chicago, Ill. 60606	Plant.....	Suffolk.
Whittemore Products, Inc.....	35 Harrison St. Roslindale, Mass. 02131	.....do.....	Do.
Roofing granules:			
Bird & Son, Inc.....	East Walpole, Mass. 02032....	.....do.....	Norfolk.
Sand and gravel:			
Ashland Sand & Concrete Co....	Box 347, Chestnut St. Ashland, Mass. 01721	Pit.....	Middlesex.
Assonet Sand & Gravel Co., Inc..	South Main St. Assonet, Mass. 02702	Pit.....	Bristol.
Burlington Sand & Gravel Co., Inc.	Blanchard Rd., Box 116 Burlington, Mass. 01803	Pit.....	Middlesex.
Courtois Sand & Gravel Co.....	Box 84 Central Falls, R. I. 02863	Pit.....	Bristol.
J.J. Cronin Co.....	P.O. Box 176 North Reading, Mass. 01864	Pit.....	Middlesex.
E. L. Dauphinais, Inc.....	160 Worcester Rd. North Grafton, Mass. 01536	Pit.....	Middlesex and Worcester.
General Sand & Stone Corp.....	444 Merrill Rd. Pittsfield, Mass. 01201	Pit.....	Berkshire.
P. J. Keating Co.....	P.O. Box 345 Fitchburg, Mass. 01420	Pit.....	Worcester.
Merrimack Materials, Inc.....	Yemma Rd. Groveland, Mass. 01830	Pit.....	Essex.
Morse Sand & Gravel Co.....	P.O. Box 175 Pawtucket, R. I. 02863	Pit.....	Bristol.
North Wilbraham Sand & Gravel & Concrete Co., Inc.	2420 Boston Rd. North Wilbraham, Mass. 01067	Pit.....	Hampden.
Northfield Washed Sand & Gravel Co., Inc.	Northfield, Mass. 01360.....	Pit.....	Franklin.
Pomerleau Bros., Inc.....	P.O. Box 236 North Chelmsford, Mass. 01863	Pit.....	Middlesex.
Thomas Qunn Co., Inc.....	20 Hobbs Ct. Arlington, Mass. 02174	Pit.....	Middlesex and Worcester.
L. Romano Const. Co.....	835 Taunton Ave. East Providence, R. I. 02914	Pit.....	Norfolk.
Rosenfeld Washed Sand & Stone Co.	40 Cedar St. Milford, Mass. 01757	Pit.....	Worcester.
San-Vel Contracting Co.....	Route No. 2, Ayer Rd. Littleton, Mass. 01460	Pit.....	Middlesex.
Stow Sand & Gravel Co.....	Box 861, Acton, Mass. 01720..	Pit.....	Do.
Tresca Bros. Sand & Gravel Inc.	66 Main St. Millis, Mass. 02054	Pit.....	Norfolk.
Varney Bros. Sand & Gravel, Inc.	Hartford Ave. Bellingham, Mass. 02019	Pit.....	Do.
Warner Bros., Inc.....	Sunderland, Mass. 01375.....	Pit.....	Franklin.
A. A. Will Sand & Gravel Corp..	Turnpike St. Canton, Mass. 02021	Pit.....	Norfolk.

See footnotes at end of table.

Table 7.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
Worcester Sand & Gravel Co.	182 Holden St. Shrewsbury, Mass. 01545	Pit.	Worcester.
Wrentham Sand & Gravel Co., Inc.	Riverside Rd. Wrentham, Mass. 02093	Pit.	Norfolk.
Stone:			
Basalt, crushed and broken:			
B. & M. Crushed Stone Division, Bayer & Mingolla Industries, Inc.	Spring St., Ashland, Mass. 01721	Quarry	Middlesex.
George Brox, Inc.	1471 Methuen St. Dracut, Mass. 01826	...do	Do.
Essex Bituminous Concrete Corp.	Russell St. West Peabody, Mass. 01960	...do	Essex.
Essex Bituminous Concrete Corp. of Dracut.	2140 Bridge St. Dracut, Mass. 01826	...do	Middlesex.
Holden Trap Rock Co.	N. Main St., Holden, Mass. 01520	...do	Worcester.
P. J. Keating Co.	P. O. Box 345 Fitchburg, Mass. 01420	...do	Do.
John S. Lane & Son, Inc.	P. O. Box 125 Westfield, Mass. 01085	...do	Hampden and Hampshire.
Lynn Sand & Stone Co.	30 Danvers Rd. Swampscott, Mass. 01907	...do	Essex.
Massachusetts Broken Stone Co.	Weston Post Rd. Weston, Mass. 02193	...do	Middlesex.
Rowe Contracting Co.	1500 Salem St. Malden, Mass. 02148	...do	Do.
Simeone Stone Corp.	P. O. Box 218 Wrentham, Mass. 02093	...do	Norfolk.
Trimount Bituminous Prod- ucts Co.	1840 Parkway St. Everett, Mass. 02149	...do	Essex.
Warner Bros., Inc.	Sunderland, Mass. 01375	...do	Franklin.
Granite, dimension:			
Bates Bros. Seam Face Granite Co. ¹	1372 Hancock St. Quincy, Mass. 02169	...do	Norfolk.
H. E. Fletcher Co. ¹	West Chelmsford, Mass. 01824	...do	Middlesex.
Forrest Road Granite Co., Inc.	20 Adams St. North Chelmsford, Mass. 01863	...do	Do.
Guilmette Bros. Corp.	57 Ledge Rd. North Chelmsford, Mass. 01863	...do	Do.
Le Masurier Granite Quarry, Inc.	P. O. Box 71, Ledge Rd. North Chelmsford, Mass. 01863	...do	Do.
Oak Hill Granite Co., Inc. ...	Middlesex St., Lowell, Mass. 01852	...do	Do.
Plymouth Quarries, Inc. ¹ ...	East Weymouth, Mass. 01402	...do	Plymouth.
Granite, crushed and broken:			
Old Colony Crushed Stone Co.	P. O. Box 230 Quincy, Mass. 02169	...do	Norfolk.
Simeone Stone Corp.	P. O. Box 218 Wrentham, Mass. 02093	...do	Do.
West Roxbury Crushed Stone Co.	10 Grove St. West Roxbury, Mass. 02132	...do	Suffolk.
Limestone and dolomite, crushed:			
John S. Lane & Son, Inc.	P. O. Box 125 Westfield, Mass. 01085	...do	Berkshire.
Lee Lime Corp.	Marble St., Lee, Mass. 01238	...do ²	Do.
Massachusetts Broken Stone Co.	Boston Post Rd. Weston, Mass. 02193	...do	Middlesex.
Pfizer, Inc.	260 Columbia St. Adams, Mass. 01220	...do	Berkshire.
Miscellaneous stone, crushed:			
Berlin Stone Co.	Sawyer Hill Rd. Berlin, Mass. 01503	...do	Worcester.
Dedham Sand & Gravel, Inc.	Walpole, Mass. 02081	...do	Norfolk.
S. M. Lorusso & Sons, Inc. ...	331 West St. Walpole, Mass. 02081	...do	Do.
Warren Bros. Co., Division of Ashland Oil & Re- fining Co.	430 Howard St. Brockton, Mass. 02402	...do	Bristol.
Sandstone, dimension:			
McCormick Longmeadow Stone Co., Inc.	East Longmeadow, Mass. 01023	...do ³	Hampden.
Vermiculite, exfoliated:			
W. R. Grace & Co., Zonolite Div.	62 Whittemore Ave. Cambridge, Mass. 02140	Plant	Hampshire.

¹ Also crushed and broken granite.² 2 quarries: 1 dolomite, 1 limestone.³ 2 quarries.

The Mineral Industry of Michigan

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

By Grace N. Broderick ¹

The mineral production of Michigan in 1971 was valued at \$640.6 million, a decrease of 4.5 percent from that of 1970. The leading commodity in terms of value continued to be iron ore, followed by cement, sand and gravel, and copper.

About 58 percent of the total Michigan

mineral value was contributed by production of a wide variety of nonmetallic minerals; metallic minerals accounted for 34 percent; mineral fuels made up the remainder.

¹ Physical scientist, Division of Ferrous Metals.

Table 1.—Mineral production in Michigan ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland.....thousand 376-pound barrels..	29,813	\$101,019	32,489	\$104,665
Masonry.....thousand 280-pound barrels..	1,519	5,253	1,704	5,872
Clays.....thousand short tons..	2,430	2,837	2,458	3,366
Copper (recoverable content of ores, etc.).....short tons..	67,543	77,945	56,005	58,245
Gypsum.....thousand short tons..	1,312	5,061	1,433	5,585
Iron ore (usable).....thousand long tons, gross weight..	13,100	168,953	11,833	159,854
Lime.....thousand short tons..	1,538	21,355	1,444	20,549
Magnesium compounds.....short tons, MgO equivalent..	411,911	38,050	272,913	27,777
Natural gas.....million cubic feet..	38,851	10,373	25,662	6,776
Natural gas liquids:				
Natural gasoline.....thousand 42-gallon barrels..	599	1,611	553	1,513
LP gases.....do..	1,176	2,764	975	2,623
Peat.....thousand short tons..	167	1,896	202	2,497
Petroleum (crude).....thousand 42-gallon barrels..	11,693	36,246	11,893	38,859
Salt.....thousand short tons..	4,899	49,963	4,458	49,007
Sand and gravel.....do..	53,092	54,646	56,613	62,898
Silver (recoverable content of ores, etc.).....thousand troy ounces..	892	1,579	670	1,036
Stone.....thousand short tons..	41,637	49,501	40,705	49,240
Value of items that cannot be disclosed: Bromine, calcium-magnesium chloride, gem stones, iodine, and potassium salts (1970).....	XX	41,622	XX	40,274
Total.....	XX	670,729	XX	640,636
Total 1967 constant dollars.....	XX	599,967	XX	556,585

Ⓜ Preliminary. XX Not applicable.

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

Employment.—Preliminary data for 1971 and final data for 1970 compiled by the Federal Bureau of Mines for employment

and injuries in the mineral industries, excluding the petroleum industry, are shown in table 4.

Table 2.—Value of mineral production in Michigan, by county ¹

		(Thousands)		
County	1970	1971	Minerals produced in 1971 in order of value	
Alcona	W	\$384	Stone, sand and gravel.	
Alger	\$39	69	Sand and gravel.	
Allegan ¹	W	924	Sand and gravel, petroleum, peat, stone, natural gas.	
Alpena	W	W	Cement, stone, clays, sand and gravel.	
Antrim	W	W	Clays, sand and gravel.	
Arenac	1,048	1,055	Petroleum, stone, sand and gravel.	
Baraga	120	81	Sand and gravel.	
Barry	W	W	Sand and gravel, petroleum, stone.	
Bay	8,738	10,805	Cement, sand and gravel, petroleum, lime.	
Benzie	3	18	Sand and gravel.	
Berrien	2,960	W	Sand and gravel, stone.	
Branch	355	W	Do.	
Calhoun ²	W	5,061	Petroleum, sand and gravel, stone, natural gas.	
Cass	W	W	Sand and gravel, stone.	
Charlevoix	12,389	W	Cement, stone, sand and gravel.	
Cheboygan	138	W	Stone, sand and gravel.	
Chippewa	4,471	3,618	Do.	
Clare ²	W	1,331	Petroleum, sand and gravel, natural gas.	
Clinton	W	807	Sand and gravel, clays.	
Crawford ²	W	W	Petroleum, sand and gravel, natural gas.	
Delta	270	W	Stone, sand and gravel.	
Dickinson	26,983	26,210	Iron ore, stone, sand and gravel.	
Eaton	1,033	729	Sand and gravel, stone, clays, peat.	
Emmet	9,342	12,882	Cement, stone, sand and gravel.	
Genesee	633	975	Sand and gravel, petroleum.	
Gladwin	W	912	Petroleum.	
Gogebic	114	W	Sand and gravel.	
Grand Traverse	W	W	Sand and gravel, petroleum.	
Gratiot ¹	W	W	Magnesium compounds, calcium-magnesium chloride, salt, bromine, sand and gravel, petroleum, natural gas.	
Hillsdale ²	W	W	Petroleum, sand and gravel, stone, natural gas.	
Houghton	119	W	Sand and gravel, stone.	
Huron	1,105	1,276	Stone, lime, sand and gravel.	
Ingham	W	1,917	Petroleum, sand and gravel, peat.	
Ionia	562	319	Sand and gravel.	
Iosco	4,893	5,306	Gypsum, sand and gravel.	
Iron	7,020	6,635	Iron ore, sand and gravel.	
Isabella ²	W	W	Sand and gravel, petroleum, natural gas.	
Jackson ²	W	2,921	Petroleum, sand and gravel, stone, natural gas.	
Kalamazoo	1,809	W	Sand and gravel, stone.	
Kalkaska	521	² 1,007	Petroleum, sand and gravel, natural gas.	
Kent ²	4,478	5,106	Sand and gravel, gypsum, petroleum, peat, natural gas.	
Keweenaw	21	5	Sand and gravel.	
Lake	685	630	Petroleum, sand and gravel.	
Lapeer ¹	1,340	1,231	Peat, petroleum, sand and gravel, calcium-magnesium chloride, natural gas.	
Leelanau	222	609	Stone, sand and gravel.	
Lenawee ²	766	1,002	Sand and gravel, clays, petroleum, natural gas.	
Livingston	3,345	2,936	Sand and gravel.	
Luce	33	W	Do.	
Mackinac	W	W	Stone, sand and gravel.	
Macomb ²	2,284	2,267	Sand and gravel, petroleum, natural gas.	
Manistee	27,573	26,701	Salt, magnesium compounds, bromine, sand and gravel.	
Marquette	135,806	128,064	Iron ore, sand and gravel, stone.	
Mason	W	26,747	Magnesium compounds, calcium-magnesium chloride, lime, bromine, sand and gravel, petroleum.	
Mecosta ²	W	W	Petroleum, sand and gravel, peat, natural gas.	
Menominee	W	W	Lime, sand and gravel.	
Midland	W	W	Bromine, salt, calcium-magnesium chloride, magnesium compounds, iodine, petroleum, sand and gravel.	
Missaukee ²	2,008	W	Petroleum, sand and gravel, natural gas.	
Monroe	W	W	Cement, stone, clays, peat, petroleum, sand and gravel.	
Montcalm	² 543	W	Petroleum, sand and gravel.	
Montmorency	54	2	Sand and gravel.	
Muskegon	2,260	W	Salt, sand and gravel, petroleum.	
Newaygo ²	493	W	Sand and gravel, petroleum, natural gas.	
Oakland	W	13,543	Sand and gravel, peat, petroleum.	

See footnotes at end of table.

Table 2.—Value of mineral production in Michigan, by county¹—Continued
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Oceana.....	\$507	\$401	Petroleum, sand and gravel.
Ogemaw ²	1,736	1,628	Petroleum, sand and gravel, stone, natural gas.
Ontonagon.....	79,618	59,282	Copper, silver, sand and gravel.
Osceola ²	2,261	W	Petroleum, sand and gravel, natural gas.
Oscola.....	50	40	Sand and gravel, petroleum.
Otsego ²	911	W	Petroleum, sand and gravel, natural gas.
Ottawa ²	W	3,763	Sand and gravel, clays, petroleum, natural gas.
Presque Isle.....	W	W	Stone, sand and gravel, petroleum.
Roscommon ²	W	W	Petroleum, sand and gravel, natural gas.
Saginaw.....	513	809	Sand and gravel, lime, clays, petroleum.
St. Clair ²	19,293	18,923	Salt, petroleum, cement, clays, sand and gravel, natural gas.
St. Joseph.....	266	198	Sand and gravel, peat, stone.
Sanilac.....	1,158	1,935	Peat, sand and gravel, lime.
Schoolcraft.....	W	W	Stone.
Shiawassee.....	682	486	Sand and gravel, peat, clays, petroleum.
Tuscola.....	W	W	Sand and gravel, petroleum, lime.
Van Buren.....	174	133	Sand and gravel, petroleum.
Washtenaw.....	1,354	2,503	Do.
Wayne.....	57,139	54,028	Cement, lime, salt, sand and gravel, stone, clays, petroleum.
Wexford.....	121	W	Sand and gravel.
Undistributed ³	238,321	202,467	
Total.....	⁴ 670,729	640,636	

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

¹ Values for natural gas and natural gas liquids are not available on a county basis; included with "Undistributed."

² Excludes value of natural gas.

³ Includes values for natural gas, natural gas liquids, gem stones, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

⁴ Data does not add to total shown because of independent rounding.

Table 3.—Indicators of Michigan business activity

	1970	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force.....thousands...	† 3,618.7	3,618.2	-0.2
Unemployment.....do.....	253.7	295.4	+16.4
Employment:			
Manufacturing.....do.....	† 1,072.7	1,049.3	-2.2
Contract construction.....do.....	† 108.9	106.2	-2.5
Mining.....do.....	† 12.3	11.7	-4.9
Transportation and public utilities.....do.....	† 149.6	149.2	- .3
Wholesale and retail trade.....do.....	† 594.5	596.2	+ .3
Finance, insurance, and real estate.....do.....	† 118.6	120.0	+1.2
Services.....do.....	† 422.4	425.9	+ .8
Government.....do.....	† 506.0	516.1	+2.0
Personal income:			
Total.....millions.....	† \$36,124	\$38,821	+7.5
Per capita.....	† \$4,058	\$4,317	+6.4
Construction activity:			
Valuation of nonresidential construction.....millions.....	† \$478.1	\$508.5	+6.4
Number of private and public residential units authorized.....	† 51,059	74,229	+45.4
State highway department: Contracts awarded.....millions.....	\$187.1	NA	NA
Portland cement shipments to and within Michigan thousand 376-pound barrels.....	14,663	17,815	+21.5
Farm marketing receipts.....millions.....	\$900.2	NA	NA
Mineral production value.....do.....	\$670.7	\$640.6	-4.5

^p Preliminary. † Revised. NA Not available.

Sources: Survey of Current Business, Construction Review, Employment and Earnings, Farm Income Situation, U.S. Bureau of Mines, Area Trends in Employment and Unemployment.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Peat	173	195	43	311	--	5	16.10	280
Metal	4,640	303	1,406	11,251	3	314	28.18	2,565
Nonmetal	1,719	296	508	4,147	2	87	21.46	3,409
Sand and gravel	2,651	215	571	4,835	1	117	24.41	1,988
Stone	2,976	294	876	7,122	--	57	8.00	251
Total ¹	12,159	279	3,396	27,665	6	580	21.18	1,969
1971: ^p								
Metal	4,015	311	1,247	9,976	--	251	25.16	1,517
Nonmetal ²	910	247	224	1,855	--	52	28.04	561
Sand and gravel	2,470	225	555	4,786	1	125	26.33	3,178
Stone	3,090	275	850	7,001	1	82	11.86	1,238
Total ¹	10,485	274	2,877	23,617	2	510	21.68	1,696

^p Preliminary.¹ Data may not add to totals shown because of independent rounding.² Beginning in 1971, data concerning peat operations are included in the nonmetals industry.

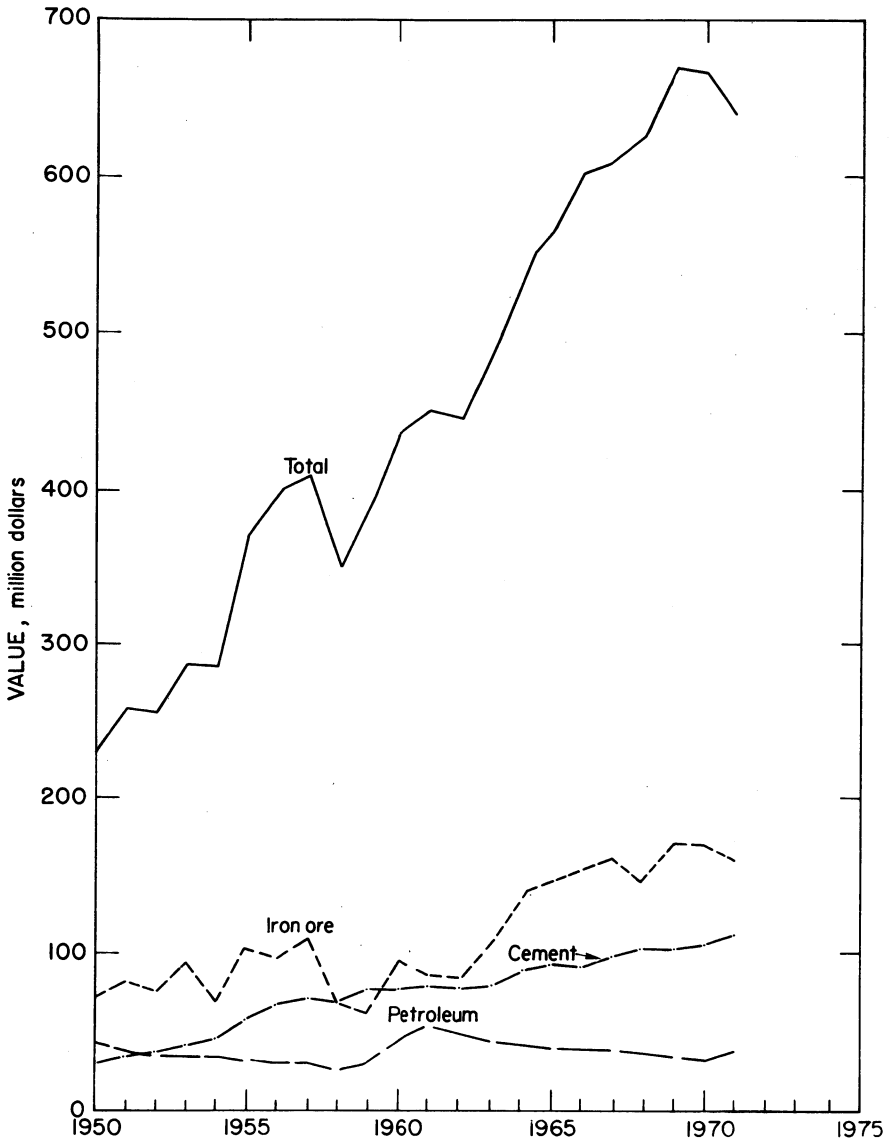


Figure 1.—Value of iron ore, petroleum, cement, and total value of all minerals produced in Michigan.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Bromine.—Two areas were productive of bromine from well brines in Michigan: Manistee and Mason Counties, which border Lake Michigan on the western edge of the State, and Midland and Gratiot Counties in central Michigan. Companies producing bromine were The Dow Chemical Co. at its Ludington and Midland plants, Morton Chemical Co. at its Manistee plant, and the Michigan Chemical Corp. at its St. Louis and East Lake plants. The latter plant discontinued operations at midyear. Bromine output decreased both in quantity and value in 1971. Nationally, Michigan continued to rank second to Arkansas in bromine production.

Calcium-Magnesium Chloride.—The Dow Chemical Co., Michigan Chemical Corp., and Wilkinson Chemical Corp. produced calcium-magnesium chloride from brine, in Gratiot, Lapeer, Mason, and Midland Counties. Output decreased 2 percent. Wyandotte Chemicals Corp. discontinued production of calcium chloride at Wyandotte in December 1970. The Dow Chemical Co. plans to increase capacity of its Ludington calcium chloride plant by about 25 percent in 1972. Process changes and other modifications will cost more than \$1 million.

Cement.—Portland cement shipments increased 9 percent, and value of shipments increased 3.6 percent over those of 1970. Masonry cement shipments increased 12 percent. Portland cement was produced at nine plants in seven counties (Alpena, Bay, Charlevoix, Emmet, Monroe, St. Clair, and Wayne); masonry cement was shipped from four of these plants. Average mill value of portland cement was \$3.22 per barrel; average mill value of masonry cement was \$3.44 per barrel. Yearend

stocks of portland cement at mills were 3.3 million barrels, compared with 4.0 million barrels in 1970. Ninety-five percent of the portland cement shipped was types I and II (general use and moderate heat); the remainder was type III (high-early strength), type V (high-sulfate resistance), and expansive. Portland and masonry cement consumed in the State totaled 17,815,000 376-pound barrels and 1,271,000 280-pound barrels, respectively. Portland cement was consumed for ready-mix concrete (64 percent), concrete products (13 percent), building materials (6 percent), contractors (12 percent), and other uses.

Michigan is the fourth largest cement-producing State in the country, outranked only by California, Pennsylvania, and Texas. The leading producers in Michigan were National Gypsum Co., Huron Cement Div.; Peerless Cement Co., Div. of American Cement Corp.; and Dundee Cement Co.

In December Peerless Cement Co.'s new \$45 million cement plant in Detroit became operational. The plant, which opened in May, has an annual capacity of 4.0 million barrels. In 1971 Huron Cement Div. was improving the dust collecting system at its plant at Alpena, and Dundee Cement Co. was installing two electrostatic precipitators at its plant in Dundee.

St. Lawrence Cement Co. acquired the cement production facilities of BASF Wyandotte Corp. in the Detroit area. Operations were conducted by Wyandotte Cement Inc., a subsidiary of St. Lawrence Cement Co., and clinker was furnished from the company's plant at Mississauga, a suburb of Toronto, Canada. Wyandotte was replacing the 94-pound bag with a new 80-pound bag.

Table 5.—Portland cement salient statistics
(Thousand 376-pound barrels and thousand dollars)

	1970	1971
Number of active plants.....	19	29
Rated clinker capacity, Dec. 31.....	29,539	33,024
Production.....	129,655	31,995
Shipments from mills:		
Quantity.....	29,813	32,439
Value.....	\$101,019	\$104,665
Stocks at mills, Dec. 31.....	3,959	3,297

¹ One plant ceased kiln and grinding operations; another plant ceased kiln operations, but continued as a grinding plant on imported clinker.

² A new (kiln and grinding) plant started operating in May 1971.

Clays.—Miscellaneous clays and shale were mined at 15 pits in 11 counties. Output of clay and shale was about 1 percent less than in 1970. Seventy-eight percent of the clay or shale was used in cement manufacture in 1971, compared with 82 percent used for this purpose in 1970. The remainder was used for lightweight aggregate and heavy clay products. The largest production was reported from Alpena, Monroe, Wayne, Antrim, Ottawa, St. Clair, and Saginaw Counties.

Gem Stones.—Agate, native copper specimens, Petoskey stone, selenite, brown calcite, pyrite, and chert were among the small quantities of semiprecious stones and minerals collected in the State in 1971. Estimated value of material found in 1971 increased over the 1970 estimate, but gem stones continued to contribute only a very minor amount of the State's total mineral value.

Gypsum.—Gypsum output and value in 1971 were 1,433 thousand short tons and \$5.6 million, respectively. The State continued to be the leading gypsum-producer. Crude gypsum was produced in Kent County from underground mines and processed at plants in Grand Rapids for plaster, lath, and wallboard. In Iosco County, gypsum was quarried at Whittemore for portland cement retarder. Quarries at Tawas City and Alabaster supplied crude gypsum for building material plants at National City, Detroit, and in other States. Gypsum materials were shipped by lake transport from deepwater ports at National City and Alabaster.

Iodine.—The Dow Chemical Co., the sole domestic producer, continued to recover crude iodine from natural well brines at Midland. Production decreased 4.9 percent from that of 1970; value increased by 48.5 percent.

Lime.—Seven companies produced lime at 10 plants in eight counties. Leading counties were Wayne, Mason, and Menominee. Leading companies were BASF Wyandotte Corp., Marblehead Lime Co., and Detroit Lime Co. Output decreased 6 percent and was 19 percent below the 1967 record. The lime was used for steel furnaces, alkalies, water purification, and other uses. The lime was consumed in Michigan, Ohio, Wisconsin, Indiana, and Canada.

Magnesium Compounds.—Output of magnesium compounds, recovered from natural well brines, declined nearly 34 percent in quantity and 27 percent in value in 1971. The State, nonetheless, continued to lead the Nation in production of refractory magnesia.

The Midland plant of Kaiser Aluminum & Chemical Corp., which produced magnesium oxide from magnesium hydroxide supplied by The Dow Chemical Co., was inactive in 1971. Morton Chemical Co. is completing an expansion of production facilities for magnesium carbonate and magnesium oxide at Manistee. Harbison-Walker Refractories Co. continued to produce refractory magnesia from purchased magnesium hydroxide.

Perlite.—Crude perlite, mined in Western States, was expanded at plants in Iosco and Wayne Counties. The material was used for roof insulation and plaster aggregate.

Salt.—Salt was produced from an underground mine in Wayne County, and from natural and artificial brines at plants in Gratiot, Manistee, Midland, Muskegon, St. Clair, and Wayne Counties. Output was 9 percent less than in 1970 and value 1.9 percent less. Michigan continued to rank fifth among the States in production of salt, outranked only by Louisiana, Texas, Ohio, and New York.

Sand and Gravel.—Michigan continued to be a leading source of sand and gravel production, the second highest in the Nation (after California). Tonnage increased 6.6 percent and was valued at \$62.9 million, an increase of more than 15 percent over 1970. The amount of sand and gravel sold or used by producers in 1971 for building, molding, and paving increased, and that sold or used for fill material declined. Nearly every county in Michigan reported sand and gravel production. In each of nine counties, output exceeded 1 million tons. These counties provided almost 51 percent of the State production. Five of these counties make up metropolitan Detroit and produced nearly 21 million tons. About 92 percent of the sand and gravel was moved by truck, and the remainder was shipped by rail or water. Production was reported from 330 commercial and 58 Government-and-contractor operations.

Table 6.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	6,971	\$6,181	8,568	\$7,952
Engine.....	W	W	39	104
Fill.....	3,655	1,783	3,184	1,619
Molding.....	3,188	5,994	3,435	7,063
Paving.....	4,884	4,720	6,773	6,610
Other uses ¹	2,131	3,765	1,406	3,608
Total².....	20,829	22,444	23,405	26,954
Gravel:				
Building.....	6,201	10,006	6,359	10,596
Fill.....	383	229	463	263
Paving.....	17,116	16,245	19,103	19,098
Railroad ballast.....	138	186	19	35
Miscellaneous.....	213	136	1,206	1,476
Other uses.....	354	522	799	624
Total².....	24,405	27,324	27,950	32,092
Government-and-contractor operations:				
Sand:				
Building.....	--	--	34	3
Fill.....	677	291	1,091	303
Paving.....	2,055	1,163	886	461
Other uses.....	132	77	183	79
Total².....	2,865	1,531	2,195	846
Gravel:				
Building.....	38	24	163	145
Fill.....	446	201	243	92
Paving.....	4,474	3,103	2,650	2,768
Other uses.....	34	19	1	(³)
Total².....	4,992	3,346	3,062	3,005
Total sand and gravel².....	53,092	54,646	56,613	62,898

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

¹ Includes abrasives, railroad ballast, blast, enamel, foundry (1971), glass, grinding and polishing, pottery, and other sands.

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

³ Less than 1/2 unit.

Table 7.—Sand and gravel sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	Number of mines	1970		1971		
		Quantity	Value	Quantity	Value	
Alcona.....	2	W	W	2	272	\$135
Alger.....	2	68	\$39	1	85	69
Allegan.....	8	933	601	7	755	497
Alpena.....	3	102	W	3	W	W
Antrim.....	1	78	62	1	84	73
Baraga.....	2	W	120	2	163	81
Barry.....	8	1,034	991	7	582	707
Benzie.....	1	8	3	1	18	18
Berrien.....	8	1,647	2,957	7	1,438	2,558
Branch.....	2	219	354	2	W	W
Calhoun.....	7	390	262	5	W	W
Cass.....	7	823	521	6	349	319
Charlevoix.....	6	132	68	6	66	50
Clare.....	2	W	W	3	82	44
Clinton.....	15	801	675	8	764	733
Delta.....	4	299	W	3	W	W
Dickinson.....	4	123	151	2	W	W
Eaton.....	8	919	702	10	652	512
Emmet.....	4	131	77	2	74	55
Genesee.....	17	534	543	9	816	753
Gogebic.....	3	120	114	3	W	W

See footnotes at end of table.

Table 7.—Sand and gravel sold or used by producers, by county—Continued
(Thousand short tons and thousand dollars)

County	1970		1971			
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Grand Traverse	1	270	W	2	W	W
Gratiot	4	428	373	6	293	262
Hillsdale	7	507	591	4	107	56
Houghton	3	153	94	2	W	W
Huron	6	319	W	4	W	W
Ingham	10	1,285	1,087	8	774	778
Ionia	8	679	562	3	338	319
Iron	3	232	246	3	W	W
Kalamazoo	10	W	W	11	1,003	1,459
Kalkaska	1	21	11	1	22	20
Kent	24	2,723	3,439	19	2,525	3,968
Keweenaw	1	40	21	1	16	5
Lake	1	49	28	1	40	22
Lapeer	6	547	384	4	328	187
Lenawee	6	670	756	11	810	996
Livingston	9	2,827	3,343	6	2,576	2,936
Luce	3	52	33	2	W	W
Mackinac	4	212	104	5	W	W
Macomb	9	2,525	2,268	10	2,147	2,254
Marquette	12	325	283	9	545	577
Mecosta	4	279	281	2	161	126
Menominee	3	397	230	3	95	90
Missaukee	2	284	276	2	W	W
Montcalm	4	435	193	3	W	W
Montmorency	2	93	54	1	49	2
Muskegon	5	476	W	4	461	1,095
Newaygo	9	754	439	4	W	W
Oakland	29	9,895	10,597	24	11,274	13,494
Oceana	5	412	300	2	271	159
Ogemaw	6	808	809	5	W	W
Ontonagon	2	155	94	1	84	1
Osceola	2	695	688	1	W	W
Oscoda	1	102	46	1	63	33
Otsego	2	43	29	2	W	W
Ottawa	12	2,519	2,769	16	2,875	3,188
Presque Isle	4	W	527	3	W	W
Saginaw	3	255	179	2	W	W
Sanilac	10	681	329	5	W	W
Schoolcraft	3	259	178	--	--	--
Shiawassee	11	440	405	5	239	239
Tuscola	13	936	1,173	8	712	953
Van Buren	5	194	156	3	155	122
Washtenaw	12	1,360	1,342	9	2,138	2,437
Wayne	8	2,352	3,953	8	2,769	4,600
Wexford	5	158	121	1	W	W
Various	--	--	--	25	8,934	7,544
Undistributed ¹	49	6,881	7,607	46	8,502	8,272
Total ²	453	53,092	54,646	388	56,613	62,898

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

¹ Includes Arenac, Bay, Cheboygan, Chippewa, Crawford, Gladwin (1970), Iosco, Isabella, Jackson, Lee-lanau, Manistee, Mason, Midland, Monroe, Roscommon, St. Clair, and St. Joseph Counties.

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

Stone.—Michigan, with a production of 40.7 million tons, ranked eighth in the Nation's output of stone. Production (principally crushed limestone and dolomite) decreased more than 2 percent from that of 1970. Over 92 percent of the production was reported from seven counties: Alpena, Chippewa, Emmet, Mackinac, Monroe, Presque Isle, and Wayne. Much of the material (66 percent) was shipped by boat from company-owned ports on Lakes Huron and Michigan to steel mills, cement and lime plants, and other consumers.

Changes in steelmaking practices (in-

creased use of pellets in the blast furnace and increased use of basic oxygen furnaces) have changed demand for flux stone. Steel mills are specifying smaller product sizes; crushing and screening plants are being revised to produce a different product mix. More crushing is required to produce the top size, which is now smaller, without producing fines in excess of market demands. As shown in table 9, crushed and broken stone sold or used by producers for use as flux decreased from 12,973 thousand short tons in 1970 to 10,740 thousand short tons in 1971.

Table 8.—Stone sold or used by producers, by kind
(Thousand short tons and thousand dollars)

Kind of stone	1970		1971	
	Quantity	Value	Quantity	Value
Dimension:				
Limestone and dolomite.....	(¹)	(¹)	1	\$26
Marble.....	4	\$91	--	--
Sandstone.....	3	47	--	--
Total ²	6	138	1	26
Crushed and broken:				
Limestone.....	35,390	39,768	32,229	35,077
Dolomite.....	6,124	9,356	7,275	11,267
Marl ³	156	221	119	111
Traprock.....	10	18	9	14
Other ⁴	--	--	1,072	2,745
Total ²	41,681	49,363	40,704	49,214
Grand total.....	41,687	49,501	40,705	49,240

¹ Withheld to avoid disclosing individual company confidential data; included with "Sandstone" for 1970.

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

³ Combined with granite for 1970 to avoid disclosing individual company confidential data.

⁴ Includes granite, sandstone, quartz and miscellaneous stone.

Table 9.—Crushed and broken stone sold or used by producers, by use
(Thousand short tons and thousand dollars)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Bituminous aggregate.....	W	W	736	\$921
Concrete aggregate.....	2,803	\$3,161	3,048	3,261
Dense graded road base stone.....	502	607	805	954
Surface treatment aggregate.....	W	220	342	494
Unspecified aggregate and roadstone.....	4,163	6,233	3,676	5,491
Agricultural limestone.....	564	666	495	529
Cement.....	8,467	7,638	8,637	7,250
Flux.....	12,973	17,121	10,740	14,392
Lime.....	7,775	8,593	7,345	8,117
Other soil conditioners.....	142	140	69	65
Riprap and jetty stone.....	W	W	595	696
Terrazzo.....			3	65
Other ¹	4,290	4,985	4,212	6,980
Total ²	41,681	49,363	40,704	49,214

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

¹ Includes stone used for chemical uses, paper manufacturing, poultry grit, macadam aggregate, railroad ballast, stone sand, sugar refining and other uses not listed; also, dead-burned dolomite (1970) and drain fields (1971).

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

Sulfur.—Byproduct sulfur was recovered from crude petroleum by Total Leonard, Inc. (Alma), Marathon Oil Co. (Detroit), and Mobil Oil Co., Inc. (Woodhaven). Shipments remained about the same as in 1970, but value of output declined by more than 12 percent.

Vermiculite.—Crude vermiculite, mined outside the State, was exfoliated at a plant in the Detroit area. It was sold for use in loose fill insulation, plaster aggregate, concrete aggregate, and for agricultural and other uses.

METALS

Copper.—Production of copper, in terms

of recoverable metal, was 17 percent less than in 1970, and its value was 25 percent lower. The White Pine Copper Co., a subsidiary of the Copper Range Co., continued to be the only producer of primary copper in Michigan. A strike at the mine, which started August 1, was terminated on September 24. The White Pine mill has a total concentrating capacity of 25,000 tons of ore per day, and adequate smelter capacity to process the output of the concentrating plant. Early in 1971, a small plant to recover copper from slag, a smelter waste product, was completed.

Table 10.—Mine production (recoverable) of silver and copper

	1969	1970	1971
Mines producing: Lode.....	1	1	1
Material sold or treated: Copper ore..... thousand short tons..	8,200	7,638	6,891
Production (recoverable):			
Quantity:			
Silver..... troy ounces..	1,009,022	891,579	670,052
Copper..... short tons..	75,226	67,543	56,005
Value:			
Silver..... thousands..	\$1,807	\$1,579	\$1,036
Copper..... do.....	71,516	77,945	58,245
Total..... do.....	73,323	79,524	59,281

Iron Ore.—Iron ore shipments in 1971 were 11.8 million long tons, a decrease of 9.7 percent from the 13.1 million long tons shipped in 1970. The average weighted mine value for Michigan usable iron ore shipments in 1971 was \$13.51, compared with \$12.90 in 1970. Iron ore continued to be the leading commodity in the State in terms of total mineral value.

About 90 percent of the crude ore production in 1971 came from four open pit mines: The Empire, Republic, and Tilden mines in Marquette County, and the Groveland mine in Dickinson County. The remaining production came from two underground mines: The Mather mine in

Marquette County and the Sherwood mine in Iron County. The Tracy underground mine of Jones & Laughlin Steel Corp., near Negaunee in Marquette County, ceased mining in January and completed shipments from stockpile in July. Other closed mines still shipping from stockpiles were the Cliffs Shaft mine and Humboldt mines in Marquette County, and the Homer and Wauseca mines in Iron County.

Cleveland-Cliffs Iron Co. plans to develop a hematite taconite mine and pellet plant near Ishpeming in the Upper Peninsula. The Tilden Project, as it is called, would double the company's domestic iron ore pellet output by mid-1974.

Table 11.—Usable iron ore¹ 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	
1854-1966.....	349,369	279,729	249,576	878,675	NA	NA
1967.....	10,231	3,750	49	14,030	8,453	60.25
1968.....	10,086	3,684	--	13,770	8,339	60.56
1969.....	10,048	3,369	--	13,417	8,183	60.99
1970.....	10,363	2,394	--	12,757	7,950	62.32
1971.....	9,495	2,424	--	11,919	7,384	61.95
Total ²	399,592	³ 295,350	³ 249,625	944,568	NA	NA

NA Not available.

¹ Exclusive, after 1905, of iron ore containing 5 percent or more manganese.² Data may not add to totals shown because of independent rounding.³ Distribution by range partly estimated before 1906.

Table 12.—Iron ore shipped from mines

(Thousand long tons)

Year	Direct-shipping ore ¹	Total concentrates and agglomerates	Total usable ore	Proportion of beneficiated ore to total usable ore (percent)
1967.....	3,011	11,119	14,130	78.7
1968.....	2,353	10,346	12,699	81.5
1969.....	1,972	12,086	14,058	86.0
1970.....	1,512	11,588	13,100	88.5
1971.....	1,439	10,393	² 11,833	87.8

¹ Includes crushed, screened, and sized ore not further treated.² Data does not add to total shown because of independent rounding.

Pig Iron and Steel.—Pig iron and steel were manufactured in the Detroit area. Pig iron shipments and value decreased 2.5 percent but increased 6.7 percent, as compared with 1970. According to the American Iron & Steel Institute, Michigan produced 9,069 thousand short tons of steel in 1971, compared with 9,547 thousand short tons of steel in 1970.

Silver.—Silver was recovered from copper ore mined at the White Pine mine. Concentrates from a silver-recovery circuit in the White Pine mill were shipped to an outside smelter for silver recovery. Output of silver in 1971 was 25 percent less than in 1970, and value was 34 percent less than in 1970.

MINERAL FUELS

Natural Gas and Natural Gas Products.—Natural gas was produced in 22 counties from both gas and oil wells; about 89 percent came from six counties—Calhoun, Hillsdale, Jackson, Macomb, Otsego, and St. Clair. Marketed production of natural gas decreased nearly 34 percent from that of the previous year. Proved natural gas reserve estimates of the American Gas Association, Inc. (AGA), for 1971 list 1,016,482 million cubic feet for Michigan, a gain of 76,811 million cubic feet. Gas-liquid reserves, according to AGA, increased from 9,903 thousand barrels in 1970 to 12,584 thousand barrels, a gain of 2,681 thousand barrels.

Peat.—Michigan again led the Nation in peat production accounting for about one-third of the U.S. total. Production, which increased from 156,699 short tons in 1970 to 209,835 short tons in 1971, was obtained from 11 counties. Seventy-nine percent of the State total came from Lapeer and San-

ilac Counties; other peat-producing counties were Allegan, Eaton, Ingham, Kent, Mecosta, Monroe, Oakland, St. Joseph, and Shiawassee.

Sales totaled 202,189 short tons in 1971, compared with 166,950 short tons in 1970, and the average value of peat produced in Michigan increased from \$11.36 per ton in 1970 to \$12.35 per ton in 1971. Ninety-three percent of the total output was used for general soil improvement; the remainder was used as an ingredient for potting soils, for mushroom beds, and packing flowers, etc. Slightly over 80 percent of the peat sold was in packaged form. Reed-sedge peat accounted for 77 percent of the total sales; humus peat, 15 percent; and moss peat, 8 percent.

Petroleum.—Petroleum was produced in 46 counties, and more than half of this production came from five counties—Calhoun, Jackson, Hillsdale, Otsego, and St. Clair. Production of 11,893 thousand barrels represented a gain of 1.7 percent over the 1970 figure. Reserves of crude oil, according to the American Petroleum Institute, were 58,765,000 barrels on December 31, 1971, an increase of 13,150,000 barrels over that of the previous year.

Total Leonard, Inc. began constructing a \$6 million hydrocarbon platforming unit at Alma, Mich. The plant capacity is expected to be 20,000 barrels of gasoline per day. The crude oil comes from northern Michigan and Canadian oilfields.

When new gas line connections are completed in the northern Michigan gasfields, it is expected that the northern part of the Lower Peninsula will change from a gas-importing area to an area exporting gas to the southern Michigan industrial areas.

Table 13.—Crude oil production, by county

(Thousand 42-gallon barrels and thousand dollars)

County	1970		1971	
	Quantity ¹	Value ²	Quantity ¹	Value ²
Allegan.....	130	\$404	122	\$399
Arenac.....	226	701	231	755
Barry.....	10	32	12	39
Bay.....	249	772	234	765
Calhoun.....	1,828	5,666	1,533	5,009
Clare.....	462	1,432	394	1,287
Crawford.....	496	1,537	524	1,712
Genesee.....	27	85	68	222
Gladwin.....	299	928	279	912
Grand Traverse.....	--	--	3	10
Gratiot.....	11	33	7	23
Hillsdale.....	2,602	8,065	2,356	7,698

See footnotes at end of table.

Table 13.—Crude oil production, by county—Continued
(Thousand 42-gallon barrels and thousand dollars)

County	1970		1971	
	Quantity ¹	Value ²	Quantity ¹	Value ²
Huron	1	4	(³)	1
Ingham	6	20	348	1,137
Isabella	201	622	187	611
Jackson	1,048	3,247	849	2,774
Kalkaska	165	510	302	987
Kent	63	194	58	190
Lake	212	657	186	608
Lapeer	62	192	81	265
Lenawee	(³)	1	(³)	1
Livingston	1	2	--	--
Macomb	5	16	4	13
Mason	37	115	29	95
Mecosta	172	535	101	330
Midland	184	571	185	604
Missaukee	559	1,732	545	1,781
Monroe	2	7	2	7
Montcalm	113	350	123	402
Muskegon	32	99	20	65
Newaygo	17	54	16	52
Oakland	(³)	1	1	3
Oceana	67	207	74	242
Ogemaw	299	927	346	1,130
Osceola	507	1,573	622	2,032
Oscoda	1	4	2	7
Otsego	285	883	815	2,663
Ottawa	59	184	51	167
Presque Isle	1	5	(³)	1
Roscommon	167	517	209	633
Saginaw	21	67	21	69
St. Clair	977	3,023	873	2,852
Shiawassee	9	28	7	23
Tuscola	63	196	60	196
Van Buren	6	18	5	16
Washtenaw	4	12	5	16
Wayne	5	16	4	13
Total ⁴	11,693	36,246	11,893	38,859

¹ Source: State of Michigan, Department of Natural Resources.

² County values calculated by using State average value per barrel: \$3.10 for 1970 and \$3.27 for 1971.

³ Less than ½ unit.

⁴ Data may not add to totals shown because of independent rounding.

Table 14.—Oil and gas well drilling completions, by county

County	Proved field wells ¹			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Allegan	--	--	--	1	--	2	3	7,545
Alpena	--	--	--	--	--	1	1	5,260
Antrim	--	--	--	--	--	1	1	6,578
Arenac	--	--	1	--	--	2	3	9,467
Barry	--	--	--	--	--	3	3	14,057
Bay	--	--	1	--	--	2	3	9,705
Benzie	--	--	--	--	--	1	1	5,445
Branch	--	--	--	--	--	1	1	3,515
Calhoun	--	1	6	--	1	5	13	52,779
Charlevoix	--	--	--	--	--	2	2	8,954
Clare	1	--	--	--	--	--	1	4,020
Clinton	--	--	--	--	--	1	1	2,647
Crawford	--	--	--	1	--	--	1	7,300
Eaton	--	--	3	1	--	3	7	30,272
Genesee	6	1	1	--	--	1	9	23,501
Gladwin	1	--	2	1	--	2	6	23,591
Grand Traverse	--	--	1	--	2	1	4	25,363
Gratiot	--	--	--	--	--	2	2	6,315
Hillsdale	5	--	11	1	--	5	22	88,034
Ingham	16	--	8	4	1	6	35	148,703
Isabella	--	--	1	--	--	2	3	11,579
Jackson	--	--	2	--	--	8	10	46,735

See footnote at end of table.

Table 14.—Oil and gas well drilling completions, by county—Continued

County	Proved field wells ¹			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Kalkaska.....	6	--	--	8	5	4	23	159,854
Lake.....	1	--	--	--	--	1	2	6,912
Lapeer.....	5	1	--	--	--	--	6	17,018
Lenawee.....	--	--	1	--	--	4	5	15,471
Livingston.....	--	8	1	--	--	2	11	43,556
Macomb.....	--	--	--	--	--	1	1	3,705
Manistee.....	--	--	--	--	--	2	2	9,901
Mason.....	--	--	1	--	--	1	2	5,122
Mecosta.....	--	--	--	--	--	4	4	11,830
Midland.....	--	--	--	--	--	1	1	3,513
Monroe.....	--	--	--	--	--	1	1	2,575
Montcalm.....	1	--	7	1	--	1	10	34,719
Montmorency.....	--	--	--	--	--	1	1	4,833
Newaygo.....	--	--	--	--	--	3	3	6,376
Oakland.....	--	4	2	--	--	--	6	26,036
Oceana.....	2	--	1	2	1	5	11	24,125
Ogemaw.....	1	--	--	--	--	1	2	12,923
Osceola.....	1	2	1	--	1	1	6	14,400
Oscoda.....	--	--	--	--	--	2	2	16,396
Otsego.....	6	--	5	5	--	8	24	149,967
Ottawa.....	--	--	--	--	--	2	2	4,373
Presque Isle.....	--	--	--	--	--	1	1	3,153
St. Clair.....	3	3	10	1	1	17	35	101,953
Tuscola.....	--	--	--	--	--	3	3	10,104
Van Buren.....	--	--	--	--	--	2	2	4,599
Washtenaw.....	--	--	--	--	1	2	3	11,002
Wexford.....	--	--	--	--	--	1	1	8,306
Total.....	55	20	66	26	13	122	302	1,254,097

¹ Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

Table 15.—Principal producers ¹

Commodity and company	Address	Type of activity	County
Cement:			
Aetna Portland Cement Co., div. of Martin Marietta Corp.	Box 8 Bay City, Mich. 48706	Portland and masonry, wet process.	Bay.
Dundee Cement Co.	Box 317 Dundee, Mich. 48131	.....do.....	Monroe.
National Gypsum Co., Huron Cement Div.	17515 West 9 Mile Rd. Honeywell Center Southfield, Mich. 48075	Portland and masonry dry process.	Alpena.
Medusa Portland Cement Co.	Box 5668 Cleveland, Ohio 44101	Portland, wet process.	Charlevoix.
Peerless Cement Co., div. of American Cement Corp.: Port Huron Plant.	900 The Executive Plaza Detroit, Mich. 48226	.....do.....	St. Clair.
..... Brennan Ave. Plant.	.....	.....do.....	Wayne.
Penn-Dixie Cement Corp.	Box 152 Nazareth, Pa. 18064	Portland and masonry, wet process.	Emmet.
Wyandotte Cement Inc.	3505 Biddle Ave. Wyandotte, Mich. 48192	.....do.....	Wayne.
Clays and shale:			
Aetna Portland Cement Co., div. of Martin Marietta Corp.	Box 8 Bay City, Mich. 48706	Pit.....	Saginaw.
Dundee Cement Co.	Box 317 Dundee, Mich. 48131	Pit.....	Monroe.
National Gypsum Co., Huron Cement Div.	17515 West 9 Mile Rd. Honeywell Center Southfield, Mich. 48075	Pit.....	Alpena.
Light Weight Aggregate Corp.	12720 Farmington Rd. Livonia, Mich. 48150	Pit and plant.....	Wayne.
Medusa Portland Cement Co.	Box 5668 Cleveland, Ohio 44101	Pit.....	Antrim.
Peerless Cement Co., div. of American Cement Corp.	900 The Executive Plaza Detroit, Mich. 48226	Pits.....	St. Clair.
Penn-Dixie Cement Corp.	Box 307 Petuskey, Mich. 49770	Pit.....	Wayne. Emmet.

See footnote at end of table.

Table 15.—Principal producers¹—Continued

Commodity and company	Address	Type of activity	County
Coke:			
Industrial Chemicals Div. Allied Chemical Corp.	Box 70 Morristown, N.J. 07960	Coke ovens	Wayne.
Ford Motor Co.	The American Rd. Dearborn, Mich. 48121	do	Do.
National Steel Corp. (Great Lakes Steel Div.)	2800 Grant Bldg. Pittsburgh, Pa. 15219	do	Do.
Copper:			
White Pine Copper Co., subsidiary of Copper Range Co.	Box 427 White Pine, Mich. 49971	Mine and mill	Ontonagon.
Gypsum:			
Georgia-Pacific Corp. Gypsum Division.	900 SW. 5th Portland, Oreg. 97204	Underground mine, and calcining and board plant.	Kent.
Grand Rapids Gypsum Co.	Box 1674 Grand Rapids, Mich. 49501	do	Do.
Michigan Gypsum Co.	2840 Bay Rd. Saginaw, Mich. 48601	Open pit mine	Iosco.
National Gypsum Co.	325 Delaware Ave. Buffalo, N.Y. 14202	Open pit mine and calcining and board plant.	Do.
United States Gypsum Co.	101 South Wacker Dr. Chicago, Ill. 60606	Open pit mine Calcining and board plant.	Do. Wayne.
Iron ore:			
Cleveland-Cliffs Iron Co.:	1460 Union Commerce Bldg. Cleveland, Ohio 44115		
Empire		Open pit mine, concentrator, and agglomerator.	Marquette.
Mather		Underground mine. Ore treated at the Ore Improvement Plant and Pioneer Pellet Plant.	Do.
Ore improvement plant		Processes Mather ore.	Do.
Pioneer pellet plant		Pelletizes ore from the Mather mine.	Do.
Republic		Open pit mine, concentrator, and agglomerator. Part of the concentrates pelletized at the Humboldt plant.	Do.
Tilden		Open pit mine and stockpile shipments.	Do.
The Hanna Mining Co.:			
Groveland	100 Erieview Plaza Cleveland, Ohio 44114	Open pit mine, concentrator, and agglomerator.	Dickinson.
Inland Steel Co.:			
Sherwood	30 West Monroe St. Chicago, Ill. 60603	Underground mine	Iron.
Iron and steel:			
Ford Motor Co.	The American Rd. Dearborn, Mich. 48121	Iron blast furnaces and open-hearth steel furnaces.	Wayne.
McLouth Steel Corp.	300 South Livernois Ave. Detroit, Mich. 48217	do	Do.
National Steel Corp., Great Lakes Steel Div.	2800 Grant Bldg. Pittsburgh, Pa. 15219	do	Do.
Lime:			
Detroit Lime Co., subsidiary of Edward C. Levy Co.	8800 Dix Ave. Detroit, Mich. 48209	Quicklime, shaft and rotary kilns.	Do.
The Dow Chemical Co.	Midland, Mich. 48640	Quicklime, 3 rotary kilns, continuous hydrator.	Mason.
Marblehead Lime Co.	300 West Washington St. Chicago, Ill. 60606	Quicklime, 2 rotary kilns.	Wayne.
BASF Wyandotte Corp.	1609 Biddle Ave. Wyandotte, Mich. 48192	Quicklime, 9 shaft kilns.	Do.
Peat:			
Anderson Peat Co.	2562 Graham Rd. Imlay City, Mich. 48444	Bog, processing plant.	Lapeer.
Fletcher & Rickard	54001 Grand River Rd. New Hudson, Mich. 48165	do	Oakland.

See footnote at end of table.

Table 15.—Principal producers¹—Continued

Commodity and company	Address	Type of activity	County
Peat—Continued			
J. M. Huber Corp.-----	(Peat Department) P.O. Box 312 Sandusky, Mich. 48471	Bog, processing plant.	Sanilac.
Michigan Peat-----	Eight Executive Mall Valley Forge, Pa. 19481	Bogs, processing plant.	Do.
Scenic Lakes, Inc.-----	Box 926 East Lansing, Mich. 48823	Bog, processing plant.	Shiawassee.
Expanded Perlite:			
National Gypsum Co.-----	325 Delaware Ave. Buffalo, N.Y. 14202	Processing plant-----	Iosco.
United States Gypsum Co.-----	101 South Wacker Dr. Chicago, Ill. 60606	-----do-----	Wayne.
Petroleum refineries:			
Bay Refining Division, The Dow Chemical Co.-----	4868 Wilder Rd. Bay City, Mich. 48709	-----	Bay.
Crystal Refining Co.-----	901 North Williams Carson City, Mich. 48811	-----	Montcalm.
Lakeside Refining Co.-----	2705 East Cork Kalamazoo, Mich. 49001	-----	Kalamazoo.
Total Leonard, Inc.:			
Alma Division-----	East Superior St. Alma, Mich. 48801	-----	Gratiot.
Marathon Oil Co.-----	1300 South Fort St. Detroit, Mich. 48217	-----	Wayne.
Mobil Oil Co., Inc.-----	Box 477 Trenton, Mich. 48183	-----	Do.
Osceola Refining Co.-----	Box 173 Reed City, Mich. 49677	-----	Ogemaw.
Salt and salines:			
American Salt Corp.-----	3142 Broadway Kansas City, Mo. 64111	Processing plant: Salt.	Midland.
Diamond Crystal Salt Co.-----	916 South Riverside St. Clair, Mich. 48079	Brine wells and process- ing plant: Salt.	St. Clair.
The Dow Chemical Co.:			
Ludington Plant-----	Midland, Mich. 48640-----	Brine wells and process- ing plant: Bro- mine, calcium-mag- nesium compounds, magnesium com- pounds.	Mason.
Midland Plant-----	-----	Brine wells and process- ing plant: Bro- mine, calcium mag- nesium compounds, iodine, magnesium compounds, salt.	Midland.
Harbison-Walker Refractories Co.-----	2 Gateway Center Pittsburgh, Pa. 15222	Processing plant: Magnesium com- pounds.	Mason.
Hardy Salt Co.-----	P.O. Drawer 449 St. Louis, Mo. 61366	Processing plant: Salt.	Manistee.
Hooker Chemical Corp.-----	Box 295 Montague, Mich. 49437	Brine wells and process- ing plant: Salt.	Muskegon.
International Salt Co.-----	Clarks Summit, Pa. 18411-----	Underground salt mine.	Wayne.
Kaiser Aluminum & Chemical Corp.-----	900 17th St., N.W. Washington, D.C. 20006	Processing plant: Magnesium com- pounds.	Midland.
Michigan Chemical Corp.:			
East Lake Plant-----	351 East Ohio St. Chicago, Ill. 60611	Processing plant: Bromine.	Manistee.
St. Louis Plant-----	-----	Brine wells and process- ing plant: Bro- mine, calcium mag- nesium compounds, magnesium com- pounds, salt.	Gratiot.
Morton Chemical Co., div. of Morton-Norwich Products, Inc.-----	110 North Wacker Dr. Chicago, Ill. 60606	Brine wells and process- ing plant: Bro- mine, magnesium compounds.	Manistee.
Morton Salt Co., div. of Morton- Norwich Products, Inc. Manistee Plant-----	-----	Brine wells and process- ing plant: Salt.	Do.

See footnote at end of table.

Table 15.—Principal producers 1—Continued

Commodity and company	Address	Type of activity	County
Salt and salines—Continued			
St. Clair Plant.....	-----	Brine wells and processing plant: Salt.	St. Clair.
Pennwalt Corp.....	4655 Biddle Ave. Wyandotte, Mich. 48192	-----do-----	Wayne.
Martin Marietta Chemicals, Refractories Division.	Executive Plaza II Hunt Valley, Md. 21030	Brine wells and processing plant: Magnesium compounds.	Manistee.
Wilkinson Chemicals Corp.....	Mayville, Mich. 48744	Brine wells and processing plant: Calcium-magnesium compounds.	Lapeer.
BASF Wyandotte Chemicals Corp.	1609 Biddle Ave. Wyandotte, Mich. 48192	Brine wells and processing plant: Salt.	Wayne.
Sand and gravel:			
American Aggregates Corp.....	Garst Ave. at Ave. B Greenville, Ohio 45331	Pits and stationary plants.	Kalamazoo, Livingston, Macomb, Oakland.
J. V. Burkett Contractors Co., Inc.	St. Joseph, Mich. 49085	Pits and portable plant.	Kent, Newaygo.
Cole Brothers, Cole Brothers Contractors, Inc.	Route 3, Box 346 Battle Creek, Mich. 49017	Pits and stationary and portable plants.	Barry, Calhoun, Hillsdale, Ionia, Kalamazoo, St. Joseph.
Construction Aggregates Corp....	120 South LaSalle St. Chicago, Ill. 60603	Pit and stationary plants.	Ottawa.
R. E. Glancy, Inc.....	1055 South Bay Dr. Tawas City, Mich. 48763	Pit and portable plant.	Iosco.
Grand Rapids Gravel Co.....	2700 28th St., SW Grand Rapids, Mich. 49509	Pits and stationary plants.	Kent.
Holloway Sand & Gravel Co.....	29250 Wixom Rd., Box 247 Wixom, Mich. 48096	Pits and portable plants.	Genesee, Oakland, Ogemaw, Otsego.
Holly Sand & Gravel Plant, J. P. Burroughs & Sons, Inc.	16240 Tindall Rd. Davisburg, Mich. 48019	Pit and stationary	Oakland.
Lyon Sand & Gravel Co., Div. of E. C. Levy Co.	9300 Dix Dearborn, Mich. 48120	-----do-----	Do.
Manley Sand Division, Martin Marietta Corp.	Rockton, Ill. 61072	-----do-----	Berrien.
Mickelson Corp.....	435 Granger Rd. Oxford, Mich. 48051	Pit, dredges, portable plant.	Oakland.
Molesworth Contracting Co.....	321 Park Ave. Yale, Mich. 48097	Pits and portable plants.	Lapeer, Macomb, St. Clair, Sanilac.
Natural Aggregates Corp.....	65545 Mound Rd. Romeo, Mich. 48065	Pits, dredge, portable and stationary plants.	Livingston, Macomb.
New Hudson Sand & Gravel Inc., Texas Industries, Inc.	Box H New Hudson, Mich. 48165	Pits and stationary plants.	Oakland.
Ottawa Silica Co., Michigan Division.	Box 577 Ottawa, Ill. 61350	Pit and stationary plant.	Wayne.
Oxford Mining Co.....	9820 Andersonville Rd. Davisburg, Mich. 48019	-----do-----	Oakland.
Pickett & Schreur, Inc.....	Box 149 Allegan, Mich. 49010	Pits and portable plants.	Allegan, Charlevoix, Clinton, Emmet, Kalamazoo, Kent, Lapeer.
Salem Gravel & Const. Plant.....	5175 Oakhill Rd. Clarkston, Mich. 48016	Stationary plant	Oakland.
Sargent Sand Co.....	2840 Bay Rd. Saginaw, Mich. 48604	Pits and stationary plants.	Bay, Mason, Saginaw, Tuscola.
Thomson Sand & Gravel, Inc....	48399 W. 7 Mile Rd. Northville, Mich. 48167	Pit, portable and stationary plants.	Wayne.
West Branch Concrete Products, Inc.	2250 Rau West Branch, Mich. 48661	Pit and stationary plant.	Ogemaw.
Whittaker & Gooding Co.....	5800 Cherry Hill Rd. Ypsilanti, Mich. 48197	-----do-----	Washtenaw.

See footnote at end of table.

Table 15.—Principal producers¹—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
John G. Yerington.....	Route 2, Box 34 Benton Harbor, Mich. 49022	Pits and portable plants.	Barry, Berrien, Branch, Calhoun, Cass, Lenawee, Muskegon, Newaygo, Van Buren.
Silver:			
White Pine Copper Co., subsidi- ary of Copper Range Co.	Box 427 White Pine, Mich. 49971	Byproduct silver.....	Ontonagon.
Smelters:			
White Pine Copper Co., subsidi- ary of Copper Range Co.	.....do.....	Primary copper smel- ter.	Do.
Stone:			
Granite: Caspian Construction Co.	Caspian, Mich. 49915.....	Quarry and station- ary plant.	Dickinson.
Limestone and dolomite:			
Bethlehem Mines Corp., Bethlehem Steel Corp.	701 East Third St. Bethlehem, Pa. 18016	.....do.....	Chippewa.
Cheney Limestone Co.....	Box 125 Bellevue, Mich. 49021	.....do.....	Eaton.
Detroit Edison Co.....	2000 South Second Ave. Detroit, Mich. 48226	Quarry and portable plant.	Monroe.
Dundee Cement Co.....	Box 317 Dundee, Mich. 48131	Quarry and station- ary plant.	Do.
The France Stone Co.....	1800 Toledo Trust Bldg. Toledo, Ohio 43604	.....do.....	Do.
National Gypsum Co., Huron Cement Div.	17515 West 9 Mile Rd. Honeywell Center Southfield, Mich. 48075	.....do.....	Alpena.
Inland Lime & Stone Co., div. of Inland Steel Co.	Box 5668 Cleveland, Ohio 44101	Quarries and station- ary plants.	Mackinac, Schoolcraft.
Medusa Portland Cement Co.	110 West Jefferson Ave. Trenton, Mich. 48183	Quarry and station- ary plant.	Charlevoix.
Michigan Foundation Quarry.	Ottawa Lake, Mich. 49267	.....do.....	Wayne.
The Michigan Stone Co.....	Box 726 Traverse City, Mich. 49684	Quarries and station- ary plants.	Monroe.
Peninsula Asphalt Corp.....	Box 726 Traverse City, Mich. 49684	Quarry and station- ary plant.	Leelanau.
Penn-Dixie Cement Corp.....	Box 307 Potoskey, Mich. 49770	.....do.....	Emmet.
Presque Isle Corp.....	Box 426 Alpena, Mich. 49707	.....do.....	Presque Isle.
United States Steel Corp. Michigan Limestone Operations.	Rogers City, Mich. 49779...	Quarries and station- ary plants.	Mackinac, Presque Isle.
The Wallace Stone Co., div. of J. P. Burroughs & Son, Inc.	Bay Port, Mich. 48720.....	Quarry and station- ary plant.	Huron.
Marl:			
Gerald Arnsman.....	Route 1 Hopkins, Mich. 49328	Pit.....	Allegan.
Case Brothers.....	Route 2, Box 136 Union City, Mich. 49094	Pit.....	Calhoun.
Darrell L. Hamilton.....	Route 3 Nashville, Mich. 49073	Pit.....	Barry.
Hayward Dry Marl.....	Route 2 Vicksburg, Mich. 49097	Pit.....	Kalamazoo.
Poehlman & Son.....	Route 2 Cassopolis, Mich. 49031	Pit.....	Cass.
Sandstone: Ray's Stone Quarry...	803 Natasawaepe St. Napoleon, Mich. 49261	Quarry and finishing plant.	Jackson.
Recovered sulfur:			
Total Leonard, Inc., Alma Division.	East Superior St. Alma, Mich. 48801	Byproduct sulfur recovery.	Gratiot.
Marathon Oil Co.....	1300 South Fort St. Detroit, Mich. 48217	.....do.....	Wayne.
Mobil Oil Co., Inc.....	Box 477 Trenton, Mich. 48183	.....do.....	Do.
Exfoliated vermiculite:			
Zonolite Division, W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	Processing plant.....	Do.

¹ A number of oil and gas producing companies operate in Michigan and they are listed in several commercial directories.

The Mineral Industry of Minnesota

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

By Harold J. Polta ¹

Mineral output in Minnesota in 1971 was valued at \$609 million, down 4 percent from that of 1970. Iron ore continued as the State's principal mineral commodity, accounting for almost 90 percent of total State output value. The value of sand and gravel production, \$38 million, represented 6 percent of total State value. Stone production value accounted for 2 percent of the State total.

Minnesota's 1971 iron ore production constituted over 63 percent of total U.S. iron ore production. It consisted of 33.8

million tons of pellets and 17.5 million tons of natural ore. All mining was from open pits. Itasca and St. Louis Counties were again the State's chief mineral producers. Because they contain the major portion of the iron ore producing Mesabi Range, they accounted for 92 percent of State mineral production value. St. Louis County's share was over 78 percent of the State total; Itasca County's share was more than 13 percent.

¹ Mining engineer, Division of Ferrous Metals.

Table 1.—Mineral production in Minnesota ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays..... thousand short tons..	227	\$335	223	\$335
Iron ore..... thousand long tons, gross weight..	54,791	571,488	49,054	547,607
Manganiferous ore (5 to 35 percent Mn) short tons, gross weight..	321,436	W	169,732	W
Peat..... thousand short tons..	r 14	335	W	W
Sand and gravel..... do.....	46,851	38,802	44,916	37,645
Stone..... do.....	4,579	12,311	5,838	14,346
Value of items that cannot be disclosed: Abrasive stone, cement, gem stones, lime, and values indicated by symbol W.....	XX	9,735	XX	8,843
Total.....	XX	633,006	XX	608,776
Total 1967 constant dollars.....	XX	566,224	XX	p 528,905

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

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

Table 2.—Value of mineral production in Minnesota, by county
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Aitkin	W	W	Sand and gravel, peat.
Anoka	\$284	--	
Becker	W	W	Sand and gravel.
Beltrami	W	W	Do.
Benton	379	W	Sand and gravel, stone.
Big Stone	W	W	Do.
Blue Earth	1,633	\$1,661	Stone, sand and gravel.
Brown	W	W	Sand and gravel, clays.
Carlton	778	W	Sand and gravel, peat, clays.
Carver	607	W	Sand and gravel, clays, stone.
Cass	206	140	Sand and gravel.
Chippewa	191	250	Do.
Chisago	253	193	Do.
Clay	W	W	Sand and gravel, lime.
Clearwater	357	219	Sand and gravel.
Cook	W	W	Do.
Cottonwood	111	117	Do.
Crow Wing	3,706	1,706	Manganiferous ore, sand and gravel, iron ore.
Dakota	W	W	Sand and gravel, stone.
Dodge	W	W	Stone, sand and gravel.
Douglas	173	W	Sand and gravel.
Faribault	65	W	Do.
Fillmore	551	772	Stone, sand and gravel.
Freeborn	665	659	Sand and gravel.
Goodhue	382	W	Sand and gravel, stone, clays.
Grant	--	W	Sand and gravel.
Hennepin	W	W	Sand and gravel, clays, stone.
Houston	W	W	Stone, sand and gravel.
Hubbard	W	W	Sand and gravel.
Isanti	W	8	Do.
Itasca	86,552	81,585	Iron ore, sand and gravel, peat.
Jackson	194	255	Sand and gravel.
Kanabec	147	38	Do.
Kandiyohi	979	W	Do.
Kittson	W	W	Do.
Koochiching	155	W	Do.
Lac qui Parle	W	481	Stone, sand and gravel.
Lake	W	W	Sand and gravel.
Lake of the Woods	64	W	Do.
Le Sueur	W	W	Sand and gravel, stone.
Lincoln	130	W	Do.
Lyon	243	W	Do.
McLeod	61	W	Sand and gravel.
Mahnomen	W	6	Do.
Marshall	410	232	Do.
Martin	297	211	Do.
Meeker	157	W	Do.
Mille Lacs	W	W	Stone, sand and gravel.
Morrison	331	38	Sand and gravel.
Mower	835	W	Stone, sand and gravel.
Murray	90	W	Sand and gravel.
Nicollet	775	W	Sand and gravel, stone.
Nobles	261	179	Sand and gravel.
Norman	119	W	Do.
Olmsted	W	W	Stone, sand and gravel.
Otter Tail	282	521	Sand and gravel.
Pennington	W	W	Do.
Pine	W	47	Do.
Pipestone	281	220	Do.
Polk	W	W	Sand and gravel, lime.
Pope	104	W	Sand and gravel.
Ramsey	W	W	Sand and gravel, clays.
Red Lake	25	W	Sand and gravel.
Redwood	229	206	Sand and gravel, stone, clays.
Renville	W	W	Sand and gravel, stone.
Rice	W	W	Do.
Rock	695	818	Sand and gravel, abrasives, stone.
Roseau	588	W	Sand and gravel.
St. Louis	493,270	476,053	Iron ore, cement, sand and gravel, lime, stone, peat.
Scott	1,071	W	Stone, sand and gravel.
Sherburne	989	687	Sand and gravel.
Sibley	W	34	Do.
Stearns	W	W	Stone, sand and gravel.
Steele	W	W	Sand and gravel, stone.
Stevens	228	431	Sand and gravel.
Swift	123	W	Do.
Todd	W	W	Do.
Traverse	W	W	Do.
Wabasha	W	W	Sand and gravel, stone.

See footnotes at end of table.

Table 2.—Value of mineral production in Minnesota, by county—Continued
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Wadena.....	\$43	W	Sand and gravel, stone.
Waseca.....	W	W	Sand and gravel.
Washington.....	W	W	Sand and gravel, stone.
Watonwan.....	W	W	Sand and gravel.
Wilkin.....	228	W	Do.
Winona.....	1,279	W	Stone, sand and gravel.
Wright.....	287	\$430	Sand and gravel.
Yellow Medicine.....	W	W	Do.
Undistributed ¹	31,077	40,577	
Total ²	633,006	608,776	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
¹ Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.
² Data may not add to totals shown because of independent rounding.

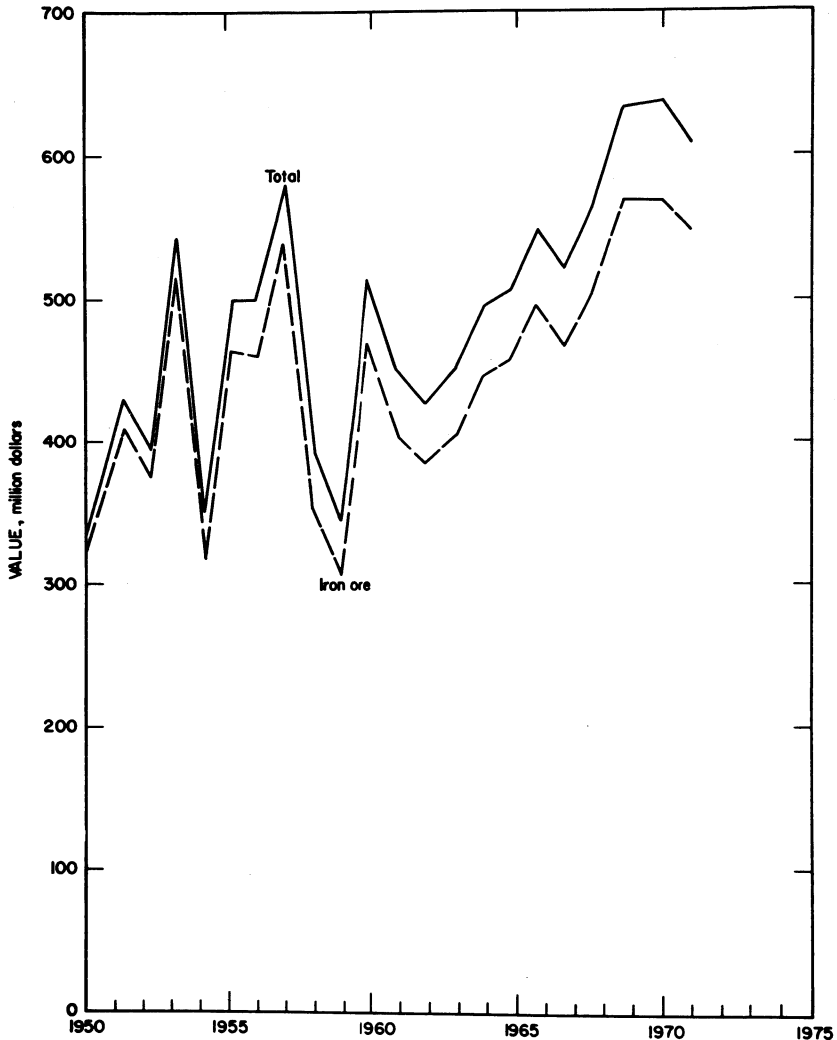


Figure 1.—Value of iron-ore shipments and total value of mineral production in Minnesota.

Table 3.—Indicators of Minnesota business activity

	1970 ^r	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force.....	1,681.3	1,688.1	+0.4
Unemployment.....	70.6	91.0	+28.9
Employment:			
Manufacturing.....	319.4	299.4	-6.3
Construction.....	63.9	63.0	-1.4
Mining.....	14.6	13.8	-5.5
Transportation and public utilities.....	86.6	85.0	-1.8
Wholesale and retail trade.....	315.7	319.7	+1.3
Finance, insurance, and real estate.....	64.2	65.2	+1.6
Services.....	212.9	214.2	+0.6
Government.....	234.9	242.1	+3.1
Personal income:			
Total.....	\$14,580	\$15,424	+5.8
Per capita.....	\$3,815	\$3,974	+4.2
Construction activity:			
Valuation of authorized nonresidential construction.....	\$245.8	\$257.4	+4.7
Number of private and public residential units authorized.....	24,465	30,638	+25.2
State highway commission contracts awarded.....	\$101.4	\$116.0	+14.4
Portland cement shipments to and within Minnesota.....	8,391	8,691	+3.6
Mineral production value.....	\$633.0	\$608.8	-3.8
International trade:¹			
Value of exports through Minnesota.....	\$366.9	\$385.1	+5.0
Value of imports through Minnesota.....	\$566.0	\$696.6	+23.1

^p Preliminary. ^r Revised.

¹ Includes Duluth and Minneapolis-St. Paul Customs Districts.

Sources: Survey of Current Business, Construction Review, Farm Income Situation, Roads and Streets, Employment and Earnings, Area Trends in Employment and Unemployment, Highlights of U.S. Export and Import Trade, U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Peat.....	35	83	3	20	--	1	49.52	446
Metal.....	8,337	330	2,755	22,042	8	86	4.26	2,432
Nonmetal.....	151	243	37	293	--	11	37.50	211
Sand and gravel.....	2,854	163	466	4,164	1	79	19.21	1,934
Stone.....	1,292	237	307	2,693	--	73	27.11	1,051
Total.....	12,669	282	3,568	29,212	9	250	8.87	2,210
1971:^p								
Metal.....	8,095	319	2,585	20,683	--	92	4.45	423
Nonmetal ¹	205	202	41	328	1	11	36.58	18,396
Sand and gravel.....	2,735	162	442	3,536	--	73	20.65	438
Stone.....	1,220	227	278	2,414	--	99	41.01	1,014
Total.....	12,255	273	² 3,347	26,961	1	275	10.24	697

^p Preliminary.

¹ Beginning in 1971, data concerning peat operations are included in the nonmetals industry.

² Data does not add to total shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

METALS

Copper-Nickel.—Exploration, including drilling and geologic mapping for copper-nickel and other base metal sulfides, in northern Minnesota continued both in the Duluth Complex and in the Precambrian greenstone belts. Mining and exploration companies drilling, maintaining explora-

tion offices, and/or otherwise showing interest in the area in the past 20 years include: American Metal Climax Inc. (AMAX); American Smelting and Refining Co.; Bear Creek Mining Co.; Cerro Exploration Co., Inc.; Cominco American, Inc.; Cleveland-Cliffs Iron Co.; Duval Corp.; The Hanna Mining Co.; Humble Oil and Refining Co.; The International Nickel Co., Inc.; W. S.

Moore Co.; Newmont Exploration Ltd.; New Jersey Zinc Co.; Phelps Dodge Corp.; Ridge Mining Corp.; and United States Steel Corp.

The Minnesota Geological Survey continued to be active in the area getting information for preparing geologic maps. In order to determine the possibility of copper-nickel deposits in parts of Koochiching and Beltrami Counties, the Iron Range Resources and Rehabilitation Commission appropriated \$10,000 to the Survey for gravity mapping in these areas.

Miscellaneous Map M-11, "Outcrop Map of Southern Part of the Duluth Complex and Associated Keweenaw Rocks, St. Louis and Lake Counties, Minnesota," published by the Minnesota Geological Survey in 1971, is a compilation of known outcrops in the poorly exposed southern part of the complex. It is used by the State for classifying State-owned mineral lands and should assist current exploration for copper-nickel deposits.

The State, on December 14, held "a sale of leases to prospect for, mine and remove copper, nickel, (and) associated minerals" from 2,955 mining units containing 1,267,307 acres. Eighty-six bids covering 78 mining units were received and 71 leases covering 35,647 acres were awarded. Action on seven leases was delayed at the request of environmental protection groups. Successful bidders were American Shield Co., The Hanna Mining Co., Humble Oil & Refining Co., International Nickel Co., and Ridge Mining Corp. By the end of 1971, the State had offered for lease 1.9 million acres of mineral rights. It had awarded 904 leases encompassing over 362,000 acres since the State Executive Council adopted copper-nickel and associated minerals rules and regulations in November 1966. As of November 22, 1971, rentals paid to the State on the leases had amounted to \$741,482.

Iron Ore.—Minnesota iron ore production in 1971 was 51.3 million long tons, down 9 percent from that of 1970. Shipments totaled 49.1 million long tons, down 10 percent from those shipped the year before. The 51.3 million long tons produced represent 63 percent of total U.S. production and 43 percent of total U.S. consumption (domestic and foreign). Comparable 1970 percentages were 62 percent of U.S. production and 42 percent of U.S. consumption. Total value of iron ore shipped

was \$547,607,000, compared with \$571,488,000 in 1970.

Production from natural ore was 17.5 million tons and from taconite 33.8 million tons. Whereas the production from natural ore declined 15.5 percent, that from taconite ores was only 4.5 percent below 1970 production. Quality continued to improve so that the average iron content of all Minnesota iron ore production was 59.89 percent, the highest ever.

Ten companies operated iron ore and manganiferous ore mines and/or concentrators. All iron ore production was from open pits on the Mesabi Range, and all manganiferous ore from open pits on the Cuyuna Range. There was no production from the Vermilion Range or from the Spring Valley district.

Although labor contract negotiations in the steel industry were successfully concluded without a national walkout, local issues and a short strike by the railroad workers disrupted iron ore production somewhat in midseason. Minnesota ore production also felt the impact of the worldwide recession in the steel industry, particularly in the latter half of the year.

Reserve Mining Co. and Erie Mining Co., each with production capacities of over 10 million long tons per year, continued to be the largest taconite pellet producers in the State. United States Steel Corp. operated its 6-million-ton-per-year Minntac plant, while at the same time having underway construction that will bring annual production capacity of the plant to 12 million tons of pellets. The company expects the first line of the new section to be in operation by April 1, 1972. The Hanna Mining Co. operated the National Steel Pellet Co. and Butler Taconite Co. plants, and Eveleth Taconite Co. operated the Fairlane Taconite plant.

There were no new pellet producers in 1971. However, the expansion of the Minntac plant, together with modifications in the other plants, will bring Minnesota pellet production capacity to about 40 million tons per year. Although Pickands Mather & Company requested and received a permit from the Minnesota Pollution Control Agency to construct and operate an industrial waste disposal system for a proposed taconite processing facility near Hibbing, by yearend the company had not made any announcement indicating early commencement of the project.

Equipment used at a typical taconite mining operation in 1971 included 100-ton trucks, 12-cubic-yard shovels, and jet piercers and/or rotary drills for making 9- to 12-inch diameter blast holes. However, the introduction of a 200-ton truck to the Mesabi in August and experimental use of larger shovel buckets indicate the trend towards increasingly larger mining equipment is continuing.

Controversy concerning Reserve Mining Co.'s tailings discharge into Lake Superior continued throughout the year. The Federal Environmental Protection Agency (EPA) in late April sent notice to the company ordering development of an acceptable tailings disposal plan within 180 days and requiring that an EPA-approved waste disposal plan be in operation by November 23, 1973. EPA at the same time employed an engineering consulting firm to also develop plans for disposal of Reserve tailings. When the report was made public in late October, EPA gave Reserve 30 days to comment on the five alternative plans presented in the report. The controversy had not been resolved by the end of the year.

Production from Minnesota natural ores continued to decline as reserves were being depleted. The 17.5 million tons of production from natural ores was the lowest since 1938. United States Steel Corp. produced significant tonnages from the Kosmerl, Rouchleau, Sherman, and Stephens mines in St. Louis County and from its Plummer and Arcturus mines in Itasca County. It also continued stripping its Donora mine in St. Louis County. Jones & Laughlin Steel Corp. produced large tonnages of concentrates from its McKinley mine in St. Louis County and from its Hill Annex and Lind-Greenway mines in Itasca County. It also operated its semitaconite plant near Calumet. The Hanna Mining Co.'s lone producer from natural ore was the Pierce mine in St. Louis County. Pickands Mather & Co.'s only natural ore production was from the Mahoning mine, also in St. Louis County. Both produced significant tonnages. The Cleveland-Cliffs Iron Co. operated its Canisteo and Hill-Trumbull mines in Itasca County and Snyder Mining Co. operated its Kosmerl, Wanless, and Whiteside mines. Pittsburgh Pacific Co. reported small production tonnages from about a dozen mines. Rhude & Fryberger, Inc., produced natural ore concentrates from its

Gross-Nelson and Hull-Rust properties and continued stripping the Rana mine.

Exhaustion of natural ore mines continued. The shutdown of the Danube mine in May left the United States Steel Corp., Cleveland-Cliffs Iron Co., and Jones & Laughlin Steel Corp. the only remaining operators of natural ore mines on the western Mesabi. Over 22 million long tons of natural ore had been produced from the Danube since its opening in 1919.

The Whiteside mine, operated by Snyder Mining Co., near the center of the Mesabi Range, was also closed in 1971. The reason given for the shutdown was that "direct shipping of ore that is minable by open pit methods has been effectively depleted." Almost 5 million tons of ore had been produced from the mine since operations began in 1911.

Taxes on iron ore were increased significantly by the 1971 Minnesota biennial legislature. The production tax on taconite ores, which had been raised from about \$0.06 per ton to \$0.12 per ton in 1969, was increased an additional \$0.04 per ton in 1971. Incremental increases the following years will bring the production tax on taconites to slightly over \$0.26 per ton by 1979. The occupation tax on natural ores was raised from 14.25 to 15.5 percent for production after December 31, 1971; and on taconites, from 12 to 15 percent for production after December 31, 1970. Royalty taxes were increased the same as the occupation taxes except that the increases are levied on royalties collected after December 31, 1971. Both the occupation and royalty taxes continue to be subject to certain labor credits that reduce the effective rates considerably.

Changes in Minnesota sales tax legislation also increased total taxes levied against taconite production. Besides increasing the sales tax from 3 to 4 percent, the legislation passed on November 1, 1971, removed the exemption the taconite industry enjoyed except that the exemption will continue for:

1. Mill liners, grinding rods, and grinding balls;
2. Construction of new taconite processing facilities started prior to July 1, 1974, and completed before June 1978; and
3. Construction of plant additions that increase existing plant capacities in excess of 10 percent.

Lower lake value of taconite pellets, which went from 25.2 cents per iron unit to 26.6 cents in 1970, rose to 28 cents per iron unit in 1971. Base value of Mesabi Bessemer ore, which went from \$10.70 to \$10.95 per long ton in 1970, rose to \$11.32 at lower lake ports. At least part of the increase resulted from increased transportation costs. In 1971 the sum of rail freight rates from the Mesabi to upper lake ports, dock handling charges, lake freight rates from upper lake ports to lower lake ports, and unloading charges, was \$4.64 per ton; the comparable sum in 1970 was \$4.08 per ton.

Almost all ore shipments went by rail to upper lake ports at the head of Lake Superior and thence by vessel to lower lake ports. Dates of first and final cargoes at upper lake ports are given in table 10.

Efforts to extend the shipping season continued. For the fifth consecutive year a new record was established for the latest closing of the iron ore shipping season on the Great Lakes. The record closing dates marked by the DM&IR at Two Harbors for the last 5 years were as follows: December 28, 1967; January 3, 1969; January 10, 1970; January 27, 1971; and January 30, 1972.

In their efforts to extend the shipping season, shippers requested help and cooperation from the U.S. Coast Guard and other governmental agencies. As a result the Soo Locks, which traditionally closed in mid-December, were kept open, and the Coast Guard dispatched the ice breaker *Ediston* from Boston to help keep the

lanes open in Whitefish Bay, St. Mary's River, and the Straits of Mackinac. To help extend the shipping season, Congress authorized \$9.5 million to the U.S. Army Corps of Engineers for making a 3-year study and demonstration program of an air-bubbling system for keeping open shipping channels. This followed a \$50,000 experiment in which compressed air forced through perforated pipe at the bottom of the main shipping channel in the Duluth-Superior port successfully produced up to 30 feet of open water late in the winter of 1970-71.

The large ore vessels under construction for Bethlehem Steel Corp. (52,400 gross tons) and United States Steel Corp. (45,000 gross tons) are expected to be in operation in 1972. By increasing its fleet from six ships to seven, because of the size of the new *Stewart J. Cort*, Bethlehem will increase its trip capacity by nearly 50 percent. In November, United States Steel Corp. moved the administrative headquarters for its Great Lakes fleet to Duluth.

Iron and Steel.—The Duluth Works of United States Steel Corp., which was shut down at the end of July in anticipation of a strike in the steel industry, resumed operations on a limited basis in September. However, because of the reduced demand for steel, only four of the nine furnaces at the plant were placed in operation. For the rest of the year, there was growing concern that the 57-year-old steel plant would never again operate as an integrated plant. Air and water pollution standards set by the Minnesota Pollution Control

Table 5.—Crude iron ore ¹ data, in 1971, by county and range

(Thousand long tons)

County and range	Production ²	Shipments	
		Direct to consumers	To concentrators
County:			
Crow Wing.....	--	--	--
Fillmore.....	--	--	--
Itasca.....	22,672	--	22,672
St. Louis.....	106,671	3,335	102,847
Total.....	129,343	3,335	125,519
Range:			
Cuyuna.....	--	--	--
Mesabi.....	129,343	3,335	125,519
Spring Valley District.....	--	--	--
Total.....	129,343	3,335	125,519

¹ Exclusive of ore containing 5 percent or more manganese.

² Entire production from open pit mines.

³ Mostly sized ore.

Table 6.—Usable iron ore¹ data, in 1971, by county and range
(Thousand long tons)

County and range	Stocks Jan. 1 ¹	Production	Iron con- tent of production	Shipments	Stocks Dec. 31
County:					
Crow Wing.....	W	--	--	W	W
Filmore.....	--	--	--	--	--
Itasca ²	980	7,632	4,575	7,750	862
St. Louis ³	4,517	43,651	26,139	41,304	6,864
Total⁴.....	5,498	51,283	30,714	49,054	7,727
Range:					
Cuyuna.....	W	--	--	W	W
Mesabi ²	5,498	51,283	30,714	49,054	7,727
Spring Valley District.....	--	--	--	--	--
Total.....	5,498	51,283	30,714	49,054	7,727

¹ Revised. W Withheld to avoid disclosing individual company confidential data.

² Exclusive of ore containing 5 percent or more manganese.

³ Includes very minor quantities from Cuyuna Range in Crow Wing County.

⁴ Includes Lake County.

⁵ Data may not add to totals shown because of independent rounding.

**Table 7.—Usable iron ore¹ produced (direct-shipment and all forms of concentrate),
by range**
(Thousand long tons)

Year	Cuyuna	Mesabi	Vermilion	Spring Valley District	Total ²
1884-1966.....	68,334	2,564,909	103,325	8,009	2,744,575
1967.....	1,041	43,857	202	58	50,157
1968.....	961	51,411	--	83	52,454
1969.....	--	55,275	--	--	55,275
1970.....	--	56,073	--	--	56,073
1971.....	--	51,283	--	--	51,283
Total².....	70,335	2,827,808	103,527	8,149	3,009,817

¹ Exclusive, after 1905, of iron ore containing 5 percent or more manganese.

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

Table 8.—Production of usable iron ore
(Thousand long tons)

Year	Direct shipping ore	Concentrates (other than agglomerates)	Agglomerates	Total		Iron content (percent)
				Usable ore	Iron content	
1967.....	11,111	14,719	24,327	50,157	28,742	57.30
1968.....	5,002	17,197	30,255	52,454	30,597	58.33
1969.....	5,461	16,433	33,381	55,275	32,555	58.90
1970.....	3,892	16,836	35,345	56,073	32,951	58.76
1971.....	3,335	14,178	33,771	51,283	30,714	59.89

¹ Data does not add to total shown because of independent rounding.

Table 9.—Iron ore¹ shipped from mines
(Thousand long tons)

Year	Direct shipping ore ²	Concentrates			Total usable ore ³	Proportion of concentrates to total usable ore (percent)
		Agglom- erates	Other	Total ³		
1967.....	11,149	23,884	14,424	38,308	49,457	77.46
1968.....	5,044	29,751	16,481	46,231	51,275	90.16
1969.....	5,461	33,693	17,802	51,496	56,957	90.41
1970.....	3,892	33,935	16,965	50,900	54,791	92.90
1971.....	3,335	32,619	13,100	45,719	49,054	93.20

¹ Exclusive of ore containing 5 percent or more manganese.

² Includes crushed, screened, and sized ore not further treated.

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

Table 10.—Dates of first and final cargoes of iron ore at Minnesota and Wisconsin upper Great Lakes

Port and dock	1970		1971	
	First	Final	First	Final
Duluth, Minn.: DM&IR.....	Apr. 1	Dec. 18	Apr. 8	Dec. 18
Silver Bay, Minn.: Reserve.....	Apr. 7	Dec. 13	Apr. 11	Dec. 17
Superior, Wis.: Burlington Northern.....	Apr. 6	Dec. 19	Apr. 12	Dec. 22
Taconite Harbor, Minn.: Erie.....	Apr. 6	Dec. 8	Apr. 14	Dec. 8
Two Harbors, Minn.: DM&IR.....	Apr. 2	¹ Jan. 27	Apr. 10	² Jan. 30

¹ 1971.² 1972.

Source: Skillings' Mining Review.

Agency required compliance by 1975, reportedly at a cost of \$5 million. Industry and political leaders tried to find ways to keep the plant in operation but were unsuccessful. In January 1972 United States Steel Corp. announced permanent close-down of major segments of the plant. About 1,600 of the plant's 2,300 jobs reportedly were to be lost. Payroll of the plant in 1970 was reported to be \$25 million. The average salary was about \$8,000. The shutdown involved the blast furnaces, open-hearth furnaces, and bloom and steel mills. The rod, merchant bar, and wire mills, along with fence post fabrication operations, were to continue and be served with semifinished steel from other United States Steel Corp. plants, according to the company.

Steel production at North Star Steel Co. in St. Paul was disrupted by a 5-week strike that started on September 30. Highlight of the agreement reached is a plan under which the upper half of the company's seniority roster will receive 13 weeks of vacation every 5 years. The company employs about 400 production workers. It produces steel from iron and steel scrap in two 65-ton electric furnaces.

Manganiferous Ore.—The shipment of 152 thousand long tons of manganiferous

ore in 1971 was 47 percent below 1970 shipments. Although the Pittsburgh Pacific Co.'s Louise mine was the only producer on the Cuyuna Range, shipments included ore stockpiled at other mines in former years.

NONMETALS

Abrasive Stone.—Jasper Stone Co. produced grinding pebbles from its quartzite deposit near Jasper in Rock County. Although output decreased in quantity, its value was somewhat above that of 1970.

Cement.—Minnesota's only cement producer was Universal Atlas Cement Division of United States Steel Corp. It produced portland and masonry cement at Duluth from slag (from the nearby U.S. Steel blast furnace), limestone, sand, gypsum, iron dust, and air-entraining compounds. The principal market was in Minnesota and deliveries were mostly in bulk by truck. The firm employs about 175 workers. In accordance with an agreement with the Minnesota Pollution Control Agency, the plant installed pollution control devices on the plant's 300-foot-high stack in mid-year. When the company fulfills the terms of the agreement with the installation of dust collection equipment on another stack at

Table 11.—Shipments of usable ¹ manganiferous iron ore and ferruginous manganese ore from mines in the Cuyuna Range

Year	Manganiferous iron ore (5 to 10 percent Mn, natural)			Ferruginous manganese ore (10 to 35 percent Mn, natural)			Total shipments (long tons)
	Shipments (long tons)	Contents (natural)		Shipments (long tons)	Contents (natural)		
		Fe (percent)	Mn (percent)		Fe (percent)	Mn (percent)	
1967.....	--	--	--	211,387	32.88	14.56	211,387
1968.....	1,596	39.89	6.88	169,695	33.15	14.23	171,291
1969.....	50	40.37	7.44	340,567	29.73	14.29	340,617
1970.....	--	--	--	286,996	29.96	13.97	286,996
1971.....	--	--	--	151,547	28.16	13.56	151,547

¹ Direct-shipping and beneficiated ore.

the plant late in 1972, the 8-million-pound annual deposition of cement dust will be cut to 1 million pounds per year. A spokesman for the company indicated cost of the cleanup program would total several hundred thousand dollars.

Clays.—Production of common clay and shale decreased 2 percent from 227,000 short tons, valued at \$335,000, in 1970 to 223,000 short tons, valued at \$335,000, in 1971. It accounted for less than 1 percent of total 1971 Minnesota mineral commodity value. Most of the clay was used in the production of light-weight aggregate and brick; very small quantities were used for manufacturing floor and wall tile.

Feldspar.—National Resources, Inc., which started feldspar production near Silver Bay in 1970, ceased operation in March. No shipments were made.

Gem Stones.—Agates and similar precious gem stones gathered by amateur collectors accounted for all State gem stone production.

Lime.—Cutler-Magner Co. and American Crystal Sugar Co. produced lime in Clay, Polk, and St. Louis Counties for paper and pulp, sugar refining, and other uses. Output declined 13 percent.

Perlite.—Zonolite Division, W. R. Grace & Co., produced expanded perlite at its Minneapolis plant from material mined outside the State. It was Minnesota's only expanded perlite producer. The material was used for plaster aggregate, concrete aggregate, insulation, horticultural purposes, paint additives, textured granules, and foundry uses.

Sand and Gravel.—Sand and gravel production in Minnesota in 1971 was 44,916,000 tons, valued at \$37,645,000. Compared with 1970, production was down 4 percent, and value was down 3 percent. It was outranked in both quantity and value only by iron ore. Average value was \$0.84 per ton, compared with \$0.83 per ton in 1970.

Table 12.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	4,627	\$4,332	4,458	\$4,075
Fill.....	813	707	1,240	922
Paving.....	2,091	1,547	5,217	4,256
Railroad ballast.....	29	W	93	63
Other uses ¹	809	1,731	758	1,623
Total ²	8,368	8,317	11,765	10,940
Gravel:				
Building.....	3,518	5,929	4,502	6,324
Fill.....	1,818	499	2,392	706
Paving.....	23,223	17,441	15,907	13,700
Railroad ballast.....	166	191	201	194
Miscellaneous.....	131	166	136	190
Other uses.....	510	629	982	1,060
Total ²	29,365	24,855	24,170	22,174
Government-and-contractor operations:				
Sand:				
Fill.....	123	53	461	155
Paving.....	2,037	1,210	1,692	1,020
Other uses.....	90	40	56	33
Total ²	2,251	1,302	2,210	1,213
Gravel:				
Building.....	--	--	679	387
Fill.....	517	233	204	89
Paving.....	6,351	4,095	5,862	2,841
Other uses.....	--	--	25	2
Total ²	6,868	4,327	6,770	3,319
Total sand and gravel ²	46,851	38,802	44,916	37,645

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

¹ Includes blast (1970), engine, filler, foundry, glass, molding, oil (hydrafrac), and other sands.

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

Table 13.—Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Aitkin	3	47	\$27	4	54	\$35
Anoka	8	251	284	--	--	--
Becker	10	610	566	3	W	W
Beltrami	8	843	537	4	W	W
Benton	7	510	379	5	649	564
Big Stone	4	143	115	4	141	118
Blue Earth	12	748	707	4	746	690
Brown	10	174	117	9	515	317
Carlton	19	718	512	12	699	527
Cass	10	335	206	8	151	140
Chippewa	7	318	191	9	368	250
Chisago	7	427	253	6	315	193
Clay	12	1,596	2,535	10	1,244	1,895
Clearwater	7	414	357	5	277	219
Cottonwood	5	162	111	5	246	117
Crow Wing	9	259	253	9	531	501
Dakota	15	2,674	2,385	15	3,053	2,550
Douglas	4	253	173	3	W	W
Faribault	4	88	65	6	W	W
Fillmore	2	46	32	4	154	129
Freeborn	16	981	665	16	386	659
Goodhue	9	203	200	9	294	286
Hennepin	21	5,150	3,544	28	6,794	4,254
Isanti	4	W	W	--	15	8
Itasca	12	493	344	10	576	453
Jackson	6	254	194	8	442	255
Kanabec	5	223	147	3	77	38
Kandiyohi	6	364	175	4	W	W
Koochiching	6	194	155	5	W	W
Lac qui Parle	10	384	245	9	223	181
Lake of the Woods	4	94	64	2	93	66
Le Sueur	3	744	1,493	4	W	W
Lincoln	5	173	130	3	W	W
Lyon	6	219	243	2	W	W
McLeod	3	106	61	7	W	W
Mahnomen	2	W	W	--	57	6
Marshall	4	512	410	2	343	232
Martin	7	373	297	9	365	211
Meeker	6	183	157	2	W	W
Mille Lacs	7	403	176	5	W	W
Morrison	6	397	331	2	267	33
Murray	4	157	90	6	W	W
Nobles	8	403	261	5	231	179
Norman	3	206	119	6	W	W
Olmsted	6	355	313	9	690	592
Otter Tail	19	559	282	6	666	521
Pine	8	297	206	5	215	47
Pipestone	10	489	281	6	434	220
Polk	8	1,083	933	11	331	332
Pope	4	157	104	3	W	W
Red Lake	2	25	25	4	W	W
Redwood	8	245	154	5	234	153
Renville	8	377	235	11	589	725
Rice	18	1,073	675	4	676	614
Rock	9	227	253	5	362	374
Roseau	12	715	583	6	W	W
St. Louis	34	4,304	2,994	40	4,360	3,262
Scott	6	287	245	4	W	W
Sherburne	10	897	989	7	622	637
Sibley	3	W	W	1	71	34
Stearns	13	1,222	1,136	7	858	543
Steele	12	360	451	5	366	493
Stevens	4	265	223	3	530	431
Swift	6	220	123	1	W	W
Traverse	1	14	W	1	W	W
Wabasha	5	76	76	4	103	100
Wadena	1	57	34	1	54	8
Waseca	1	6	W	1	31	W
Washington	16	3,970	3,674	14	2,960	3,436
Wilkin	4	449	223	1	W	W
Wright	5	373	237	11	564	430

See footnotes at end of table.

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

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Yellow Medicine.....	9	334	\$204	8	W	W
Undistributed ¹	52	5,045	3,963	48	9,823	\$9,025
Total ²	625	46,851	38,802	504	44,916	37,645

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

¹ Includes Carver, Cook, Dodge, Grant (1971), Houston, Hubbard, Kittson, Lake, Mower, Nicollet, Pennington, Ramsey, Todd, Watonwan, Winona, and some sand and gravel that cannot be assigned to specific counties.

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

Stone.—Value of all stone produced in Minnesota in 1971 was \$14,346,000, up 17 percent from that of 1970. Stone ranked third in value of State mineral commodity production, accounting for 2 percent of total value. Limestone and dolomite accounted for 88 percent of total stone output and 64 percent of total stone value. Principal production was as crushed rock. However, the 0.3 percent produced as dimension stone was 18 percent of total limestone and dolomite value.

Granite was quarried in Minnesota for use as crushed rock and dimension stone. The crushed granite was valued at

\$775,000; that of dimension stone \$3,411,000.

Minor quantities of basalt, quartzite, and marl are included in total stone statistics. Total production of these was 218,000 short tons, valued at \$939,000. All basalt and most of the quartzite quarried was used as aggregate or riprap.

Sulfur.—Great Northern Oil Co. and Northwestern Refining Co. continued recovering sulfur as a byproduct from their petroleum refining operations near Pine Bend, Dakota County, and St. Paul Park, Washington County, respectively.

Table 14.—Limestone and dolomite sold or used by producers, by use
(Thousand short tons and thousand dollars unless otherwise specified)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Dimension:				
Rough architectural ¹.....thousand cubic feet..	29	\$115	18	\$94
Cut stone.....do.....	74	1,075	72	1,275
House stone veneer ².....do.....	73	293	68	307
Total (approximate thousand short tons) ⁵	14	1,483	13	1,677
Crushed and broken:				
Bituminous aggregate.....	277	418	187	247
Concrete aggregate.....	382	643	W	W
Dense graded road base stone.....	1,263	1,727	2,332	3,227
Macadam aggregate.....	950	1,210	152	228
Surface treatment aggregate.....	³ 444	³ 1,032	322	436
Unspecified aggregate & roadstone.....	W	W	682	773
Agricultural limestone.....	221	416	241	491
Railroad ballast.....	81	107	W	W
Riprap and jetty stone.....	74	95	32	68
Other ⁴	180	W	1,191	2,014
Total ⁵	3,872	5,650	5,138	7,544
Grand total ⁵	3,886	7,134	5,151	9,220

W Withheld to avoid disclosing individual company confidential data; included with "Other" unless otherwise specified.

¹ Data includes irregular-shaped stone, rubble, and other rough flagging.

² Data includes sawed stone and dressed flagging.

³ 1970 data includes small amount of unspecified aggregate and the value data for "Other" crushed and broken stone.

⁴ Data includes stone used for flux, poultry grit and other uses not listed. Also, asphalt filler (1970) and concrete aggregate, other filler and railroad ballast (1971).

⁵ Data may not add to totals shown because of independent rounding.

Table 15.—Granite sold or used by producers, by use

Use	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rough architectural..... thousand cubic feet..	22	\$77	8	\$47
Rough monumental.....do.....	19	72	35	118
Dressed architectural (cut).....do.....	224	3,357	209	3,181
Dressed monumental.....do.....	4	102	3	115
Total (approximate thousand short tons).....	23	3,608	22	3,411
Crushed and broken:				
Aggregate and roadstone..... thousand short tons..	171	381	103	155
Railroad ballast.....do.....	301	424	335	510
Riprap and jetty stone.....do.....	11	20	2	3
Other ¹.....do.....	7	118	7	108
Total ².....do.....	491	943	447	775
Grand total ².....do.....	514	4,550	469	4,187

¹ Includes granite for poultry grit and other uses not listed or unspecified.

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

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

(Thousand short tons and thousand dollars)

County	1970			1971			Kind of stone produced in 1971 ¹
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value	
Beltrami.....	4	W	W	--	--	--	Granite.
Benton.....	--	W	W	1	W	W	Other.
Big Stone.....	2	W	W	1	W	W	Granite.
Blue Earth.....	4	W	\$926	4	W	\$971	Limestone.
Carver.....	--	--	--	1	W	W	Other.
Dakota.....	1	W	W	1	W	W	Limestone.
Dodge.....	3	W	W	3	73	91	Do.
Fillmore.....	8	316	519	11	366	643	Do.
Goodhue.....	8	156	182	7	164	201	Do.
Hennepin.....	--	--	--	2	W	W	Do.
Houston.....	10	69	63	14	252	336	Do.
Lac qui Parle.....	3	1	W	3	2	300	Granite.
Le Sueur.....	3	22	W	3	W	W	Limestone, Quartzite.
Mille Lacs.....	1	W	W	1	W	W	Granite.
Mower.....	4	W	W	4	W	W	Limestone.
Nicollet.....	1	W	W	1	W	W	Quartzite.
Olmsted.....	7	W	W	8	W	W	Limestone.
Redwood.....	3	W	W	2	W	W	Granite.
Renville.....	1	W	W	1	W	W	Do.
Rice.....	2	30	W	2	W	W	Limestone.
Rock.....	1	W	W	1	W	W	Quartzite.
St. Louis.....	1	62	124	3	W	W	Traprock, Other Stone.
Scott.....	4	368	826	4	593	1,179	Limestone.
Stearns.....	8	W	W	10	W	W	Granite.
Steele.....	1	W	W	1	W	W	Limestone.
Wabasha.....	4	W	W	3	W	W	Do.
Wadena.....	1	W	9	1	W	W	Marl.
Washington.....	4	W	W	3	W	W	Limestone.
Winona.....	4	W	1,006	7	W	927	Do.
Yellow Medicine.....	2	W	W	1	195	300	Granite.
Undistributed.....	--	3,555	8,656	--	4,192	9,398	
Total.....	95	4,579	12,311	104	25,838	14,346	

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

¹ "Limestone" used generally to include dolomite.

² Data does not add to total shown because of independent rounding.

Vermiculite.—Three Twin City firms principally as loose fill insulation and as aggregate in lightweight plaster and concrete. The expanded material was sold for use

MINERAL FUELS

Peat.—Six companies reported peat production in Minnesota in 1971. It consisted principally of moss and reed-sedge peats used in general soil improvement and in potting soils. Most was sold in packaged

form, but some minor quantities were sold in bulk. Although Minnesota has 50 percent of the Nation's known peat supply, it produces less than 5 percent of total U.S. production. Peat accounts for less than 1 percent of State mineral production value.

Table 17.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasive stone—Grinding pebbles and tube-mill liners:			
Jasper Stone Co.....	Box 206 Sioux City, Iowa 51102	Quarry and processing plant.	Rock.
Cement:			
Universal Atlas Cement Division United States Steel Corp.	Chatham Center, Box 2969 Pittsburgh, Pa. 15230	Portland and masonry, wet process.	St. Louis.
Clays and shale:			
North Central Lightweight Aggregate Co., Inc.	4901 West Medicine Lake Dr. Minneapolis, Minn. 55427	Pit and plant.....	Hennepin.
Ochs Brick & Tile Co.....	Springfield, Minn. 56087....	Pits and plant.....	Brown, Redwood.
Twin City Brick Co.....	790 Joy Ave. St. Paul, Minn. 55118	Pit and plant.....	Ramsey.
Coke:			
American Steel & Wire Division United States Steel Corp.	Morgan Park Duluth, Minn. 55800	Coke ovens.....	St. Louis.
Koppers Co., Inc.....	1000 Hamline Ave. North St. Paul, Minn. 55104	....do.....	Ramsey.
Iron ore:			
Cleveland-Cliffs Iron Co.:	1460 Union Commerce Bldg. Cleveland, Ohio 44115		
Canisteo and Hill Trumbull.....	.....	Mines and concentrators.	Itasca.
The Hanna Mining Co.:	100 Erieview Plaza Cleveland, Ohio 44114		
Rabbit Lake.....	.....	Stockpile shipments....	Crow Wing.
Butler Taconite Project.....	.....	Mine, concentrator, and agglomerator.	Itasca.
National Steel Pellet Project.....	.....	....do.....	Itasca, St. Louis.
Pierce Group.....	.....	Mine and concentrator.	St. Louis.
South Agnew Group.....	.....	Stockpile shipments....	Do.
West Hill.....	.....	....do.....	Itasca.
Jones & Laughlin Steel Corp., Minnesota Ore Division:	Virginia, Minn. 55792....		
Hill Annex and Lind- Greenway.....	.....	Mines and concentrators.	Do.
McKinley and Schley Group.....	.....	Mine and concentrator.	St. Louis.
Oglebay Norton Co.:	Hanna Bldg. Cleveland, Ohio 44115		
Thunderbird Mine.....	.....	Mine: Ore treated at Fairlane Plant.	Do.
Fairlane Plant.....	.....	Concentrator and agglomerator.	Do.
Pickands Mather & Co.:	2000 Union Commerce Bldg. Cleveland, Ohio 44115		
Erie Commercial.....	.....	Mine, concentrator, and agglomerator.	Do.
Mahoning.....	.....	Mine and concentrator.	Do.
Pittsburgh Pacific Co.:	2521 First Ave. Hibbing, Minn. 55746		
Dunwoody, Gilbert, Lincoln West, Monroe, and others.	.....	Ore treated at Coons Pacific Plant.	Do.
Julia Plant.....	.....	Concentrator.....	Do.
Reserve Mining Co.:	Silver Bay, Minn. 55614....		
Peter Mitchell.....	.....	Mine and primary crushing.	Do.
E. W. Davis Works.....	.....	Concentrator and agglomerator.	Lake.
Rhude & Fryberger, Inc.:	Box 66 Hibbing, Minn. 55746		
Gross Nelson and Hull-Rust Group.....	.....	Mines and concentrators.	St. Louis.
Snyder Mining Co.:	Box 1106 Pittsburgh, Pa. 15230		

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Iron ore—Continued			
Snyder Mining Co.—Continued			
Kosmerl Lease Area, Wanless, Whiteside.		Mines	St. Louis.
United States Steel Corp., Minnesota Ore Operations:	Box 417 Mountain Iron, Minn. 55768		
Plummer Group		Mine and concentra- tor.	Itasca.
Kosmerl		Mined by Snyder Mining Co. in con- junction with Whiteside Mine.	St. Louis.
Minntac		Mine, concentrator, and agglomerator.	Do.
Rouchleau Group		Ore treated at Julia Plant.	Do.
Sherman Group		Mine and concentra- tor.	Do.
Stephens Mine		do.	Do.
Iron and steel:			
American Steel & Wire Division United States Steel Corp.	Morgan Park Duluth, Minn. 55800	Iron blast furnace and open-hearth steel furnaces.	Do.
North Star Steel Co.	1400 Red Rock Rd. St. Paul, Minn. 55119	Electric steel furnace	Ramsey.
Secondary lead smelters:			
Gopher Smelting & Refining Co.	Hwy. 49 and Hwy. 55 St. Paul, Minn. 55111	Processing plant	Dakota.
N L Industries, Inc.	3650 Hampshire St. Minneapolis, Minn. 55426	do.	Hennepin.
Lime:			
American Crystal Sugar Co.	Boston Bldg. Denver, Colo 80201	Quicklime, shaft kilns.	Carver, Clay, Polk.
Cutler-Magner Co.	12th Ave. & Waterfront Duluth, Minn. 55802	Quicklime and hy- drated lime, one rotary kiln.	St. Louis.
Manganiferous ore:			
The Hanna Mining Co.:	100 Erieview Plaza Cleveland, Ohio 44114		
Lauretta		Mine	Crow Wing.
Pittsburgh Pacific Co.:	2521 First Ave. Hibbing, Minn. 55746		
Louise and Mangan No. 1		Stockpile shipments	Do.
Peat:			
Colby Pioneer Peat Co.	Box 8 Hanlontown, Iowa 50444	Peat bog	Aitkin.
Power-O-Peat Co.	Gilbert, Minn. 55741	do.	St. Louis.
Red Wing Peat Corp.	Box 3006 Houston, Tex. 77001	do.	Carlton.
Expanded perlite:			
Zonolite Division, W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 01109	Processing plant	Hennepin.
Sand and gravel:			
Alexander Construction Co., Inc.	4641 Hiawatha Ave. Minneapolis, Minn. 55406	Pits and portable plants.	Dakota, Hennepin, Washington.
Anderson Aggregates, Inc.	100 North Seventh St. Minneapolis, Minn. 55403	Pit; one stationary, one portable plant.	Hennepin.
Barton Contracting Co.	10300 89th Ave. North Osseo, Minn. 55369	Pits and stationary plants.	Carlton, Chisago, Dakota, Hennepin, Sherburne, Washington.
Duininck Bros. & Gilchrist	Olivia, Minn. 56277	Pits and portable plants.	Big Stone, Carlton, Clearwater, Kandiyohi, Kittson, Marshall, Polk, Redwood, Renville, Roseau.
W. Hodgman & Sons, Inc.	1100 Marcus St. Fairmont, Minn. 56031	do.	Brown, Carlton, Faribault, Goodhue, Jackson, Martin, Polk Stevens, Watsonwan, Winona.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
McLean Construction Co.....	1255 Tower Ave. Superior, Wisc. 54880	Pits and portable plants.	Itasca, St. Louis.
Mark Sand & Gravel Co.....	Box 396 Fergus Falls, Minn. 56537	.....do.....	Clay, Clear- water, Doug- las, Grant, Mahnomon, Norman, Otter Tail, Wilkin.
Minnesota Valley Improvement Co.	Granite Falls, Minn. 56241..	.....do.....	Benton, Blue Earth, Chippewa, Hennepin, Jackson, Mille Lacs, Nicollet, Nobles, Olmsted, Pine, Polk, Pope, Red Lake, Ren- ville, Rock, Scott, Yellow Medicine.
J. L. Shiely Co.....	1101 North Snelling Ave. St. Paul, Minn. 55108	Pit and stationary plant.	Washington.
Ulland Brothers, Inc.....	Box 98 Austin, Minn. 55912	Pits and portable plants.	Freeborn, Mower, Olmsted, Steele.
Do.....	Box 340 Cloquet, Minn. 55720	.....do.....	Carlton, Cook, Lake, St. Louis.
Stone:			
Granite:			
Cold Spring Granite Co.....	Cold Spring, Minn. 56320...	Quarries.....	Big Stone, Lac qui Parle, Mille Lacs, Renville.
Do.....	.....do.....	Quarries and station- ary plants.	Stearns.
Delano Granite, Inc.....	Delano, Minn. 55328.....	Quarries.....	Lac qui Parle, Stearns.
Do.....	.....do.....	Stationary plant.	Wright.
The Green Co.....	Granite Falls, Minn. 56241.	Quarry and station- ary plant.	Yellow Medicine.
Shiely-Petters Crushed Stone Co., Inc.	Box 69 St. Cloud, Minn. 56301	.....do.....	Stearns.
Limestone and dolomite:			
The Babcock Co.....	Kasota, Minn. 56050.....	.....do.....	Le Sueur.
Biesanz Stone Co., Inc.....	116 West 7th St. Winona, Minn. 55987	.....do.....	Winona.
Bryan Rock Products, Inc....	Box 215 Shakopee, Minn. 55379	Quarries; stationary and portable plants.	Scott, Washington.
Hector Construction Co., Inc.	Box 410 Caledonia, Minn. 55921	Quarries and portable plants.	Houston, Winona.
Edward Kraemer & Sons, Inc.	Plain, Wis. 53577.....	Quarry and stationary plant.	Dakota.
Mankato Ag Lime & Rock Co.	Route 3 Mankato, Minn. 56001	.....do.....	Blue Earth.
Mankato Stone Co.....	826 North Front St. Mankato, Minn. 56001	.....do.....	Do.
Osmundson Brothers.....	Adams, Minn. 55909.....	Quarries and portable plant.	Mower.
Patterson Quarries, Div. of Mathy Construction Co.	St. Charles, Minn. 55972...	Quarry and portable plant.	Olmsted, Wabasha.
Quarve & Anderson Co.....	Route 3, Box 27 Rochester, Minn. 55901	Quarries and portable plants.	Dodge, Olmsted, Wabasha, Winona.
River Warren Aggregates, Inc.	Lakeville, Minn. 55074.....	.....do.....	Scott.
J. L. Shiely Co.....	1101 North Snelling Ave. St. Paul, Minn. 55108	Quarries and station- ary plants.	Scott, Washington.
Vetter Stone Co.....	Route 4, Mankato, Minn. 56001	.....do.....	Blue Earth, Le Sueur.
Marl:			
Richard Nanik Marl Pit.....	Star Route Staples, Minn. 56479	Pit.....	Wadena.
Quartzite:			
Jasper Stone Co.....	Box 206 Sioux City, Iowa 51102	Quarry and station- ary plant.	Rock.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Quartzite—Continued			
New Ulm Quartzite Quarries, Inc.	New Ulm, Minn. 56073	Quarry and stationary plant.	Nicollet.
Traprock (Basalt):			
Arrowhead Blacktop Co.	14th Ave. West & Waterfront Duluth, Minn. 55802	Pit	St. Louis.
Sulfur (recovered):			
Great Northern Oil Co.	Box 3596 St. Paul, Minn. 55101	Elemental sulfur recovered as a by-product of oil refining.	Dakota.
Northwestern Refining Co.	P. O. Drawer 9 St. Paul Park, Minn. 55071	do.	Washington.
Exfoliated vermiculite:			
MacArthur Co.	936 Raymond Ave. St. Paul, Minn. 55114	Processing plant.	Ramsey.
The B. F. Nelson Manufacturing Co.	401 Main St. Northeast Minneapolis, Minn. 55413	do.	Hennepin.
Zonolite Division, W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 01109	do.	Do.

The Mineral Industry of Mississippi

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

By C. L. Reading¹ and Alvin R. Bicker, Jr.²

Value of mineral production in Mississippi increased 5 percent to \$262 million, the highest value ever attained. Mineral fuels—petroleum, natural gas, and natural gas liquids—constituted 87.3 percent of the total value. Though overall production of mineral fuels declined, its value accounted for an \$8.7 million increase over the 1970 value. Value of all other mineral production increased \$3.7 million.

In mid-July startup operations were completed at the Mississippi Power and Light Co.'s (MP&L) 750,000-kilowatt electricity-generating unit at the Baxter Wilson steam electric station near Vicksburg. Completion of this unit increased generating capability of the entire MP&L system by 63 percent. Ground-breaking ceremonies for construction of a new 750,000-kilowatt plant south of Greenville were held in November. This plant, which will be the fifth in the MP&L system, is scheduled for completion in 1974.

Mississippi Power Company began the largest construction program in its history in 1970. A major project is construction of a new 500,000-kilowatt steam-electricity-generating unit at the utility's Jack Watson plant between Biloxi and Gulfport in Harrison County. This new unit, scheduled for completion in mid-1973, will increase the plant's total capacity to 1,051,360 kilowatts.

The Tennessee Valley Authority acquired a tract on the eastern shore of the Yellow Creek arm of Pickwick Lake about 10 miles north of Iuka for a future electric power-plant site.

The Federal lease sale of over 366,000 acres offshore Louisiana was cancelled as a result of court action brought by environ-

¹ Mineral specialist, Division of Fossil Fuels.

² Economic geologist, Mississippi Geological, Economic, and Topographical Survey, Jackson, Miss.

Table 1.—Mineral production in Mississippi¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays.....thousand short tons..	1,553	\$8,062	2,278	\$8,501
Natural gas.....million cubic feet..	126,031	23,190	118,805	24,830
Natural gas liquids:				
Natural gasoline and cycle products				
thousand 42-gallon barrels..	544	1,465	W	W
LP gases.....do.....	428	964	W	W
Petroleum (crude).....do.....	65,119	194,706	64,066	201,808
Sand and gravel.....thousand short tons..	10,859	11,950	11,289	13,526
Stone.....do.....	W	W	848	938
Value of items that cannot be disclosed: Cement, lime, magnesium compounds, and values indicated by symbol W.....	XX	9,636	XX	12,790
Total.....	XX	249,973	XX	262,393
Total 1967 constant dollars.....	XX	223,601	XX	227,967

W Withheld to avoid disclosing individual company confidential data. XX Not applicable.

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

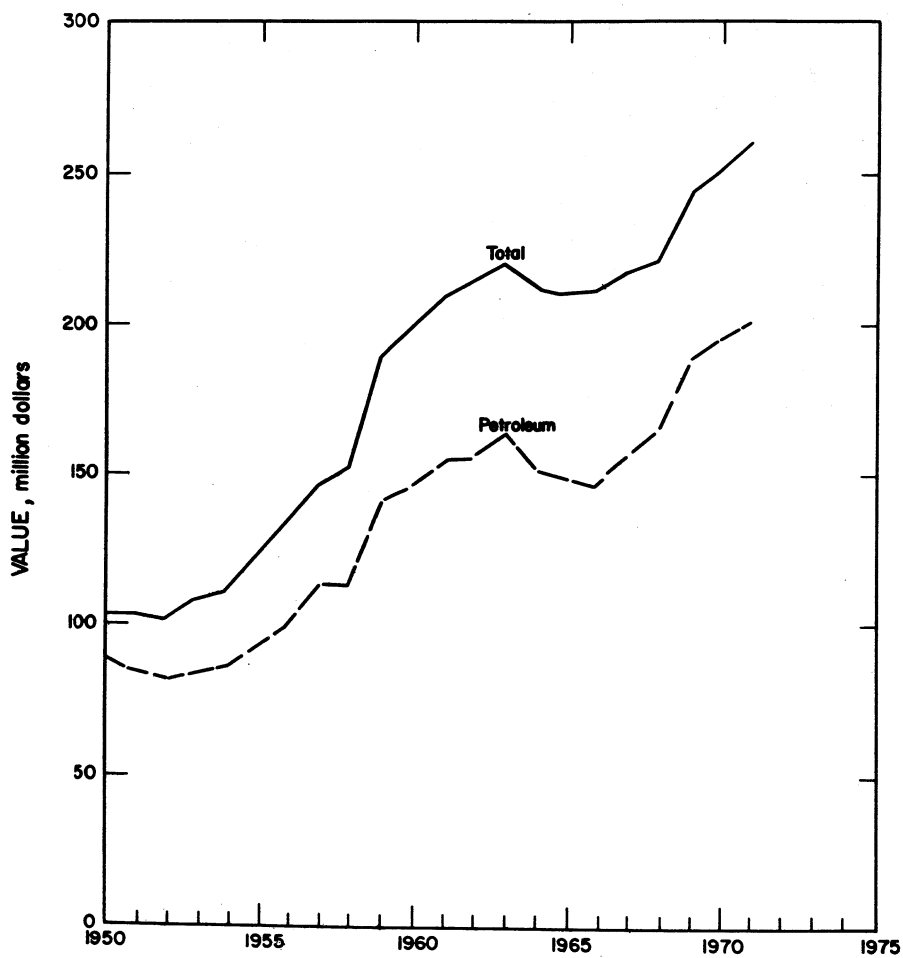


Figure 1.—Value of petroleum and total value of mineral production in Mississippi.

Table 2.—Value of mineral production in Mississippi, by county ¹
(Thousands)

County	1970	1971	Minerals produced in 1971, in order of value
Adams.....	\$23,053	\$22,014	Petroleum, sand and gravel, natural gas, natural gas liquids, clays.
Alcorn.....	W	W	Sand and gravel.
Amite.....	3,732	5,364	Petroleum, natural gas.
Attala.....	W	W	Clays.
Bolivar.....	W	W	Sand and gravel.
Carroll.....	W	W	Sand and gravel, clays.
Clarke.....	40,010	44,119	Petroleum, natural gas, natural gas liquids, sand and gravel.
Clay.....	477	682	Sand and gravel, stone, natural gas.
Copiah.....	W	W	Sand and gravel.
Covington.....	847	920	Petroleum, sand and gravel, natural gas.
De Soto.....	W	W	Sand and gravel.
Forrest.....	3,649	3,460	Natural gas, sand and gravel, petroleum, clays.
Franklin.....	12,022	9,913	Petroleum, natural gas.
Greene.....	313	234	Do.
Hancock.....	288	270	Natural gas, petroleum, sand and gravel.
Harrison.....	174	W	Sand and gravel.
Hinds.....	1,555	2,128	Petroleum, clays, natural gas, stone, sand and gravel.
Holmes.....	349	376	Sand and gravel, petroleum, natural gas.
Humphreys.....	W	49	Petroleum, natural gas.
Itawamba.....	W	W	Clays, natural gas.
Jackson.....	W	W	Magnesium compounds, lime, sand and gravel.
Jasper.....	25,880	26,786	Petroleum, natural gas, natural gas liquids, clays, sand and gravel.
Jefferson.....	1,334	1,220	Petroleum, natural gas.
Jefferson Davis.....	5,543	5,985	Natural gas, petroleum, natural gas liquids.
Jones.....	10,870	11,841	Petroleum, natural gas, natural gas liquids, clays.
Lafayette.....	W	W	Sand and gravel.
Lamar.....	18,530	28,436	Petroleum, natural gas, sand and gravel.
Lauderdale.....	W	W	Clays, sand and gravel.
Lee.....	W	W	Clays, sand and gravel, natural gas.
Leflore.....	W	W	Natural gas, petroleum.
Lincoln.....	5,739	4,777	Petroleum, sand and gravel, clays.
Lowndes.....	W	W	Sand and gravel, clays.
Madison.....	1,751	1,559	Petroleum, natural gas.
Marion.....	W	W	Natural gas, petroleum, sand and gravel.
Marshall.....	W	362	Clays.
Monroe.....	W	3,230	Clays, sand and gravel, natural gas, petroleum.
Noxubee.....	W	W	Clays, sand and gravel.
Oktibbeha.....	W	W	Natural gas.
Panola.....	W	W	Clays, sand and gravel.
Pearl River.....	587	649	Natural gas, petroleum, clays.
Perry.....	W	W	Sand and gravel, petroleum.
Pike.....	3,127	2,045	Petroleum, natural gas liquids, natural gas.
Pontotoc.....	W	W	Sand and gravel.
Prentiss.....	W	W	Clays.
Rankin.....	5,074	5,344	Cement, petroleum, stone, sand and gravel, natural gas.
Scott.....	171	295	Petroleum, natural gas.
Simpson.....	2,048	2,018	Petroleum, natural gas, sand and gravel.
Smith.....	16,067	12,098	Petroleum, natural gas, natural gas liquids, clays, sand and gravel.
Stone.....	W	W	Sand and gravel.
Sunflower.....	W	W	Clays.
Tate.....	59	W	Sand and gravel.
Tippah.....	W	1,760	Clays.
Tishomingo.....	W	W	Sand and gravel.
Union.....	16	W	Do.
Walthall.....	5,599	8,180	Natural gas, petroleum, sand and gravel.
Warren.....	1,865	3,280	Cement, stone.
Washington.....	W	W	Sand and gravel.
Wayne.....	17,031	16,150	Petroleum, natural gas, sand and gravel.
Wilkinson.....	7,541	6,570	Do.
Winston.....	W	W	Clays.
Yalobusha.....	W	W	Sand and gravel.
Yazoo.....	8,035	9,201	Petroleum, natural gas.
Undistributed.....	26,685	21,031	
Total ²	249,973	262,393	

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

¹ The following counties were not listed because no production was reported: Benton, Calhoun, Chickasaw, Choctaw, Claiborne, Coahoma, George, Grenada, Issaquena, Kemper, Lawrence, Leake, Montgomery, Neshoba, Newton, Quitman, Sharkey, Tallahatchie, Tunica, and Webster.

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

Table 3.—Indicators of Mississippi business activity

	1970	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total work force..... thousands	829.0	844.8	+1.9
Unemployment..... do	39.8	41.7	+4.8
Employment:			
Construction..... do	32.5	30.6	-5.8
Mining..... do	6.5	6.1	-6.2
All manufacturing..... do	181.7	188.3	+3.6
Other industries ¹ do	356.6	365.8	+2.6
Personal income:			
Total..... millions	\$5,706	\$6,157	+7.9
Per capita.....	\$2,575	\$2,766	+7.4
Construction activity:			
Building permits, total private nonresidential..... millions	\$61.8	\$71.8	+16.2
Cement shipments to and within Mississippi thousand 376-pound barrels.....	4,328	4,198	-3.0
Mineral production..... millions	\$250.0	\$262.4	+5.0

^p Preliminary.

¹ Includes transportation and public utilities; wholesale and retail trade; finance, insurance, and real estate; services; and government.

Sources: Survey of Current Business, Construction Review, Employment and Earnings and Monthly Report on the Labor Force, Area Trends in Employment and Unemployment, and U.S. Bureau of Mines.

mental groups. Though technically off the coast of Louisiana, 25,000 acres lie due south of Mobile, Ala., and 45,000 acres lie south of Mississippi.

Oil- and gas-drilling operations declined in 1971 primarily owing to a continued drop in drilling activity in the Eocene Wilcox area. Deep drilling in the Jurassic trend continued to highlight the drilling activity in Mississippi, and the Upper Cretaceous trend continued a rejuvenation that began in 1970. Dinan field in Walthall County, a 1970 lower Tuscaloosa (Upper Cretaceous) discovery, had 11 successful oil completions during 1971. Humphreys County was added to the list of oil- and gas-producing counties with completion of the Houston Natural Gas Production Co.'s, Turner Well 1, which will produce from the Smackover reservoir (Jurassic System).

Standard Oil Co. of Kentucky completed an \$85 million construction and modernization program at its refinery in Pascagoula. The program included five new processing plants, an enlarged dock area, increased tank storage, improved computer capability, larger laboratory and machine shop facilities, and additional water and air emission control equipment.

The Mississippi Geological, Economic, and Topographic Survey published another bulletin ³ in its series of comprehensive investigations of the mineral resources of individual counties.

A team of National Aeronautics and Space Administration (NASA) experts, provided through the Mississippi Test Facility,

completed a study of offshore oil and gas operations for the U.S. Geological Survey.⁴

Employment.—The number of wage-and-salary workers in petroleum production, refining, and related industries decreased 1.3 percent according to the Mississippi Employment Security Commission. Employment in the mining industry decreased 6.2 percent and constituted only 1 percent of total nonagricultural labor force.

Legislation and Government Programs.—The Legislature authorized the State to deed 64,000 acres of submerged lands in Mississippi Sound to the Department of the Interior for \$1, with the State reserving mineral rights. This will clear the way for the proposed Gulf Islands National Seashore project on three offshore islands.

The Mississippi Air and Water Pollution Control Commission disbursed almost \$2 million to municipalities during fiscal year 1971 under a new State grant-in-aid program for constructing waste water treatment plant facilities. The 1971 legislature approved an extra \$4 million appropriation for fiscal year 1972.

The Mississippi Air and Water Pollution Control Commission issued a notice in

³ Baugham, Wilbur T., Thomas E. McCutcheon, Alvin R. Bicker, Jr., Theo H. Dinkins, Jr., and Thad N. Shows. Rankin County Geology and Mineral Resources. Mississippi Geol., Econ., and Topographical Survey Bull. 115, 1971, 226 pp.

⁴ Dyer, Morris K., Dewey G. Little, Earl G. Hoard, Alfred C. Taylor, and Rayford Campbell. Applicability of NASA Contract Quality Management and Failure Mode Effect Analysis Procedures to the USGS Outer Continental Shelf Oil and Gas Lease Management Program. U.S. Geol. Survey, 1971, 36 pp.

December which scheduled a statewide public hearing for the purpose of establishing an Air Implementation Plan for the State of Mississippi in compliance with the Clean Air Act (42 U.S.C. 1857-18571 as amended by Public Law 91-604, 84 Stat. 1676).

Transportation. — Houston Contracting completed a dual 36-inch gas pipeline across the Mississippi River for Columbia Gulf Transmission Co. The lines were pulled by a hydraulically powered 200,000-pound continuous-pulling machine. The dual crossing, a short distance northeast of Lake Providence, La., was the first use of a machine designed expressly for pulling river crossings, marine loading lines, and comparable pipeline installations.

A new 150-mile, 20-inch products line was completed from the new Gulf Oil Corp.

Alliance refinery at Myrtle Grove, La., to Collins, Miss. Plantation Pipe Line Co. completed a 113-mile 30-inch products line from Epes, Ala., to Collins, Miss. The Colonial Pipeline Co. completed a 30-inch looping of an existing 36-inch products line between Baton Rouge, La., and Atlanta, Ga.

Southern Natural Gas Co. completed 36 miles of 30-inch pipeline from Brooksville to Muldon, Miss.

According to the Bureau of Mines crude oil and product pipelines triennial report, there were 3,058 miles of petroleum pipelines in place in the State as of January 1, 1971. This is a net increase of 702 miles, or 29.8 percent since 1968. There were 16,403 miles of utility gas mains in Mississippi at the end of 1970, according to the American Gas Association.

Table 4.—Wage-and-salary workers in petroleum production, refining, and related industries

Year	Crude petroleum and natural gas production	Petroleum refining ¹	Pipeline transportation (except natural gas)	Gas utilities	Retail filling stations	Chemicals manufactured as byproducts of petroleum or used in refining of petroleum ²
1967.....	4,904	827	151	2,193	5,100	873
1968.....	5,482	862	151	2,164	5,144	393
1969.....	5,515	864	158	2,141	5,034	417
1970.....	5,900	1,000	175	2,153	5,238	424
1971.....	5,738	1,059	181	2,187	5,115	411

¹ Employment in petroleum refineries and petrochemicals manufactured in petroleum refineries.

² Employment in petrochemical manufacturing facilities located outside petroleum refineries.

Source: Mississippi Employment Security Commission.

Table 5.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Nonmetal.....	713	250	178	1,435	--	33	22.99	368
Sand and gravel.....	636	244	155	1,429	--	39	27.29	702
Stone.....	125	211	26	214	--	1	4.67	135
Total ¹	1,474	244	360	3,078	--	73	23.71	507
1971: ^p								
Nonmetal.....	530	240	127	1,028	--	23	22.38	237
Sand and gravel.....	690	261	180	1,642	--	33	20.09	649
Stone.....	120	232	23	230	--	--	--	--
Total ¹	1,340	250	336	2,900	--	56	19.31	469

^p Preliminary.

¹ Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The combined value of natural gas, natural gas liquids, and crude petroleum production increased by \$8.7 million and was 4 percent higher than the comparable 1970 value. The combined value of \$229.1 million was 87.3 percent of the State's total mineral production value, compared with 88.1 percent last year.

Mississippi ranked ninth in order of crude oil production and eleventh in natural gas production, and 17th in natural gas liquids production. Leading counties, in order of mineral fuels value, were Clarke, Lamar, Jasper, Adams, Wayne, Smith, Jones, and Franklin.

According to the Mississippi State Oil and Gas Board, there were six new gas fields and 11 oil fields discovered during the year. Two gas discoveries and five oil discoveries were productive from Jurassic age sediments, and three gas discoveries and two oil discoveries were productive from formations of Cretaceous age. Four oil discoveries produced from the Wilcox Formation (Tertiary age). The remaining gas discovery, Maben field, was productive from the Knox-Ordovician pool (Paleozoic age).

Jurassic discoveries were Missionary (Cotton Valley), Belzoni (Smackover), Archusa Springs (Norphlet), Garland Creek (Smackover), Lake Utopia (dual completion—Upper and Lower Smackover), Fomosla (Smackover), and Piney Woods (Smackover). Cretaceous discoveries were Kirklin (Paluxy), Two Mile Creek (Tuscaloosa), Zion Hill (Tuscaloosa), Center Point (Tuscaloosa), and Tiger (Hosston). Wilcox discoveries were Tony Creek (McShane), Willow Glen (Wilson), Giles Bend (Parker A), and Long Lake (Wilson).

According to the Mississippi State Oil and Gas Board, as of December 31, 1971, there were 413 oil pools and 67 gas pools producing in 402 fields in the State. There were 3,509 producible wells, a small increase from 3,472 at yearend 1970.

Consolidation Coal Co. began exploring the lignite belt, which runs through southern Alabama and Mississippi.

Natural Gas.—Marketed natural gas production in 1971 was 119 billion cubic feet, a decline of 5.7 percent from the 126 billion cubic feet marketed in 1970. This was the

seventh consecutive year that marketed natural gas volume declined. Wellhead value in 1971 averaged 20.9 cents per thousand cubic feet (Mcf), up 13.6 percent from 18.4 cents per Mcf in 1970. Mississippi ranked eleventh in the Nation in marketed natural gas.

Six counties supplied 81.1 percent of the natural gas produced in the state. In descending order of production, they were Jefferson Davis, Marion, Walthall, Smith, Forrest, and Clarke. Reserves of natural gas declined for the 10th consecutive year extending the downward trend that began in 1961. According to the American Gas Association, Inc., estimated gas reserves were 1,117.4 billion cubic feet at the end of 1971, 16.2 percent less than at yearend 1970. The reserve-to-production ratio declined from 16.4:1 in 1961 to 9.4:1 in 1971.

Six new gasfields were discovered, according to the Mississippi State Oil and Gas Board: Southeastern Exploration, Ltd., Lacy F. Davis No. 1, in Sec. 11-T1N-R11E, Kirklin field, Paluxy Gas Pool, Walthall County; Texaco, Inc., Clyde Q. Sheely No. 1, Sec. 28-T19N-R12E, Maben field, Knox-Ordovician Gas Pool, Oktibbeha County; Ralph Hines et al Dixie and Phoenix Minerals Corp. Unit 1, No. 1, Sec. 6-T1S-R16W, Two Mile Creek, Lower Tuscaloosa Gas Pool, Pearl River County; Amoco Production Co., Pat M. Barrett No. 1, Sec. 22-T16N-R2W, Fomosla field, Smackover Gas Pool, Humphreys County; Shell Oil Co. No. 2 Cox et al, Sec. 29-T3N-R3E Piney Woods field, Smackover Gas Pool, Rankin County; and Union Oil Co. of California U.S.A. No. 1, Sec. 33-T6N-R10W, Tiger field, Hosston Gas Pool, Jones County.

Underground storage of gas was at three operations: Amory field in Monroe County, Jackson Dome in Rankin and Hinds Counties, and Eminence Dome in Covington County. These operations have a total gas storage capacity of about 10 billion cubic feet.

Natural Gas Liquids.—Reversing 4 consecutive years of increases, reserves of natural gas liquids decreased 9.7 million barrels, or 34.1 percent, according to the American Gas Association, Inc. Mississippi contained 0.2 percent of domestic natural gas liquids reserves.

Table 6.—Oil and gas well drilling completions, by county

County	Proved field wells ¹			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Adams	11	--	34	3	--	41	89	547,251
Amite	11	--	5	2	--	4	22	246,526
Clarke	29	--	13	2	--	24	68	776,452
Forrest	--	--	2	--	--	1	3	25,325
Franklin	3	--	16	1	--	21	41	266,317
Greene	--	--	1	--	--	--	1	21,632
Hinds	1	1	--	--	--	--	2	27,002
Holmes	--	--	2	--	--	6	8	70,468
Humphreys	1	1	2	1	--	--	5	54,844
Issaquena	--	--	--	--	--	2	2	26,896
Itawamba	--	--	--	--	--	1	1	1,707
Jasper	43	--	6	3	--	4	56	443,365
Jefferson	--	--	--	--	--	5	5	28,782
Jefferson Davis	2	4	1	--	--	--	7	75,467
Jones	3	--	3	1	--	1	8	108,028
Kemper	--	--	--	--	--	1	1	4,020
Lamar	29	--	2	--	--	--	31	274,945
Lauderdale	--	--	--	--	--	1	1	6,810
Leflore	--	--	1	--	--	2	3	22,888
Lincoln	--	--	3	--	--	2	5	34,681
Madison	--	--	--	--	--	2	2	9,051
Marion	1	2	2	--	--	1	6	65,609
Monroe	--	--	--	--	--	1	1	2,626
Oktibbeha	--	--	--	--	1	--	1	17,420
Pearl River	--	1	1	--	1	--	4	39,968
Pike	--	--	--	--	--	3	3	34,054
Scott	--	--	1	--	--	3	4	61,482
Sharkey	--	--	--	--	--	1	1	4,506
Simpson	--	1	1	--	--	1	3	37,532
Smith	1	--	2	--	--	2	5	76,656
Sunflower	--	--	--	--	--	4	4	33,782
Walshall	11	--	6	--	1	1	19	209,539
Washington	--	--	--	--	--	1	1	3,708
Wayne	7	--	2	--	--	9	18	235,747
Wilkinson	8	--	8	--	--	32	48	364,370
Yazoo	1	--	--	--	--	6	7	71,953
Total	162	10	114	13	3	184	486	4,326,404

¹ Development Wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

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

Commodity	Proved reserves Dec. 31, 1970	Changes in proved reserves due to extensions and discoveries 1971	Proved reserves Dec. 31, 1971 (production deducted)	Changes from 1970 (percent)
Crude oil..... thousand barrels..	354,741	50,895	342,368	-3.5
Natural gas liquids..... do.....	22,651	-5,605	14,983	-34.1
Natural gas..... million cubic feet..	1,333,905	-84,661	1,117,432	-16.2

Source: American Petroleum Institute and American Gas Association.

According to the Oil and Gas Journal annual survey of natural gas plants,⁵ nine plants in Mississippi at yearend 1971 had a total capacity of 205 million cubic feet per day (MMcfd), a decrease of 10.9 percent from the previous year. This capacity was slightly less than 0.3 percent of the U.S. total. Tonkawa Gas Processing Co. shut down operations at two gas processing plants: Clarke County Gas Processing Plant (Clarke County) and Diamond Gas Proc-

essing Plant (Wayne County). Gas from these plants was processed through Tonkawa Gas Processing Co.'s Harmony Gas Processing Plant in Clarke and Wayne Counties. East Nancy Gas Processing Plant (Clarke County) of the Southwest Gas Producing Co., Inc., also processed gas through the Harmony Gas Processing Plant.

Petroleum.—Mississippi ranked ninth in

⁵ Oil and Gas Journal. 1972 Survey of Gas Processing Plants. V. 70, No. 28, 1972, p. 91.

crude petroleum production and accounted for approximately 2 percent of U.S. output in 1971. State production of 64.1 million barrels of crude petroleum was valued at \$201.8 million; an average unit value of \$3.15 per barrel, 5.4 percent greater than the average unit value of \$2.99 last year. Oktibbeha and Humphreys became the 34th and 35th oil- and/or gas-producing counties. Gas was found in the Knox Formation in Maben field in Oktibbeha County by Texaco, Inc. In Humphreys County,

Houston Natural Gas Production Co. discovered oil in the Smackover reservoir, Belzoni field. Ten counties produced more than 2 million barrels of crude petroleum, accounting for 88.1 percent of the State's production. These counties, in descending order of production, were Clarke, Lamar, Jasper, Adams, Wayne, Jones, Franklin, Yazoo, Smith, and Wilkinson. Salt water produced in association with crude petroleum production was 199 million barrels, an average of slightly more than 3 barrels of water for each barrel of petroleum produced.

Approximately 2 percent of the wells drilled for oil and gas in the United States were drilled in Mississippi. According to American Petroleum Institute (API) drilling statistics, exploratory and proved field well drilling activities decreased 14.9 percent and 10.9 percent, respectively, compared with 1970 activities. There were 13 successful oil and three successful gas ventures from a total of 200 exploratory wells drilled—a success ratio of 8 percent. There were 172 successes—162 oil and 10 gas producers—from 286 proved field wells drilled.

Exploratory oil and gas drilling totaled 1,822,015 feet. Average depth of wells drilled in Mississippi was approximately 8,900 feet, considerably deeper than the national average of approximately 4,800 feet per well.

According to Mississippi State Oil and Gas Board monthly bulletin data, 46 percent of exploratory wells were drilled to the Wilcox Formation, 30 percent to formations of Jurassic age and 15 percent of the exploratory wells were drilled to formations of Cretaceous age. Of the proved field well completions, 40 percent were drilled to the Wilcox Formation, 39 percent to Cretaceous age formations, and 20 percent to formations of Jurassic age. According to the API estimates, proved crude oil reserves as of December 31, 1971, were 342.4 million barrels, 12.4 million barrels less than at yearend 1970. The decrease in reserves resulted in a change in reserve-to-production ratio from 5.5:1 to 5.3:1. Nationwide, the reserve-to-production ratio in 1971 averaged 11.0:1.

Standard Oil Co. of Kentucky completed refinery expansions started in 1969 at Pascagoula, doubling distillation capacity to 270,000 barrels per calendar day. Coupled with the expansion of the Southland Oil

Table 8.—Crude oil production, indicated demand, and stocks in 1971, by month

(Thousand 42-gallon barrels)			
Month	Production	Indicated demand ¹	End-of-month stocks originating in Mississippi
January.....	5,539	5,557	4,653
February.....	5,057	4,912	4,798
March.....	5,647	5,764	4,681
April.....	5,542	5,395	4,828
May.....	5,576	5,156	5,248
June.....	5,313	5,414	5,147
July.....	5,410	5,752	4,805
August.....	5,444	5,878	4,371
September.....	5,222	5,210	4,383
October.....	5,222	4,874	4,781
November.....	4,964	5,243	4,452
December.....	5,130	5,454	4,128
Total:			
1971....	64,066	64,609	XX
1970....	65,119	65,726	XX

XX Not applicable.

¹ Calculated from monthly production and changes in stocks.

Table 9.—Crude petroleum production, by field

(Thousand 42-gallon barrels)			
Field	1970	1971	Cumulative to Dec. 31, 1971
Baxterville.....	6,616	8,783	142,868
Bay Springs.....	2,858	2,375	20,733
Brookhaven.....	1,358	1,090	65,856
Bryan.....	1,090	1,362	20,424
East Eucutta.....	1,225	1,042	35,423
Gillsburg.....	(¹)	1,131	2,392
Goodwater.....	1,412	(¹)	(¹)
East Heidelberg.....	2,286	2,760	66,569
West Heidelberg.....	1,243	1,175	32,135
East Nancy.....	1,498	1,252	4,576
West Nancy.....	1,163	1,994	3,157
Pachuta Creek.....	4,217	3,941	12,883
Quitman.....	2,188	1,925	11,051
Quitman Bayou.....	1,479	1,434	10,048
Raleigh.....	(¹)	1,035	18,701
Soso.....	1,436	1,123	50,112
Tallahala Creek.....	1,452	(¹)	(¹)
East Tallahala Creek.....	1,178	(¹)	(¹)
Tinsley.....	2,283	2,566	187,246
Other fields.....	30,137	29,078	647,679
Total.....	65,119	64,066	1,331,853

¹ Included in "Other fields."

Source: Mississippi State Oil and Gas Board.

Co. refinery at Lumberton to 2,000 barrels per calendar day, capacity of the five refineries in Mississippi increased to 308,500 barrels per calendar day.

Amerada-Hess Corp. purchased the Lamar County Pontiac Eastern Black Creek refinery of the Gulf Oil Corp. at Purvis, Miss., and certain of Gulf's related pipeline and terminal facilities. The corporation plans a \$25 million expansion that will increase the refinery's present 25,000-barrel-per-day capacity to more than 100,000 barrels of crude oil per day.

Petrochemicals.—The Conoco Plastics Division of Continental Oil Co. terminated production of polyvinyl copolymer resin at its Aberdeen plant owing to the limited market potential for copolymers and recent cost increases at the plant.

Shell Oil Co. continued construction of its Thomasville gas treating and sulfur recovery plant near Jackson. Designed to treat 100 million cubic feet per day of sour gas, the installation will turn out more than 50 million cubic feet per day of sweet gas, (mostly methane) and recover about 1,250 long tons per day of sulfur.

NONMETALS

The combined value of nonmetals production was \$33.3 million, 12.5 percent greater than the comparable 1970 value. The value of nonmetals production represented 12.7 percent of the value of mineral production.

Cement.—Portland and masonry cements were produced at two plants using the wet process. Marquette Cement Mfg. Co. curtailed production at its plant in Brandon because of a natural gas shortage. Modifications made at the plant to burn oil and gas separately or together were completed in November. Shipments of portland cement

increased 32 percent over 1970 shipments; masonry cement shipments were up 9 percent. Nearly all of the portland cement shipped was type I and II (general use and moderate heat); the remainder was type III (high-early-strength.)

Portland and masonry cement consumed in the State totaled 4,198,000 376-pound barrels and 449,000 280-pound barrels, respectively.

Clays.—Total clays sold and used increased 46.7 percent over that of last year for a record high of 2.28 million tons. However, average unit value decreased from \$5.19 to \$3.73 per ton. Clay formerly classified as fire clay was reevaluated as common clay because of its use for heavy clay products.

Clays were mined from 42 pits in 22 counties and contributed 3 percent of the State's mineral production value. Leading counties, in descending order of production, were Hinds, Noxubee, Lowndes, and Marshall. Production from the four counties represented 68 percent of the State total. Common clay used for heavy clay products and lightweight aggregates was mined in 14 counties. Bentonite was mined in six counties. Fuller's earth was produced in Tippah County and ball clay in Panola County.

Lime.—Corchem, Inc., produced quicklime at Pascagoula in Jackson County from stone quarried in Alabama. The lime was used in the production of magnesite. Output decreased 12 percent below the 1970 record. The lime was consumed in Mississippi. Total consumption of lime in Mississippi was 118,187 tons.

Magnesium Compounds.—Production of magnesium compounds used in the manufacture of refractory bricks decreased 28.5 percent from 1970, and unit value decreased 15.7 percent for the same period.

Table 10.—Clays sold or used by producers, by kind
(Thousand short tons and thousand dollars)

Year	Bentonite		Ball clay, fire clay, and fuller's earth		Common clay		Total ¹	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1967-----	259	\$3,067	306	\$3,306	1,089	\$1,479	1,654	\$7,852
1968-----	277	3,128	353	4,525	1,063	1,422	1,693	9,075
1969-----	299	3,525	305	3,999	1,099	1,136	1,703	8,660
1970-----	262	3,124	318	3,930	974	1,008	1,553	8,062
1971-----	281	3,396	² 137	² 2,966	1,860	2,139	2,278	8,501

¹ Data may not add to totals shown because of independent rounding.

² Ball clay and fuller's earth.

Perlite.—Johns-Manville Products Corp., continued to produce expanded perlite in Adams County. It was used for roof insulation board. Production was 11 percent less than in 1970. Average unit value increased by less than ½ percent.

Sand and Gravel.—Production was reported from 40 of the State's 82 counties. Output was 11.29 million tons, a 4-percent increase from the preceding year. Unit value increased 9 percent to \$1.20 per ton. The leading producing counties, in descending rank of output, were Forrest, Copiah, De Soto, Adams, and Washington. The five counties accounted for 46.6 percent of the tonnage and 48.5 percent of the value.

Sand output totaled 4,488,000 tons. Construction accounted for 57.8 percent of sand used; paving, 38.9 percent; and other uses,

3.3 percent. Principal uses for the 6,801,000 tons of gravel were construction, 40.1 percent; paving, 57.9 percent; and other uses, 1.9 percent. The average unit value of gravel increased 11.1 percent to \$1.35 per short ton.

Stone.—Crushed and broken stone output from 15 quarries totaled 848,000 short tons. Average unit value for all stone increased 32 percent; average unit value for marl nearly tripled. Principal uses of stone produced in Mississippi were for the manufacture of cement and for agricultural purposes.

Sulfur.—Recovery of sulfur from refinery and natural gases was reported from Clarke and Lamar Counties. Production increased 8.3 percent but average unit value decreased 13.1 percent from comparable 1970 figures.

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

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	2,255	\$1,912	2,595	\$2,348
Paving	1,765	1,703	1,719	1,746
Other uses ¹	243	323	149	223
Total	4,263	3,938	4,463	4,317
Gravel:				
Building	2,264	2,682	2,729	3,516
Paving	3,761	4,751	3,910	5,330
Other uses ²	310	366	131	249
Total ³	6,335	7,800	6,770	9,095
Government-and-contractor operations:				
Sand: Paving	25	37	25	37
Gravel: Paving	235	174	31	77
Total sand and gravel ³	10,859	11,950	11,289	13,526

¹ Includes fill, molding, railroad ballast and other sand.

² Includes fill, railroad ballast (1970), miscellaneous, and other gravel.

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

Table 12.—Principal producers

Commodity and company	Address	Type of activity or producing fields	County
Cement:			
Marquette Cement Manufacturing Co.	20 North Wacker Dr. Chicago, Ill. 60606	Plant	Rankin.
Valley Cement Ind., Inc.	Box 22491 Jackson, Miss. 39205	do	Warren.
Clays:			
American Colloid Co.	5100 Suffield Ct. Skokie, Ill. 60076	Mine	Itawamba and Monroe.
Delta-Macon Brick & Tile Co. Inc.	R.F.D. 3, Box 2 Macon, Miss. 39341	Mine and plant	Noxubee.
Dresser Minerals, div. of Dresser Industries, Inc.	Box 6504 Houston, Tex. 77005	do	Attala.
Filtrol Corp.	3250 East Washington Blvd. Los Angeles, Calif. 90023	do	Itawamba and Smith.
Holly Springs Brick & Tile Co., Inc.	Box 310 Holly Springs, Miss. 38635	do	Marshall.
International Minerals & Chemical Corp.	Administration Center Old Orchard Rd. Skokie, Ill. 60076	Mine	Monroe.
Kentucky-Tennessee Clay Co.	Box 447 Mayfield, Ky. 42066	do	Panola.
Oil Dri Production Co.	Box 285 Ripley, Miss. 38661	do	Tippah.
Tri-State Brick & Tile Co., Inc.	Box 9787 Jackson, Miss. 39206	Mine and plant	Hinds.
Wyandotte Chemicals Corp.	1609 Biddle Ave. Wyandotte, Mich. 48192	do	Tippah.
Lime: Corchem, Inc.	Box 1707 Pascagoula, Miss. 39567	Plant	Jackson.
Magnesium compounds:			
Corchem, Inc., Pascagoula Miss. plant.	Box 1486 Pascagoula, Miss. 39567	do	Do.
Sand and Gravel:			
American Sand & Gravel Co.	Box 272 Hattiesburg, Miss. 39401	Stationary	Forrest.
J. J. Ferguson Sand & Gravel.	Box 318 Greenwood, Miss. 38930	do	Carroll.
Green Bros. Gravel Co., Inc.	Rt. 4 Box 17 Franklinton, La. 70438	do	Copiah.
Greenville Gravel Co.	Box 220 Greenville, Miss. 38701	Dredge	Washington.
Memphis Stone & Gravel Co.	Box 6246 Memphis, Tenn. 38111	Stationary	De Soto.
St. Catherine Gravel Co.	Box 928 Natchez, Miss. 39120	do	Adams.
Traxler Gravel Co., div. of Delta Ind., Inc.	Box 1292 Jackson, Miss. 39205	Stationary and dredge.	Copiah.
Weymouth Construction Co.	Box 319 Memphis, Tenn. 38101	Stationary	De Soto.
Yazoo Valley Gravel Co.	1115½ Jackson Ave. Oxford, Miss. 38655	do	Panola.
Stone:			
Valley Cement Ind., Inc.	Box 22491 Jackson, Miss. 39205	Quarry	Warren.
State Dept. of Agriculture and Commerce.	West Point, Miss. 39773	do	Clay.
Oil and gas:			
Atlantic Richfield Co.	Box 2819 Dallas, Tex. 75221	East Heidelberg	Jasper.
Chevron Oil Co., Western Div.	Box 599 Denver, Colo. 80201	Brookhaven South Center Ridge Cranfield	Lincoln. Smith. Adams and Franklin.
		Hub	Marion.
		Hub East	Do.
		Knox	Walthall.
		East Mallalieu	Lincoln
		West Mallalieu	Do.
		Mize	Smith.
		Pisgah	Rankin.
		Puckett	Rankin and Smith.
		Raleigh	Simpson.
		Reedy Creek	Jones.
		Hazlit Creek	Wilkinson.
		North Mud Creek	Do.
		Davis	Clarke.
Cities Service Oil Co.	Box 12026 Jackson, Miss. 39211	East Nancy	Do.
Continental Oil Co.	Box 2197 Houston, Tex. 77001	West Nancy	Do.
Getty Oil Co.	Box 1404 Houston, Tex. 77001		

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity or producing fields	County
Oil and gas:—Continued			
Gulf Oil Corp.-----	Box 1166 Pittsburgh, Pa. 15230	Baxterville..... Bolton..... Gwinville..... Heidelberg..... East Heidelberg..... West Heidelberg..... Pistol Ridge..... Soso.....	Lamar and Marion. Hinds. Jefferson Davis. Jasper. Do. Do. Forrest and Pearl River. Jasper, Jones and Smith.
Humble Oil & Refining Co.	Box 2180 Houston, Tex. 77001	East Yellow Creek..... Baxterville..... Bryan..... East Fairview..... Gillsburg..... Gwinville..... Hub..... Hub East..... Knoxo..... Pistol Ridge..... Sandy Hook..... East Yellow Creek.....	Wayne. Marion and Lamar. Jones and Jasper. Adams. Amite. Jefferson Davis. Marion. Do. Walthall. Pearl River. Marion. Wayne. Adams.
Meason Operating Co.	Natchez, Miss. 39120	North Carthage Point. Clear Springs..... Courtland..... Dexter..... Clear Springs..... Collins..... Dollar Lake..... Dry Bayou..... North Freewoods..... Knoxville..... North Knoxville..... Quitman Bayou..... Stringer..... Zeigler Creek..... Tinsley.....	Adams. Franklin. Adams. Walthall. Franklin. Covington. Leflore. Franklin. Do. Do. Do. Adams. Jasper. Franklin. Yazoo.
Amoco Production Co.	Box 591 Tulsa, Okla. 74102	Nancy.....	Clarke.
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	Pachuta Creek..... Goodwater..... Bay Springs..... Tallahala Creek..... East Tallahala Creek..... Bay Springs..... Goodwater..... Baxterville..... Diamond..... West Eucutta..... East Franklin..... East Heidelberg..... Kokomo..... Mantua..... McComb..... Mercer..... Pistol Ridge.....	Do. Do. Jasper. Smith. Do. Jasper. Clarke. Lamar. Wayne. Do. Franklin. Jasper. Walthall. Adams. Pike. Adams. Forrest and Pearl River.
Skelly Oil Co.	Box 1650 Tulsa, Okla. 74101	Sandy Hook..... Smithdale..... Tom Branch..... West Yellow Creek.....	Marion. Amite. Franklin. Wayne.
Sun Oil Co.	1608 Walnut Philadelphia, Pa. 19103	Baxterville..... Pachuta Creek.....	Lamar. Clarke.
Texaco, Inc.	Box 60252 New Orleans, La. 70150		

The Mineral Industry of Missouri

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

By J. Patrick Ryan ¹ and James A. Martin ²

In 1971, mineral output in Missouri reached a record high for the eighth consecutive year as mining and metallurgical activity grew and expanded in the State. The total value of the State's mineral and metal products increased slightly over that of 1970 to \$400 million. Lead production reached an alltime high in tonnage, but lower market prices brought total value down slightly from the previous year. Cement production also set a new record of about 25 million barrels.

Highlights of mineral related developments in Missouri in 1971 included the start-up of a new aluminum reduction facility in the southeast corner of the State, progress on a new lead mine-mill project in the Viburnum Trend area of southeast Missouri, opening of a new coal mine, continued investigation of an iron-copper mineralized area, passage of mined land reclamation laws, new geologic studies by the Missouri Geological Survey, and continued research on environmental problems relating to the mineral industry of the State. Many new bills directly affecting the mineral industry were introduced in a presession filing period for consideration by the Missouri General Assembly, which will convene in January 1972.

Lead, cement, stone, and sand and gravel accounted for 70 percent of the total mineral value. The distribution of production value by mineral groups was nonmetals, 49 percent; metals, 46 percent; and mineral fuels, 5 percent.

Missouri Limestone Producers' Association held its 27th Annual Convention at Jefferson City, December 1-3. Missouri's new land reclamation law was a main subject of the convention.

In December the Mining Industry Council of Missouri, an association of all types of mining companies, was formally incorporated in Missouri with a principal purpose of informing the public on the importance of mining to the economy and employment in the State.

Trends and Developments.—Missouri continued to rank 17th among the States in mineral output in 1971. The most evident trend in Missouri minerals was greatly increased output in recent years and the establishment of alltime records in the production of individual commodities as well as in the total value of State mineral output. New mineral discoveries and new plant construction in recent years have resulted in a broadly-based expansion of Missouri's mineral industry, and this trend continued with exploration and development still underway in several areas.

The Missouri Geological Survey continued to expand its mineral-related investigations, mapping, and disseminating of basic Precambrian data.

The Missouri Division of Commerce and Industrial Development issued the "Missouri Directory of Manufacturing and Mining—1971."

Activity in the Old Lead Belt of southeast Missouri continued to be cutback as plans were being made to abandon that district in the near future as the full capacity of the New Lead Belt, 50 miles to the west, was developed.

¹ Mining engineer, Division of Nonferrous Metals.

² Chief, Mineral Resources Section, Missouri Geological Survey and Water Resources, Rolla, Mo.

Table 1.—Mineral production in Missouri¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite.....thousand short tons..	230	\$3,555	232	\$3,606
Cement:				
Portland.....thousand 376-pound barrels..	21,224	64,261	24,017	77,568
Masonry.....thousand 280-pound barrels..	402	1,234	518	1,629
Clays ².....thousand short tons..	2,128	6,480	2,354	7,454
Coal (bituminous).....do.....	4,447	19,526	4,036	19,670
Copper (recoverable content of ores, etc.) short tons..	12,134	14,003	8,445	8,783
Iron ore (usable).....thousand long tons, gross weight..	2,612	38,100	2,727	W
Lead (recoverable content of ores, etc.) short tons..	421,764	131,751	429,634	118,579
Natural gas.....million cubic feet..	87	21	22	5
Petroleum.....thousand 42-gallon barrels..	66	W	66	W
Sand and gravel.....thousand short tons..	12,446	15,379	10,327	15,109
Silver (recoverable content of ores, etc.) thousand troy ounces..	1,817	3,218	1,661	2,568
Stone.....thousand short tons..	39,726	³ 57,235	41,099	³ 64,772
Zinc (recoverable content of ores, etc.) short tons..	50,721	15,540	48,215	15,525
Value of items that cannot be disclosed: Other non- metals and fuels and values indicated by symbol W..	XX	22,643	XX	64,821
Total.....	XX	392,996	XX	400,089
Total 1967 constant dollars.....	XX	351,535	XX	^p 347,597

^p Preliminary. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

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

² Excludes certain clays, included with "Value of items that cannot be disclosed."

³ Excludes value of certain stone, included with "Value of items that cannot be disclosed."

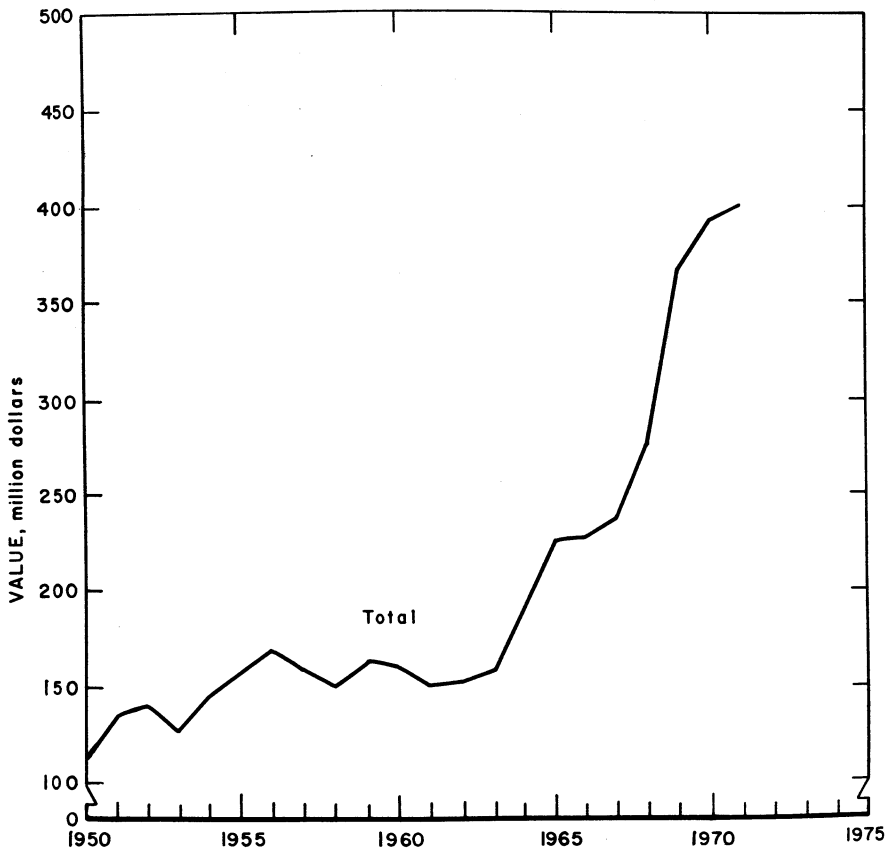


Figure 1.—Total value of mineral production in Missouri.

Table 2.—Value of mineral production in Missouri, by county 1

(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Adair	W	W	Stone.
Atchison	W	W	Sand and gravel.
Audrain	\$756	\$1,761	Clays.
Barry	--	W	Stone.
Barton	W	W	Coal, native asphalt, stone.
Bates	176	149	Stone.
Benton	--	W	Do.
Boone	4,131	5,063	Coal, stone, sand and gravel, clays.
Buchanan	327	W	Sand and gravel, stone.
Butler	W	269	Sand and gravel, clays.
Caldwell	W	W	Stone.
Callaway	2,181	1,624	Clays, stone, coal, sand and gravel.
Camden	W	W	Stone.
Cape Girardeau	W	W	Cement, stone, sand and gravel, clays.
Cass	W	W	Stone.
Cedar	--	94	Do.
Chariton	--	W	Sand and gravel.
Christian	460	W	Stone.
Clark	W	W	Stone, sand and gravel.
Clay	W	W	Do.
Clinton	W	W	Stone.
Cole	605	391	Stone, sand and gravel, lead.
Cooper	W	W	Stone, sand and gravel.
Crawford	6,296	3,990	Lead, copper, zinc, stone, silver.
Dade	107	W	Stone.
Dallas	W	W	Do.
Daviess	585	527	Stone, sand and gravel.
De Kalb	107	125	Stone.
Douglas	W	W	Sand and gravel.
Dunklin	90	W	Do.
Franklin	W	W	Stone, clays, sand and gravel.
Gasconade	1,982	1,765	Clays, sand and gravel.
Gentry	W	W	Stone, sand and gravel.
Greene	W	W	Stone, lime.
Grundy	W	W	Stone, sand and gravel.
Harrison	W	W	Stone.
Henry	W	W	Coal, stone.
Hickory	W	W	Stone.
Holt	W	W	Do.
Howard	W	W	Stone, sand and gravel.
Howell	2,023	W	Do.
Iron	84,225	84,729	Lead, iron ore, zinc, copper, silver, stone.
Jackson	W	12,632	Cement, stone, sand and gravel, clays.
Jasper	W	W	Stone, sand and gravel.
Jefferson	W	W	Cement, stone, sand and gravel, clays, lead.
Johnson	W	W	Stone.
Knox	W	W	Do.
Laclede	W	W	Do.
Lafayette	W	W	Stone, sand and gravel.
Lawrence	W	W	Stone.
Lewis	W	W	Sand and gravel, stone.
Lincoln	486	W	Sand and gravel, stone, clays.
Linn	W	W	Stone.
Livingston	W	1,237	Stone, clays, sand and gravel.
Macon	W	W	Coal.
Madison	W	20	Stone.
Marion	W	W	Lime, stone.
Mercer	383	W	Stone.
Miller	W	W	Sand and gravel, stone.
Moniteau	85	W	Stone.
Monroe	329	271	Clays, stone, sand and gravel.
Montgomery	687	765	Do.
Newton	W	137	Stone.
Nodaway	746	W	Stone, sand and gravel.
Oregon	W	15	Stone.
Osage	W	W	Sand and gravel, clays.
Ozark	W	--	
Pemiscot	W	350	Sand and gravel.
Perry	W	W	Stone.
Pettis	W	W	Do.
Phelps	W	151	Stone, clays, sand and gravel.
Pike	W	W	Cement, stone, clays, sand and gravel.
Platte	583	1,210	Clays, stone, sand and gravel.
Polk	--	W	Stone.
Pulaski	W	176	Sand and gravel, stone.
Putnam	W	W	Coal.
Ralls	W	W	Cement, stone, clays.
Randolph	W	W	Coal, stone, sand and gravel.
Ray	920	1,710	Stone, sand and gravel.
Reynolds	58,540	45,421	Lead, zinc, copper, silver, sand and gravel, stone.

See footnotes at end of table.

Table 2.—Value of mineral production in Missouri, by county¹—Continued

(Thousands)			
County	1970	1971	Minerals produced in 1971 in order of value
St. Charles	\$2,061	\$2,368	Stone, sand and gravel, clays.
St. Francois	17,337	12,734	Lead, lime, stone, copper, silver, zinc.
St. Louis	26,213	29,663	Cement, stone, sand and gravel, clays, natural gas.
Ste. Genevieve	26,661	33,211	Lime, stone, sand and gravel.
Saline	466	476	Stone.
Scotland	W	W	Do.
Scott	W	W	Clays.
Shannon	64	W	Stone.
Shelby	W	W	Do.
Stoddard	W	434	Sand and gravel.
Vernon	229	235	Stone, coal, native asphalt.
Warren	264	252	Clays, stone.
Washington	43,337	45,177	Iron ore, lead, barite, zinc, copper, silver, sand and gravel.
Wayne	W	135	Stone.
Webster	W	—	
Wright	W	W	Stone.
Undistributed ²	109,548	111,343	
Total ³	392,996	400,089	

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

¹ The following counties were not listed because no production was reported: Andrew, Bollinger, Carroll, Carter, Dent, McDonald, Maries, Mississippi, Morgan, New Madrid, Ripley, St. Clair, Schuyler, Stone, Sullivan, Taney, Texas, and Worth.

² Includes value of sand and gravel and stone not assigned to specific counties, and value of petroleum for which county data was unavailable for 1971.

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

Table 3.—Indicators of Missouri business activity

	1970 ^r	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force.....	thousands.. 2,091.0	2,073.5	-0.8
Unemployment.....	do... 95.6	111.5	+16.6
Employment.....	1,995.4	1,962.0	-1.7
Construction.....	do... 71.1	66.9	-5.9
Mining.....	do... 9.1	8.5	-6.6
Manufacturing.....	do... 446.1	424.3	-4.9
Personal income:			
Total.....	millions.. \$17,350.0	\$18,413.0	+6.1
Per capita.....	\$3,697.0	\$3,877.0	+4.9
Construction activity:			
Building permits, total private nonresidential.....	millions.. \$276.4	\$279.1	+1.0
Cement shipments to and within Missouri.....	thousand 376-pound barrels.. 9,291	10,777	+16.0
Mineral production value.....	millions.. \$393.0	\$400.1	+1.8

^p Preliminary. ^r Revised.

Sources: Area Trends in Employment and Unemployment; Employment and Earnings; Survey of Current Business; Construction Review; U.S. Bureau of Mines.

Labor and Employment.—According to the Division of Employment Security, Missouri Department of Labor and Industrial Relations, the mining industry employed 8,507 workers in 1971, a slight decrease from the 9,079 (revised) employed in 1970. Employment in metal mining was 3,682 persons, compared with 3,955 in 1970. Employment in coal mining increased slightly to 1,032 from 949 in 1970, as Missouri coal output continued to rise and new mines opened. Employment in the nonmetals segment decreased slightly to 3,793 from 4,175 in 1970.

Pilot Knob Pellet Co. experienced a brief shutdown during October. A new 3-year contract provided for wage increases, improved pension benefits, an improved pay scale for Sunday work, and a ninth paid holiday.

The coal industry strike in October shut down the production operations of Peabody Coal Co. in Missouri.

A 7-month strike at the Glover Lead Smelter of American Smelting and Refining Company (Asarco) ended in April 1971 with a contract extending to September 1973.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Coal.....	490	315	155	1,155	1	41	36.36	6,097
Metal.....	3,047	293	892	7,154	4	386	54.51	4,767
Nonmetal.....	702	238	167	1,364	--	62	45.46	4,650
Sand and gravel.....	572	218	125	1,079	--	19	17.61	373
Stone.....	4,181	273	1,139	9,317	1	191	20.61	2,027
Total.....	8,992	276	2,478	20,069	6	699	35.13	3,323
1971:^p								
Coal.....	525	297	156	1,178	1	39	33.94	5,942
Metal.....	2,950	276	815	6,521	6	260	40.79	6,448
Nonmetal.....	710	242	172	1,382	1	43	31.84	5,256
Sand and gravel.....	525	239	125	1,080	1	22	21.30	6,420
Stone.....	4,185	271	1,134	9,278	4	219	24.04	3,455
Total ¹	8,890	270	2,401	19,439	13	583	30.66	4,903

^p Preliminary.¹ Data may not add to totals shown because of independent rounding.**Legislation and Government Programs.**

—Senate Bill No. 1, to regulate strip mining of coal and barite was passed in April by the Legislature and approved by the Governor, ending a 14-year struggle to control strip mining in Missouri. This was the first major bill, other than an emergency appropriations bill, to be passed in the 1971 legislative session, and was to take effect September 29, 1971. The House added regulation of barite mining to the Senate bill, which had been originally restricted to coal. A Land Reclamation Commission will be created and located at the Missouri Geological Survey for administrative purposes.

The Commission, to be composed of seven members, will include the State Geologist, the Director of the Department of Conservation, the Executive Secretary of the State Water Pollution Board, and four others to be appointed by the Governor subject to Senate approval. Appointees must be residents of Missouri with an interest in and a knowledge of conservation and land reclamation. One member should be experienced in surface mining, but not more than one can have a direct connection with the mining industry. A full-time director will be appointed by the Commission to act as administrative agent.

Four citizen members were added to the Commission by the Governor on October 5.

The measure requires strip mining companies to purchase permits at a basic fee of \$50 plus \$17.50 for each acre to be affected. Accompanying each application for

a permit must be a map identifying the property (certified by a professional engineer), a drainage plan, and a reclamation proposal, including the method of operation, grading, etc. A bond of not less than \$300 for coal and \$200 for barite nor more than \$700 for coal and \$500 for barite for each acre is to be posted with the Commission prior to issuance of a permit. The amount of bond will be based on the character and nature of the overburden, proposed use of the land, and cost of reclamation; minimum bond would be \$2,000.

The bill specifies that at least 75 percent of all land strip mined must be restored to a rolling topography suitable for farming. The other 25 percent can be graded for use as a park or wildlife habitat.

Environment.—A graduate training program with emphasis on environmental protection and control was initiated by the Department of Mining, Petroleum, and Geological Engineering at the University of Missouri at Rolla, beginning with the 1971 fall semester. Oriented toward the mining and petroleum industries, the program is designed to lead to a Masters degree in mining, petroleum, or geological engineering.

St. Joe Minerals Corp. has awarded Kaiser Engineers a contract to design a larger and more complete dust and fume control system for the lead blast furnaces at the firm's Herculaneum, Mo., plant, the country's largest lead smelter. The new \$4 million emission control system is designed to treat more than 500,000 cubic feet of gas

per minute collected from the blast furnace hoods. The Herculeum smelter has three Port Pirie-type lead blast furnaces with a combined capacity of 200,000 tons per year. New facilities will include an improved fume collection system, gas cooling facilities, a new 550,000-cubic-foot-per-minute baghouse that will double existing gas cleaning capacity, duct work, and the necessary fans, motors, and instrumentation.

Exploration, Geologic Studies, and Mapping.—An up-to-date index of published maps was issued by the Missouri Geological Survey, which shows not only topographic maps of the State that are currently available but also indicates maps that are being made and will be available at a later date.

Table 5.—Exploratory drilling in Missouri
(Linear feet)

Year	Churn	Rotary	Diamond
1967	94,908	37,978	237,031
1968	45,272	49,011	211,493
1969	78,874	21,442	167,179
1970	38,080	23,556	248,009
1971	26,548	29,188	223,110

During the year Dr. William C. Hayes resigned as State Geologist and Director of the Missouri Geological Survey. Dr. Wallace B. Howe, a member of the Missouri Geological Survey for 20 years, was appointed by the Governor to become Missouri's sixteenth State Geologist.

In the special series of reports on Mis-

souri's Precambrian geology³ a report issued in 1971 was concerned with the mafic rocks in the St. Francois Mountains of the Missouri Ozarks. Horizontal sheets of the dark-colored igneous rock masses up to 900 feet thick, and vertical dikes up to 3,000 feet wide are common in western Madison and central Iron Counties.

Because significant mineral deposits have been found in Missouri's Precambrian, the Survey is emphasizing investigations, mapping, and printing of basic Precambrian data. This effort, termed Operation Basement, is directed toward providing additional knowledge which, when coupled with improved geophysical techniques, may be a valid guide to future mineral exploration.

With Operation Basement underway, results of other investigations will be published as they become available. Other Precambrian special reports may be ordered from the Missouri Geological Survey, Box 250, Rolla, Mo. 65401.⁴

The Bibliography of the Geology of Missouri, 1970, was made available by the Missouri Geological Survey. A total of 127 papers were listed, as well as an index by subject, county, and author.

A landmark contribution to Missouri geology was the release of the most comprehensive report on Missouri structural features ever published.⁵ It contains information on faults, folds, domes, cryptoexplosive structures, uplifts in basins, joints, and miscellaneous structures.

REVIEW BY MINERAL COMMODITIES

NONMETALS

In 1971, nonmetals accounted for about 49 percent of the total value of mineral production, compared with 43 percent in 1970.

Barite.—Missouri was again the largest producer of barite in the nation with a slightly increased output over the previous year. Most Missouri barite continued to go to grinding plants, which prepared it for use in well-drilling fluids.

Missouri Geological Survey continued to drill several barite tailings ponds in Washington County to determine the grade, distribution, and quantity of barite discarded in past milling operations. The project is a cooperative effort with the U.S. Bureau of Mines.

Cement.—Record levels of construction and cement consumption nationally were reflected in the major markets of Missouri cement producers.

Shipments of cement from Missouri plants reached an alltime high of almost 25 million barrels valued at approximately \$80 million. The seven cement plants oper-

³ Amos, Dewey H., and George A. Desborough. Mafic Intrusive Rocks of Precambrian Age in Southeast Missouri. Missouri Geol. Sur. Rept. Inv. 47, 1971, 22 pp.

⁴ Missouri Geological Survey. Exposed Precambrian Rocks in Southeast Missouri. Rept. Inv. 44, 1969, 68 pp.

Anderson, R. E. Ash-Flow Tuffs of Precambrian Age in Southeast Missouri. Missouri Geol. Sur. Rept. Inv. 46, April 1970, 50 pp.

⁵ Missouri Geological Survey. Structural Features of Missouri. Rept. Inv. 49, 1971, 106 pp.

ated by six companies were approaching the capacity of their operations estimated to be about 30 million barrels per year.

Clays.—Production of clay continued to decline slowly but Missouri, with some of the newest and most modern plants in the country, continued to be a major refractories manufacturing center.

Table 6.—Portland cement salient statistics
(Thousand 376-pound barrels and thousand dollars)

	1970	1971
Number of active plants.....	7	7
Production.....	20,733	22,040
Shipments from mills:		
Quantity.....	21,224	24,017
Value.....	\$64,261	\$77,568
Stocks at mills, Dec. 31.....	2,011	1,530

Table 7.—Clay sold or used by producers, by kind

(Thousand short tons and thousand dollars)

	Fire clay		Common clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1967.....	1,131	\$4,747	1,174	\$1,473	2,305	\$6,220
1968.....	1,064	4,334	1,369	1,824	2,433	6,158
1969.....	1,040	4,968	1,211	1,437	2,251	6,405
1970.....	927	4,854	1,201	1,626	2,128	6,480
1971.....	872	4,896	1,440	2,553	2,354	7,454

¹ Excludes bentonite and fuller's earth.

² Excludes fuller's earth.

³ Data does not add to total shown because of independent rounding.

⁴ Excludes bentonite and kaolin.

Table 8.—Sand and gravel sold or used by producers, by class of operation and use

(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	4,352	\$3,866	3,587	\$4,095
Fill.....	330	232	275	197
Paving.....	1,514	1,456	1,624	1,576
Other uses ¹	1,044	3,963	1,414	4,970
Total ².....	7,239	9,517	6,901	10,839
Gravel:				
Building.....	1,916	2,590	1,853	2,659
Fill.....	9	10	39	21
Paving.....	3,111	3,104	1,372	1,414
Miscellaneous.....	100	83	W	W
Other uses ³	20	23	98	98
Total ².....	5,156	5,810	3,362	4,192
Government-and-contractor operations:				
Sand:				
Fill.....	--	--	1	1
Paving.....	16	17	17	18
Total.....	16	17	18	19
Gravel:				
Fill.....	--	--	1	1
Paving.....	29	31	40	55
Other uses.....	5	4	6	4
Total ².....	35	35	47	60
Total sand and gravel ².....	12,446	15,379	10,327	15,109

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

¹ Includes railroad ballast (1971), ground and unground, and other sands.

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

³ Includes miscellaneous gravel (1971).

Lime.—Mississippi Lime Co., Ash Grove Cement Co., Valley Dolomite Corp., and Marblehead Lime Co. produced lime in Greene, Marion, St. Francois, and Ste. Genevieve Counties for steel furnaces, water purification, calcium carbide, and other uses. Output was about the same as in 1970 but was 1 percent below the 1969 record. The lime was consumed in Kentucky, Indiana, Illinois, and other States. Total consumption of lime in Missouri was 196,000 tons.

Sand and Gravel.—Although the level of construction and building activity in-

creased in 1971, the quantity of sand and gravel used declined.

Stone.—Production of stone was relatively steady and remained the third largest segment, after lead and cement, in terms of value in the State's minerals industry.

Sulfur.—Two lead smelters in the State recovered substantial tonnages of sulfur as sulfuric acid, which is a byproduct of lead smelting. St. Joe Minerals Corp. operated its acid plant at the Herculeaneum smelter and Missouri Lead Operating Co. also recovered sulfuric acid at its lead smelter near Boss.

Table 9.—Stone sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Dimension stone.....	13	W	8	W
Crushed and broken:				
Bituminous aggregate.....	2,314	\$3,654	1,990	\$3,253
Concrete aggregate.....	6,084	8,529	7,018	10,374
Dense graded roadbase stone.....	5,403	7,711	6,998	9,734
Macadam aggregate.....	2,579	3,419	1,564	2,427
Stone sand.....	73	130	126	319
Surface treatment aggregate.....	3,786	5,143	2,364	3,504
Unspecified construction aggregate.....	2,233	3,631	2,979	5,015
Agricultural purposes ¹	3,395	5,718	3,315	5,746
Riprap and jetty stone.....	3,519	3,317	1,898	1,969
Railroad ballast.....	36	49	W	W
Asphalt filler.....	W	123	(²)	W
Cement and lime manufacture ³	5,705	4,126	10,943	17,105
Mineral fillers, extenders, and whiting.....	W	W	141	² W
Other ⁴	4,585	11,736	1,754	5,326
Total ⁵	39,726	57,285	41,099	64,772

W Withheld to avoid disclosing individual company confidential data; crushed and broken data withheld included with "Other."

¹ Data includes agricultural limestone and poultry grit.

² Data for asphalt filler included with mineral fillers, extenders, and whiting.

³ 1970 data represents cement manufacture only.

⁴ Includes stone for terrazzo, roofing aggregate, filter stone, flux stone, chemicals, mine dusting, abrasives, glass, and unspecified uses; 1970 data also includes stone used in lime manufacture, other fillers, whiting, and fill; 1971 data also includes ferrosilicon.

⁵ Data may not add to totals shown because of independent rounding.

Table 10.—Stone sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Kind of stone	1970		1971	
	Quantity	Value	Quantity	Value
Dimension limestone.....	3	\$43	W	W
Crushed and broken:				
Limestone.....	38,207	54,613	39,564	\$62,164
Dolomite.....	874	1,057	680	880
Other stone ¹	642	1,616	855	1,727
Total ²	39,726	57,285	41,099	64,772

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

¹ Includes granite, marble, sandstone, and crushed and broken traprock. Value data for dimension stone not included.

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

METALS

Metals accounted for about 46 percent of Missouri's total mineral output value, off slightly from that of 1970. Lead was Missouri's single most valuable product; the State continued to be the nation's leading lead producer with about three-fourths of total U.S. newly mined lead. Iron ore production held steady.

Aluminum.—Noranda Aluminum Inc. put a second pot line in operation late in 1971 at its new aluminum smelter near New Madrid in the bootheel area of southeast Missouri. The plant has an estimated capacity of about 75,000 tons of aluminum metal per year. Part of this primary aluminum will go to a wire and rod mill completed in 1969 adjacent to the aluminum reduction plant.

Copper.—Recovery of copper concentrates from the ores mined in the Viburnum Trend area of southeast Missouri was reduced because of difficulties in finding markets.

Iron Ore and Steel.—Iron ore output increased slightly as the State's two producers made alterations in their facilities to improve efficiency.

The Pilot Knob Pellet Co. began developing the western section of its mine near Ironton. A shaft was being deepened by nearly 1,000 feet to open up additional reserves.

Table 11.—Ferrous scrap and pig iron consumption

(Thousand short tons)

Year	Ferrous scrap	Pig iron	Total scrap and pig iron
1967	1,051	31	1,082
1968	1,049	24	1,073
1969	1,058	20	1,078
1970	1,062	21	1,083
1971	W	17	W

W Withheld to avoid disclosing individual company confidential data.

Lead.—Production from Missouri mines increased 7,900 tons to 429,600 tons representing 74 percent of the total domestic mine output of lead. Only one of the four major mine operators, Missouri Lead Operating Co., reported a production gain, the other three mine operators, St. Joe Minerals Corp., Cominco American Inc., and Ozark Lead Co., had lower output in 1971.

The Buick mine of Missouri Lead Operating Co. increased its ore milled over 40 percent and recovered 124,049 tons of lead concentrate. The company reported improved ore extraction and processing methods and increased labor efficiency. Ore reserves at yearend were estimated at 61 million tons averaging 4.7 percent lead and 1.7 percent zinc.⁶

Ozark Lead Co.'s production declined 11,600 tons to 55,300 tons of lead attributed largely to a labor strike at the Glover smelter, which treats Ozark's lead concentrates.⁷

At the Magmont mine operated by Cominco American Inc., ore production was increased 14 percent, but, owing to its lower grade, lead content of concentrates declined 15 percent compared with that of 1970.

St. Joe Minerals production of lead concentrate decreased 5 percent to 303,190 tons, but output of lead metal and alloys at the company's Herculaneum smelter was about 16,000 tons more than that of 1970. The company began construction of a \$4.5 million facility that will double the smelters gas cleaning capacity and improve sulfur dioxide recovery.

Development of the company's new \$19 million Brushy Creek mine and mill continued satisfactorily. The production shaft was completed to a final depth of about 1,400 feet, and construction of surface facilities was begun. The new facilities will have a capacity of 70,000 tons of lead concentrate per year.⁸

Asarco's smelter and refinery at Glover, Mo., resumed operations in April after settlement of a 7-month strike. Refinery output was 66,500 tons, compared with 59,200 tons in 1970.

MINERAL FUELS

Mineral fuels accounted for 5 percent of the State's total mineral value. Of 23 wells drilled in 1971, 17 were development wells and six were service wells. Total footage drilled was 8,559. About 22 million cubic feet of natural gas was marketed during the year, compared with 87 million cubic feet in 1970.

⁶ Homestake Mining Co. Ninety-Fourth Annual Report, 1971, pp. 5-6.

⁷ Kennecott Copper Corp. Annual Report, 1971, p. 22.

⁸ St. Joe Minerals Corp. Annual Report, 1971, pp. 13, 16.

Table 12.—Tenor of lead ore milled and concentrates produced in Missouri, 1971

Total material.....	short tons..	8,624,668
Metal content of ore: ¹		
Copper.....	percent..	0.10
Lead.....	do.....	4.98
Zinc.....	do.....	0.56
Concentrates produced and average content:		
Copper-lead.....	short tons..	24,089
Recovery ratio.....	percent..	0.28
Average copper content.....	do.....	26.63
Average lead content.....	do.....	11.11
Lead.....	short tons..	601,227
Recovery ratio.....	percent..	6.97
Average lead content.....	do.....	72.97
Zinc.....	short tons..	97,572
Recovery ratio.....	percent..	1.13
Average zinc content.....	do.....	54.80

¹ Figures represent metal content of crude ore only as recovered in the concentrate.

Table 13.—Mine production (recoverable) of silver, copper, lead, and zinc ¹

	1969	1970	1971
Mines producing:			
Lode.....	10	11	14
Material sold or treated:			
Ore.....	7,876	8,821	8,625
Barium sulphate.....	NA	5	
Lead.....	7,874	8,816	8,625
Production (recoverable):			
Quantity:			
Silver.....	1,442,090	1,816,978	1,660,879
Copper.....	12,664	12,134	8,445
Lead.....	355,452	421,764	429,634
Zinc.....	41,099	50,721	48,215
Value:			
Silver.....	\$2,582	\$3,218	\$2,568
Copper.....	12,039	14,003	8,783
Lead.....	105,889	131,751	118,579
Zinc.....	12,001	15,540	15,525
Total ²	132,512	164,511	145,455

NA Not available.

^r Revised.

¹ Based on Missouri ore (dirt), old tailings treated at mills, and barite ore containing lead shipped to smelter (1969-70).

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

Table 14.—Total value of mineral production in Missouri and production and value of lead in Missouri and the United States

(Short tons and thousand dollars)

Year	Total value of Missouri mineral production	Lead production					
		Missouri				United States	
		Quantity	Value	Percent of U.S. production	Percent of world production	Quantity	Value
1967.....	\$237,010	152,649	\$42,742	48.2	4.8	316,931	\$88,741
1968.....	276,238	212,611	56,180	59.2	6.4	359,156	94,903
1969.....	367,232	355,452	105,889	69.8	10.1	509,013	151,635
1970.....	392,996	421,764	131,751	73.8	11.3	571,767	178,609
1971.....	400,089	429,634	118,579	74.3	15.0	578,548	159,679

Laclede Gas is expected to have a capacity of 1,100 million cubic feet per day next winter if its supplier, Mississippi River Transmission Corp., fulfills its contract. The increase over last winter's 1,038 million cubic feet per day will come primarily from expanded propane facilities. A mined cavern is being dug in north St. Louis

County to hold about 800,000 barrels of propane to supplement natural gas from the pipeline and from an underground storage reservoir beneath the propane storage cavern. Laclede is also seeking additional storage facilities in St. Charles County and other areas.

Coal.—The Missouri Geological Survey published a 100-page report on the State's coal resources.⁹ The report, which includes nine large maps, one for each of the State's major coal seams, is the most comprehensive evaluation of coal resources ever to be made in Missouri. It was based on several years study of published and unpublished reports, field notes, and well log data, plus interviews with coal company personnel and others. Field investigations included reconnaissance mapping of coal beds, measuring coal seams in outcrops, and locating mine shafts and drifts.

The current energy crisis and the environmental aspects of coal mining and coal consumption have prompted the Missouri Geological Survey to accelerate research on the extent and quality of the State's coal resources. The investigations encompassed calculation of reserves, correlation of coal seams, and delineation of promising areas for prospecting and potential development. The 3-year program, partly financed by the National Air Pollution Control Administration, includes drilling, coal sampling and analysis, and an initial compilation of all available data on Missouri's coal resources. Resources and reserves are being

computed in terms of seam thickness and sulfur content, by coal seam and by degree of reliability of data. Analyses, including trace element analysis, are being made by the U.S. Bureau of Mines in Pittsburgh.

The Pittsburgh & Midway Coal Co. (P&M) was developing its Midway mine near the Missouri-Kansas State line south of Kansas City to supply coal to a new powerplant at La Cygne, Kans. The Midway mine will be a surface operation, and raw coal will be delivered directly from the mine to the coal handling facilities of the powerplant by truck. At peak production, P&M will deliver 2.4 million tons of coal per year. The mine was expected to be in full production by 1973. Overburden will be removed by two electric draglines with a total capacity of 180 cubic yards. Coal will be removed by small loading shovels. Reclamation of all lands affected by the mining operations will conform with recently enacted State reclamation laws. The affected land will be graded to a rolling terrain and seeded.

⁹ Missouri Geological Survey. Evaluation of Missouri's Coal Resources. Rept. Inv. 48, 1971, 100 pp.

Table 15.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt, native:			
Bar-Co-Roc Asphalt Co.	P.O. Box 11 Iantha, Mo. 64753	Mine	Barton.
Silica Rock Asphalt Corp.	Sheldon, Mo. 64784	.....do.....	Vernon.
Barite:			
Dresser Minerals Div.	P.O. Box 6504 Houston, Tex. 77005	.....do.....	Washington.
Milchem, Incorporated	P.O. Box 22111 Houston, Tex. 77027	Mine and mill..	Do.
National Lead Co., Baroid Division	P.O. Box 1675 Houston, Tex. 77001	.....do.....	Do.
National Lead Co., DeLore Division.	P.O. Box 2808 Carondelet Sta. St. Louis, Mo. 63111	Mill	St. Louis.
Chas. Pfizer & Co., Inc.	Box 47 Mineral Point, Mo. 63660	Mine and mill..	Washington.
Cement:			
Alpha Portland Cement Co.	15 South Third St. Easton, Pa. 18043	Plant and quarry.	St. Louis.
Dundee Cement Co.	P.O. Box 317 Dundee, Mich. 48131	.....do.....	Pike.
Marquette Cement Mfg. Co.	20 North Wacker Dr. Chicago, Ill. 60606	.....do.....	Cape Girardeau.
Missouri Portland Cement	7751 Carondelet Ave. St. Louis, Mo. 63105	.....do.....	Jackson, St. Louis.
River Cement Co.	Festus, Mo. 63028	.....do.....	Jefferson.
Universal Atlas Cement Div. of U.S. Steel Corp.	Chatham Center, Box 2969 Pittsburgh, Pa. 15230	.....do.....	Ralls.
Clay and shale:			
Allied Chemical Corp.	Box 70 Morristown, N.J. 07960	Mine and plant.	Gasconade.
Alton Brick Co.	Box 1025 Maryland Heights, Mo. 63042	.....do.....	St. Louis.
Carter-Waters Corp.	2440 Pennway Kansas City, Mo. 64108	.....do.....	Platte.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clay and Shale—Continued			
C-E Refractories Div. of Combustion Engineering.	101 Ferry St. St. Louis, Mo. 63147	Mine and plant.	Callaway, Monroe, Montgomery.
Dundee Cement Co.	Dundee, Mich. 48131	.....do.....	Pike.
U.S. Gypsum: A. P. Green Refractories Co.	Mexico, Mo. 65265	.....do.....	Franklin, Gasconade.
Dressers Industries Inc.: Harbison-Walker Refractories Co.	2 Gateway Center Pittsburgh, Pa. 15222	.....do.....	Audrain, Callaway, Gasconade, Lincoln, Montgomery, St. Charles, Warren.
Kaiser Refractories	P.O. Box 499 Mexico, Mo. 65265	.....do.....	Audrain, Callaway, Gasconade, Montgomery, Osage, Warren.
Marquette Cement Mfg. Co.	20 North Wacker Dr. Chicago, Ill. 60606	.....do.....	Cape Girardeau.
Midland Brick & Tile Co.	Box 428 Chillicothe, Mo. 64601	.....do.....	Livingston.
Missouri Portland Cement Co.	7751 Carondelet Ave. St. Louis, Mo. 63105	.....do.....	Jackson, St. Louis.
H. K. Porter Co., Inc.	4705 Ridgewood Ave. St. Louis, Mo. 63116	.....do.....	Callaway, Gasconade, Monroe.
Universal Atlas Cement Div., U.S. Steel Corp.	P.O. Box 2969 Pittsburgh, Pa. 15230	.....do.....	Ralls.
Wellsville Fire Brick Co.	West Highway 19 Wellsville, Mo. 63384	.....do.....	Audrain, Montgomery.
Coal:			
Clayton-Hensley Coal Co.	Route 3 Fulton, Mo. 65251	Strip mine	Callaway.
Ellis Coal Co.	Bronaugh, Mo. 64728	.....do.....	Vernon.
Kirkville Coal Co., Inc.	Box 332 Centerville, Iowa 52544	.....do.....	Putnam.
Peabody Coal Co.	301 North Memorial Dr. St. Louis, Mo. 63102	.....do.....	Boone, Henry, Macon, Randolph.
Copper: See Lead.			
Iodine (consumers):			
Hoffman-Taft, Inc.	West Bennett Rd. Springfield, Mo. 65800	Plant	Greene.
Interstate Chemical Co., Inc.	501 Santa Fe Kansas City, Mo. 64102	.....do.....	Jackson.
Mallinckrodt Chemical Works	3600 North Second St. St. Louis, Mo. 63147	.....do.....	St. Louis.
Iron ore:			
Meramec Mining Co.	Route 4 Sullivan, Mo. 63080	Underground mine.	Washington.
Pilot Knob Pellet Co.	Box 26 Ironton, Mo. 63650	.....do.....	Iron.
Lead:			
Cominco American, Inc.	Box 430 Salem, Mo. 65560	.....do.....	Do.
Missouri Lead Operating Co. for Amax Lead Co. and Homestake Lead Co. of Mo.	Boss, Mo. 65440	.....do.....	Do.
Ozark Lead Co.	Sweetwater, Mo. 63680	.....do.....	Reynolds.
St. Joe Minerals Corp.	Bonne Terre, Mo. 63628	.....do.....	Crawford, Iron, Reynolds, St. Francois, Washington.
Lime:			
Ash Grove Cement Co.	1000 Ten Main Center Kansas City, Mo. 64105	Plant	Greene.
Marblehead Lime Co.	300 West Washington Chicago, Ill. 60606	.....do.....	Marion.
Mississippi Lime Co.	7 Alby St. Aiton, Ill. 62002	.....do.....	Ste. Genevieve.
Valley Dolomite Corp.	915 Olive St. St. Louis, Mo. 63101	.....do.....	St. Francois.
Perlite:			
J. J. Brouk & Co.	1367 South Kingshighway Blvd. St. Louis, Mo. 63110	Expanding plant.	St. Louis.
Roofing granules:			
GAF Corp.	Box 278 Annapolis, Mo. 63620	Plant	Iron.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel:			
Eureka Sand & Gravel Co.....	Rt. 1, Box 77 Eureka, Mo. 63025	Stationary.....	St. Louis.
Holliday Sand & Gravel Co.....	6811 West 63rd St. Overland Park, Kans. 66202	Dredge.....	Various.
Mississippi River Sand & Matl. Co.	650 Rosedale St. Louis, Mo. 63112	Stationary and dredge.	St. Louis.
Missouri Aggregates, Inc.....	801 South Lindberg St. St. Louis, Mo. 63100	Stationary.....	Do.
Missouri Gravel Co.....	313 16th St. Moline, Ill. 61265	Dredge.....	Lewis.
Norbroco, Inc.....	P.O. Box 414 Hazelwood, Mo. 63042	....do.....	St. Louis.
PPG Industries, Inc.....	1 Gateway Center Pittsburgh, Pa. 15219	Stationary.....	Jefferson.
Pennsylvania Glass Sand Corp....	Berkeley Springs, W. Va. 25411	....do.....	St. Louis, St. Charles.
Riverside Sand & Dredging.....	5000 Bussen Rd. St. Louis, Mo. 63129	Dredge.....	St. Louis.
St. Charles Sand Co.....	Rt. 1, Box 253 Bridgeton, Mo. 63042	Stationary.....	Do.
Stewart Sand & Material Co.....	4049 Pennsylvania Ave. Kansas City, Mo. 64111	....do.....	Jackson.
Taylor Sand & Gravel Co.....	Caruthersville, Mo. 63830	Dredge.....	Pemiscot, New Madrid.
Welton & Gray Gravel Co.....	Rt. 4, Ava, Mo. 65608	Portable.....	Douglas.
Winter Bros. Material Co.....	13098 Gravois Rd. St. Louis, Mo. 63127	Stationary.....	St. Louis.
Silver: See Lead.			
Stone:			
Brown Quarries.....	Washington, Mo. 68090	Quarry.....	Various.
Bussen Quarries, Inc.....	5000 Bussen Rd. St. Louis, Mo. 63129	....do.....	Jefferson, St. Louis.
Dundee Cement Co.....	P.O. Box 317 Dundee, Mich. 48131	....do.....	St. Louis.
Gordon Bros. Quarries, Inc.....	Forest City, Mo. 64451	....do.....	Holt.
Mississippi Lime Co.....	7 Alby St. Alton, Ill. 62002	....do.....	Ste. Genevieve.
Missouri Portland Cement Co....	7751 Carondelet Ave. St. Louis, Mo. 63105	....do.....	Jackson, St. Louis.
River Cement Company.....	Festus, Mo. 63028	....do.....	Jefferson.
Vigus Quarries, Inc.....	7929 Alabama Ave. St. Louis, Mo. 63111	....do.....	Jefferson, St. Louis.
West Lake Quarry & Material Co.	Rt. 1, Box 206, Taussig Rd. Bridgeton, Mo. 63042	....do.....	St. Louis, Scott.
Tripoli:			
The Carborundum Co., American Tripoli Div.	Seneca, Mo. 64865	Mill.....	Newton.
Vermiculite:			
W. R. Grace & Co., Zonolite Div..	62 Whittemore Ave. Cambridge, Mass. 01109	Exfoliating plant.	St. Louis.
Zinc: See Lead.			

The Mineral Industry of Montana

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

By J. R. Welch ¹

In 1971, Montana mineral production was valued at \$285.1 million, a decrease of 8.9 percent compared with 1970. The year's events included a strike against The Anaconda Company beginning July 1, which closed down virtually all production operations of the firm. The strike lasted until September 22 and was the principal factor adversely affecting copper output, resulting in a 26-percent decrease below 1970 production. Other metals also showed significant decreases in production: Gold (30

percent), silver (36 percent), lead (38 percent), zinc (75 percent).

Fuels, except for coal, showed decreases in production as compared with 1970. Coal continued a sharp upturn in production, more than doubling 1970 output because of greatly expanded open pit coal mining. Natural gas production decreased to 32.7 million cubic feet in 1971 from 42.7 million cubic feet in 1970. Petroleum output fell 9 percent.

¹ Physical scientist, Division of Nonferrous Metals.

Table 1.—Mineral production in Montana ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony.....short tons..	W	W	135	\$81
Clays.....thousand short tons..	² 41	² \$71	³ 264	³ 1,712
Coal (bituminous and lignite).....do....	3,447	6,394	7,064	12,817
Copper (recoverable content of ores, etc.).....short tons..	120,412	138,955	88,581	92,125
Gem stones.....	NA	109	NA	114
Gold (recoverable content of ores, etc.).....troy ounces..	22,456	817	15,613	644
Iron ore (usable).....thousand long tons, gross weight..	14	W	14	W
Lead (recoverable content of ores, etc.).....short tons..	996	311	615	169
Lime.....thousand short tons..	208	W	199	2,416
Manganese ore and concentrate (35 percent or more Mn).....short tons, gross weight..	512	W	142	W
Natural gas.....million cubic feet..	42,705	4,399	32,720	3,959
Petroleum (crude).....thousand 42-gallon barrels..	37,879	105,403	34,599	104,128
Sand and gravel.....thousand short tons..	19,275	20,249	15,781	25,207
Silver (recoverable content of ores, etc.).....thousand troy ounces..	4,304	7,622	2,748	4,248
Stone.....thousand short tons..	⁴ 6,501	⁴ 6,896	W	W
Tungsten ore and concentrate.....short tons, 60-percent WO ₃ basis..	9	23	W	W
Zinc (recoverable content of ores, etc.).....short tons..	1,457	446	361	116
Value of items that cannot be disclosed: Cement, clays (bentonite 1970 and fire clay 1971), fluorspar, gypsum, natural gas liquids, peat, phosphate rock, stone (dimension 1970), talc, vermiculite and values indicated by symbol W.....	XX	21,321	XX	37,337
Total.....	XX	313,016	XX	285,073
Total 1967 constant dollars.....	XX	279,993	XX	^p 247,671

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

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

² Excludes bentonite; included with "Value of items that cannot be disclosed."

³ Excludes fire clay; included with "Value of items that cannot be disclosed."

⁴ Excludes certain dimension stone; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Montana, by county

(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Beaverhead.....	\$715	\$540	Stone, sand and gravel, silver, copper, lead, zinc, gold.
Big Horn.....	1,702	4,742	Sand and gravel, stone, petroleum, lime, natural gas.
Blaine.....	349	459	Petroleum, sand and gravel, stone, natural gas.
Broadwater.....	W	W	Sand and gravel, iron ore, stone.
Carbon.....	7,366	6,135	Petroleum, natural gas, sand and gravel, clays, zinc, copper, gold, silver, lead.
Carter.....	W	W	Clays, petroleum, sand and gravel.
Cascade.....	W	3,273	Sand and gravel, stone, clays.
Chouteau.....	W	W	Sand and gravel, stone.
Custer.....	935	W	Do.
Daniels.....	W	762	Sand and gravel, petroleum.
Dawson.....	W	2,317	Petroleum, sand and gravel, stone.
Deer Lodge.....	2,516	2,695	Lime, stone, sand and gravel, silver, copper, clays, gold.
Fallon.....	19,752	21,435	Petroleum, natural gas liquids, natural gas.
Fergus.....	W	W	Gypsum, sand and gravel, clays.
Flathead.....	W	565	Sand and gravel, lead, silver, copper, zinc, stone.
Gallatin.....	W	W	Cement, stone, sand and gravel, clays.
Garfield.....	43	30	Sand and gravel.
Glacier.....	W	2,219	Petroleum, natural gas liquids, stone.
Golden Valley.....	W	37	Sand and gravel.
Granite.....	1,268	481	Sand and gravel, silver, zinc, copper, lead, gold.
Hill.....	280	W	Sand and gravel.
Jefferson.....	W	W	Cement, stone, sand and gravel, silver, lead, gold, copper, zinc, clays.
Judith Basin.....	160	--	
Lake.....	W	W	Sand and gravel, peat.
Lewis and Clark.....	W	548	Sand and gravel, stone, silver, lead, copper, gold, zinc.
Liberty.....	1,631	1,363	Petroleum, natural gas, sand and gravel.
Lincoln.....	12,691	12,277	Sand and gravel, vermiculite, stone, lead, silver, zinc.
McCone.....	1,203	858	Petroleum, stone, sand and gravel.
Madison.....	W	W	Talc, gold, silver, zinc, copper, lead.
Meagher.....	W	W	Lead, zinc, silver, gold.
Mineral.....	W	W	Sand and gravel, silver, copper, lead, stone, gold, zinc.
Missoula.....	536	237	Sand and gravel, silver, lead, zinc.
Musselshell.....	2,329	2,551	Petroleum, coal, clays.
Park.....	261	W	Sand and gravel, stone.
Petroleum.....	6	5	Sand and gravel.
Phillips.....	W	549	Sand and gravel, clays, stone.
Pondera.....	700	4,037	Stone, petroleum, sand and gravel.
Powder River.....	24,271	19,134	Petroleum, natural gas, coal.
Powell.....	W	W	Phosphate rock, sand and gravel, stone, gold, silver, copper.
Prairie.....	1,186	--	
Ravalli.....	W	W	Fluorspar, silver, lead, zinc, sand and gravel, stone, gold, copper.
Richland.....	7,182	7,142	Petroleum, coal, lime, sand and gravel, stone.
Roosevelt.....	W	5,369	Petroleum, sand and gravel, stone.
Rosebud.....	7,425	14,283	Coal, petroleum, clays, sand and gravel.
Sanders.....	W	371	Sand and gravel, antimony.
Sheridan.....	W	6,725	Petroleum, sand and gravel.
Silver Bow.....	146,072	96,448	Copper, silver, gold, sand and gravel, clays, manganese ore.
Stillwater.....	1,355	134	Natural gas, stone.
Sweet Grass.....	1,378	6	Sand and gravel.
Teton.....	149	356	Sand and gravel, petroleum, stone.
Toole.....	2,663	2,291	Petroleum, sand and gravel, natural gas, stone.
Treasure.....	W	W	Clays, sand and gravel.
Valley.....	W	W	Sand and gravel.
Wheatland.....	9	--	
Wibaux.....	W	W	Stone, sand and gravel.
Yellowstone.....	2,168	2,384	Stone, sand and gravel, lime, petroleum, clays.
Yellowstone National Park.....	--	1,126	Sand and gravel.
Combined counties ¹	28,112	30,313	
Undistributed ²	36,604	29,321	
Total ³	313,016	285,073	

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

¹ Petroleum and natural gas production from fields underlying two or more counties.

² Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

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

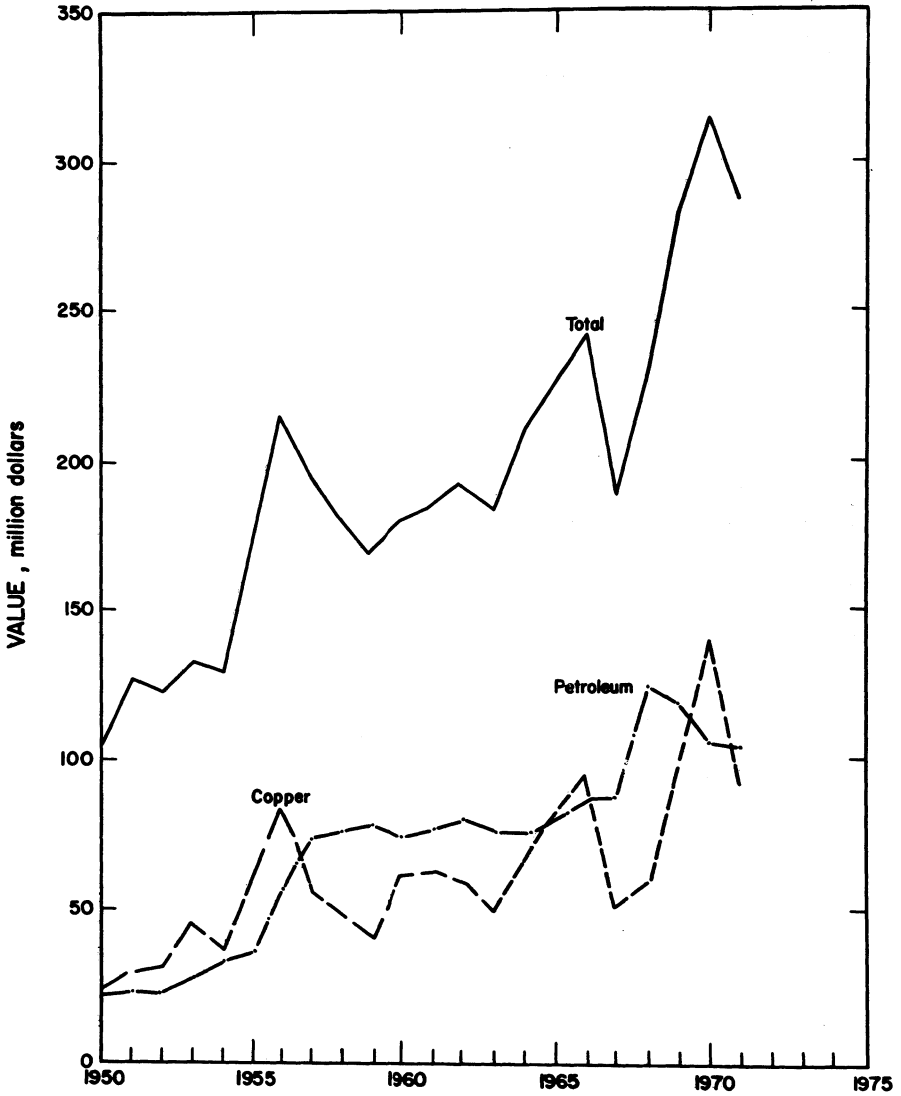


Figure 1.—Value of copper, petroleum, and total value of mineral production in Montana.

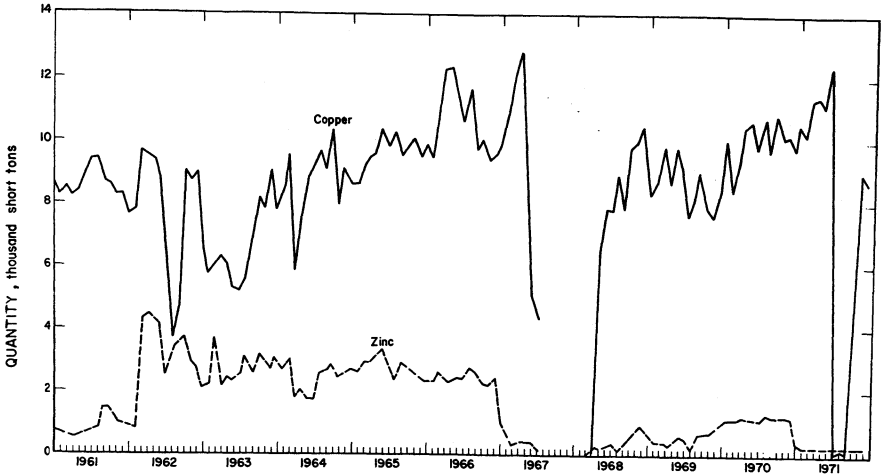


Figure 2.—Mine production of copper and zinc in Montana, by month, in terms of recoverable metals.

The State legislature passed two laws early in 1971 requiring mine operators to restore land disturbed by strip, open pit, and underground mining. The two bills are considered important conservation measures. S.B. 70 dealt with strip mining of coal, bentonite, clay, sand and gravel, phosphate rock, and uranium and required the mining firms to contract with the State Land Board to restore land disturbed by mining. H.B. 243 was directed at hard rock mining and required licensing and permits for mines and provided for reclamation of mined land and general regulations for hard-rock mining. The legislature passed an appropriation bill calling for funds (\$168,000) to administer the Act.

In March 1971 the State Supreme Court ruled the 1969 Dredge Mining Regulations and Land Preservation Act in violation of State and Federal Constitutions.

The University of Montana was scheduled to conduct an archeological survey of 2,000 acres in Big Horn County. The land leased by Decker Coal Co. was scheduled for strip mining operations which could endanger or destroy objects of historic or prehistoric interest. The project was sponsored and financed by Decker Coal.

Anaconda Aluminum Co. installed a new scrubber system at its plant in Columbia Falls, Mont. A marked reduction in fluoride emission, approximately two-thirds reduction from the 1969 level, was said to have resulted.

Five companies Hoerner-Waldorf Corp., W. R. Grace & Co., Anaconda Wire and Cable Co., Ideal Cement Co., and Stauffer Chemical Co., received 1-year extensions of pollution variances while steps were taken to control emissions. Some variances have been granted.

Coal companies continued reclaiming mined land. Spoil banks, undisturbed since 1923, were graded into smooth contours in preparation for conversion to grassy slopes. The acreage to be reclaimed was in the vicinity of Western Energy's mine at Colstrip. A total of 1,000 additional acres will be reclaimed by Burlington Northern Railroad Co. and other companies. American Metal Climax, Inc. (Amax), Cyprus Mines Corp., Freeport Minerals Co., Anaconda, Kerr-McGee and others conducted programs to reclaim disturbed lands resulting from exploration, development, and mining.

Vo-Tech, a federally supported vocational training school located in Butte, trains miners in various phases of underground work. Opening classes began on February 22, 1971, with a total of 30 trainees. An underground laboratory is located on the 3,900-foot level of The Anaconda Company's Kelley mine, and all underground instruction is in actual working stopes, drifts, and raises. Certification signifying completion of the program was presented to 13 trainees at the Kelley mine on December 17, 1971.

Table 3.—Indicators of Montana business activity

	1970 ^r	1971 ^p	Change, percent
Annual average labor force and employment:			
Total labor force.....	thousands.. 282.9	290.8	+2.8
Unemployment.....	do..... 18.8	20.1	+6.9
Employment:			
Manufacturing.....	do..... 23.9	23.6	-1.3
Wholesale and retail trade.....	do..... 48.1	49.1	+2.1
Mining.....	do..... 6.6	5.3	-19.7
Construction.....	do..... 11.0	10.8	-1.8
Transportation and public utilities.....	do..... 17.4	17.4	--
Finance, insurance, and real estate.....	do..... 8.1	8.5	+4.9
Services.....	do..... 33.7	34.9	+3.6
Government.....	do..... 52.6	54.1	+2.9
Personal income:			
Total.....	millions.. \$2,349	\$2,463	+4.9
Per capita.....	do..... \$3,370	\$3,479	+3.2
Construction activity:			
Value of authorized nonresidential construction.....	millions.. \$19.8	\$19.5	-1.5
Highway construction contracts awarded.....	do..... \$74.5	\$67.2	-9.8
Cement shipments to and within Montana.....	thousand 376-pound barrels.. 1,699	1,627	-4.2
Mineral production value.....	millions.. \$313.0	\$285.1	-8.9

^p Preliminary. ^r Revised.

Sources: Area Trends in Employment and Unemployment; Employment and Earnings; Survey of Current Business; Construction Review; Streets and Roads Magazine; and U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Coal and peat.....	111	248	28	220	--	3	13.66	41
Metal.....	3,430	300	1,029	8,234	2	171	21.01	3,029
Nonmetal.....	416	265	110	892	--	28	31.38	5,740
Sand and gravel.....	1,016	150	152	1,313	--	31	23.61	704
Stone.....	459	255	117	942	--	21	22.28	632
Total.....	5,432	264	1,436	11,601	2	254	22.07	2,723
1971: ^p								
Coal.....	120	240	29	231	--	3	12.97	39
Metal.....	3,645	237	865	6,899	1	132	19.28	1,634
Nonmetal ¹	455	273	124	990	--	38	38.37	945
Sand and gravel.....	940	152	142	1,177	--	31	26.34	637
Stone.....	465	242	113	901	--	13	14.43	303
Total.....	5,625	226	1,273	10,198	1	217	21.38	1,298

^p Preliminary.

¹ Beginning in 1971, data concerning peat operations are included in the nonmetals industry on a continuing basis.

REVIEW BY MINERAL COMMODITIES

METALS

Aluminum.—Output of aluminum from the Anaconda Aluminum Co. plant at Columbia Falls was about 3.2 percent less than in 1970. As a result of the installation of a new scrubber system, a marked reduction in fluoride emission was reported, approximately two-thirds reduction from the 1969 level.

Antimony.—The U.S. Antimony Corp. continued development of its stibnite mine

in the Prospect Creek drainage near Thompson Falls, Sanders County. By the end of November, production reached the rate of 33 tons of contained metal per month.

Copper.—Annual production of copper decreased 26 percent below the 1970 level, to 88,581 tons. Mines of The Anaconda Company accounted for virtually all of the copper produced in the State. Strikes against the company were the major cause for the reduced production.

Table 7.—Mine production of gold, silver, copper, lead, and zinc in 1971, by type of material processed and method of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode:					
Smelting of concentrates from:					
Ore.....	13,832	2,494,574	70,526	68	199
Direct smelting of:					
Ore.....	1,618	219,733	48	547	162
Precipitates.....	---	---	17,970	---	---
Tailings.....	111	33,248	38	---	---
Total.....	1,729	252,981	18,056	547	162
Placer.....	52	2	---	---	---
Grand total.....	15,613	2,747,557	188,581	615	361

¹ Data does not add to total shown because of independent rounding.

Table 8.—Mine production of gold, silver, copper, lead, and zinc in Silver Bow County, in terms of recoverable metals

Year	Mines producing		Material sold or treated ¹ (thousand short tons)	Gold, lode and placer (troy ounces)	Silver, lode and placer (thousand troy ounces)
	Lode	Placer			
1967.....	5	---	9,041	8,339	1,856
1968.....	6	---	10,089	9,782	1,466
1969.....	5	---	16,022	15,423	2,563
1970.....	4	---	18,745	19,454	3,590
1971.....	4	---	13,531	13,789	2,415
1882-1971.....	---	---	² 406,114	2,490,619	655,070
	Copper (short tons)	Lead (short tons)	Zinc (short tons)	Total value (thousands)	
1967.....	65,448	64	816	\$53,450	
1968.....	69,362	---	---	61,580	
1969.....	103,179	---	---	103,321	
1970.....	120,292	---	---	145,831	
1971.....	88,503	---	---	96,344	
1882-1971.....	8,611,756	415,425	2,406,818	4,432,234	

W Withheld to avoid disclosing individual company confidential data.

¹ Does not include gravel washed.

² Complete data not available: 1882-1904.

Plans were announced for future expansion of copper smelting at Anaconda, Mont., from 30 to 50 million pounds per month. Ore would come mainly from expanded pit and deep mining development at Butte. The projects call for a \$26 million smelter engineering and construction expenditure and, in addition, include the construction of a 600-ton-per-day sulfuric acid plant and a 1,400-ton-per-day lime kiln, the lime to be used for pollution abatement. Experiments were conducted to find suitable methods to reduce airborne dust from tailing disposal areas at Anaconda. Also, an estimated \$1.3 million was to be spent by The Anaconda Company to recycle reduction plant water and clarify water discharges from their facilities.

During 1971, Montana underwent a very active year of mineral exploration and development. Freeport Minerals Co. was active in the Neihart and Helena areas; Phelps Dodge Corp. was in the Thompson Falls area; Kennecott Copper Corp. in the Troy-Bull Lake area; Copper Range Co. was in the Helena area; Vanguard Exploration was in the Yoho Peak area; and American Exploration Co. throughout the State. The Anaconda Company also conducted exploratory activity throughout the State, but in particular continued a drilling program in the Continental area near Butte. This area, a short distance southeast of Butte, can be considered to be an extension of the mineralized zone of Butte with copper and molybdenum being the metals of prime concern.

Gold.—Total gold production in the State was 15,613 troy ounces, approximately 30 percent less than the 22,456 ounces produced in 1970. Approximately 88 percent of the gold produced originated as a byproduct of copper production from the Butte area, Silver Bow County. Value of total gold produced in the State declined from \$817,174 in 1970 to \$644,038 in 1971. Placer output increased slightly from three operations. Seven gold mines in Granite County contributed to the total gold production. Additional gold was obtained from four mines in Jefferson County and three mines in Madison County.

Plans were announced to reactivate placer mining at Boulder Bar in historical Confederate Gulch near Townsend. Operations were to conform with recently passed State laws covering mining and reclamation of mined lands.

Iron Ore.—Iron ore continued to come only from the Iron Cross open pit mine of R & W Iron Company near Radersburg; all was used in cement manufacture.

Lead.—Lead production declined about 38 percent compared with 1970. Mine output was reported from 17 lead operations throughout the State, mainly from mines in Flathead, Beaverhead, Jefferson, Granite, Lewis and Clark and Mineral Counties. The American Smelting and Refining Company (ASARCO) smelter at East Helena accounted for the State's production of refined lead.

Efforts were made to control and minimize pollution from operations of the East Helena lead smelter. ASARCO was granted a temporary air pollution variance by the State Board of Health.

Manganese.—Taylor-Knapp Mining Co. ceased operations at Philipsburg on January 31, 1971, after 35 years of mining. The company produced battery grade manganese dioxide until 1967. Recently, it operated the True Fissure mine producing silver and zinc ores which were shipped to the Bunker Hill mill in Idaho for processing.

No manganese ore was mined during 1971 and shipments from The Anaconda Company stockpile, totaling 142 tons, accounted for all the manganese attributed to the State. Total shipments were 72 percent less than those in 1970.

Silver.—Byproduct silver from The Anaconda Company mines in the Butte area accounted for about 2.4 million ounces, or

87 percent of the total silver produced in the State. Total production of 2.75 million ounces was a 36-percent decline from 1970 reflecting the results of the 3-month strike in the copper industry. The average annual price of silver was \$1.54 per ounce compared with \$1.77 for 1970, contributing to a drop in total value for the year of about 44 percent to \$4.25 million.

Silver output came from about 49 operations in 14 counties, including 19 mines classified as principally silver producers. Only Silver Bow County with 2.4 million ounces had mine output exceeding 100,000 ounces. Significant amounts (more than 10,000 ounces) were also reported from mines in Granite, Jefferson, and Lincoln Counties.

Interest in exploration and development of silver deposits throughout the State remained high despite curtailment of exploration in other Western States. The K & W Mining Co. of Lincoln began work on a copper claim that was reported to have good values in both copper and silver. Reserves were estimated in excess of 1 million tons. The Nancy Lee mine, 5 miles west of Superior, was active and shipped a carload of high-grade silver-lead-copper ore. Humble Oil & Refining Co. leased 105 claims covering copper and silver mineralization in Sanders and Mineral Counties. Phelps Dodge was reported to have begun test drilling the Life Apex Group of mining claims near Trout Creek, Sanders County, and Trojan Silver-Lead Mines, Inc., had nearly completed construction of a 125-ton-per-day mill at the old Snowstorm mine near Troy, Lincoln County.

Tungsten.—Only a few tons of tungsten concentrate was produced in 1971.

Zinc.—Output of zinc was derived mainly from small lead-zinc-silver operations. Zinc production was reported from 26 mines, including four mines classified as principally zinc producers and three mines classified as principally lead-zinc producers. The largest zinc mining operation in the State was the True Fissure mine operated by Taylor-Knapp Co. During 1971 a total of 361 tons of zinc was produced in the State as compared with 1,457 tons in 1970.

The Anaconda Company announced that all of its Montana zinc smelting and refining facilities would be closed down, with the phase out of these operations expected to take place by September 1972. This will

end more than 50 years of zinc operations by the firm in Montana and effectively reduces the United States zinc-producing capacity by 162,000 tons annually. Also, The Anaconda Company completed negotiations with ASARCO for the sale of its zinc fuming plant at East Helena. The plant treats slag from the ASARCO East Helena smelter.

NONMETALS

Cement.—Portland cement shipments increased 11 percent and masonry cement shipments increased 3 percent over those of 1970. Cement was produced at two plants, one near Helena, the other at Trident. The portland and masonry cement consumed in the State totaled 1,627,000 376-pound barrels and 17,000 280-pound barrels, respectively. The portland cement was consumed by ready-mix concrete companies, concrete products manufacturers, building material dealers and contractors. Raw material used in making this cement included limestone, clay and shale, sand, gypsum and iron-bearing materials. The producing companies were Ideal Cement Co., Division of Ideal Basic Industries Inc. and Kaiser Cement & Gypsum Corp.

A major construction program was underway at Ideal Cement Company's plant at Trident near Bozeman. This construction, estimated to cost \$10 million, will result in virtually a new plant. The new facilities will include air-pollution control equipment, a new crusher, a new raw-grinding and blending department, and a new 12 by 450-foot kiln to replace four small ones. Capacity will be increased from 282,000 to 320,000 tons per year, about 13 percent. Completion is expected in April 1973. When completed, the plant will be in full compliance with State air and water pollution regulations.

Clays.—Output of all types of clays and shale for use in building products, iron ore pelletizing, and oil well drilling muds (bentonite) came from mines in 13 counties. Miscellaneous clays and shale for making heavy clay products, mainly building brick and drain tile, was mined by Lewistown Brick & Tile Co. near Lewistown, Fergus County, and by Lovell Clay Products Co. near Billings, Yellowstone County. Treasure State Industries, Inc., mined clays and shale for use in lightweight aggregate near Great Falls, Cascade

County. International Minerals and Chemicals Corp. operated four pits in Carter County where bentonite was produced for use in drilling muds, foundries, and animal feeds. Hallett Minerals Co. operated three pits in the State where bentonite was produced for use in iron ore pelletizing. One pit was in Phillips County near Malta, one in Treasure County near Forsyth, and one in Rosebud County near Vananda. N L Industries, Inc., Baroid Division operated three pits all in Carter County, near Colony, where bentonite was produced for use in drilling muds.

Fluorspar.—Roberts Mining Co. mined fluorspar at the Crystal Mountain mine, Ravalli County. The material, upgraded to metallurgical-grade fluorspar by milling at a heavy-media separation plant at Darby, was marketed principally to the steel industry. Production in 1971 increased about 8 percent over that of 1970.

A favorable fluorspar prospect was reported found on the south flank of Black Butte Mountain near Lewistown, Mont. Two diamond drill holes have been completed by Master Mining Co. indicating on ore body 70 feet in width at a 100-foot depth.

Gem Stones.—The sapphire market was reported to be active with good quality gems coming from the Phillipsburg area. Other types of semiprecious materials found included petrified wood and agate.

Gypsum.—The tonnage of gypsum mined was estimated to be about the same as in 1970. Gypsum was mined by United States Gypsum Co. from the Shoemaker mine near Heath.

Lime.—The Anaconda Company, Great Western Sugar Co. and Holly Sugar Corp. produced lime in Big Horn, Deer Lodge, Richland, and Yellowstone Counties for copper ore concentration, sewage treatment, sugar refining, neutralization of acids, and other uses. Output declined 4 percent and was 22 percent below the 1969 record.

Phosphate Rock.—Output of phosphate rock, all from operations in Powell County, was by Cominco American, Inc., from the Anderson-Brock and Warm Springs mines. The phosphate rock went directly to Trail, British Columbia, Canada, for manufacturing phosphate fertilizer by the Consolidated Mining and Smelting Co. of Canada Ltd.

Stauffer Chemical Co. was completing an emission control program at an estimated cost of \$1 million to reduce particulate emission from a phosphoric acid plant near Rocker.

Sand and Gravel.—Output of sand and gravel decreased 18 percent below 1970 production but total value increased by 24 percent. Commercial sand and gravel firms operated 44 plants.

Sand and gravel was produced in 47 of the 56 counties in the State. The use dis-

tribution was in road material, 91 percent; building, 3 percent; and miscellaneous uses, including fill and railroad ballast, 6 percent.

Stone.—Output of stone increased over the amount produced in 1970. Stone was produced in 29 counties and consisted of traprock, granite, limestone, marble, sandstone, quartz, quartzite, and miscellaneous stone. The traprock was used mainly in road construction, riprap, fill, and as railroad ballast.

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

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	272	\$440	167	\$272
Fill.....	5	6	14	21
Paving.....	77	122	61	85
Other uses ¹	14	32	152	254
Total ²	369	600	393	632
Gravel:				
Building.....	502	665	279	397
Fill.....	169	118	125	114
Paving.....	1,002	1,166	823	729
Railroad ballast.....	75	92	W	W
Other uses ³	72	120	289	373
Total ²	1,820	2,161	1,516	1,612
Government-and-contractor operations:				
Sand:				
Building.....	--	--	3	10
Fill.....	26	18	--	--
Paving.....	2,193	3,042	1,133	2,989
Other uses.....	--	--	8	4
Total ²	2,218	3,060	1,143	2,954
Gravel:				
Building.....	--	--	40	40
Fill.....	475	276	198	97
Paving.....	14,336	14,122	12,364	19,793
Other uses.....	57	31	126	80
Total ²	14,867	14,429	12,729	20,009
Total sand and gravel ²	19,275	20,249	15,781	25,207

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

¹ Includes blast (1970) and other sands.

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

³ Includes miscellaneous, other, and railroad ballast sand (1970).

Limestone came from six quarries and was used for manufacturing cement, for making lime, and for metallurgical purposes. Limestone was mined in Stillwater, Beaverhead, Broadwater, Deer Lodge, Gallatin, and Jefferson Counties.

Granite from one quarry in Gallatin County was used for jetty construction. Granite was also produced in four other counties.

Sulfur.—Production of high-purity elemental sulfur from oil refinery waste gases decreased slightly below the 1970 total. Montana Sulfur & Chemical Co. recovered sulfur from hydrogen sulfide gas byproducts obtained from oil-refining operations of Continental Oil Co. and Humble Oil & Refining Co. at Billings. Farmer's Union Central Exchange operated a sulfur recovery system utilizing byproduct gases received from its oil refinery at Laurel.

Talc.—Production of talc decreased about 6 percent under the 1970 total. Talc was mined by two companies in Madison County. Pfizer, Inc., operated two mines, the Treasure State and the Regal-Keystone. The talc was hauled to the plant at Baratts for grinding.

The United Sierra Division, Cyprus Mines Corp., mined talc at the Yellowstone mine in Johnny Gulch, 15 miles south of Cameron, Madison County, and at the Beaverhead mine in the Stone Creek district of the Ruby Range about 10 miles west of Alder, Madison County. The use distribution of talc by industry was paper, 38 percent; paint, 28 percent; ceramics, 8 percent; and exports and miscellaneous uses, including insecticides, rice polishing, textiles, and toilet preparations, 26 percent.

Vermiculite.—Crude vermiculite production increased 8 percent over the 1970 total. Production of exfoliated vermiculite was about the same during the same period. The open pit mine of the Zonolite Division, W. R. Grace & Co., about 6 miles northeast of Libby, Lincoln County, continued to be the principal source of vermiculite in the United States. Crude ore was milled at the mine site, and the sized concentrate was shipped mainly out-of-State for processing.

W. R. Grace & Co. announced it would build a new beneficiation plant at Libby to treat vermiculite from its deposits northeast of Libby. The expansion, to cost an estimated \$6.75 million, was to boost daily output of vermiculite to 1,000 tons, about a one-third increase, in 1973. This

expanded mill is expected to more than double the life of the Libby mine.

MINERAL FUELS

Coal.—Bituminous coal and lignite production from 10 active mines (four underground and six strip) increased 105 percent above the 1970 level. The increase was due to continued expansion of coal mining facilities at Colstrip, Rosebud County, by Western Energy Co., a subsidiary of Montana Power Co., and Peabody Coal Co.

Consolidation Coal Co., a Pittsburgh, Pa. based firm, opened a test pit for coal mining in the Bull Mountain area, southeast of Roundup, Musselshell County. A total of 15 acres was to be strip-mined, with production of 50,000 tons of low-sulfur subbituminous coal anticipated. The coal lies under a 20-foot cap of sandstone. The mined coal will be shipped to Chicago for testing by Commonwealth Edison Co. Consolidation Coal Co. has leased portions of 8,492 acres owned by Burlington Northern Railroad Co. and has extensively core-drilled to determine the location and depth of the coal.

The Montana Power Co. announced in July it would build a \$60 million, 350,000-kilowatt coal-burning steam-electric generating plant at Colstrip, 100 miles east of Billings. The plant, to be completed in 1975, was to be located adjacent to the coal mine operations of Western Energy Co., from which coal has been supplied to markets in Montana and the Midwest.

Table 10.—Bituminous coal and lignite production, by type of mine and county¹

County	Number of mines			Production (thousand short tons)			Value (thousands)
	Underground	Strip	Total	Underground	Strip	Total	
Bituminous:							
Musselshell.....	4	2	6	20	61	81	W
Rosebud.....	--	2	2	--	6,657	6,657	W
Total.....	4	4	8	20	6,718	6,738	\$12,074
Lignite:							
Powder River.....	--	1	1	--	2	2	W
Richland.....	--	1	1	--	325	325	W
Total.....	--	2	2	--	327	327	743
Total Montana...	4	6	10	20	7,045	7,064	12,817

W Withheld to avoid disclosing individual company confidential data.

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

² Data does not add to total shown because of independent rounding.

Rosebud Coal Co., a subsidiary of Peter Kiewit & Co., intends to start a coal strip-mining operation in southeastern Montana in partnership with Pacific Power & Light Co. The section of State land near the Tongue River Reservoir is reported to contain a seam of coal averaging 60 feet in thickness.

Small mines in the Roundup area of Montana remained closed because of the enforcement of the Federal Mine Health and Safety Act of 1969.²

Petroleum and Natural Gas.—Recovery of crude petroleum declined 9 percent from the 1970 recovery of 37.9 million barrels. Petroleum represented about 36.5 percent of the State mineral production value. About 62 percent of the crude oil recovered came from six fields: The Bell Creek field (5.9 million barrels) in southeastern Montana's Powder River Basin; the Cabin Creek (3.5 million barrels), Pine (3.0 million barrels), and Pennel fields (1.7 million barrels) in the Williston Basin; the Cut Bank field (5.5 million barrels) in northern Montana; and the Elk Basin field (1.8 million barrels) in south central Montana.

The Bell Creek field continued as the largest source of petroleum in the State,

accounting for 5.9 million barrels, slightly above the 5.5 million barrels recovered from the Cut Bank field. However, the Bell Creek field operated at a significantly lower rate than in 1970. The Cut Bank field, Glacier and Toole Counties, remained the leading alltime-producing field in Montana. Its cumulative output was 129.1 million barrels, about 17 percent of total cumulative State production of 756.4 million barrels. The rate of production decline in the Bell Creek field should lessen during 1972 since the field has now been completely unitized for secondary recovery by water flooding.

Water flooding continued to be effective in central and northern Montana fields and in three additional flood projects in the Cut Bank field. Several discoveries in the Williston Basin indicate substantial reserves for that part of the State. Production in central Montana increased over 350,000 barrels in 1972 partly because of the discovery of a new field which taps the Tyler sandstone. This field was named the Jim Coulee and at the end of the year had a total of 12 productive wells.

² Ozman, Ray. Law "Killing" Small Coal Mines. Great Falls Tribune, July 11, 1971, p. 1.

Table 11.—Oil and gas well drilling completions, by county

County	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Big Horn	--	--	7	--	5	35	6	37,031
Blaine	--	--	2	--	--	4	8	90,586
Carbon	--	2	2	--	--	5	5	46,545
Carter	--	--	--	--	1	22	23	18,760
Chouteau	--	--	1	--	--	--	1	45,471
Custer	--	--	--	--	--	1	1	2,000
Daniels	--	--	--	--	--	2	3	8,920
Dawson	1	--	--	--	--	2	4	27,195
Fallon	2	--	--	--	--	8	8	36,632
Fergus	--	--	--	--	--	1	1	25,432
Gallatin	--	--	--	--	--	4	4	7,154
Garfield	--	--	4	--	--	6	13	22,266
Glacier	3	--	--	--	--	44	85	65,312
Hill	--	15	21	--	5	22	24	133,988
Liberty	--	--	2	--	--	11	17	68,070
McCone	2	--	2	2	--	1	1	109,627
Meagher	--	--	--	--	--	13	29	2,272
Musselshell	8	--	8	--	--	2	2	109,928
Petroleum	1	--	1	--	4	11	15	1,745
Phillips	2	--	--	--	--	5	9	37,655
Pondera	1	--	2	--	--	9	14	27,730
Powder River	3	--	2	--	--	4	10	80,293
Richland	5	--	--	1	--	9	11	125,501
Roosevelt	--	--	2	--	--	15	18	102,622
Rosebud	--	1	2	--	--	3	5	95,319
Sheridan	9	--	4	1	--	3	17	151,312
Stillwater	--	--	1	--	--	5	6	27,864
Sweet Grass	--	--	--	--	--	3	3	17,785
Teton	1	--	--	--	--	--	1	2,198
Toole	3	--	5	--	1	15	24	53,523
Treasure	--	--	--	--	--	1	1	6,764
Valley	--	--	--	--	--	12	12	51,229
Yellowstone	--	--	--	--	--	4	4	17,895
Total	41	17	66	4	16	283	427	1,656,624

Source: American Petroleum Institute.

Marketed production of natural gas amounted to 32.7 billion cubic feet, which represents the gross withdrawal less quantities used for repressuring, venting, and flaring. The Cut Bank and Reagan fields were the largest source of natural gas, followed by the Cedar Creek field. The Tiger Ridge Gas field in north-central Montana continued to be a "shut-in" field awaiting approval for an interstate pipeline outlet.

There were 427 wells drilled for oil and gas. Exploratory drilling totaled 303 wells of which four were oil discoveries, 16 were gas wells, and 283 were dry holes. Development drilling totaled 124 holes of which

41 were oil producers, 17 were gas producers, and 66 were dry holes. Exploratory and development drilling was most extensive in Blaine, Hill, and Musselshell Counties where a combined total of 161 wells were drilled. The average well depth in the State was 3,880 feet.

An estimated 45.0 million barrels of oil was refined in Montana at nine oil refineries. The three largest refiners, which processed 39.4 percent of the total refined, were Humble Oil & Refining Co. (14.6 million barrels), Continental Oil Co. (14.8 million barrels), and Farmer's Union Central Exchange, Inc. (10.0 million barrels).

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
METALS			
Aluminum:			
Anaconda Aluminum Co.	Columbia Falls, Montana 59912	Reduction plant	Flathead.
	Great Falls, Montana 59401	Rolling mill	Cascade.
Copper:			
The Anaconda Company ¹	Anaconda, Montana 59711	Smelter	Deer Lodge.
	Butte, Montana 59701	Mine, concentrator, precipitating plant.	Silver Bow.
	Great Falls, Montana 59401	Refinery, rolling mill.	Cascade.
Iron ore: R & S Iron Co.	Radersburg, Montana 59641	do	Broadwater.
Lead-zinc:			
American Smelting & Refining Co.	East Helena, Montana 59635	Smelter	Lewis and Clark.
The Anaconda Company	do	Slag fuming plant.	Do.
	Great Falls, Montana 59401	Zinc plant	Cascade.
John Hand ²	Dillon, Montana 59725	Mine	Beaverhead.
J. W. Keenan ²	Helena, Montana 59601	do	Lewis and Clark.
William Schneider ²	Philipsburg, Montana 59858	do	Granite.
Taylor-Knapp Co. ³	do	Mine and mill	Do.
Silver:			
Frank Antonioli ⁴	Butte, Montana 59701	Mine	Granite, Silver Bow.
Delbert Bullock ⁴	Basin, Montana 59631	do	Jefferson.
Flathead Mines, Inc. ⁵	Kalispell, Montana 59901	do	Flathead.
Harold Giulio ⁴	Boulder, Montana 59632	do	Jefferson.
Joe Metesh ⁶	Philipsburg, Montana 59858	do	Granite.
Moulton Mines ⁷	Niehart, Montana 59465	do	Broadwater.
Pacific Mines, Inc. ⁴	Virginia City, Montana 59755	do	Madison.
Tierra Explorations, Inc. ⁴	2003 Wilco Bldg. Midland, Texas 79701	do	Mineral.
Dick Tunstill ⁶	Philipsburg, Montana 59858	do	Deer Lodge, Granite.
Albert Walkup ⁶	do	do	Granite.
James W. Young ⁶	do	do	Do.
Tungsten: Minerals Engineering Co.	Glen, Montana 59732	Mine and mill	Beaverhead.
NONMETALS			
Cement:			
Ideal Cement Co.	420 Ideal Cement Bldg. Denver, Colorado 80202	Plant	Gallatin.
Kaiser Cement & Gypsum Corp.	Permanente Road Permanente, California 95014	do	Jefferson.
Clays:			
Hallett Minerals Co.	P.O. Box 491 Forsyth, Montana 59327	Pit	Rosebud, Treasure.
Ideal Cement Co., Division of Basic Industries Inc.	420 Ideal Cement Bldg. Denver, Colorado 80202	Pit and plant	Gallatin.
Kanta Products, Inc.	P.O. Box 96 Three Forks, Montana 59752	do	Do.
Kaiser Cement & Gypsum Corp.	Permanente Road Permanente, California 95014	do	Jefferson.

See footnotes at end of table.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
NONMETALS—Continued			
Clays—Continued			
Lewistown Brick & Tile Co.-----	P.O. Box 573 Lewistown, Montana 59457	Pit and plant..	Fergus.
Lovell Clay Products Co.-----	1312 Lockwood Road Billings, Montana 59101	....do-----	Yellowstone.
Baroid Division N L Industries, Inc	P.O. Box 1675 Houston, Texas 77001	Pit.-----	Carter.
Stauffer Chemical Co.-----	P.O. Box 3146 Butte, Montana 59701	Pit and plant..	Silver Bow.
Treasurelite, Division of Treasure State Industries, Inc.	P.O. Box 2750 Great Falls, Montana 59401	....do-----	Cascade.
Fluorspar: Roberts Mining Co.-----	P.O. Box 365 Darby, Montana 59829	Mine and plant.	Ravalli.
Gypsum:			
United States Gypsum Co.-----	Lewistown, Montana 59457.....	Underground mine and calcining plant.	Fergus.
Lime: The Anaconda Company-----	Butte, Montana 59701-----	Plant.-----	Deer Lodge.
Phosphate rock:			
Cominco American, Inc.-----	Garrison, Montana 59731-----	Mine and plant.	Powell.
A. G. Jackson-----	Elliston, Montana 59728-----	Mine.-----	Do.
Stauffer Chemical Co.-----	299 Park Avenue New York, New York 10017	Plant.-----	Silver Bow.
Sand and gravel:			
Midland Materials Co.-----	Box 2521 Billings, Montana 59103	Pit.-----	Yellowstone.
MS Ready Mix.-----	Box 1501 Missoula, Montana 59801	Pit.-----	Missoula.
Oscar J. Mortenson-----	Cascade, Montana 59421-----	Pit.-----	Cascade.
Barry O'Leary-----	Box 1102 Billings, Montana 59103	Pit.-----	Yellowstone.
Pioneer Ready Mix.-----	Box 813 Bozeman, Montana 59715	Pit.-----	Gallatin.
Richardson Construction Co.-----	Box 449 Miles City, Montana 59301	Pit.-----	Various.
Stone:			
The Anaconda Company-----	Anaconda, Montana 59711-----	Quarry and plant.	Deer Lodge.
Ideal Cement Co.-----	420 Ideal Cement Bldg. Denver, Colorado 80202	....do-----	Gallatin.
Kaiser Cement & Gypsum Corp.---	Permanente Road Permanente, California 95014	....do-----	Jefferson.
Morrison-Knudsen Co. Inc.-----	Seattle, Washington 98101-----	Pit and plant..	Lincoln.
Sulfur:			
Farmer's Union Central Exchange, Inc.	P.O. Box 126 Laurel, Montana 59044	Plant.-----	Yellowstone.
Montana Sulphur & Chemical Co.	P.O. Box 1084 Billings, Montana 59103	....do-----	Do.
Sulfuric acid:			
The Anaconda Company-----	Anaconda, Montana 59711-----	....do-----	Deer Lodge.
Talc and soapstone:			
Pfizer, Inc.-----	Dillon, Montana 59725-----	....do-----	Beaverhead.
United Sierra Division of Cyprus Mines Corp.	Cameron, Montana 59720-----	....do-----	Madison.
	Three Forks, Montana 59752-----	Plant.-----	Gallatin.
Vermiculite: W. R. Grace & Co.-----	62 Whittemore Avenue Cambridge, Massachusetts 01109	Pit and plant..	Lincoln.
Exfoliated vermiculite:			
Robinson Insulation Co.-----	12th St. N. & River Drive Great Falls, Montana 59401	Plant.-----	Cascade.
MINERAL FUELS			
Coal:			
Divide Coal Mining Co.-----	P.O. Box 342 Roundup, Montana 59072	Mine.-----	Musselshell.
Knife River Coal Mining Co.-----	Savage, Montana 59262-----	....do-----	Richland.
Nies Coal Co.-----	905 First St. W Roundup, Montana 59072	....do-----	Musselshell.
Peabody Coal Co.-----	Box 235 St. Louis, Missouri 63166	....do-----	Rosebud.
P & M Coal Mine.-----	Goulding Creek Route Roundup, Montana 59072	....do-----	Musselshell.
John H. Schoonover-----	P.O. Box 94 Ashland, Montana 59003	....do-----	Powder River.
Square Deal Coal Co.-----	220 7th St. W Roundup, Montana 59072	....do-----	Musselshell.
Western Energy Co.-----	40 E. Broadway Butte, Montana 59701	....do-----	Rosebud.

See footnotes at end of table.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
MINERAL FUELS—Continued			
Natural gas processing:			
Union Texas Petroleum Division, Allied Chemical Corp.	P.O. Box 2120 Houston, Texas 77001	Plant	Fallon.
Westco Refining Co.	Box 318 Cut Bank, Montana 59427	do	Glacier.
Peat: Martin's Peat & Potting Soils	Swan Lake, Montana 59872	Bog	Lake.
Petroleum refining:			
Big West Oil Co. of Montana	Kevin, Montana 59454	Refinery	Toole.
Continental Oil Co.	Billings, Montana 59101	do	Yellowstone.
Diamond Asphalt Co.	Chinook, Montana 59523	do	Blaine.
Farmer's Union Central Exchange, Inc.	Laurel, Montana 59044	do	Yellowstone.
Humble Oil & Refining Co.	Billings, Montana 59101	do	Do.
Jet Fuel Refinery	Mosby, Montana 59058	do	Garfield.
Phillips Petroleum Co.	Great Falls, Montana 59401	do	Cascade.
Spruce Oil Corp.	Wolf Point, Montana 59201	do	Roosevelt.
Westco Refining Co.	Box 318 Cut Bank, Montana 59427	do	Glacier.

¹ Also gold and silver. ² Also copper, gold, and silver. ³ Also silver. ⁴ Also copper, gold, lead, and zinc.
⁵ Also copper, lead, and zinc. ⁶ Also copper and gold. ⁷ Also lead and zinc.

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 Donald E. Eilertsen¹ and Raymond R. Burchett²

Nebraska's total mineral production value of \$74.08 million in 1971, consisting of nonmetallic minerals and fuels, was 2 percent larger than that of 1970 and almost 32 percent less than the record high of 1962. The 2-percent increase in mineral production value over that of 1970 was attributed to gains in the value of nonmetallic minerals, especially those of cement, sand and gravel, stone, and lime.

Natural gas production and value were the smallest in over 20 years. Petroleum production was the smallest in 17 years and the value the smallest in 16 years.

The Conservation and Survey Division of the University of Nebraska investigated the Elk Creek gravity and magnetic anomaly which has a circular area of approximately 12 square miles in Johnson and Pawnee Counties. A hole was drilled to a depth of 703 feet and 15 samples of core were ob-

tained, at various footages between 629 and 703 feet, for petrographic and chemical analyses. Petrographically, the rocks consisted primarily of dolomite with ankerite, hematite, chlorite, phlogophite, barite, and quartz and smaller quantities of pyrite, chalcopyrite, galena, serpentine, and possible feldspar, apatite, and fluorite. X-ray fluorescence spectrometer analyses showed the presence of barium, columbium, strontium, zinc, copper, iron, titanium, manganese, and nickel in almost every sample. The analyses also showed that some rare-earth elements also were present—up to 1.1 percent cerium, up to 0.34 percent lanthanum, and traces of europium. This mineral data suggested that

¹ Physical scientist, Division of Nonmetallic Minerals.

² Research geologist, Nebraska Geological Survey.

Table 1.—Mineral production in Nebraska¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays..... thousand short tons..	90	\$147	69	\$82
Gem stones.....	NA	5	NA	10
Lime..... thousand short tons..	27	W	29	W
Natural gas (marketed)..... million cubic feet..	5,991	1,024	3,496	612
LP gases..... thousand 42-gallon barrels..	365	855	W	W
Petroleum (crude)..... do	11,451	35,384	10,062	34,010
Sand and gravel..... thousand short tons..	12,232	12,974	13,224	13,626
Stone..... do	4,265	7,378	4,174	7,392
Value of items that cannot be disclosed: Cement, natural gasoline and cycle products, pumice, and values indicated by symbol W.....	XX	14,887	XX	17,847
Total.....	XX	72,657	XX	74,079
Total 1967 constant dollars.....	XX	64,992	XX	P 64,360

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

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

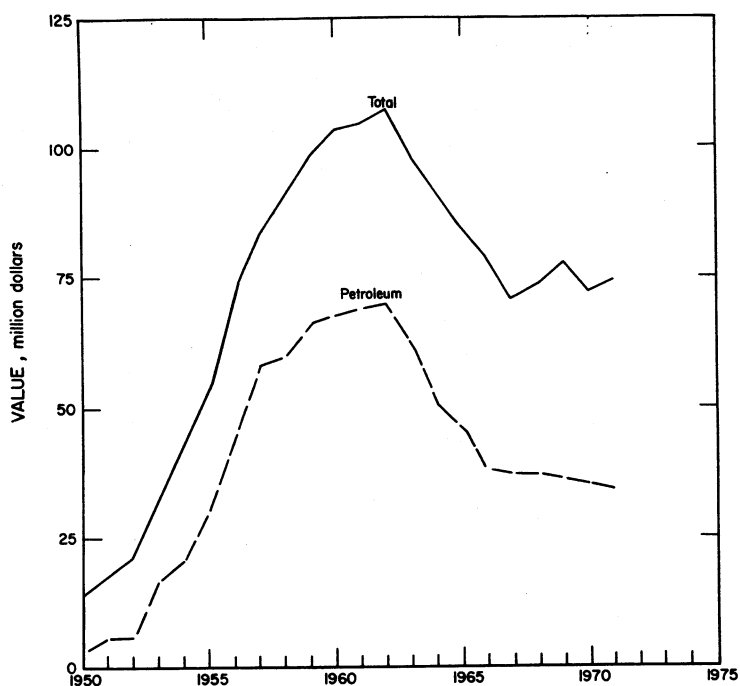


Figure 1.—Value of petroleum and total value of mineral production in Nebraska.

Table 2.—Value of mineral production in Nebraska, by county¹
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Adams.....	W	W	Sand and gravel.
Antelope.....	W	\$121	Do.
Banner.....	\$4,148	3,853	Petroleum, sand and gravel, natural gas.
Blaine.....	--	8	Sand and gravel.
Boone.....	W	--	
Boyd.....	W	--	
Brown.....	140	W	Sand and gravel.
Buffalo.....	430	508	Do.
Butler.....	333	W	Do.
Cass.....	14,978	16,279	Cement, stone, sand and gravel.
Cedar.....	W	223	Sand and gravel.
Chase.....	10	3	Do.
Cherry.....	W	--	
Cheyenne.....	W	W	Petroleum, natural gas liquids, natural gas, sand and gravel.
Clay.....	W	61	Sand and gravel.
Colfax.....	170	81	Do.
Cuming.....	476	618	Do.
Custer.....	63	90	Do.
Dakota.....	W	9	Do.
Dawson.....	384	369	Do.
Deuel.....	W	W	Natural gas, sand and gravel.
Dixon.....	W	W	Sand and gravel, stone.
Dodge.....	637	423	Sand and gravel.
Douglas.....	W	W	Sand and gravel, clays.

See footnotes at end of table.

Table 2.—Value of mineral production in Nebraska, by county 1—Continued

(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Dundy	\$7	\$10	Petroleum, sand and gravel.
Fillmore	22	—	—
Franklin	W	76	Sand and gravel.
Frontier	242	247	Petroleum, natural gas.
Furnas	W	W	Sand and gravel, petroleum.
Gage	W	W	Sand and gravel, stone.
Garden	W	40	Petroleum, sand and gravel.
Hall	247	224	Sand and gravel.
Hamilton	49	2	Do.
Harlan	W	W	Petroleum, sand and gravel.
Hayes	W	W	Sand and gravel.
Hitchcock	608	W	Petroleum, sand and gravel.
Holt	241	399	Sand and gravel.
Hooker	W	—	—
Howard	W	W	Sand and gravel.
Jefferson	W	W	Sand and gravel, clays.
Johnson	W	W	Stone, sand and gravel.
Kearney	25	28	Sand and gravel.
Keith	71	97	Do.
Keya Paha	1	2	Do.
Kimball	7,474	7,560	Petroleum, natural gas liquids, natural gas, sand and gravel.
Knox	139	155	Sand and gravel.
Lancaster	250	255	Stone, clays, sand and gravel.
Lincoln	W	W	Sand and gravel, petroleum, pumice.
Loup	W	35	Sand and gravel.
McPherson	W	W	Do.
Madison	445	W	Do.
Merrick	W	W	Do.
Morrill	W	W	Petroleum, sand and gravel, lime, natural gas.
Nance	182	W	Sand and gravel.
Nemaha	W	W	Stone.
Nuckolls	W	W	Cement, sand and gravel.
Otoe	W	W	Clays.
Pawnee	W	W	Stone.
Perkins	14	9	Sand and gravel.
Phelps	W	W	Do.
Pierce	43	75	Do.
Platte	W	W	Do.
Polk	77	W	Do.
Red Willow	13,396	12,678	Petroleum, sand and gravel.
Richardson	W	234	Petroleum, stone.
Rock	1	1	Sand and gravel.
Saline	W	166	Do.
Sarpy	W	W	Stone, sand and gravel.
Saunders	W	W	Sand and gravel, stone.
Scotts Bluff	W	W	Petroleum, lime, sand and gravel, natural gas.
Seward	W	W	Stone.
Sherman	21	—	—
Stanton	W	W	Sand and gravel.
Thayer	195	W	Do.
Thomas	W	W	Do.
Thurston	W	—	—
Valley	W	W	Sand and gravel.
Washington	W	W	Stone.
Webster	65	14	Sand and gravel.
Wheeler	W	W	Do.
York	126	W	Do.
Undistributed ²	26,946	29,119	—
Total ³	72,657	74,079	—

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

¹ The following counties are not listed because no production was reported: Arthur, Box Butte, Burt, Dawes, Garfield, Gosper, Grant, Greeley, Logan, Sheridan, Sioux, and Wayne.

² Includes gem stones, some sand and gravel, and some stone which cannot be assigned to specific counties.

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

the basement rocks associated with the Elk Creek anomaly are carbonatites.³

Later, the U.S. Bureau of Mines supported the deepening of the core hole from 703 feet to 952 feet. Preliminary analysis indicated that this section of core was similar to core previously sampled.

The Conservation and Survey Division

(Nebraska Geological Survey) also initiated a mineral resource inventory program

³ Treves, S. B., Russell Smith, M. P. Carlson, and George Coleman. The Elk Creek Carbonatite, Johnson and Pawnee Counties, Nebraska. Abstracts With Programs, Geol. Soc. Amer., v. 4, No. 4, February 1972, p. 297.

Treves, S. B., Russell Smith, Jon Rinehart, George Coleman, and M. P. Carlson. Petrology and Mineralogy of the Elk Creek Carbonatite, Nebraska. Abstracts With Programs, Geol. Soc. Amer., v. 4, No. 5, March 1972, pp. 352-353.

to obtain information on active and abandoned quarries, pits, and mines utilizing information from the Soil Conservation Service, the Nebraska Department of Roads Materials Division, and information available through field investigations by the Nebraska Geological Survey.

A report describing the diatomaceous sediments in outcrops on the Pine Ridge escarpment, Sioux County, Nebraska, 2 to 10 miles southwest of Crawford, was published.⁴

⁴ Andrews, George W. Early Miocene Nonmarine Diatoms From the Pine Ridge Area, Sioux County, Nebraska. U.S. Geol. Surv. Prof. Paper 683-E, 1971, 21 pp.

Table 3.—Indicators of Nebraska business activity

	1970 ^r	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force.....	670.8	682.7	+1.8
Unemployment.....	18.7	22.9	+22.5
Employment.....	482.1	488.0	+1.2
Mining.....	1.6	1.6	--
Construction.....	24.6	24.5	-.4
Manufacturing.....	85.0	82.9	-2.5
Government.....	101.0	105.3	+4.3
Other nonagricultural employment ¹	269.9	273.8	+1.4
Personal income:			
Total.....	\$5,570.0	\$6,045.0	+8.5
Per capita.....	\$3,738	\$3,998	+7.0
Construction activity:			
Value of nonresidential construction.....	\$63.6	\$80.6	+26.7
Number of new housing units.....	8,014	12,977	+61.9
Cement shipments to and within the State.....	4,437	4,463	+6
Mineral production value.....	\$72.7	\$74.1	+1.9

^p Preliminary. ^r Revised.

¹ Includes services; wholesale and retail trade; finance, insurance, and real estate; transportation; and public utilities.

Sources: Area Trends in Employment and Unemployment, Survey of Current Business, Employment and Earnings, Construction Review, and the U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Metal.....	2	10	(1)	(1)	--	--	--	--
Nonmetal.....	14	207	3	23	--	--	--	--
Sand and gravel.....	830	212	176	1,641	--	17	10.36	137
Stone.....	600	287	172	1,476	--	31	21.01	338
Total ²	1,446	243	352	3,140	--	48	15.29	231
1971:^p								
Metal.....	(3)	10	(1)	(1)	--	--	--	--
Nonmetal.....	15	205	3	23	--	--	--	--
Sand and gravel.....	880	209	184	1,715	--	31	18.08	996
Stone.....	590	296	157	1,344	--	34	25.30	2,631
Total ²	1,430	241	344	3,082	--	65	21.09	1,701

^p Preliminary.

¹ Less than 1/2.

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

³ Less than 3.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Slightly more cement was produced in 1971 than in 1970. Cement was produced by Ash Grove Cement Co. near

Louisville, Cass County, and Ideal Cement Co. near Superior, Nuckolls County. Cement consumption in the State in 1971 was 4,463,000 376-pound barrels of portland ce-

ment and 81,000 280-pound barrels of masonry cement.

Ash Grove Cement Co. began construction of a modern multimillion-dollar cement plant adjacent to its existing plant. The new plant will replace the old plant, in operation since 1929, and will meet State pollution control regulations. The work will be done in three phases; the first phase was scheduled for completion by December 1972.

Clays.—Three firms produced clay and another firm produced shale in Nebraska in 1971. Total production declined 23 percent from 1970, to 69,401 tons valued at \$82,358, the lowest in over 20 years. The following firms produced clay and made building brick: Endicott Clay Products Co. near Endicott, Jefferson County; Omaha Brick Works near Ralston, Douglas County; and Yankee Hill Brick Manufacturing Co. near Lincoln, Lancaster County. Western Brick & Aggregate Co., near Nebraska City, Otoe County, produced shale for brick, tile and lightweight aggregate.

Fertilizer Materials.—Consumption of fertilizers in Nebraska during crop year 1971, which ended June 30, 1971, was 1.35 million tons, compared with 1.24 million tons in crop year 1970 (12th in national ranking for both years).⁵

Nitrogen is the only one of the three principal fertilizer materials produced in the State; phosphorus and potassium source materials are obtained elsewhere. Anhydrous ammonia (NH₃) production was 554,496 tons in 1970, compared with 542,866 tons in 1969.⁶ According to the Tennessee Valley Authority, the following four firms produced anhydrous ammonia: Phillips Petroleum Co. at Beatrice, with 210,000 tons of NH₃ capacity per year; Allied Chemical Corp., at La Platte, with 202,000 tons capacity; Farmland Industries, Inc., at Hastings, with 140,000 tons capacity; and CF Industries, Inc., at Fremont with 48,000 tons capacity.

Shipments of domestic and imported potash salts (K₂O) into Nebraska in 1971 were 38,096 tons of K₂O equivalent for agricultural purposes (26th in national ranking on deliveries) and 167 tons of K₂O equivalent for chemical purposes (33rd in national ranking on deliveries). Of the agricultural potash, 8.7 percent was in the form of standard potassium muriate, 33.0

percent as coarse potassium muriate, 30.3 percent as granular potassium muriate, 17.5 percent as soluble potassium muriate, and 10.5 percent as potassium-magnesium sulfate. The industrial potash was all potassium muriate.⁷

Gypsum.—A report was published describing the extensive gypsum deposit discovered in Nemaha County in 1970.⁸ The deposit is about 10 feet thick, extends over an area of approximately 118 square miles, and in one place is less than 100 feet below surface. The report describes test hole cores and discusses the geology and structure of the gypsum deposit.

Lime.—Great Western Sugar Co. produced lime near Bayard, Morrill County, and near Gering, Mitchell, and Scottsbluff, Scotts Bluff County. The company used limestone from its quarry in Wyoming to make lime. The lime was used to refine beet sugar. Lime production sold or used in 1971 was 28,987 tons, compared with 26,871 tons in 1970.

Apparent consumption of lime in Nebraska in 1971 was 54,000 tons, compared with 43,000 tons in 1970.

Perlite.—W. R. Grace & Co., Zonolite Division, produced expanded perlite near Omaha from out-of-State crude perlite. The quantity of expanded perlite sold or used in 1971 was much less than that of 1970; major uses were as aggregate for plaster, horticulture, and concrete.

Pumice.—LaRue Axtell Pumice Co. produced pumice at its LeMaster strip mine near Arnold, Lincoln County. The pumice was used to produce cleansing and scouring compounds and hand soaps.

Sand and Gravel.—Nebraska's production of 13.22 million tons of sand and gravel in 1971 was the third largest quantity ever produced in the State. This year's production was 9.7 percent below the rec-

⁵ U.S. Department of Agriculture, Commercial Fertilizers—Consumption in the United States, Fiscal Year Ended June 30, 1971. No. SpCr7, May 1972, 26 pp.

⁶ U.S. Department of Commerce, Bureau of Census, Current Industrial Reports, Inorganic Chemicals 1970. No. M28A(70)-14, June 1972, 35 pp.

⁷ Potash Institute of North America, Atlanta, Ga. Deliveries of Potash Salts, Calendar Year and Fourth Quarter 1971. Press Release E-213, February 1972, 12 pp.

⁸ Burchett, R. R. Occurrence of Gypsum in Johnson Shale (Permian) in Nemaha County, Nebraska. University of Nebraska, Conservation and Survey Division, Resource Rept. No. 3, November 1970, 23 pp.

ord high of 14.64 million tons produced in 1964. Nationally, Nebraska ranked 24th in the production of sand and gravel in 1971 and accounted for 1.44 percent of the national output, compared with the rank of 30th largest producer in 1970 accounting for 1.30 percent of the national output. The average value of sand and gravel in 1971 was \$1.030 per ton, compared with \$1.061 per ton in 1970.

Five companies accounted for 39 percent of the total production of sand and gravel. In alphabetical order they are Central Sand & Gravel Co. in Butler, Hall, Madison, Pierce, and Platte Counties; Hartford Sand & Gravel Co. in Dodge and Douglas

Counties; Lyman-Richey Sand & Gravel Corp. in Cass, Dodge, Douglas, Morrill, Platte, Sarpy, and Saunders Counties; McCann Sand & Gravel Co. in Douglas County; and Western Sand & Gravel Co. in Cass and Saunders Counties.

Of 12.6 million tons of sand and gravel produced by 245 commercial operations in Nebraska in 1971, 12 percent was produced at 116 plants, each producing less than 25,000 tons; 17 percent at 59 plants, each producing between 25,000 and 50,000 tons; 21 percent at 39 plants, each producing between 50,000 and 100,000 tons; and 50 percent at 31 plants, each producing over 100,000 tons.

Table 5.—Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Antelope.....	4	93	W	5	131	\$121
Banner.....	1	46	\$23	1	39	29
Blaine.....	--	--	--	1	7	8
Brown.....	6	72	140	4	W	W
Buffalo.....	11	787	430	14	645	508
Butler.....	4	286	333	3	W	W
Cedar.....	2	W	W	5	188	223
Chase.....	1	20	10	1	14	3
Clay.....	2	W	W	1	35	61
Colfax.....	4	141	170	4	111	81
Cuming.....	5	435	476	7	552	618
Custer.....	4	84	63	4	100	90
Dakota.....	2	W	W	1	13	9
Dawson.....	11	468	384	11	455	369
Deuel.....	2	W	W	2	40	35
Dodge.....	10	473	637	9	357	423
Douglas.....	10	1,903	2,503	9	2,399	2,553
Dundy.....	1	3	3	1	4	3
Fillmore.....	1	5	22	--	--	--
Franklin.....	3	W	W	5	92	76
Garden.....	2	W	W	3	38	10
Hall.....	8	298	247	7	312	224
Hamilton.....	1	49	49	1	53	2
Hitchcock.....	4	29	32	2	W	W
Holt.....	8	278	241	10	331	399
Jefferson.....	8	253	301	6	W	W
Johnson.....	1	4	12	1	2	7
Kearney.....	1	50	25	1	59	23
Keith.....	4	100	71	8	154	97
Keya Paha.....	1	4	1	2	2	2
Kimball.....	2	83	17	2	36	8
Knox.....	10	142	139	11	160	155
Lincoln.....	7	W	118	4	W	W
Loup.....	2	W	W	3	41	35
Madison.....	8	395	445	8	W	W
Nuckolls.....	2	W	W	1	W	32
Perkins.....	2	73	14	2	23	9
Phelps.....	2	143	W	2	149	W
Pierce.....	1	38	43	3	W	75
Platte.....	6	639	W	6	711	W
Polk.....	4	65	77	2	W	W
Red Willow.....	5	105	90	5	121	143
Rock.....	1	1	1	1	1	1
Saline.....	4	W	W	5	142	166
Sarpy.....	9	553	510	7	500	467
Saunders.....	9	1,048	1,015	9	1,273	1,293
Scotts Bluff.....	6	241	236	4	228	209
Sherman.....	3	10	21	--	--	--

Table 5.—Sand and gravel sold or used by producers, by county—Continued
(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Thayer.....	6	139	\$195	1	W	W
Washington.....	1	8	34	--	--	--
Webster.....	4	W	65	1	18	\$14
York.....	4	109	126	5	W	W
Undistributed ¹	53	2,555	3,658	57	3,687	5,023
Total².....	273	12,232	12,974	268	13,224	13,626

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

¹ Includes Adams, Boone (1970), Boyd (1970), Cass, Cherry (1970), Cheyenne, Dixon, Furnas, Gage, Harlan, Hayes, Hooker (1970), Howard, Lancaster, McPherson, Merrick, Morrill, Nance, Stanton, Thomas, Valley, and Wheeler Counties, and some sand and gravel that cannot be assigned to specific counties.

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

Table 6.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	2,591	\$2,709	2,705	\$2,543
Fill.....	699	608	494	427
Paving.....	1,477	1,658	1,788	2,058
Railroad ballast.....	2	2	--	--
Other uses ¹	17	17	40	34
Total².....	4,787	4,994	5,027	5,062
Gravel:				
Building.....	325	364	995	1,043
Fill.....	298	160	162	138
Paving.....	5,055	5,758	5,862	6,462
Miscellaneous.....	209	175	W	W
Other uses ³	127	113	528	514
Total².....	6,514	7,071	7,548	8,156
Government-and-contractor operations:				
Sand:				
Fill.....	11	5	--	--
Paving.....	96	181	75	30
Total².....	107	187	75	30
Gravel:				
Building.....	29	44	36	4
Fill.....	38	25	--	--
Paving.....	748	630	447	243
Other uses.....	9	25	90	131
Total².....	824	722	573	377
Total sand and gravel.....	12,232	12,974	13,224	13,626

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

¹ Includes blast sand (1970) and other underground sand (1971).

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

³ Includes miscellaneous (1971), railroad ballast (1970), and other gravel.

Stone.—Limestone was the only stone produced in Nebraska. Dimension and crushed and broken stone were produced at 28 quarries in approximately 12 of the State's 93 counties. Of the total production, 4 percent was produced at 11 quarries, each producing up to 50,000 tons; 10

percent at 7 quarries, each producing between 50,000 and 75,000 tons; 13 percent at 4 quarries, each producing between 75,000 and 200,000 tons; and 73 percent at 6 quarries, each producing over 200,000 tons. The average value of limestone was \$1.89 per ton in 1971, compared with \$1.73 per

Table 7.—Limestone sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Dimension stone total	(1)	\$8	6	\$75
Crushed and broken stone:				
Dense graded road base stone.....	341	632	1,536	2,984
Macadam aggregate.....	52	101	--	--
Surface treatment aggregate.....	W	W	248	555
Unspecified aggregate and roadstone.....	17	29	W	W
Agricultural lime.....	216	401	119	225
Riprap.....	757	1,172	W	W
Other uses ²	2,881	5,039	2,265	4,102
Crushed total ³	4,264	7,375	4,168	7,817
Grand total ³	4,265	7,378	4,174	7,892

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

¹ Less than ½ unit.² Includes stone used in asphalt filler, bituminous aggregate, concrete aggregate, cement, poultry grit, whiting, and dam construction (1971).³ Data may not add to totals shown because of independent rounding.

ton in 1970. Nebraska ranked 34th among the States in stone output in 1971 and accounted for 0.48 percent of the national output compared with ranking 35th and producing 0.49 percent of the national output in 1970.

Talc.—The United Sierra Division of Cyprus Mines Corp. produced ground talc at its plant near Grand Island. The talc came from company mines in Montana and California and from another firm in California. The total quantity of ground talc sold or used was slightly less than that of 1970; the material was prepared for export and also for uses such as in the manufacture of ceramics, insecticides, paint, paper, rubber, textiles, and toilet articles.

Vermiculite.—W. R. Grace & Co., Construction Products Division, produced exfoliated vermiculite near Omaha from out-of-State crude vermiculite. The quan-

tity sold was slightly more than that of 1970. The material was used principally in loose fill insulation, concrete and plaster aggregate, and horticulture.

MINERAL FUELS

The Nebraska Oil and Gas Conservation Commission issued 249 permits to drill for oil and gas in 1971. Of these permits, 150 were for exploration in 20 counties, principally in Cheyenne (39), Banner (25), and Kimball (21); 96 were for development in eight counties, mostly in Cheyenne (43) and Red Willow (21), and three were for drilling at facilities in Kimball County. Drilling data on oil and gas well exploration and development completions in 1971 are shown in table 8.

The number and location of active and capped oil and dry gas wells in Nebraska at yearend are shown in table 9.

Table 8.—Oil and gas well drilling completions, by county—1971

County	Oil	Gas	Dry	Total	Footage
Exploratory completions:					
Antelope.....	--	--	1	1	3,085
Banner.....	1	--	12	13	75,773
Cheyenne.....	2	--	21	23	117,532
Custer.....	--	--	3	3	10,709
Dawson.....	--	--	1	1	3,777
Deuel.....	--	--	2	2	7,048
Dundy.....	--	--	2	2	10,692
Franklin.....	--	--	1	1	3,233
Frontier.....	--	--	1	1	3,840
Garden.....	--	--	5	5	17,193
Hayes.....	--	--	1	1	4,444
Hitchcock.....	--	--	1	1	4,210
Keith.....	--	--	1	1	3,285
Kimball.....	1	--	16	17	108,231
Morrill.....	1	--	13	14	62,073

Table 8.—Oil and gas well drilling completions, by county—1971—Continued

County	Oil	Gas	Dry	Total	Footage
Exploratory completions—Continued					
Phelps			1	1	3,925
Red Willow	2		6	8	29,577
Scotts Bluff			8	8	42,317
Sioux			2	2	7,194
Washington			2	2	4,428
Total	7		100	107	522,566
Development completions:					
Banner	2		3	5	30,532
Cheyenne	15	1	19	35	174,057
Hayes			1	1	4,713
Kimball	1		9	10	64,752
Morrill	3		3	6	27,452
Red Willow	18		3	21	74,552
Richardson	1			1	2,280
Scotts Bluff			1	1	4,603
Total	40	1	39	80	382,946
Total all drilling	47	1	139	187	905,512

Source: American Petroleum Institute.

Table 9.—Number of active and capped oil and dry gas wells at yearend 1971

County	Oil wells		Dry gas wells	
	Active	Capped	Active	Capped
Banner	192	120		
Cheyenne	233	10	20	3
Deuel			8	6
Dundy	1			
Frontier	10	1		
Furnas	1	2		
Garden	2			
Harlan	8	5		
Hitchcock	32	11		
Kimball	309	236	1	1
Lincoln	2	1		
Morrill	67	23		
Red Willow	286	120		
Richardson	16	18		
Scotts Bluff	32	5		
Total	1,191	557	29	10

Source: Nebraska Oil and Gas Conservation Commission.

Natural Gas.—According to the Nebraska Oil and Gas Conservation Commission, 4,955 million cubic feet of natural gas was produced in Nebraska in 1971. It consisted of 2,969 million cubic feet of dry gas, principally methane, and 1,986 million cubic feet of casinghead gas, mostly butane and propane. The dry gas was produced in Cheyenne (68.3 percent), Deuel (25.6 percent), and Kimball Counties (6.1 percent). The casinghead gas was produced in six counties, Cheyenne (57.7 percent), Kimball County (24.5 percent), and the remainder (17.8 percent) in Banner, Morrill, Scotts Bluff, and Frontier. Of the total production of natural gas, the marketed production was 3,496 million cubic feet valued at

\$612,000. The marketed production of natural gas declined for the 10th consecutive year, 41.7 percent less than that of 1970 and 77.8 percent below the record high of 1961.

At yearend the proved reserve of natural gas was 59,433 million cubic feet. This consisted of 19,511 million cubic feet of dry gas, 20,674 million cubic feet of casinghead gas, and 19,248 million cubic feet of gas in underground storage.⁹

⁹ American Gas Association, Inc., American Petroleum Institute, and Canadian Petroleum Association. Reserves of Crude Oil, Natural Gas Liquids and Natural Gas in the United States and Canada and United States Productive Capacity as of Dec. 31, 1971, v. 26, May 1972, 248 pp.

Natural Gas Liquids.—Production and value of liquid petroleum (LP) gases in 1971 and natural gasoline and cycle products in 1970-71 were withheld from publication to avoid disclosure of company confidential data.

Yearend proved reserves of natural gas liquids in Nebraska were estimated at 1.42 million barrels, compared with 1.86 million barrels at yearend 1970.¹⁰

Petroleum.—A total of 10.06 million barrels of crude oil valued at \$34.01 million was produced in Nebraska in 1971. This

production was the lowest since 1954 and 59.6 percent less than the record high of 24.89 million barrels produced in 1962. Data on crude oil production by counties are shown in table 10 and production data of the 25 largest fields are shown in table 11.

The estimated yearend reserves of crude oil in Nebraska were 36.1 million barrels, compared with 40.9 million barrels at yearend 1970.¹¹

¹⁰ Work cited in footnote 9.

¹¹ Work cited in footnote 9.

Table 10.—Crude petroleum production, by county

(Thousand 42-gallon barrels)

County	1970	1971	Principal fields
Banner.....	1,385	1,125	Singleton, Johnson, Harrisburg, Willson Ranch.
Cheyenne.....	1,811	1,859	Southwest Sidney, Graff, Southwest Potter, Doran, West Engelland.
Dundy.....	1	2	East Indian Creek, Rock Canyon.
Frontier.....	79	73	Bed Canyon. ¹
Furnas.....	6	5	Southwest Wilsonville.
Garden.....	9	9	Richards and McCord.
Harlan.....	27	40	South Alma.
Hitchcock.....	186	159	Reiher.
Kimball.....	2,414	1,979	Sloss, Enders, Bertramson, Axial, Houtby, Fernquist, Jacinto.
Lincoln.....	1	5	Red Willow Creek.
Morrill.....	551	499	Bridgeport.
Red Willow.....	4,306	3,707	Sleepy Hollow, Ackman, Silver Creek, Northwest Sleepy Hollow, Bed Canyon. ¹
Richardson.....	63	50	Dawson, Falls City, Barada.
Scotts Bluff.....	662	550	Cedar Valley, Minatare.
Total.....	11,451	10,062	

¹ Partly in Frontier and Red Willow counties.

Source: Production figures from Nebraska Oil and Gas Conservation Commission.

Table 11.—Crude oil production in the 25 largest fields in 1971

(42-gallon barrels)

Field	County	Annual output	Average daily output
Sleepy Hollow.....	Red Willow	2,949,440	8,081
Cedar Valley.....	Scotts Bluff	323,810	887
Ackman.....	Red Willow	243,212	666
Southwest Sidney.....	Cheyenne	223,779	613
Silver Creek.....	Red Willow	217,803	597
Bridgeport.....	Morrill	211,555	580
Singleton.....	Banner	191,129	524
Sloss.....	Kimball	160,684	440
Enders.....	do	136,644	374
West Engelland.....	Cheyenne	121,131	332
Margate.....	do	117,018	321
Bertramson.....	Kimball	103,477	283
Johnson.....	Banner	103,355	283
Axial.....	Kimball	100,338	275
Reiher.....	Hitchcock	97,683	268
Minatare.....	Scotts Bluff	93,655	257
Southwest Potter.....	Cheyenne	87,352	239
Bed Canyon.....	Frontier and Red Willow	85,731	235
Houtby.....	Kimball	83,605	229
Northwest Sleepy Hollow.....	Red Willow	82,348	227
Graff.....	Cheyenne	79,461	213
Jormar.....	do	77,574	213
Filon.....	do	73,033	200
Willson Ranch.....	Banner	71,144	195
Harrisburg.....	do	71,069	195

Source: Nebraska Oil and Gas Conservation Commission.

METALS

No metallic minerals were mined in Nebraska. However, antimony, bismuth, gold,

lead, and silver were recovered from out-of-State lead bullion and other smelter products by American Smelting and Refining Co. at its Omaha refinery.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ash Grove Cement Co.....	1000 Tenmain Center Kansas City, Mo. 64105	Wet process, 6-rotary kiln plant.	Cass.
Ideal Cement Co., a division of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	Wet process, 2-rotary kiln plant.	Nuckolls.
Clays:			
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 Manufacturing Co.	Route 1 Lincoln, Nebr. 68502	.....do.....	Lancaster.
Lime:			
The Great Western Sugar Co., a subsidiary of Great Western United Corp.	Box 5308 Denver, Colo. 80217	Pot kiln at beet-sugar plant. 5 pot kilns at beet-sugar plants.	Morrill. Scotts Bluff.
Natural gas and petroleum¹			
Pumice:			
LaRue Axtell Pumice Co.....	Callaway, Nebr. 68325.....	Open pit mine and plant..	Lincoln.
Sand and gravel (commercial):			
Central Sand & Gravel Co.....	Box 626 Columbus, Nebr. 68601	Dredging operation.....	Butler.
		.....do.....	Hall.
		.....do.....	Pierce.
		2 dredging operations.....	Madison.
		3 dredging operations.....	Platte.
		.....do.....	Cuming.
Hank Stalp Gravel Co.....	Box 6 West Point, Nebr. 68788		
Hartford Sand & Gravel Co.....	Box 571 Valley, Nebr. 68064	2 dredging operations....	Douglas.
		4 pits.....	Dodge.
Lyman-Richey Sand & Gravel Corp.	4315 Cuming St. Omaha, Nebr. 68131	Pit and plant.....	Cass.
		2 pits and plants.....	Dodge.
		.....do.....	Douglas.
		Pit and plant.....	Morrill.
		.....do.....	Platte.
		2 pits and plants.....	Sarpy.
		Pit and plant.....	Saunders.
McCann Sand & Gravel Co.....	Valley, Nebr. 68064.....	2 dredging operations....	Douglas.
Overland Sand & Gravel Co.....	22 Main St. Stromberg, Nebr. 68666	4 dredging operations....	Merrick.
		Dredging operation.....	Nance.
		.....do.....	Polk.
		.....do.....	Cass.
		3 dredging operations....	Saunders.
Stone:			
Ash Grove Cement Co.....	1000 Tenmain Center Kansas City, Mo. 64105	Quarry and plant.....	Cass.
Fort Calhoun Stone Co.....	1255 South St. Blair, Nebr. 68008	.....do.....	Thurston.
		.....do.....	Washington.
Hopper Bros. Quarries.....	Weeping Water, Nebr. 68463	3 quarries and plant.....	Cass.
		Quarry and plant.....	Nemaha.
		.....do.....	Pawnee.
		.....do.....	Saunders.
		.....do.....	Cass.
Kerford Limestone Co.....	Box 434 Weeping Water, Nebr. 68463		
United Rock Construction, Inc....	1117 Woodman of the World Bldg. Omaha, Nebr. 68102	.....do.....	Do.

¹ Most of the major oil and gas companies and many smaller companies operate in Nebraska, and several commercial directories contain complete lists of them.

The Mineral Industry of Nevada

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

By V. Anthony Cammarota, Jr.¹

Lower production of all metal commodities, especially copper, gold, iron ore, and mercury, served to decrease the value of Nevada's mineral output by 12 percent. The total value was \$164.8 million, compared to \$186.3 million in 1970. Production value of metals as a group decreased 19 percent, nonmetals increased 18 percent, and mineral fuels (petroleum) decreased 17 percent.

Copper production, which accounted for 61 percent of the total value of the State's mineral production, was off 9 percent from that of 1970. Gold and mercury registered significant declines of 22 percent and 68 percent, respectively.

Of the 18 nonmetallic materials, nine showed increases in production, five showed decreases, and three, barite, gem stones and pyrite, were essentially unchanged. No talc or soapstone was produced. Gains of over 40 percent were made by clays, gypsum, and pumice. Declines of less than 12 percent were registered by fluorspar, lime, and lithium compounds.

Mineral exploration activity in Nevada emphasized geological exploration and detailed mapping rather than drilling. Interest was high for copper, molybdenum, vanadium, tungsten, and fluorspar, but lower for silver and gold. Many of the operations continued to be centered in Lyon County. The Nevada Oil and Gas Conservation Commission issued three well-drilling permits, down sharply from the 16 issued in 1970.

Consumption, Trade, and Markets.—All of Nevada's requirements for mineral fuels and metals and most of its nonmetal needs other than for construction materials were supplied by out-of-State processors.

All of the fluorspar, most of the barite and perlite, and some of the gypsum and limestone produced were shipped out of State in crude form. Most of the lime output went to consumers in California although some was used in Nevada. All petroleum production was consigned to refineries in Utah. With few exceptions, metal ore concentrates and precipitates were processed in mills and smelters outside the State. The one smelter (copper) in the State, at McGill, White Pine County, was dependent on Nevada ore. All usable iron ore was exported or shipped to steel plants in other States. The electrolytic manganese dioxide plant of American Potash & Chemical Corp., Clark County, operated on ore purchased from out-of-State producers, and the tungsten carbide plant of the Nevada Scheelite Division of Kennametal Inc., Churchill County, used concentrates purchased from various domestic and foreign producers.

Trends and Developments.—The non-profit Smelter Control Research Association, Inc. (SCRA), formed in February 1971 by eight major copper companies, has constructed a pilot plant for testing processes for the removal of sulfur dioxide from stack gases. The eight companies are The Anaconda Company, American Smelting and Refining Co., Cities Service Co., Copper Range Co., Inspiration Consolidated Copper Co., Kennecott Copper Corp., Newmont Mining Corp., and Phelps Dodge Corp. SCRA has a broad charter to conduct research, sponsor investigations and studies, and engage in pilot-plant testing of processes for control of stack gas

¹ Physical scientist, Division of Nonferrous Metals.

emissions at member company plants. The pilot plant is located at Nevada Mines Division, Kennecott Copper Corp., near McGill.

Revegetation of the reduction plant tailings pile at the McGill facility will be a primary consideration by Kennecott in the expansion of an existing ecological research effort. The research is a cooperative endeavor between the Renewable Natural Resources Division, College of Agriculture, University of Nevada, Reno, and Kennecott.

The mercury mining industry virtually ceased operations in Nevada as the price of mercury continuously fell during the year from about \$350 per flask in January to about \$216 per flask in December. In mid-1971 the Ruja Mining Co. closed its mine at McDermitt, Humboldt County. Some equipment from the milling and furnacing facility at the adjacent Cordero mine has been sold. By yearend a few small mines remained active in the State.

Ranchers Exploration & Development Corp. completed drilling at the Big Mike copper property in Pershing County south of Winnemucca and has begun leaching of the oxide ore. Near Mountain City, Elko County, Cliffs Copper Corp. erected a new headframe for rehabilitation of the Rio Tinto shaft prior to commencement of their heap-leaching program for copper recovery. United States Steel Corp. suspended its drilling program at Yerington, Lyon County, where deposits of iron and copper were located by the company.

Rayrock Mines, Ltd., of Canada announced that the Cordex Syndicate had obtained encouraging drilling results on an optioned gold prospect along the Getchell fault north of Golconda, Humboldt County. Although indicated grade is not high, the deposit is considered amenable to open-pit mining. Copper Range Exploration Co., in a joint venture with Ordrich Gold Reserves Co., Inc., has begun an extensive sampling program on the gold-bearing gravel deposits at Round Mountain, Nye County. Several exploratory drifts along the bedrock and raises will be sampled and processed through the new pilot plant which has a capacity of 4 cubic yards per hour. Nevada Canadian Mining and Exploration Co. built a 600-ton-per-day mill near Manhattan, Nye County, to produce concentrates of antimony, lead,

zinc, gold, and silver from an open-pit mine in the Smoky Mountains.

Silver King Mines, Inc., and Pacific Silver Corp. of Hawaii moved ahead with rehabilitation of the Hales shaft in the Tybo Mining District. A steel headframe was erected and a large double-drum hoist has been installed. Timbering of the shaft was begun in preparation for descent to the 1,500-foot level. Surface exploration was continued by Hecla Mining Co. on the Ruby Hill lead-zinc-silver project, Eureka County, including some fill-in holes in the ore reserve area in the vicinity of the Fad shaft.

N L Industries, Inc., converted its antimony mill at Oreana, Pershing County, into a tungsten mill until the softness in the antimony market eases. Rawhide Mining Co. started producing tungsten from the recently reopened Nevada Scheelite mine near Rawhide, Mineral County. The company leased the property from Kennametal Inc., to whom Rawhide will sell its entire output. A 300-ton-per-day pilot plant was being built by Tungsten Properties, Ltd., near Imlay, Pershing County, to concentrate 3.5 million tons of tailings. The tailings contain 0.1 percent tungsten oxide. General Electric Co. provided the financing for the project and will take all the production. Mt. Wheeler Mines, Inc., and W. S. Moore Co. continued development and exploratory work between the Osceola and Tungsten mining districts of the Snake Range, White Pine County. Beryllium and tungsten values were sought by underground diamond drilling.

Titanium Metals Corp. of America shut down its titanium sponge plant in Henderson because of the low level of orders and high inventory. The plant was maintained on standby in anticipation of a resumption of production in 1972.

Shipments of colemanite were begun from a calcining plant put into operation in Nye County by Tenneco, Inc. The colemanite is being mined near Death Valley Junction, Inyo County, Calif., and trucked to the plant about 10 miles away in Nevada. The plant has a capacity of 150,000 tons per year of raw ore.

Several fluorspar claims in the La Plata Mining District east of Fallon were acquired by Original Klondyke Divide Mining Co. The company purchased the former Kaiser Steel Corp. fluorspar mill at Fallon.

A new record depth in oil well drilling has been set in Nevada by A. Paul Sutherland, who reached 13,832 feet in a new well in Nye County.

The U.S. Geological Survey, implementing provisions of the Geothermal Steam Act of 1970, classified about 1.8 million

acres of land as being within known geothermal resource areas. Of this total, 344,027 acres are in Nevada. An additional 96 million acres, of which 13.5 million are in Nevada, were considered as having prospective value for geothermal steam.

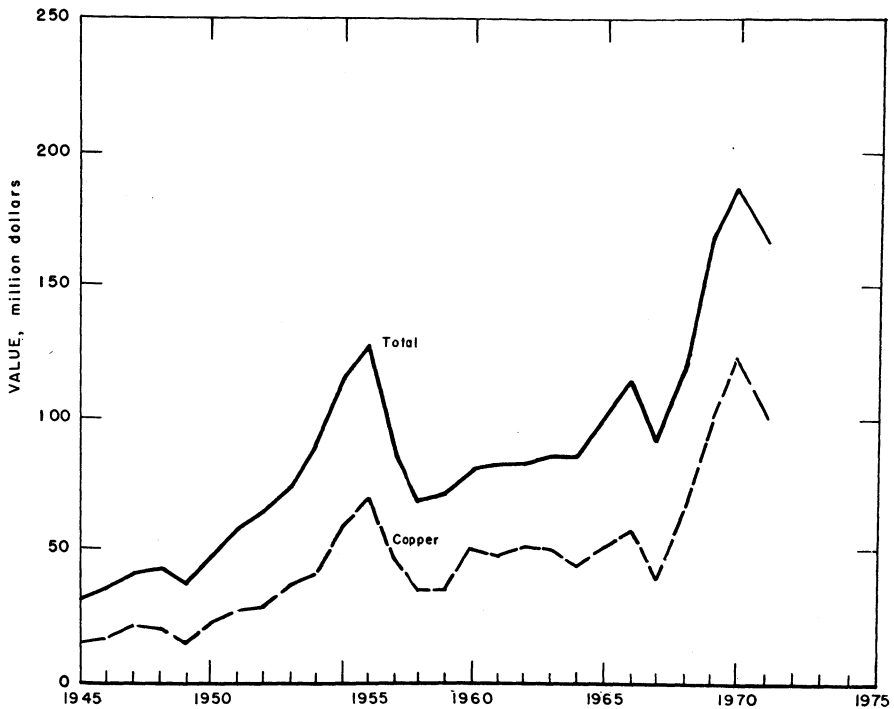


Figure 1.—Value of copper and total value of production in Nevada.

Table 1.—Mineral production in Nevada ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite (crude)..... thousand short tons	192	\$1,455	192	\$1,490
Copper (recoverable content of ores, etc.)..... short tons	106,688	123,118	96,928	100,806
Gem stones.....	NA	100	NA	105
Gold (recoverable content of ores, etc.)..... troy ounces	480,144	17,472	374,878	15,464
Gypsum..... thousand short tons	451	1,457	695	2,372
Iron ore (usable)..... thousand long tons, gross weight	575	W	W	W
Lead (recoverable content of ores, etc.)..... short tons	364	114	111	30
Mercury..... 76-pound flasks	r 4,909	r 2,001	1,589	465
Perlite..... short tons	8,470	73	9,600	114
Petroleum (crude)..... thousand 42-gallon barrels	149	W	113	W
Pumice, pumicite, and volcanic cinder..... thousand short tons	80	191	112	232
Sand and gravel..... do.	8,574	9,819	9,379	12,225
Silver (recoverable content of ores, etc.)..... thousand troy ounces	718	1,271	601	930
Talc and soapstone..... thousand short tons	1,860	2,722	2,531	3,800
Tungsten concentrate..... short tons	W	W	--	--
Tungsten concentrate..... short tons, 60 percent WO ₃ basis	122	306	33	88
Zinc (recoverable content of ores, etc.)..... short tons	127	39	71	23
Value of items that cannot be disclosed: Antimony, brucite, cement, clays, diatomite, fluorspar, lime, lithium minerals, magnesite, molybdenum concentrates (content), pyrite, salt, and values indicated by symbol W	XX	26,207	XX	26,630
Total.....	XX	r 186,345	XX	164,774
Total 1967 constant dollars.....	XX	166,686	XX	p 143,156

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

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

Table 2.—Value of mineral production in Nevada, by county

(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Carson City ¹	W	W	Pumice, stone, sand and gravel.
Churchill.....	\$113	\$102	Sand and gravel, salt, tungsten.
Clark.....	13,443	16,689	Sand and gravel, lime, stone, gypsum, zinc, lead, silver, tungsten, copper.
Douglas.....	W	W	Iron ore, sand and gravel.
Elko.....	584	490	Sand and gravel, barite, gold, silver, lead, stone, tungsten, copper, zinc.
Esmeralda.....	2,982	2,503	Lithium, diatomite, clays.
Eureka.....	8,285	8,866	Gold, iron ore, sand and gravel, stone, mercury, silver, lead, copper, zinc.
Humboldt.....	W	816	Sand and gravel, mercury, silver, gold, tungsten, copper, lead, zinc.
Lander.....	25,853	23,722	Copper, gold, barite, silver, sand and gravel, antimony.
Lincoln.....	334	482	Stone, sand and gravel, pyrites, perlite, fluorspar, copper, silver, lead, pumice, zinc, gold.
Lyon.....	56,813	52,407	Copper, cement, stone, petroleum, sand and gravel, diatomite, clays.
Mineral.....	36	23	Sand and gravel, stone, mercury.
Nye.....	2,515	2,034	Magnesite, fluorspar, sand and gravel, brucite, pumice, mercury, clays, tungsten, stone.
Pershing.....	16,454	5,991	Diatomite, gypsum, iron ore, perlite, copper, mercury, sand and gravel, antimony, tungsten, clays.
Storey.....	W	W	Diatomite, pumice.
Washoe.....	3,193	2,911	Sand and gravel, pumice, clays, stone.
White Pine.....	49,283	43,992	Copper, gold, lime, silver, molybdenum, sand and gravel, stone, lead, zinc, clays.
Undistributed ²	r 6,457	3,741	
Total ³	r 186,345	164,774	

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

¹ Independent city; formerly listed as Ormsby County.

² Includes gem stones, gold (1970), lead (1970), mercury, silver (1970), tungsten, and zinc (1970) that cannot be assigned to specific counties and values indicated by symbol W.

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

Table 3.—Indicators of Nevada business activity

	1970 ^r	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force.....	thousands .. 243.3	251.9	+3.5
Employed.....	do .. 203.0	208.1	+2.5
Unemployed.....	do .. 13.4	16.4	+22.4
Employment:			
Mining.....	do .. 4.1	3.7	-9.8
Contract construction.....	do .. 12.2	12.4	+1.6
Manufacturing.....	do .. 8.4	8.3	-1.2
Government.....	do .. 36.9	38.1	+3.2
Other ¹	do .. 141.4	145.6	+3.0
Personal income:			
Total.....	millions .. \$2,267	\$2,482	+9.5
Per capita.....	do .. \$4,599	\$4,895	+6.4
Construction activity:			
Valuation of private authorized nonresidential construction.....	millions .. \$80.6	\$60.4	-25.1
Total authorized residential units.....	do .. 9,247	12,843	+38.9
Cement shipments to and within Nevada.....	thousand 376-pound barrels .. 1,600	2,198	+37.4
Farm marketing receipts.....	millions .. \$80.5	NA	NA
Mineral production value.....	do .. \$186.3	\$164.8	-11.5

^p Preliminary. ^r Revised. NA Not available.

¹ Includes transportation and public utilities; wholesale and retail trade; finance, insurance, and real estate; and services.

Sources: Construction Review; Survey of Current Business; Farm Income Situation; Area Trends in Employment and Unemployment; Employment and Earnings and Annual Report on the Labor Force; and Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Metal.....	2,027	299	606	4,898	4	108	22.37	5,955
Nonmetal.....	739	251	185	1,492	--	51	34.17	2,343
Sand and gravel.....	418	206	86	719	--	12	16.69	452
Stone.....	294	279	82	681	--	21	30.85	835
Total.....	3,478	276	959	7,790	4	192	25.16	4,308
1971: ^p								
Metal.....	1,840	302	556	4,462	2	72	16.58	3,314
Nonmetal.....	765	250	191	1,534	--	42	27.37	1,143
Sand and gravel.....	450	193	87	750	1	10	14.67	3,190
Stone.....	300	289	86	712	--	16	22.48	770
Total ¹	3,350	274	919	7,458	3	140	19.17	3,115

^p Preliminary.

¹ Data may not add to totals shown because of independent rounding.

Legislation and Government Programs.

—Public land orders by the U.S. Bureau of Land Management withdrew 3,631 acres of land in Clark and Nye Counties from all forms of appropriation, including mining and mineral leasing laws. In Nye, Lander, and Douglas Counties, an additional 2,755 acres were withdrawn from mining only. In Clark County, 5 acres were restored for mining. Classification of 21,240 acres in Clark County and 2,880 acres in Lander County segregated the land from mining, and from both mining and mineral leasing, respectively. Nevada received U.S. Treasury checks totalling \$318,579 in

bonuses, royalties, and rentals covering mineral leases and permits.

The Nevada State Legislature passed a bill, which became law on July 1, 1971, making extensive changes in the procedure for locating lode and placer mining claims in Nevada. The basic change is the substitution of filing a map of the claims with the County Recorder in place of digging a pit or doing other physical work on the claim for location purposes.

The Bureau of Mines continued to provide consulting service to the Atomic Energy Commission (AEC) on preshot and postshot structural installations in connec-

tion with underground nuclear tests on and adjacent to AEC's Nevada Test Site.

Significant accomplishments by the Bureau of Mines Reno and Boulder City Metallurgy Research Centers included pollution-free methods for extracting copper from sulfide minerals, producing titanium dioxide pigment from ilmenite, improvements in electrowinning zirconium from fused-salt baths, large-scale demonstration of electrolytic cells designed for recovering aluminum from aluminum scrap and aluminum-silicon alloys, and improvements in extracting molybdenum and rhenium from sulfide minerals by electrooxidation.

In an attempt to eliminate sulfur dioxide emissions associated with conventional smelting of sulfide minerals, chalcopyrite (CuFeS_2) concentrate was roasted with lime to convert nearly all the sulfur to insoluble calcium sulfate. A rougher flotation product containing molybdenum was used as feed. The calcine was leached with hydrochloric acid to extract 99 percent of the copper and 96 percent of the molybdenum. Molybdenum was removed from the leach solution with activated carbon, and copper was recovered by cementation on sponge iron. The spent solution can be spray-roasted to regenerate hydrochloric acid and produce iron oxide as a byproduct.

Improvements in the preparation of a feed substitute for ilmenite in pigment production included: A lower borate-ilmenite ratio in the smelting charge; the use of oxygen to oxidize all the titanium to Ti(IV); and the recycling of the sodium borate. Successful adaptation of the sodium titanate route in the conventional sulfate process for TiO_2 pigment manufacture would eliminate the generation of iron sulfate, a water pollutant. A 1,000-ampere cell was designed for electrowinning zirconium from zirconium tetrachloride in order to obtain an economic evaluation of the improved process.

Scaled-up tests using a three-layer molten-salt electrolytic cell were made to recover aluminum, copper, and precious metals from electronic scrap. Over 90-percent recovery of aluminum was obtained; copper and precious metals were recovered as a concentrate suitable for fire refining.

Molybdenum and rhenium extractions in excess of 99 percent were obtained from copper-molybdenum concentrates by electrooxidation in a flow-through cell. An amine-carbon adsorption recovery sequence was used to separate and recover over 99 percent of the molybdenum and rhenium as ammonium molybdate and ammonium perrhenate.

REVIEW BY MINERAL COMMODITIES

METALS

Copper.—Copper output declined by 9.2 percent from 1970. A drop in copper prices reduced the value by an even greater margin, 18.1 percent, compared with that of 1970. Most of the output came from operations of The Anaconda Company, Lyon County; Kennecott Copper Corp., White Pine County; and Duval Corp., Lander County. Mining operations at Kennecott were closed during July because of a labor strike, but Anaconda and Duval, whose employees were not members of the striking union, continued to operate. During the year, Kennecott phased out the Tripp-Veteran pit and began mining a substantial quantity of ore from the New Ruth pit.

Ranchers Exploration & Development Corp. completed a plant to produce cement copper at its Big Mike mine near Winnemucca, Pershing County. Production

came from the treatment of 164,000 tons of stockpiled ore.

Lesser quantities of copper were recovered as a byproduct from complex lead, zinc, gold, and silver ores.

Gold.—Gold output decreased 22 percent compared with that of 1970 but the value declined only 12 percent because of higher gold prices. Two lode gold mines provided most of the total production. The balance was produced primarily as byproduct gold from copper ores. Lower production from the lode mines accounted for the major portion of the decline.

Cortez Gold Mines continued its exploration program at the Buckhorn site near the present mine in Lander County.

Carlin Gold Mining Co., Eureka County, reported higher net income, owing to the increased free market price of gold, even though costs were somewhat higher owing to operation of the new treatment plant

for carbonaceous ore. The plant successfully treated 143,414 tons of ore that otherwise would not have responded economically to ordinary cyanidation. In the process, carbon is oxidized with chlorine

before extracting the gold by cyanidation. Reserves at yearend were 3,526,000 tons assaying 0.297 ounces of gold per ton compared with 4,337,000 tons assaying 0.293 ounce per ton at the end of 1970.

Table 5.—Mine production (recoverable) of gold, silver, copper, lead and zinc, by county

County	Mines producing		Material sold or treated (short tons) ¹	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1969, Total.....	48	1	20,214,657	456,294	\$18,940,764	884,155	\$1,583,231
1970, Total.....	38	1	20,142,006	480,144	17,472,328	718,011	1,271,468
1971:							
Clark, Elko, Eureka, Lander, Lincoln, and Lyon ²	9	--	11,706,124	335,453	13,837,436	467,528	722,798
Humboldt.....	3	1	409	107	4,414	5,329	8,239
Pershing.....	1	--	164,000	--	--	--	--
White Pine.....	5	--	6,788,685	39,318	1,621,869	123,613	198,835
Total.....	18	1	18,659,218	374,878	15,463,719	601,470	929,872
	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1969, Total.....	104,924	\$99,749,148	1,420	\$423,019	941	\$274,771	\$120,970,933
1970, Total.....	106,688	123,118,472	364	113,831	127	39,086	142,015,135
1971:							
Clark, Elko, Eureka, Lander, Lincoln, and Lyon ²	56,905	59,181,304	28	7,742	17	5,522	73,754,802
Humboldt.....	(³)	416	1	221	(³)	145	13,435
Pershing.....	66	68,224	--	--	--	--	68,224
White Pine.....	39,957	41,555,644	82	22,577	54	17,307	43,416,232
Total.....	96,928	100,805,588	111	30,540	71	22,974	117,252,698

¹ Does not include gravel washed or precipitates shipped.

² Combined to avoid disclosing individual company confidential data.

³ Less than $\frac{1}{2}$ unit.

Table 6.—Mine production of gold, silver, copper, lead, and zinc in 1971, by class of ore or other source material, in terms of recoverable metal

Source	Number of mines ¹	Material sold or treated (thousand short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode ore:							
Dry gold, gold-heap leach, dry gold-silver, and dry silver ²	7	1,650	319,139	6,933	1	1	1
Copper.....	6	17,008	55,593	588,202	86,937	15	5
Lead, lead-zinc and zinc ²	5	(³)	140	6,335	5	95	65
Total.....	11	17,008	55,733	594,537	86,942	110	70
Other lode material:							
Copper precipitates.....	3	11	--	--	9,986	--	--
Placer.....	1	--	6	--	--	--	--
Total all sources.....	18	18,670	374,878	601,470	96,928	111	71

¹ Detail will not necessarily add to totals shown because some mines produce more than one class of material.

² Combined to avoid disclosing individual company confidential data.

³ Less than $\frac{1}{2}$ unit.

⁴ Data may not add to totals shown because of independent rounding.

Table 7.—Mine production of gold, silver, copper, lead, and zinc in 1971, 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)
Lode:					
Amalgamation and cyanidation: Ore-----	319,036	--	--	--	--
Smelting of concentrates: Ore-----	55,712	586,188	186,926	3	(2)
Direct smelting:					
Ore-----	124	15,282	16	108	71
Copper precipitates-----	--	--	9,986	--	--
Total-----	124	15,282	10,002	108	71
Placer-----	6	--	--	--	--
Grand total-----	374,878	601,470	96,928	111	71

¹ Includes copper from heat leaching, combined to avoid disclosing individual company confidential data.

² Less than $\frac{1}{2}$ unit.

Iron Ore.—As in 1970, four mines were active in 1971, but usable iron ore production and shipments declined. Production ceased in June at the Minnesota mine, Douglas County, of Standard Slag Co., owing to exhaustion of iron ore reserves. The ore was concentrated at the Wabuska plant in Lyon County for export to Japan. Direct shipping-grade ores were produced by Nevada-Barth Corp., Eureka County, and by Cooney Brothers and Nevada Iron Ore Co., Inc., both in Pershing County.

Lead.—With only 10 lode mines in 1971 compared with 26 in 1970, lead production decreased 70 percent. Most of the production came from zinc, lead, and lead-zinc ores, a lesser amount from copper ores, and less than 2 percent from silver and silver-gold ores.

Mercury.—Although production of mercury decreased 68 percent from that of 1970, Nevada retained its position as the second largest mercury-producing State. Only eight mines operated in 1971 compared with 13 in 1970.

The Ruja Mining Co. (Ruja mine) and Sierra Mineral Management, both in Humboldt County, each produced over 500 flasks. Sierra leased the Cordero mine from Fred H. Lenway & Co., Inc. and furnaced the ore at the adjacent Ruja plant. Crofoot Tungsten Co. treated ore from the Red Bird mine, Pershing County, at its plant near Lovelock. One producer, Cinyon, Inc. (Mina mine), Mineral County, concentrated its ore prior to retorting. By yearend the Carlin Gold Mining Co., which produced mercury as a byproduct from its gold mine in Eureka County, re-

mained as the only continuous producer of prime virgin mercury in Nevada.

Five producers recovered mercury by furnace operations and three used retorts. No mercury was recovered from old surface ores, dumps, or placers during the year.

Molybdenum.—Molybdenum was recovered by Kennecott Copper Corp. as a coproduct of treating copper ores from the Ruth and Tripp-Veteran pits, White Pine County. Both production and shipments were substantially lower than in 1970.

Silver.—The production of silver decreased 16 percent from that of 1970. The number of lode silver mines decreased to two from 11 in the previous year. Copper ores yielded most of the total lode silver, which came from 13 mines. The remainder came from silver, silver-gold, zinc, lead, and lead-zinc ores.

Tungsten.—The number of active tungsten properties increased to 28 from 19 in the previous year. However, the quantity of tungsten concentrates produced and shipped was about one-third that of 1970. Most of the output was shipped to the tungsten carbide plant of Kennametal Inc., in Churchill County. Several tungsten producers also shipped concentrates to the Pine Creek ammonium paratungstate plant of Union Carbide Corp. near Bishop, Calif.

Rawhide Mining Co. started producing tungsten from its Scheelite mine, near Rawhide, Mineral County. The company leased the property from Kennametal Inc., which formerly produced tungsten there for its nearby tungsten carbide mill. Rawhide will sell its tungsten concentrate to Kennametal.

Table 8.—Mercury production, by method of recovery

Year	Recovery method					Total	
	Operating mines	Furnaced		Retorted		76-pound flasks	Value ² (thousands)
		Ore treated (short tons)	76-pound flasks ¹	Ore treated (short tons)	76-pound flasks		
1967.....	25	51,693	4,457	1,567	246	4,703	\$2,301
1968.....	17	67,711	4,325	5,842	455	4,780	2,560
1969.....	24	108,715	7,735	9,985	430	8,165	4,124
1970.....	13	89,200	4,884	258	25	4,909	2,001
1971.....	8	13,960	1,571	268	18	1,589	465

¹ Revised.

² Includes less than 100 flasks of byproduct mercury.

³ Value calculated at average New York price.

⁴ Includes mercury recovered from old surface ores, dumps, and placers.

⁵ Includes 1,800 short tons of tailings.

⁶ Includes ore treated in concentrators prior to retorting.

Zinc.—Zinc output and value were down 44 percent and 41 percent, respectively, from those of 1970. Eight lode mines, down from 22 in 1970, accounted for the total zinc production. Over 90 percent of the recoverable zinc came from lead-zinc, zinc, and lead ores. Copper, silver, and silver-gold ores supplied the remainder. The three largest mines, one each in Clark, Lincoln, and White Pine Counties, contributed most of the recoverable metal.

NONMETALS

Barite.—The quantity of primary barite sold or used by Nevada producers was unchanged from that of 1970. Sales of ground barite, including tonnages used by producers, increased by 31 percent. Nearly all the ground and crushed barite was sold for use in well drilling.

Dresser Minerals was in the process of adding an additional grinding unit to its plant and constructing a new jigging mill at its mine 30 miles southeast of Battle Mountain, Lander County.

Cement.—Portland cement was produced by Nevada Cement Co. in a dry-process plant at Fernley, Lyon County. Both shipments and value increased 35 percent over those of 1970. Most of the cement was used by ready-mix concrete and concrete products manufacturers, building material dealers, and highway contractors.

Total consumption of cement in Nevada, including material received from out of State, was 2.2 million barrels, 38 percent more than in 1970.

Clays.—Clays sold or used increased 70 percent in quantity compared with the 1970 total. Common clay was obtained

from a deposit near Flanigan, Washoe County, by Nevada Cement Co. for use at the company cement plant in Lyon County, and by J. G. Bigger Co. in White Pine County. Kelley-Moore Paint Co., Inc., mined kaolin near Lovelock, Pershing County, and bentonite from two mines near Weeks, Lyon County. Western Talc Co. mined bentonite at the New Discovery mine near Beatty, Nye County, and the Blanco mine near Tonopah, Esmeralda County.

Diatomite.—Sales of prepared diatomite increased 1 percent in quantity and 11 percent in value compared with those of 1970. No sales of crude materials were reported. As in 1970, four deposits were mined. Eagle-Picher Industries, Inc., remained the largest Nevada producer from its Celatom mine and filtration-media preparation plant at Colado, Pershing County, and the Tunnel Hill mine and Clark Siding plant east of Reno, Storey County. GREFCO, Inc., the second largest producer, operated its mine at Basalt and a plant near Mina, both in Esmeralda County. United Sierra Division of Cyprus Mines Corp. produced diatomite from its mine and plant at Fernley, Lyon County. Product sales were mainly for filtration filler and lightweight aggregate, and lesser amounts were used for coating and fertilizer anticaking agents, insecticide carriers, insulation, and abrasives.

Fluorspar.—Production and shipments of metallurgical-grade fluorspar were about the same as in 1970. In addition to J. Irving Crowell, Jr., Nye County, and Carp Fluoride Co., Lincoln County, Adaven Fluorspar Co. mined fluorspar in the

Quinn Canyon area of Nye County and shipped it to Kaiser Steel Corp. in California.

Gypsum.—Crude gypsum production was 54 percent higher in quantity than in 1970. Output was 695,000 tons for use at Nevada and California plants making plaster and board products, and as a retarder in portland cement. The three Nevada plants of United States Gypsum Co., Flintkote Co., and Johns-Manville produced 330,000 tons of calcined gypsum, compared with 240,000 tons in 1970. Sales of gypsum for gypsum board were mainly responsible for the increase.

Lime.—The Flintkote Co., and Morrison & Weatherly Chemical Products produced lime in Clark and White Pine Counties for steel furnaces, construction, copper ore concentration, and other uses. Output decreased 4 percent and was 5 percent below the 1969 record. The lime was consumed in California, Nevada, Oregon, and other States. Total consumption of lime in Nevada was 52,237 tons.

Lithium Compounds.—The output of lithium carbonate from the Silver Peak facility of Foote Mineral Co. in Esmeralda County decreased 12 percent compared with that of 1970. Expansion of the plant, including additional evaporation pond capacity and a number of process improvements, was completed during the year.

Magnesite and Brucite.—Basic Inc., the only domestic producer of magnesite and brucite, operated an open pit mine at Gabbs, Nye County, and upgraded the ore in nearby processing facilities. Production of both magnesite and brucite was significantly lower in 1971 compared with 1970. Most of the ore was used in the manufacture of refractories and special products.

Perlite.—As in 1970, three companies produced all of the crude perlite. Nutritional Additive Corp. (Grass Valley mine) and United States Gypsum Co. (Pearl Hill quarry) both operated mines in Pershing County, and Delamar Perlite Co. worked the Mackie claims in Lincoln County. Most of the crude perlite output was sold to out-of-State consumers. Total sales, however, declined for the 14th consecutive year.

Pumice (Volcanic Cinder).—Output of pumice, pumicite, and volcanic cinder increased 40 percent compared with that of 1970. The increase was due primarily to greater demand in concrete aggregate. Use

in concrete admixtures, road construction, and roofing remained at the 1970 level. Demand slackened for volcanic cinder in landscaping, and none was used for fill. Cind R Lite Co. mined volcanic cinder from the Cinder Cone deposit southeast of Beatty, Nye County, for landscaping and concrete aggregate use. Volcanic cinder from the Cinderlite Aggregates property of Savage Construction Co., Inc., Carson City, was prepared for use in concrete admixture, road construction, landscaping, and roofing. Pumicite from the Lory Free pit of Pozzolan Portland Cement Co. (formerly Kemway Enterprises), Lincoln County, was prepared for use in concrete admixtures. Pumicite from the Naturalite group of claims of Kaiser Industries Corp., Storey County, and from the Rilite Aggregate Co., Washoe County, were prepared for use in concrete aggregate.

Salt.—The sole salt producer in the State was Huck Salt, which leased and operated the Leslie Salt Co. solar evaporation plant in Churchill County. All of the production, which was 25 percent higher compared with that of 1970, 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 by water-conditioning service companies and metal processors.

Sand and Gravel.—Output of sand and gravel rose from 8.6 million tons in 1970 to 9.4 million tons in 1971. There were 84 sand and gravel operations, 22 less than in 1970. Of these, 45 were classified as commercial and 39 were classified as Government-and-contractor. Most of the increased output came from Clark and Humboldt Counties, while much less was produced in Washoe County.

Stone.—About 2.5 million tons of stone were quarried from 17 locations, compared with 1.9 million tons in 1970. The increase was due mostly to a larger output of granite and smaller increases in the production of limestone, quartzite and sandstone. No dolomite was produced. Quartzite was mined by one company in Lincoln County.

Most of the limestone was either converted to lime or used in cement. The remainder was used as a road base and as a metallurgical flux, primarily in the smelting of copper. A small amount of granite was used in concrete; the bulk was used in

Table 9.—Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Carson City ¹	4	16	\$13	2	17	\$12
Clark.....	28	4,439	5,558	22	5,088	7,636
Elko.....	13	303	356	10	483	409
Eureka.....	3	W	W	2	28	27
Humboldt.....	5	166	101	6	315	433
Lander.....	1	W	W	1	8	11
Lincoln.....	3	26	34	3	79	87
Lyon.....	9	255	302	9	195	262
Mineral.....	2	W	W	1	22	21
Nye.....	3	72	70	3	248	191
Pershing.....	3	59	62	3	56	64
Washoe.....	18	2,741	3,005	12	2,039	2,661
White Pine.....	7	43	38	6	69	110
Undistributed ²	7	453	280	4	232	302
Total ³	106	8,574	9,819	84	9,379	12,225

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

¹ Independent city, formerly Ormsby County.² Includes Churchill, Douglas, and Esmeralda (1970) Counties.³ Data may not add to totals shown because of independent rounding.

Table 10.—Sand and gravel sold or used by producers, by class of operation and use

(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	893	\$1,473	895	\$1,448
Fill.....	114	167	195	244
Paving.....	25	39	155	508
Other uses ¹	239	990	289	1,278
Total ²	1,271	2,668	1,534	3,479
Gravel:				
Building.....	1,119	1,894	1,172	1,920
Fill.....	1,365	1,110	1,483	1,297
Paving.....	2,090	2,066	1,934	2,620
Railroad ballast.....	525	236	—	—
Miscellaneous.....	34	169	—	—
Other uses ²	—	—	385	875
Total ²	5,133	5,475	4,975	6,712
Government-and-contractor operations:				
Sand:				
Building.....	1	5	—	—
Fill.....	70	34	45	32
Paving.....	189	235	535	498
Other uses.....	8	4	1	1
Total.....	268	328	581	531
Gravel:				
Building.....	389	234	36	71
Fill.....	141	116	11	6
Paving.....	1,368	994	2,241	1,421
Other uses.....	4	4	2	4
Total ²	1,902	1,349	2,290	1,503
Total sand and gravel ²	8,574	9,819	9,379	12,225

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

¹ Includes glass, molding, fire-furnace, and other sands.² Data may not add to totals shown because of independent rounding.³ Includes miscellaneous gravel.

road construction. Marble was quarried in Mineral County for terrazzo.

Public work crews and contractors produced sandstone, limestone, granite, quartzite, and miscellaneous stone in several counties for use as riprap, road base, and concrete aggregate.

MINERAL FUELS

Petroleum.—The Eagle Springs oilfield remained the only producing area in the State; 12 wells produced oil during the year. Production was 112,951 barrels, compared with 149,324 barrels in 1970. The

field has yielded a total of 2,525,672 barrels of oil through December 1971. No gas was produced. The Nevada Oil and Gas Conservation Commission issued three well drilling permits in 1971, down sharply from the 16 issued in 1970. The three wells, two in Nye County and one in White Pine County, were plugged and abandoned.

The Pan American Petroleum Corp., which earlier in the year set a depth record of 13,600 feet, was later surpassed by A. Paul Sutherland with a depth of 13,832 feet.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Antimony:			
DOWCO Mining Co.....	Battle Mountain, Nev. 89820	Open pit mines...	Eureka and Lander.
Barite:			
Baroid Division, N L Industries, Inc.	P.O. Box 1675 Houston, Tex. 77001	---do-----	Elko.
Dresser Minerals.....	P.O. Box 94 Houston, Tex. 77005	---do-----	Lander.
FMC Corp.....	P.O. Box 3808 Modesto, Calif. 95352	---do-----	Do.
Milchem, Inc., Mineral Division....	P.O. Box 22111 Houston, Tex. 77027	---do-----	Do.
Brucite:			
Basic Inc.....	845 Hanna Bldg. Cleveland, Ohio 44115	---do-----	Nye.
Cement:			
Nevada Cement Co.....	Fernley, Nev. 89408	Dry-process, portland- cement plant.	Lyon.
Clays:			
Nevada Cement Co.....	Fernley, Nev. 89408	Open pit mine....	Washoe.
Western Tale Co.....	P.O. Box 363 Yermo, Calif. 92398	---do-----	Clark, Esmeralda, Nye, Pershing.
Copper:			
The Anaconda Company.....	P.O. Box 1000 Weed Heights, Nev. 89443	---do-----	Lyon.
Duval Corp.....	P.O. Box 451 Battle Mountain, Nev. 89820	---do-----	Lander.
Kennecott Copper Corp., Nevada Mines Division.	McGill, Nev. 89318	---do-----	White Pine.
Ranchers Exploration & Develop- ment Corp.	P.O. Box 803 Winnemucca, Nev. 89445	---do-----	Pershing.
Diatomite:			
Eagle-Picher Industries, Inc.....	P.O. Box 1869 Reno, Nev. 89505	---do-----	Pershing and Storey.
GREFCO, Inc.....	630 Shatto Place Los Angeles, Calif. 90005	---do-----	Esmeralda.
United Sierra Division, Cyprus Mines Corp.	P.O. Box 1201 Trenton, N.J. 08606	---do-----	Churchill.
Fluorspar:			
Carp Fluoride Co.....	P.O. Box 536 Delta, Utah 84624	---do-----	Lincoln.
J. Irving Crowell, Jr.....	P.O. Box 96 Beatty, Nev. 89003	Underground mine.	Nye.
Gold:			
Carlin Gold Mining Co.....	P.O. Box 672 Elko, Nev. 89801	Open pit mine....	Eureka.
Cortez Gold Mines.....	Cortez, Nev. 89821	---do-----	Lander.
Duval Corp.....	P.O. Box 451 Battle Mountain, Nev. 89820	---do-----	Do.
Kennecott Copper Corp., Nevada Mines Division.	McGill, Nev. 89318	---do-----	White Pine.
Gypsum:			
The Flintkote Co.....	P.O. Box 2678 Terminal Annex Los Angeles, Calif. 90054	---do-----	Clark.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Gypsum—Continued			
Johns-Manville Products Corp.-----	4301 East Firestone Blvd. South Gate, Calif. 90280	Open pit mine....	Clark.
United States Gypsum Co.-----	101 South Wacker Drive Chicago, Ill. 60606	....do.-----	Pershing.
Iron ore:			
Nevada-Barth Corp.-----	P.O. Box 425 Carlin, Nev. 89822	....do.-----	Eureka.
Standard Slag Co.-----	P.O. Box 4400 Reno, Nev. 89501	....do.-----	Douglas.
Lead:			
Bristol Silver Mines Co.-----	P.O. Box 276 Pioche, Nev. 89043	Underground mine.	Lincoln.
Hal Jensen.-----	East Ely, Nev. 89315	....do.-----	White Pine.
Lime:			
The Flintkote Co.-----	P.O. Box 57867 Flint Station Los Angeles, Calif. 90057	Rotary kilns, batch and continuous hydrators.	Clark.
Morrison & Weatherly Chemical Products.	P.O. Box 1105 McGill, Nev. 89318	Rotary kilns....	White Pine.
Lithium:			
Foote Mineral Co.-----	Route 100 Exton, Pa. 19341	Dry lake brines...	Esmeralda.
Magnesite:			
Basic Inc.-----	845 Hanna Bldg. Cleveland, Ohio 44115	Open pit mine....	Nye.
Mercury:			
Ruja Mining Co.-----	P.O. Box 31 McDermitt, Nev. 89421	Underground mine.	Humboldt.
Sierra Mineral Management.-----	4741 E. Sunrise Drive Tucson, Ariz. 85718	....do.-----	Do.
Molybdenum:			
Kennecott Copper Corp., Nevada Mines Division.	McGill, Nev. 89318	Open pit mine....	White Pine.
Perlite:			
Combined Metals Reduction Co., Panacalite Division.	218 Felt Bldg. Salt Lake City, Utah 84110	....do.-----	Lincoln.
Delamar Perlite.-----	Pioche, Nev. 89043	Underground mine.	Do.
United States Gypsum Co.-----	101 South Wacker Drive Chicago, Ill. 60606	Open pit mine....	Pershing.
Petroleum:			
James L. Davis.-----	21 Boyd Road Pleasant Hill, Calif. 94523	Producing crude- oil wells.	Nye.
North American Resources Corp.---	811 San Jacinto Bldg. Houston, Tex. 77002	....do.-----	Do.
Western Oil Lands, Inc.-----	330 Linden St. Reno, Nev. 89502	....do.-----	Do.
Pumice:			
Kaiser Industries Corp.-----	300 Lakeside Drive Oakland, Calif. 94612	Open pit mine....	Storey.
Rilite Aggregate Co.-----	P.O. Box 5665 Reno, Nev. 89503	....do.-----	Washoe.
Savage Construction, Inc.-----	P.O. Box 970 Carson City, Nev. 89701	....do.-----	Carson City.
Salt:			
Fallon Development Co.-----	Harrigan Road Fallon, Nev. 89406	Dry lake brines...	Churchill.
Sand and gravel:			
C. M. Brown Construction Co.-----	1770 North Leonard Lane Las Vegas, Nev. 89108	Open pit mine....	Clark.
Frehner Trucking Service, Inc.-----	Las Vegas, Nev. 89101	....do.-----	Do.
R. Helms Construction Co.-----	3025 Mill St. Reno, Nev. 89502	....do.-----	Washoe.
Las Vegas Building Materials, Inc.---	P.O. Box 530 Las Vegas, Nev. 89101	....do.-----	Clark.
Nevada Aggregates & Asphalt.-----	P.O. Box 7424 Reno, Nev. 89502	....do.-----	Washoe.
Simplot Silica Products.-----	P.O. Box 308 Overton, Nev. 89040	....do.-----	Clark.
Stewart Brothers Co.-----	P.O. Box 2775, Huntridge Station Las Vegas, Nev. 89101	....do.-----	Do.
Stock Mill & Supply Co.-----	3336 Cinder Lane Las Vegas, Nev. 89103	....do.-----	Do.
Wells-Cargo, Inc.-----	2394 West Spring Mountain Rd. Las Vegas, Nev. 89114	....do.-----	Do.
Whiting Bros.-----	6418A East Vegas Valley Rd. Las Vegas, Nev. 89109	....do.-----	Do.
W. M. K. Transit Mix, Inc.-----	1606 Industrial Rd. Las Vegas, Nev. 89102	....do.-----	Do.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Silver:			
Bristol Silver Mines Co.....	P.O. Box 276 Pioche, Nev. 89043	Underground mine.	Lincoln.
Duval Corp.....	P.O. Box 451 Battle Mountain, Nev. 89820	Open pit mine....	Lander.
Kennecott Copper Corp., Nevada Mines Division.	McGill, Nev. 89318.....	...do.....	White Pine.
Stone:			
Morrison & Weatherly Chemical Products.	P.O. Box 1105 McGill, Nev. 89318	Open quarry.....	Do.
Nevada Cement Co.....	Fernley, Nev. 89408.....	...do.....	Lyon.
U.S. Lime Division, The Flintkote Co.	P.O. Box 57367 Flint Station Los Angeles, Calif. 90057	...do.....	Clark.
Tungsten:			
Henry C. & John Crofoot.....	P.O. Box 797 Lovelock, Nev. 89419	...do.....	Churchill.
Zinc:			
Hal Jensen.....	East Ely, Nev. 89315.....	Underground mine.	White Pine.

The Mineral Industry of New Hampshire

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

By Avery H. Reed ¹

The total value of mineral production in New Hampshire increased 18 percent and established a new record, 12 percent above the 1968 record. The increase was wholly due to expanded production of sand and gravel.

Leading mineral producing counties were Hillsboro, Merrimack, and Carroll. Leading producers were Kitlege Granite Corp., with a quarry in Hillsboro County; R. S. Audley, Inc., with a sand and gravel pit in Merrimack County; and the New Hampshire Department of Public Works and Highways, with sand and gravel pits and granite quarries. Among the States, New Hampshire ranked 48th in total value

of mineral production.

The first modern glass plant in New Hampshire began operation in Greenland. The fluorescent tube plant of the Sylvania Division of General Telephone and Electronics Corp. uses low-iron sand from New Jersey.

The New Hampshire Department of Resources and Economic Development denied a permit to mine diatomaceous earth from the bottom of Lake Umbagog, on the grounds that "it was not in the public interest."

¹ Physical scientist, Division of Nonmetallic Minerals.

Table I.—Mineral production in New Hampshire ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays.....thousand short tons..	40	\$32	37	\$34
Gem stones.....	NA	W	NA	40
Sand and gravel.....thousand short tons..	6,529	4,753	8,404	6,777
Stone.....do.....	W	† 845	429	3,433
Value of items that cannot be disclosed: Mica (1970), and values indicated by symbol W.....	XX	† 3,100	XX	XX
Total.....	XX	8,730	XX	10,284
Total 1967 constant dollars.....	XX	7,809	XX	† 8,935

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

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

Table 2.—Value of mineral production in New Hampshire, by county
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Belknap.....	W	W	Sand and gravel, stone.
Carroll.....	W	W	Do.
Cheshire.....	W	W	Do.
Coos.....	\$184	W	Sand and gravel.
Grafton.....	677	\$956	Sand and gravel, stone, clays.
Hillsboro.....	3,086	3,341	Stone, sand and gravel.
Merrimack.....	2,051	2,141	Sand and gravel, stone.
Rockingham.....	900	595	Stone, sand and gravel, clays.
Strafford.....	275	351	Sand and gravel, clays, stone.
Sullivan.....	147	W	Sand and gravel, stone.
Undistributed ¹	1,410	2,898	
Total.....	8,730	² 10,284	

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

¹ Includes value of sand and gravel and gem stones not assigned to specific counties and values indicated by symbol W.

² Data may not add to total shown because of independent rounding.

Table 3.—Indicators of New Hampshire business activity

	1970	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force..... thousands..	301.2	307.0	+1.9
Unemployment..... percent of work force..	3.5	4.9	+40.0
Employment:			
Manufacturing employment..... thousands..	92.0	85.5	-7.1
Durable goods..... do.....	43.2	39.8	-7.9
Nondurable goods..... do.....	48.8	45.7	-6.4
Nonmanufacturing employment..... do.....	167.7	171.6	+2.3
Mining and construction..... do.....	12.8	12.2	-4.7
Factory payrolls:			
Average weekly hours.....	38.8	39.1	+0.8
Average hourly earnings.....	\$2.81	\$3.01	+7.1
Personal income:			
Total..... millions..	\$2,660.0	\$2,826.0	+6.2
Per capita.....	\$3,585.0	\$3,708.0	+3.4
Construction activity:			
Portland cement shipments to New Hampshire thousand 376-pound barrels..	887	964	+8.7
Mineral production value..... thousands..	\$8,730	\$10,284	+17.8

^p Preliminary.

Sources: New England Economic Indicators; Survey of Current Business; Employment and Earnings and Annual Report on the Labor Force; and U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Nonmetal.....	34	222	8	60	--	--	--	--
Sand and gravel.....	376	182	68	606	--	9	14.84	322
Stone.....	172	237	41	330	--	13	39.43	437
Total ¹	582	200	117	997	--	22	22.07	340
1971: ^p								
Nonmetal.....	35	250	9	72	--	1	13.87	250
Sand and gravel.....	305	176	54	452	--	13	28.74	615
Stone.....	190	244	47	384	--	15	39.09	704
Total ¹	535	206	110	908	--	29	31.94	623

^p Preliminary.

¹ Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Clays—W. S. Goodrich Inc., The Kane-Gonic Brick Corp., and Densmore Brick Co. mined 37,000 tons of common clay valued at \$34,000 for building brick, in Grafton, Rockingham, and Strafford Counties, respectively. Output declined 8 percent.

Gem Stones.—Assorted gem stones and mineral specimen were collected principally in Grafton County.

Gypsum.—National Gypsum Co. calcined gypsum at Portsmouth. The crude material was imported from Canada.

Perlite.—National Gypsum Co. expanded perlite at Portsmouth. The crude material was mined in Colorado.

Sand and Gravel.—Twenty-six operators produced sand and gravel at 52 mines

in 10 counties for building, paving, fill, and other uses. Commercial output was 20 percent higher, owing mainly to the new operation by Ossipee Sand & Gravel Co. In value, the leading counties were Merrimack, Carroll, and Hillsboro. Leading producers were the New Hampshire Department of Public Works and Highways: R. S. Audley Inc.; Manchester Sand, Gravel, and Cement Co.; Thomopoulis Sand and Gravel Pit; and Ossipee Sand & Gravel Co.

Ossipee Sand & Gravel Co. opened a large plant in Carroll County and shipped sand and gravel by unit train to the Boston, Mass., metropolitan area.

There was a great increase in production by the New Hampshire Department of Public Works and Highways.

Table 5.—Sand and gravel sold or used by producers, by class of operation and use

(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	794	\$701	1,521	\$1,843
Fill.....	434	259	W	W
Paving.....	656	548	428	404
Other uses ¹	649	392	1,480	655
Total ²	2,533	1,901	3,429	2,902
Gravel:				
Building.....	385	554	805	1,373
Fill.....	239	129	927	628
Paving.....	1,095	1,104	565	805
Other uses ³	909	771	447	424
Total ²	2,627	2,557	2,744	3,231
Government-and-contractor operations:				
Sand:				
Fill.....	18	6		
Paving.....	396	119	653	227
Total ²	414	125	653	227
Gravel: Paving.....				
	955	171	1,578	417
Total sand and gravel ²	6,529	4,753	8,404	6,777

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

¹ Includes other industrial sand.

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

³ Includes railroad ballast, miscellaneous, and other gravel.

Stone.—Kitledge Granite Corp. and The John Swenson Granite Co. Inc. quarried dimension granite in Hillsboro and Merrimack Counties for dressed architectural, dressed construction, and dressed monumental stone, and for curbing. Lebanon Crushed Stone, Inc., and Iafolla Construction Co., Inc., crushed traprock in Grafton and Rockingham Counties for concrete and

roadstone. North Country Aggregates, Inc., crushed quartz in Hillsboro County for exposed aggregate in decorative concrete. The New Hampshire Department of Public Works and Highways crushed granite for roadstone.

Total stone production and value was greater than that of 1970.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Densmore Brick Co.	Lebanon, N.H. 03766	Pit	Grafton.
W.S. Goodrich, Inc.	Epping, N.H. 03042	Pit	Rockingham.
The Kane-Gonic Brick Corp.	Gonic, N.H. 03867	Pit	Strafford.
Gypsum (calcined):			
National Gypsum Co.	325 Delaware Ave. Buffalo, N.Y. 14202	Plant	Rockingham.
Perlite (expanded):			
National Gypsum Co.	do	do	Do.
Sand and gravel:			
R.S. Audley, Inc.	Rt. 3A Bow, N.H. 03302	Pit	Merrimack.
Campton Sand & Gravel, Inc.	Box 2 W. Campton, N.H. 03228	Pit	Grafton.
Cold River Sand & Gravel Corp.	P.O. Box 429 Bellows Falls, Vt. 05101	Pit	Cheshire.
J.J. Cronin Company	P.O. Box 176 N. Reading, Mass. 01864	Pit	Hillsboro.
Iafolla Construction Co., Inc.	Peverly Hill Rd. Portsmouth, N.H. 03801	Pit	Rockingham and Strafford.
Keene Sand & Gravel, Inc.	725 Main Street Keene, N.H. 03431	Pit	Cheshire.
Lessard Sand & Gravel, Inc.	Lancaster Rd. Gorham, N.H. 03581	Pit	Coos.
Manchester Sand, Gravel & Cement Co.	P.O. Box 415 Hooksett, N.H. 03106	Pit	Merrimack.
Nashua Sand & Gravel.	Route 130 Nashua, N.H. 03060	Pit	Hillsboro.
Ossipee Aggregates Corp.	Rt. 16 Ossipee, N.H. 03864	Pit	Carroll.
Thomopoulos Sand & Gravel Pit.	Londonderry, N.H. 03053	Pit	Rockingham.
Tilton Sand & Gravel, Inc.	Tilton, N.H. 03276	Pit	Belknap.
Stone:			
Granite, dimension:			
Kitledge Granite Corp.	Oak Street Milford, N.H. 03055	Quarry	Hillsboro.
The John Swenson Granite Co., Inc.	North State Street Concord, N.H. 03301	do	Merrimack.
Miscellaneous stone, crushed:			
Iafolla Construction Co., Inc.	Peverly Hill Rd. Portsmouth, N.H. 03801	do	Rockingham.
Lebanon Crushed Stone, Inc.	Plainfield Rd. W. Lebanon, N.H. 03784	do	Grafton.
Quartz, crushed:			
North Country Aggregates, Inc.	P.O. Box 55 S. Lyndeboro, N.H. 03082	do	Hillsboro.
Traprock, crushed:			
Lebanon Crushed Stone, Inc.	Plainfield Rd. W. Lebanon, N.H. 03784	do	Grafton.

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 Donald C. Wininger¹

The value of New Jersey's mineral production totaled \$93.6 million, a 4.8-percent increase over that of 1970, establishing a new high for the third consecutive year. Output of sand and gravel, one of the State's major mineral products, increased 11 percent. The leading commodity continued to be stone, which accounted for 39 percent of the total value of all minerals

produced. Sussex County was the leading mineral-producing area and was followed, in decreasing order of value, by Somerset, Cumberland, Passaic, Morris, and Ocean. Counties. Mineral production was reported from all counties except Salem.

¹ Physical scientist, Division of Nonmetallic Minerals.

Table 1.—Mineral production in New Jersey¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays.....thousand short tons..	262	\$990	201	\$864
Gem stones.....	NA	10	NA	15
Peat.....thousand short tons..	45	557	46	526
Sand and gravel.....do.....	16,732	31,571	18,511	38,279
Stone ².....do.....	15,160	40,567	13,469	36,057
Zinc ³ (recoverable content of ores, etc.).....short tons..	28,683	8,788	29,977	9,653
Value of items that cannot be disclosed: Lime, magnesium compounds, manganiferous residuum, greensand marl, stone (dimension), and titanium concen- trate (ilmenite).....	XX	6,798	XX	8,181
Total.....	XX	89,281	XX	93,575
Total 1967 constant dollars.....	XX	79,862	XX	^p 82,298

^p Preliminary. NA Not available. XX Not applicable.

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

² Excludes certain dimension stone; included with "Value of items that cannot be disclosed."

³ Recoverable zinc valued at yearly average price of Prime Western slab zinc, East St. Louis market. Represents value established after transportation, smelting, and manufacturing charges have been added to the value of ore at the mine.

Table 2.—Value of mineral production in New Jersey, by county ¹

(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Atlantic.....	\$254	\$185	Sand and gravel.
Bergen.....	1,749	W	Do.
Burlington.....	1,700	1,621	Sand and gravel, clays.
Camden.....	1,256	2,506	Do.
Cape May.....	W	W	Magnesium compounds, sand and gravel.
Cumberland.....	11,960	13,774	Sand and gravel, clays.
Essex.....	W	W	Stone.
Gloucester.....	573	503	Greensand marl, sand and gravel.
Hudson.....	W	W	Stone.
Hunterdon.....	3,253	2,696	Do.
Mercer.....	W	W	Do.
Middlesex.....	2,043	2,313	Sand and gravel, clays.
Monmouth.....	1,347	1,444	Sand and gravel.
Morris.....	7,735	7,405	Sand and gravel, stone.
Ocean.....	4,168	6,764	Sand and gravel, titanium concentrate (ilmenite).
Passaic.....	6,194	7,877	Stone, sand and gravel.
Somerset.....	18,436	15,029	Stone, clays.
Sussex.....	15,141	17,247	Zinc, stone, sand and gravel, lime, peat, manganiferous residuum.
Union.....	W	W	Stone.
Warren.....	1,832	1,402	Sand and gravel, peat, stone.
Undistributed ²	11,640	12,812	
Total ³	89,281	93,575	

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

¹ Salem County is not listed because no production was reported.² Includes value of gem stones and values indicated by symbol W.³ Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of New Jersey business activity

	1970	1971 ^a	Change, percent
Employment and labor force, annual average:			
Total work force.....	3,088.4	3,130.6	+1.4
Unemployment.....	5.5	6.9	+25.4
Employment:			
Manufacturing.....	861.8	815.5	-5.4
Nonmanufacturing:			
Construction.....	119.2	114.3	-4.1
Transportation and public utilities.....	132.3	130.1	-1.2
Finance, insurance, and real estate.....	117.7	121.6	+3.3
Service.....	411.7	419.6	+1.9
Government.....	374.7	385.2	+2.8
Mining.....	3.2	2.8	-12.5
Payroll, average weekly earnings: Manufacturing.....	\$139.44	\$149.45	+7.2
Personal income:			
Total.....	\$33,085	\$35,271	+6.6
Per capita.....	\$4,598	\$4,832	+5.1
Construction activity:			
Housing units authorized.....	39,596	56,664	+43.1
Cement shipments to New Jersey.....	10,995	11,619	+5.7
Mineral production value.....	\$89,281	\$93,575	+4.8

^a Preliminary.

Sources: U.S. Department of Labor: Bureau of Labor Statistics, Manpower Administration; U.S. Department of Commerce: Survey of Current Business, Construction Review; and U.S. Bureau of Mines.

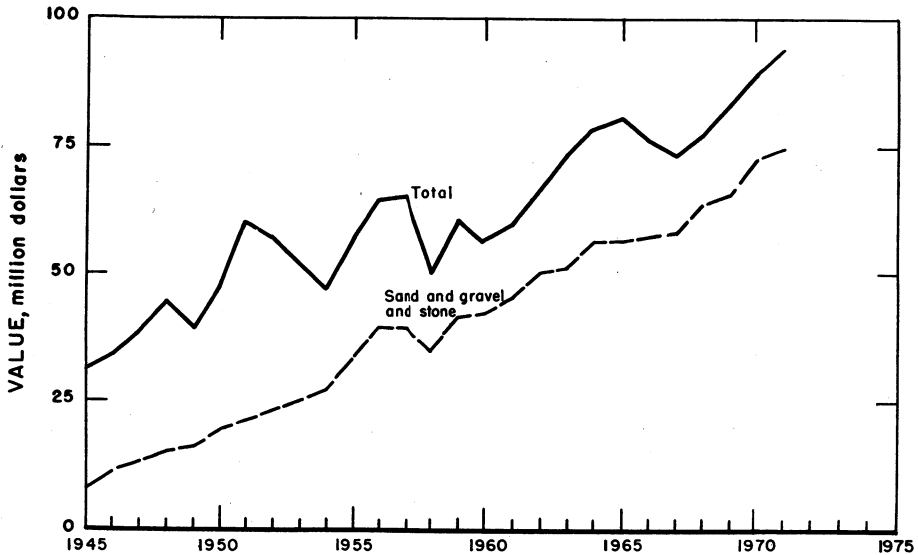


Figure 1.—Value of sand and gravel and stone, and total value of mineral production in New Jersey.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Peat.....	25	226	6	44	--	1	22.75	227
Metal.....	162	292	47	380	1	19	52.66	21,748
Nonmetal.....	320	281	90	719	--	26	36.17	761
Sand and gravel.....	938	248	232	1,924	--	53	27.55	746
Stone.....	946	250	236	1,980	--	89	44.96	743
Total ²	2,391	256	611	5,046	1	188	37.45	2,323
1971: ^p								
Metal.....	165	298	49	390	1	27	71.72	16,716
Nonmetal ¹	215	212	45	362	1	19	55.20	17,257
Sand and gravel.....	975	248	242	2,024	--	71	35.08	800
Stone.....	935	252	236	1,954	--	78	39.92	832
Total ²	2,285	250	572	4,730	2	195	41.65	3,387

^p Preliminary.

¹ Beginning in 1971, data concerning peat operations are included in the nonmetals industry.

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

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Shipments of portland cement into New Jersey totaled 11.6 million barrels, 5 percent greater than in 1970. Masonry cement shipments into New Jersey were 558,000 barrels, 4 percent less than in 1970. Most of the portland and masonry cement was manufactured in eastern Penn-

sylvania and eastern New York. Cement was distributed from five terminals, two in Jersey City, and one each in Bayonne, Elizabethport, and Newark.

Clays.—The quantity of clay produced declined 23 percent as compared to the 1970 output, continuing the trend since 1965. Value, however, was only 13 percent lower, reflecting an increase in the average

unit value. Common clay and shale, used for building brick and heavy clay products, accounted for 67 percent of the total clay tonnage, but fire clay contributed more than half of the value. Fire clay was used principally for firebrick, foundry clay, and refractory mortar. Quantities of kaolin were used for paper coating, drilling mud, wall and floor tile, and whiteware. Ball clay was used for clay crucibles and stoneware. Common clay and shale were produced in Somerset, Camden, Burlington, and Middlesex Counties, in descending order of tonnage. Fire clay was mined in Middlesex and Cumberland Counties. Kaolin and ball clay were produced in Middlesex County.

Gem Stones.—Collectors and dealers collected mineral specimens from several localities, mine dumps, and quarries, principally in the northern part of the State. Value of the material collected was estimated to be \$15,000, 50 percent greater than in 1970, reflecting increased activity by amateur mineral collectors during the year.

Gypsum.—Crude gypsum was calcined at four plants, two in Burlington County and one each in Bergen and Camden Counties. The production of 452,000 tons of calcined gypsum valued at \$7.4 million was 35 percent higher than that in 1970. Output was used mainly in the manufacture of wallboard, lath, and sheathing.

Iodine.—Consumption of organic and inorganic iodine chemical and pharmaceutical companies in the State totaled 651,000 pounds compared with 668,000 pounds in 1970. The iodine was used for medicines, sanitation products, and other chemicals.

Lime.—Limestone Products Corp. of America produced hydrated lime in Sussex County for agriculture, road stabilization, water purification, and other uses. Output declined 30 percent and was 36 percent below the 1969 record. Total consumption of lime in New Jersey was 142,700 tons.

Magnesium Compounds.—Production of refractory magnesia expanded 15 percent. An increase in the average unit value also was reported. The refractory magnesia was produced in Cape May County from seawater and dolomite shipped in from out of State. J. T. Baker Chemical Co., Warren County, converted purchased materials to a variety of magnesium compounds.

Marl, Greensand.—Production of greensand marl was greater in quantity and value than in 1970. Marl, recovered by hydraulic mining from a pit in Gloucester County, was processed and used for water treatment.

Perlite.—Crude perlite mined in Colorado, Nevada, and New Mexico was expanded at three plants, two in Middlesex County and one in Mercer County. Expanded perlite was used primarily in roof insulation board and acoustical plaster; other uses included aggregate for ultralightweight concrete, loose-fill insulation and soil conditioner, and as a lightweight filler.

Pigments.—Metal-base pigments, used primarily in the manufacture of paint, were produced at a number of plants in New Jersey. Iron oxide pigments were produced by Pigments and Specialties Division, Cities Service Co., 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.

Sand and Gravel.—Output of sand and gravel increased 11 percent over that of 1970, and the value was 21 percent higher. Production of sand and gravel for construction increased 9 percent in quantity and 17 percent in value compared with 1970. Average value per ton increased \$0.11 to \$1.49 per ton. Of the 15.1 million tons of sand and gravel used for construction, 1.8 million (12 percent) was unprocessed. Output of industrial sand for all uses increased 20 percent in quantity and 28 percent in value, reflecting an increase of \$0.30 in the average value per ton. Industrial sand accounted for 17 percent of the tonnage and 40 percent of the value of all sand and gravel produced in the State. Most of the industrial sand was produced in Cumberland County where most operations used suction pumps mounted on barges floating on ponds fed by ground water. The sand and water slurry was pumped to processing plants for sizing, grinding, or other treatment. Many of the ponds created by removal of the sand were used for fishing and other recreational activities.

The number of sand and gravel opera-

Table 5.—Sand and gravel sold or used by producers, by class of operation and use

(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Blast.....	114	\$455	128	\$799
Building.....	4,358	5,573	5,726	8,678
Fill.....	1,002	575	1,446	1,048
Molding.....	613	2,949	499	2,493
Paving.....	1,833	2,159	2,989	3,952
Other uses ¹	4,639	12,354	3,031	12,439
Total².....	12,559	24,064	13,819	29,409
Gravel:				
Building.....	1,532	3,356	1,977	4,341
Fill.....	1,235	1,856	1,461	2,076
Paving.....	1,016	1,450	941	1,793
Railroad ballast.....			8	20
Miscellaneous.....	W	W	219	530
Other uses.....	380	838	78	105
Total².....	4,163	7,499	4,685	8,866
Government-and-contractor operations:				
Sand: Other uses.....				
	5	5	2	2
Total².....	5	5	2	2
Gravel:				
Building.....	3	2	--	--
Fill.....	2	1	2	1
Other uses.....	--	--	3	1
Total².....	5	3	5	2
Total sand and gravel².....	16,732	31,571	18,511	38,279

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

¹ Includes fire or furnace, engine, filtration, railroad ballast, glass, ground, and other sands.² Data may not add to totals shown because of independent rounding.

tions increased to 107 (86 in 1970). Production was reported from 14 of the State's 21 counties and exceeded 1 million tons in each of seven counties. Cumberland County ranked first in tonnage and value; its industrial sand accounted for more than one-third of the total value of sand and gravel produced in the State.

Only two operations produced more than 1 million tons, six produced from 500,000 to 1 million tons, and 40 produced from 100,000 to 500,000 tons. Shipments to consumers were primarily by truck (15 million tons) and rail (3 million tons).

Stone.—A decline in the level of building activity, especially highway construction, in the State's northern and northwestern counties, caused a decline in the demand for stone aggregates. Stone production decreased by 11 percent both in quantity and value from the 1970 level. Stone was quarried in 10 counties, led by Somerset, Passaic, Sussex, and Hunterdon Counties, in decreasing order of value. Types of

stone produced in decreasing order of tonnage were basalt, granite, limestone, miscellaneous stone, and sandstone. There was no output of marble reported in 1971. Basalt (traprock) continued as the leading type of stone quarried and accounted for 78 and 74 percent, respectively, of the State's total stone production and value. Output of 10.5 million tons was 13 percent lower than in 1970; average value decreased from \$2.65 per ton to \$2.56. Somerset County with 5.4 million tons and Passaic County with 1.9 million tons were the leading basalt producing areas. Quarries also were active in Essex, Hudson, Hunterdon, Mercer, and Union Counties. Ninety-seven percent of the output was used as aggregate for highway and building construction, but quantities also were sold for riprap and other uses.

Granite production decreased 3 percent to 2.3 million tons. Average value decreased \$0.05 per ton to \$2.06. Quarries were operated at eight locations in Hun-

terdon, Morris, Passaic, and Sussex Counties. Small quantities were sold for riprap; the bulk of the output was used for concrete aggregate and roadstone.

Crushed limestone was produced at two quarries in Sussex County and one in Warren County. Output was 5 percent less than that of 1970, but value increased about 28 percent reflecting an increase in average value. Limestone was used principally for agricultural stone (agstone), concrete aggregate, filler, manufacturing hydrated lime, and poultry grit. Sandstone was quarried for dimension stone in Hunterdon County.

Sulfur.—Shipments of byproduct sulfur increased 8 percent to 52,700 long tons. Value was substantially higher because the average price per long ton increased to \$29.26 from \$27.64 in 1970. Elemental sulfur was recovered as a byproduct of petroleum refining at four plants, two in Gloucester and one each in Union and Middlesex Counties.

Vermiculite.—Exfoliated vermiculite was produced by one plant each in Essex, Mercer, and Middlesex Counties from crude material shipped from other States or imported. The exfoliated vermiculite was used mainly as loose-fill insulation, plaster and lightweight concrete aggregate, and for agricultural purposes.

METALS

Ferroalloys.—Shieldalloy Corp., Newfield, Gloucester County, produced ferroalloys of vanadium, titanium, boron, chromium, columbium, and columbium-nickel.

Lead.—N. L. Industries Inc., announced plans to build a secondary antimonial lead smelting plant. The facility will be on a 46-acre site near Pedricktown, Salem County, and is expected to cost in excess of \$6 million.²

Titanium.—Both quantity and value of ilmenite concentrate production were higher than in 1970. The average unit value also was higher. Glidden-Durkee Division 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.

American Smelting and Refining Co. announced plans to develop beach sand deposits and began site preparation for the plant near Lakehurst. The concentrates will be shipped to E.I. du Pont de Nemours & Co., in Edge Moor, Del., for use in manufacturing white pigment for paint, plastics, and paper.³

Zinc.—The quantity of manganiferous zinc ore mined at Sterling Hill, Sussex County increased 5 percent over 1970. The ore was crushed and shipped directly to a company-owned smelter at Palmerton, Pa., where zinc and manganiferous residuum were recovered.

MINERAL FUELS

Coke and Coal Chemicals.—Koppers Co., Inc., produced coke and coal chemicals at its merchant oven-coke plant at Kearney, Hudson County. Coal chemicals recovered included crude coal tar and crude light oil. The company ceased operations in March of 1971, due to difficulties in meeting the State's new sulfur emission regulations.

Peat.—Production and sales of peat remained at about the same level as in 1970. Peat was recovered from bogs near Newton, Stanhope, and Sussex in Sussex County and from Great Meadows in Warren County. About 90 percent of the output was used for general soil improvement. The remainder was used in mushroom beds and mixed fertilizers.

Petroleum.—Six petroleum refineries active in the State reported a total crude oil capacity of 532,000 barrels per day. Products recovered included gasoline, fuel oil, asphalt, coke, lubricants, and paraffin.

² Engineering and Mining Journal. V. 172, No. 9, September, 1971, p. 252.

³ American Smelting and Refining Co. 1971 Annual Report, p. 13.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Fire clay:			
Crossman Co.	P.O. Box 38 South Amboy, N.J. 08879	Pit.	Middlesex.
Daniel Goff Division, Jesse S. Morie & Son, Inc. A.P. Green Refractories Co., U.S. Gypsum Co.	P.O. Box 35 Mauricetown, N.J. 08329 Pennal Road Woodbridge, N.J. 07095	Pit.	Cumberland. Middlesex.
Miscellaneous clay:			
Church Brick Co.	P.O. Box 129 Bordentown, N.J. 08505	Pit.	Burlington.
Glen-Gery Corp.	P.O. Box 1656 East Canton, Ohio 44730	Pit.	Camden, Somerset.
New Jersey Shale Brick & Tile Corp. The Rosehill Corp. t/a Oschwald Brick Works.	P.O. Box 490 Somerville, N.J. 08876 Cliffwood, N.J. 07721	Pit.	Somerset. Middlesex.
Greensand marl: Inversand Co.	226 Atlantic Avenue Clayton, N.J. 08312	Pit.	Gloucester.
Gypsum, calcined:			
The Celotex Corp.	1500 North Dale Mabry Tampa, Fla. 33607	Plant.	Bergen.
The Flintkote Co., Building Products Groun-East. Kaiser Gypsum Co., Inc. National Gypsum Co.	480 Central Ave. East Rutherford, N.J. 07073 Delanco, N.J. 08075 325 Delaware Ave. Buffalo, N.Y. 14202	....do....do....do	Camden. Burlington. Do.
Ilmenite: Glidden-Durkee, Division, of SCM Corp. Iron oxide pigments (manufactured): Cities Service Co.	P.O. Box 5 Lakehurst, N.J. 08733 380 Madison Ave. New York, N.Y. 10017	Pit.	Ocean.
E.I. du Pont de Nemours & Co., Inc. Lime: Limestone Products Corp. of America. Magnesium compounds: J.T. Baker Chemical Co. Northwest Magnesite Co.	Du Pont Building Wilmington, Del. 19898 122 Main St. Newton, N.J. 07860 600 North Broad St. Phillipsburg, N.J. 08865 2 Gateway Center Pittsburgh, Pa. 15222	....do....do....do....do	Mercer, Middlesex. Essex. Sussex. Warren. Cape May.
Peat:			
Hyper-Humus Co. Kelsey Humus Co., Partac Peat Co. Mt. Bethel Humus Co., Inc. Netcong Natural Products.	Lafayette Rd. Newton, N.J. 07860 Kelsey Park Great Meadows, N.J. 07838 1270 Broadway New York, N.Y. 10001 Lackawanna Drive Stanhope, N.J. 07874	Bog. Bog. Bog. Bog.	Sussex. Warren. Sussex. Do.
Perlite (expanded):			
Coralux Perlite Corp. of New Jersey. Grefco, Inc. Zonolite Division, W.R. Grace & Co.	P.O. Box 251 Metuchen, N.J. 08840 630 Shatto Place Los Angeles, Calif. 90005 62 Whittemore Ave. Cambridge, Mass. 02140	Plant. .... ....do....do	Middlesex. Do. Mercer.
Petroleum refineries:			
Chevron Oil Co. Hess Oil & Chemical Corp. Humble Oil and Refining Co. Mobile Oil Corp. ¹	1200 State St. Perth Amboy, N.J. 08861 State St. Perth Amboy, N.J. 08861 Box 22, Linden, N.J. 07036 P.O. Box 927 Philadelphia, Pa. 19105	....do....do....do....do	Middlesex. Do. Union, ¹ Hudson. Gloucester.
Texaco Inc.	135 East 42d St. New York, N.Y. 10017	....do	Do.
Sand and gravel:			
Amico Sand & Gravel Co. Bennett Sand & Gravel Co., Inc. Brick-Wall Corp. Buck Brothers, Inc. Conklyn Brothers. Crossman Co. Fisher Bros. Sand & Gravel Co.	Norman Ave. Riverside, N.J. 08075 Box 517 Manasquan, N.J. 08736 Route 70 Lakehurst, N.J. 08733 Edison, N.J. 08817 Montville, N.J. 07045 P.O. Box 38 South Amboy, N.J. 08879 115 Hickory Lane Bayville, N.J. 08721	Pit. Pit. Pit. Pit. Pit. Pit. Pit.	Burlington. Monmouth. Ocean. Middlesex. Morris. Middlesex. Ocean.

See footnotes at end of table.

Table 6.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
Houdaille Construction Materials, Inc.	10 Park Place Morristown, N.J. 07960	Pit.....	Morris, Ocean, Warren.
Steckel Concrete Co.....	P.O. Box 47 Phillipsburg, N.J. 08865	Pit.....	Warren.
Tri-Borough Sand & Stone, Inc.	Haddonfield-Berlin Rd. Gibbsboro, N.J. 08026	Pit.....	Camden.
United States Dredging Corp...	39 Broadway New York, N.Y. 10006	Dredge.....	Monmouth.
Whitehead Brothers Co.....	60 Hanover Rd. Florham Park, N.J. 07932	Pit.....	Cumberland.
Smelters (copper):			
American Metal Climax, Inc...	1270 Avenue of the Americas New York, N.Y. 10020	Plant.....	Middlesex.
American Smelting & Refining Co.	120 Broadway New York, N.Y. 10005	...do.....	Do.
The Anaconda Co.....	25 Broadway New York, N.Y. 10004	...do.....	Do.
Stone:			
Granite, crushed and broken:			
Braen Industries, Inc.....	Box 188, Wyckoff, N.J. 07481	Quarry.....	Morris.
Glen Gardner Quarry Corp.	Box 344 Glen Gardner, N.J. 08826	...do.....	Hunterdon.
Hamburg Quarry, Inc.....	Route 23, Hamburg, N.J. 07419	...do.....	Sussex.
Passaic Crushed Stone Co., Inc.	Foot of Broad Pompton Lakes, N.J. 07442	...do.....	Passaic.
Shahmoon Industries, Inc...	R.D. #1, Wharton, N.J. 07885	...do.....	Morris.
Somerset Crushed Stone Division, Anthony Ferrante & Sons, Inc.	Route 202, Mine Brook Rd Bernardsville, N.J. 07924	...do.....	Hunterdon.
Tri County Asphalt Corp...	Beaufort Ave. Roseland, N.J. 07068	...do.....	Sussex.
Limestone, crushed:			
Farber White Limestone Co.	Franklin, N.J. 07416	...do.....	Do.
Limestone Products Corp. of America.	122 Main St. Newton, N.J. 07860	...do.....	Do.
Sandstone, dimension: Delaware Quarries.			
Traprock (basalt), crushed and broken:			
Samuel Braen's Sons.....	662 Goffle Rd. Hawthorne, N.J. 07500	...do.....	Passaic.
Callanan Trap Rock Corp.	South Bethlehem, N.Y. 12161	...do.....	Hudson.
Dock Watch Quarry Pit, Inc.	Box 245 Martinsville, N.J. 08836	...do.....	Somerset.
Fanwood Crushed Stone Co.	141 Central Avenue Westfield, N.J. 07090	...do.....	Do.
Houdaille Construction Materials, Inc.	10 Park Place Morristown, N.J. 07960	...do.....	Hunterdon, Passaic, Somerset, Union.
M.L. Kernan Quarry.....	500 Tillon Rd. South Orange, N.J. 07079	...do.....	Essex.
Orange Quarry Co.....	318 Eagle Rock Ave. West Orange, N.J. 07050	...do.....	Do.
Somerset Crushed Stone Division, Anthony Ferrante & Sons, Inc.	Route 202, Mine Brook Rd. Bernardsville, N.J. 07924	...do.....	Somerset.
Trap Rock Industries, Inc.	Laurel Ave. Kingston, N.J. 08528	...do.....	Hunterdon, Mercer, Somerset.
The Union Building & Construction Corp.	315 Howe Ave. Passaic, N.J. 07055	...do.....	Passaic.
Warren Brothers Co., Sowerbutt-Standard District.	Planten Ave. Prospect Park Paterson, N.J. 07502	...do.....	Do.
Sulfur (recovered): The Anlin Co. of New Jersey.			
	1200 State St. Perth Amboy, N.J. 08861	Plant.....	Middlesex.
Vermiculite (exfoliated):			
Coralux Perlite Corp. of New Jersey.	P.O. Box 251 Metuchen, N.J. 08840	...do.....	Do.
Vermiculite Industrial Corp....	308 Gilligan Ave. Fort Newark, N.J. 07114	...do.....	Essex.
Zonolite Division, W.R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	...do.....	Mercer.

¹ Also byproduct elemental sulfur.

The Mineral Industry of New Mexico

By Roman V. Sondermayer ¹

During 1971 the value of New Mexico's mineral production ranked seventh among the 50 States, and the mineral industry continued to comprise a major sector of the State's economy. In 1971 mineral produc-

tion value totaled \$1,046 million, 1.3 percent less than in 1970, and New Mexico was the leading producer of uranium, per-

¹ Petroleum engineer, Division of Fossil Fuels.

Table 1.—Mineral production in New Mexico ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays.....thousand short tons..	67	\$91	² 76	\$114
Coal (bituminous).....do....	7,361	21,249	8,175	26,657
Copper (recoverable content of ores, etc.).....short tons..	166,278	191,885	157,419	163,715
Gem stones.....	NA	60	NA	65
Gold (recoverable content of ores, etc.).....troy ounces..	8,719	317	10,681	441
Helium:				
Crude.....million cubic feet..	1	18	--	--
Grade A.....do....	(³)	6	W	W
Lead (recoverable content of ores, etc.).....short tons..	3,550	1,109	2,971	820
Lime.....thousand short tons..	37	W	35	W
Manganese concentrate (35 percent or more Mn) short tons, gross weight..	4,225	W	--	--
Manganiferous ore (5 to 35 percent Mn).....do....	46,166	W	28,490	W
Natural gas (marketed).....million cubic feet..	1,138,980	162,874	1,167,577	175,137
Natural gas liquids:				
LP gases.....thousand 42-gallon barrels..	25,999	37,179	27,082	43,381
Natural gasoline and cycle products.....do....	9,606	25,548	9,952	28,465
Peat.....thousand short tons..	(³)	7	1	W
Perlite.....short tons..	382,456	4,321	385,746	4,559
Petroleum (crude).....thousand 42-gallon barrels..	128,184	410,320	118,412	402,602
Potassium salts.....thousand short tons, K ₂ O equivalent..	2,390	85,877	2,291	86,689
Pumice.....thousand short tons..	203	442	287	601
Salt.....do....	W	W	146	1,130
Sand and gravel.....do....	10,666	10,516	8,869	7,975
Silver (recoverable content of ores, etc.) thousand troy ounces..	782	1,385	782	1,210
Stone ⁴.....thousand short tons..	3,100	4,090	2,913	5,337
Uranium (recoverable content U ₃ O ₈).....thousand pounds..	11,574	69,970	10,567	65,517
Zinc (recoverable content of ores, etc.).....short tons..	16,601	5,086	13,959	4,495
Value of items that cannot be disclosed: Carbon dioxide (natural), clay (fire) (1971), cement, fluorspar, gypsum, iron ore (usable), mica (scrap), molybdenum, stone (dimension), vanadium, and values indicated by symbol W.....	XX	28,068	XX	27,424
Total.....	XX	1,060,358	XX	1,046,284
Total 1967 constant dollars.....	XX	948,490	XX	^p 909,185

^p Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Values of items that cannot be disclosed." XX Not applicable.

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

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

³ Less than ½ unit.

⁴ Excludes certain dimension stone; included with "Value of items that cannot be disclosed."

lite, and potassium salts. Furthermore, the State was among the leaders in output of copper, molybdenum, natural gas, natural gas liquids, pumice, and petroleum.

Fuels were first in value among minerals produced, followed by metals and nonmetals. Principal minerals in 1971 and their share in the total value of mineral production in New Mexico were as follows: Crude oil, 38.5 percent; natural gas, 16.7 percent; copper, 15.6 percent; potash, 8.3 percent; natural gas liquids, 6.9 percent; uranium 6.3 percent; and coal, 2.5 percent.

Output of mineral fuels was valued at \$676.4 million, 2.9 percent higher than in 1970. Increases in value were recorded for

each mineral fuel except petroleum. Although production and values for natural gas and natural gas liquids increased, estimated reserves for these commodities continued to decline. Petroleum production declined to 118 million barrels after attaining a peak of 128 million barrels in 1970. Estimated reserves declined for the fifth consecutive year to 657 million barrels, the lowest level in 20 years.

Value of metallic mineral output declined 12.0 percent to \$254.3 million. Value of each mineral except gold declined. Major value declines were in copper and uranium. The principal factor in the lower value of copper was the average unit price.

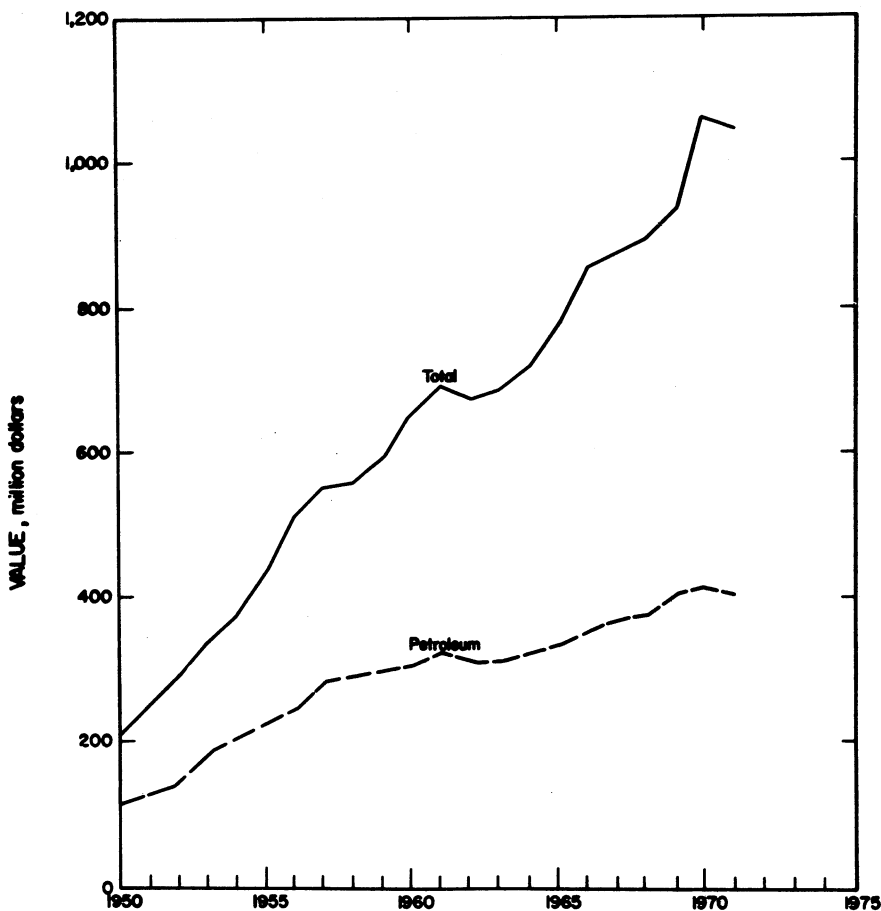


Figure 1.—Value of petroleum and total value of all mineral production in New Mexico.

Uranium output declined 8.7 percent and was accompanied by a decrease in exploration and development activity. Footage drilled to find and develop uranium reserves declined from 5.2 million feet in 1970 to 3.0 million feet in 1971.

Nonmetallic mineral output was valued at \$115.5 million, a 1.4-percent increase over the 1970 figure. The value trend in nonmetallics was mixed; eight commodities increased and five decreased. Largest increases were recorded for cement, stone, and potassium salts. The value of sand and gravel output declined 24 percent to \$8 million. Table 1 shows details of minerals output value by commodities, and table 2 gives the breakdown by counties.

Although there are mining operations

throughout the State most of the petroleum and natural gas was produced in the southeastern and northwestern parts. Copper output came from the southwestern corner of the State, uranium was mined and processed into yellow cake in the central section of the western part of the State, potash was mined in the southeastern area of the State, and most of the perlite was produced in the central section of the northern part of New Mexico.

During 1971 principal events in the mining industry of New Mexico included: Commencement of copper production in the Nacimiento mine near Cuba, operated by Earth Resources Corp.; expansion of mining capacity at the Tyrone mine of Phelps Dodge Corp.; beginning of prelimi-

Table 2.—Value of mineral production in New Mexico, by county
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Bernalillo.....	\$8,198	\$11,802	Cement, sand and gravel, stone, clay.
Catron.....	W	W	Sand and gravel, salt.
Chaves.....	16,484	12,326	Petroleum, natural gas, sand and gravel, stone.
Colfax.....	W	W	Stone.
Curry.....	W	W	Stone, sand and gravel.
De Baca.....	W	W	Sand and gravel.
Doña Ana.....	416	699	Sand and gravel, pumice, clay, stone.
Eddy.....	168,151	176,494	Potassium salts, petroleum, natural gas liquids, salt, stone, sand and gravel.
Grant.....	199,169	168,929	Copper, zinc, silver, molybdenum, lead, lime, gold, manganese ore, sand and gravel, stone, fluorspar.
Guadalupe.....	W	W	Sand and gravel, stone.
Harding.....	W	W	Carbon dioxide, sand and gravel.
Hidalgo.....	2,695	1,575	Copper, gold, silver, clay, sand and gravel, zinc.
Lea.....	395,329	394,296	Petroleum, natural gas, natural gas liquids, stone, sand and gravel.
Lincoln.....	125	W	Stone, sand and gravel.
Los Alamos.....	2	--	
Luna.....	578	204	Sand and gravel, clay, stone.
McKinley.....	70,958	71,304	Uranium, natural gas liquids, petroleum, coal, stone, natural gas, molybdenum, sand and gravel.
Mora.....	W	W	Sand and gravel, stone.
Otero.....	W	W	Stone, sand and gravel.
Quay.....	W	W	Sand and gravel, stone.
Rio Arriba.....	16,052	36,563	Natural gas, petroleum, natural gas liquids, sand and gravel, stone, pumice.
Roosevelt.....	21,961	18,686	Petroleum, natural gas, natural gas liquids, sand and gravel.
Sandoval.....	829	2,836	Copper, gypsum, petroleum, natural gas, sand and gravel, silver, peat, pumice, clay, stone, zinc.
San Juan.....	102,934	93,571	Natural gas, coal, petroleum, natural gas liquids, sand and gravel, helium, stone, pumice, uranium, clay.
San Miguel.....	W	W	Sand and gravel, stone.
Santa Fe.....	1,584	2,045	Sand and gravel, copper, pumice, gold, silver, stone, zinc.
Sierra.....	W	W	Sand and gravel, copper, silver.
Socorro.....	225	61	Sand and gravel, iron ore.
Taos.....	21,796	21,105	Molybdenum, perlite, sand and gravel, mica, stone.
Torrance.....	W	W	Sand and gravel.
Union.....	W	W	Pumice, sand and gravel.
Valencia.....	21,826	22,477	Uranium, perlite, sand and gravel, stone.
Undistributed ¹	11,045	11,309	
Total ²	1,060,358	1,046,284	

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

¹ Includes gem stones and vanadium which cannot be assigned to specific counties; and values indicated by symbol W.

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

nary studies for coal gasification; increased coal production; and decreased output of crude oil in the State with a decline of resources of both commodities.

Legislative and Government Programs.—Taxation and environment were the focal points of government activities related to the mineral industry of New Mexico during 1971.

The legislative branch of the State government conducted hearings on a new mineral tax bill during 1971. No legislation was adopted during the year, but higher taxation was strongly supported. The State Senate rejected a bill regulating surface mining. The Governor signed into law two measures related to environmental controls in New Mexico. One law creates an Environmental Improvement Agency, to take over functions formerly assigned to the Environmental Services Division of the Health and Social Services Department. A five-member Environmental Board, appointed by the Governor, will take over from the Health and Services Board the responsibilities for adoption of rules governing environmental controls in the State. The Board will have broad responsibilities for the quality of the environment, including air and water pollution, waste disposal, and radiation exposure. The second law creates a three-member Council on Environmental Quality to conduct studies into

environmental problems in the State. The Council will gather data on conditions and trends in the quality of the environment, and through analysis determine whether such conditions are likely to offset the environmental objectives.

The mineral wealth of the State of New Mexico was covered by three publications of U.S. Geological Survey,² four publications of the Federal Bureau of Mines,³ and five publications of the New Mexico State Bureau of Mines and Mineral Re-

² Akers, J. P., J. C. Shorty and P. R. Stevens. Hydrogeology of the Cenozoic Igneous Rocks, Navajo and Hopi Indian Reservation. U.S. Geological Survey Prof. Paper 521-D, 1971, 18 pp.

Irwin, J. H., P. R. Stevens, M. E. Cooley. Geology of the Paleozoic Rock, Navajo and Hopi Indian Reservation. U.S. Geological Survey Prof. Paper 521-C, 1971, 32 pp.

Fassett, J. E. and J. S. Hinds. Geology and Fuel resources of the Fruitland Formation and Kirtland Shale of the San Juan Basin. U.S. Geological Survey Prof. Paper 676, 76 pp.

³ Cardwell, L. E., and L. F. Benton. Analysis of Natural Gases 1970. BuMines IC 8518, 1971, 130 pp.

Ross, J. R., and D. R. George. Recovery of Uranium From Natural Mine Waters by Counter-current Exchange. BuMines RI 7471, 1971, 17 pp.

Schlottler, G. Analysis of Uranium Distribution in Diamond-Drill Cores. Section 23 Mine, Amrosia Area, Grants District, New Mexico. BuMines RI 7558, 1971, 29 pp.

U.S. Bureau of Mines. Strippable Reserves of Bituminous Coal and Lignite in the United States. IC 8531, 1971, 148 pp.

Table 3.—Indicators of New Mexico business activity

	1970 ^r	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total work force.....thousands..	375.8	387.7	+3.2
Unemployment.....do.....	22.5	24.9	+10.7
Total nonagricultural employment.....do.....	292.7	300.8	+2.8
Mining.....do.....	17.0	16.3	-4.1
Construction.....do.....	16.6	19.0	+14.5
Manufacturing.....do.....	21.0	21.3	+1.4
Transportation and public utilities.....do.....	20.3	20.4	+5
Wholesale and retail trade.....do.....	62.0	64.2	+3.5
Finance, insurance, and real estate.....do.....	12.7	13.4	+5.5
Services.....do.....	53.9	54.2	+6
Government.....do.....	89.2	92.1	+3.3
Personal income:			
Total.....millions..	\$3,185	\$3,495	+9.7
Per capita.....do.....	\$3,128	\$3,394	+8.5
Construction activity:			
Total residential units authorized.....do.....	6,981	12,113	+73.5
Value of nonresidential construction.....millions..	\$44.1	\$57.3	+29.9
Cement shipments to and within New Mexico thousand 376-pound barrels..	2,282	2,705	+18.5
Mineral production value.....millions..	\$1,060.4	\$1,046.3	-1.3

^p Preliminary. ^r Revised.

Sources: Employment and Earnings, Area Trends in Employment and Unemployment, Construction Review, Survey of Current Business, and the U.S. Bureau of Mines.

sources (a division of New Mexico Institute of Mining and Technology).⁴

The Interstate Highway system in New Mexico at yearend consisted of 846.93 miles open to traffic, 55.49 miles under construction, and 64.35 miles under preparation of plans and specifications or right-of-way acquisition. Of the 998.93 miles of designated Interstate system, all but 32.16 miles was completed or had experienced some progress towards completion. The amount of Interstate highway open to traffic increased 21.6 miles during the year.

The number of mining and oil and gas leases on Federal lands in New Mexico decreased slightly in 1971 to 15,239 leases comprising 10,014,488 acres.⁵ This area amounts to almost one-third of the 33,979,363 acres of Federal lands in the State and 13 percent of the total area of the State. Mining leases on Federal lands decreased from 728 at yearend 1970 to 579 a year later. Acreage in mining leases increased by 7.7 percent from 707,240 to 762,298 acres during 1971. Oil and gas leases increased 6.4 percent to 9,435,123 acres during 1971.⁶

Employment and Injuries.—Final data for 1970 and preliminary data for 1971,

compiled by the Bureau of Mines on employment and injuries in the mineral industries of New Mexico, are reported in table 4. The 1971, data on mineral fuels are excluded except for coal.

⁴Cash, D. J. Bibliography of Geophysics for New Mexico through 1970. New Mexico State Bureau of Mines and Mineral Resources Circular 119, 1971, 27 pp.

Kelley, Vincent C. Geology of the Pecos County, Southeastern New Mexico. New Mexico State Bureau of Mines and Mineral Resources Memoirs 24, 1971, 75 pp.

Roman, J. Ronald, and Don H. Baker, Jr. Selected papers from 1970 Uranium Symposium at Socorro, New Mexico. New Mexico State Bureau of Mines and Mineral Resources Circular 118, 1971, 61 pp.

Seager, William R., John W. Hawley, and Russell E. Clemons. Geology of San Diego Mountain Area, Doña Ana County, New Mexico. New Mexico State Bureau of Mines and Mineral Resources Bulletin 97, 1971, 38 pp.

Shomaker, John W., Edward C. Beaumont, and Frank E. Kottowski. Strippable Low-Sulfur Coal Resources of the San Juan Basin in New Mexico and Colorado. New Mexico State Bureau of Mines and Mineral Resources Memoirs 25, 1971, 189 pp.

⁵U.S. Geological Survey. Oil and Gas and Mineral Leases, Licenses, and Permits; Public, Acquired, Indian, Naval Petroleum Reserve, and Outer Continental Shelf; Under Supervision Dec. 31, 1969 and 1970, Table 1.

⁶Office of the Commissioner of Public Lands, State of New Mexico. Annual Report, 58th Fiscal Year, July 1, 1969 to June 30, 1970, September 1970, p. 6.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Coal and peat.....	429	248	106	841	--	46	54.68	625
Metal.....	4,453	285	1,267	10,144	5	399	39.83	4,375
Nonmetal.....	2,162	325	708	5,626	2	185	33.24	3,298
Sand and gravel.....	984	176	174	1,410	--	37	26.24	417
Stone.....	247	237	59	472	--	12	25.44	545
Total.....	8,275	279	2,309	18,493	7	679	37.09	3,480
1971: ^p								
Coal.....	470	240	113	903	--	54	59.80	658
Metal.....	4,190	280	1,174	9,411	3	385	41.23	3,063
Nonmetal ¹	2,110	340	716	5,732	4	166	29.66	6,427
Sand and gravel.....	935	194	181	1,534	--	41	26.73	1,290
Stone.....	270	214	57	461	--	12	26.06	1,018
Total.....	7,975	281	2,242	18,041	7	658	36.86	3,809

^p Preliminary.

¹ Beginning in 1971, data concerning peat operations are included in the nonmetals industry on a continuing basis.

² Data does not add to total shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The value of mineral fuels production increased \$19.1 million, or 2.9 percent, in 1971. The total value of mineral fuels, \$676.4 million, comprised 64.6 percent of the State's mineral output. The share of petroleum and natural gas liquids decreased slightly and amounted to \$474.4 million, or 70.1 percent of the total value of fuels; natural gas marketed production contributed \$175.1 million, or 25.9 percent, and participation of coal was valued at \$26.7 million, or 3.9 percent.

Carbon Black.—During 1971, the Continental Carbon Co. plant in Lea County was the only producer of carbon black in New Mexico.

Carbon Dioxide.—Production of carbon dioxide increased by 14.2 percent, and the wellhead value went up 17.2 percent compared with the value reported in 1970. About two-thirds of the State's total was produced by the S.E.C. Corp. The balance was from facilities operated by Schwartz Carbonic Co. All production was in Harding County.

Coal.—Bituminous coal output reached 8.2 million tons in 1971, a 11.1-percent increase over the output in 1970. The value of coal production in 1971 reached \$26.7 million, showing an increase of \$5.4 million. Larger output and an increase of the average price of coal from \$2.89 in 1970 to \$3.26 in 1971 contributed to the increased value of production. The higher coal prices in 1971 ended the down trend, which started in 1961, when the price per ton was quoted at \$6.01. (In 1961 most of the coal produced in New Mexico was from underground mines and for coking use, therefore the costs were high.)

Six mines were in operation in New Mexico during 1971, of which one was underground. Coal mines employed a total of 576 persons, including 163 underground miners. Most of the coal production was from the San Juan basin, where the largest part of exploratory drilling was conducted.

The principal coal producer in the State was the Navajo strip mine of Utah International, Inc., formerly Utah Construction & Mining Co., located southwest of Fruitland. The Navajo mine supplied low-sulfur, high-ash coal to the Four Corners powerplant of the Arizona Public Service

Co. Ash from the Four Corners powerplants was used in conjunction with reclamation of the stripped portion of the mine. Placing the ash in the valleys of mined areas and covering it with spoil materials pushed from the peaks created an undulating topography which reportedly has a greater resistance to water and wind erosion than the former natural terrain. The air pollution control devices of the Four Corners powerplant, are essential for the operation of the Navajo mine because the plants are the principal users of the mine's production and their shutdown or slowdown would adversely affect coal consumption and mining activities.

Coking coal mined by Kaiser Steel Corp. at the York Canyon underground mine west of Raton continued to be shipped by unit trains to Kaiser's Fontana, Calif. steel plant. During the year mine management was evaluating the possibility of changing the present room-and-pillar mining method to long-wall mining. Mining equipment manufacturers from the United Kingdom were consulted as possible suppliers of the equipment necessary for long-wall mining. Because of a coal miner's strike, of 1 week, shipments of coal by special unit train were halted. During July 1971 Kaiser filed a registration with the State Inspector of Mines to start a new strip coal mine, named the "West York Strip." No company reports on the status of operations at West York Strip mine were received during the last half of the year.

A 100-car train hauled 10,000 tons of low-sulfur coal from the Sundance Coal Co. mine near Gallup, for testing at the Commonwealth Edison Co. State Line Generating Station in Hammond, Ind.

The State's large coal reserves, amenable for strip mining, have attracted prospective producers of synthetic natural gas (SNG). According to reports, Pacific Lighting Corp., Texas Eastern Transmission Corp., and Utah International Inc. have agreed to conduct a feasibility study on a coal gasification project having a capacity of 250 million cubic feet per day. If built, the plant will be located near Utah International coal reserves on the Navajo reservation in northwest New Mexico. To produce 250 million cubic feet per day, about 7.5 mil-

lion tons of coal per year will be required. Another aspect of the same study is to investigate the possibility of constructing up to three additional coal gasification plants, making the capacity of the four plants total 1 billion cubic feet per day. The uncommitted coal reserves of Utah International are sufficient to support a production of 1 billion cubic feet per day of gas for approximately 25 years. Construction costs of one 250 million cubic feet per day gas plant were estimated at \$200 million. Tentatively the beginning of operations was set for 1975. Furthermore, El Paso Natural Gas Co. announced intentions to build another 250 million cubic feet per day SNG plant at an undisclosed site near the company's pipeline system in the San Juan coal basin in northwestern New Mexico. The company has acquired deposits of about 900 million tons of recoverable coal in the same area.

Helium.—Output of helium in New Mexico came from the former Bureau of Mines plant in Shiprock. The plant, presently owned by the Navajo Indian Tribe, was operated under lease as a pilot plant operation by Linde Division, Union Carbide Corp.

Natural Gas.—Marketed natural gas was up 29 billion cubic feet to 1,168 billion cubic feet, or 2.5 percent. Principal gas producing counties were San Juan (32.7 percent), Lea (37.1 percent), Eddy (11.7 percent), and Rio Arriba (15.7 percent), and they shared 97.2 percent of New Mexico marketed gas production during 1971. According to the New Mexico Oil Conservation Commission, at yearend there were 9,388 wells producing natural gas in the State, or 288 wells more than in 1970. As of yearend 1971, natural gas reserves were reported by the American Gas Association Inc. (AGA) and by the American Petroleum Institute (API) at 13,067,954 million cubic feet, or about 1.7 percent less than in 1970. The 905 billion cubic feet of reserves added by revisions and new field and pool discoveries were not sufficient to offset the 1971 production. In the southeast part of the State 1971 reserves declined 3.1 percent, compared with a drop of only 0.7 percent in the northwest part of the State.

Royalties and taxes received by the State from gas production amounted to \$14.7 million, up 8.1 percent above that of 1970. Taxes paid to the State and fee produc-

tion of gas amounted to \$10.2 million, up 8.5 percent. These figures do not include receipts from the State's share (37.5 percent) of royalties paid on production from Federal public domain lands, nor bonuses and rentals paid for leases on State lands. Seven exploratory gas wells were completed during the year, a decrease of one well from the 1970 level. Table 7 shows the most significant gas discoveries in the State during 1971.

Natural Gas Liquids.—Production of natural gas liquids increased about 4 percent to 37.0 million barrels and about 14.5 percent in value. According to the New Mexico Oil and Gas Engineering Committee, a total of 1,008.5 billion cubic feet of gas was processed in 39 plants. After extraction of liquids, 971.6 billion cubic feet was shipped to transmission companies, and 1.4 billion cubic feet was reinjected. Plant fuel and shrinkage accounted for 11.5 billion cubic feet, and the remainder was delivered directly to customers.

As of December 31, 1971, estimates made by API and AGA gave the State proved reserves of 550 million barrels of natural gas liquids⁷ a decline of 8.6 million barrels, or about 1.5 percent, from the 1970 estimate. The gain in natural gas liquids reserves of 6.4 million barrels (2.5 percent) in the southeastern part of the State failed to compensate for the northwest's 14.9-million-barrel decrease.

Petroleum.—Output of petroleum totaled 118.4 million barrels, or 9.8 million barrels (7.6 percent) less than in 1970. Increased production in McKinley, Rio Arriba, Eddy, and Sandoval Counties could not offset production losses in Chaves, Lea, Roosevelt, and San Juan Counties. Table 5 shows details of production by county.

According to the State Oil Conservation Commission, 17,210 oil wells in 723 reservoirs were in production at yearend, a decrease of 104 wells and increase of 10 reservoirs. There were 2,734 injection wells in secondary-recovery or pressure-maintenance projects. The Permian basin in southeast New Mexico remained the prin-

⁷ American Gas Association, Inc. American Petroleum Institute, and Canadian Petroleum Association. Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas in the United States and Canada and United States Productive Capacity as of Dec. 31, 1971. V. 26, May 1972, p. 248.

Table 5.—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)	
	1970	1971	1970	1971
Southwest New Mexico:				
Chaves.....	4,474	2,974	11,822	13,412
Eddy.....	18,009	18,930	139,622	136,479
Lea.....	91,165	83,479	436,252	433,432
Roosevelt.....	5,848	4,214	11,045	16,313
Subtotal.....	119,496	109,597	598,741	599,686
Northwest New Mexico:				
McKinley.....	1,214	1,754	56	872
Rio Arriba.....	1,499	2,038	62,853	183,841
San Juan.....	5,938	4,924	462,035	381,638
Sandoval.....	37	99	53	1,540
Subtotal.....	8,688	8,815	524,997	567,891
Total New Mexico.....	128,184	118,412	1,123,738	1,167,577

Source: New Mexico Oil Conservation Commission. 1971 Oil and Gas Statistics.

cipal oil-producing area, accounting for about 92.5 percent of the output.

Direct revenue to the State from petroleum production in 1971, totaled \$47.1 million,⁸ an increase of 1.5 percent. Royalties amounted to \$23.4 million with the balance divided among school, severance, conservation, and ad valorem taxes. The \$47.1 million represents 11.7 percent of the value of crude oil sales during the year.

As reported by API, proved reserves of crude oil declined 13.7 percent to 656.9 million barrels as of December 31, 1971. Additions to reserves from new fields and pools totaled 975,000 barrels; extensions and revisions added another 8.3 million barrels. An additional 103.5 million barrels of indicated reserves are estimated in

known reservoirs, based on additional recoveries in known reservoirs in excess of proved reserves, which engineering knowledge and judgment indicate will be economically possible by application of fluid injections whether or not such programs are currently in effect. Depletion of reserves by production of 118.4 million barrels more than offset additions to reserves.

Based upon API data, overall drilling activity in the State totaled 816 wells with 4,344,130 feet, an increase of 88 wells and 124,562 feet compared with 1970. However, the number of exploratory wells declined from 163 in 1970 to 129 in 1971. The success ratio for wildcat drilling was 11.2 per-

⁸ New Mexico Oil and Gas Accounting Commission. Annual Report for 1971.

Table 6.—Oil and gas well drilling completions, by county

County	Proved field wells ¹			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Chaves.....	23	8	18	--	1	20	70	274,485
Doña Ana.....	--	--	--	--	--	2	2	5,698
Eddy.....	106	22	21	--	5	19	173	823,792
Harding.....	--	--	--	--	--	4	4	7,139
Hidalgo.....	--	--	--	--	--	1	1	7,073
Lea.....	209	8	46	3	--	9	275	1,953,316
Luna.....	19	4	10	1	--	32	66	180,716
Otero.....	--	--	--	--	--	3	3	3,834
Quay.....	9	61	2	--	--	1	73	483,055
Rio Arriba.....	16	2	2	--	1	7	23	181,940
Roosevelt.....	4	3	--	2	--	8	17	83,713
Sandoval.....	9	71	14	--	--	7	101	319,911
Torrance.....	--	--	--	--	--	1	1	2,051
Union.....	--	--	--	--	--	2	2	7,407
Total.....	395	179	113	6	7	116	816	4,344,130

¹ Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

Table 7.—Principal oil and gas discoveries in 1971

County and field	Well	Operator	Location			Producing formation	Total depth (feet)	Initial production	
			Section	Township	Range			Barrels of oil per day	Thousands of cubic feet of gas per day
Eddy:									
	Wildcat	No. 1-Citgo	Black River	34	25 S	24 E	Morrow	7,045	41,500
	Do	No. 1-S Empire	Midwest	6	18 S	29 E	do	12,000	45,000
	Cataclaw-Draw-Morrow	No. 1-Cataclaw Draw	Hanagan	26	21 S	25 E	do	10,950	2,800
Lea:	Garret-Drinkard	No. 1-Burson	Green & Michealson	28	16 S	38 E	Drinkard	3,308	203
McKinley:	Lone Pine	No. 2	Beard Oil	8	17 N	8 W	Dakota	2,826	368
Roosevelt:	Wildcat	No. 1 Peterson	Amoco	19	5 S	33 E	Cisco	7,986	7,210
Sandoval:									
	Venado	No. 1	Warren Drilling	8	22 N	5 W	Mesaverde	6,623	75
	Parlay	No. 1	Tesoro Petroleum	29	22 N	3 W	do	7,730	336
San Juan:	Wildcat	No. 1 Federal-1	BOC Inc.	8	23 N	8 W	Gallup	5,291	27

cent, or about 3.5 percent below results reported in 1970. For development drilling the success ratio was 85.6 percent, a slight improvement over the 84.2 percent in 1970. During 1971 Lea County with three new oil producers and Eddy County with five new gas producers were the most successful areas for wildcat drilling.

During 1971 five petroleum refineries—Caribou Four Corners Oil Co. at Kirtland, Famariss Oil and Refining Co. at Monument, Navajo Refining Co. at Artesia, Plateau Inc. at Bloomfield, and Shell Oil Co. at Ciniza—with an aggregate capacity of 44,120 barrels per day were in operation in the State. No major events were reported during the year for any of the operating refineries.

Runs of crude oil to stills at the State's five refineries totaled 15.5 million barrels, or 95.7 percent of operating crude oil throughput capacity, all of which was produced in New Mexico. Out-of-State shipments of crude oil produced in New Mexico totaled 104.5 million barrels. More than 60.0 percent of the quantity shipped was destined for Texas, 62.7 million barrels; Indiana, 13.3 million barrels; and Illinois, 16.2 million barrels.

METALS

Metal production was valued at \$254.3 million, down 12 percent from 1970. The

decrease was attributable principally to lower output of uranium and reduced prices for copper.

Copper.—New Mexico copper production declined 8,859 tons to 157,419 short tons of recoverable copper, 5.3 percent less than the previous alltime high of 166,278 short tons produced in 1970. Additional production from the Tyrone and Naciminto mines could not offset the losses in production caused by a strike and the closing of some mines. Grant County remained the largest producer of copper in the State, accounting for 97.7 percent of the State's total copper production. The principal events in the copper industry include the initiation of production at the Naciminto copper mine and concentrator near Cuba, the expansion of the Tyrone mine, and the installation of a fourth converter at the Hurley Chino Mines Division of Kennecott Copper Corp. Tables 8, 9 and 10 shows statistical details of copper production in New Mexico.

At the Earth Resources Co., Naciminto open pit mine, the ore bearing Agua-Zarca Formation, 100 feet thick, dips from east to west at approximately 25° and is overlain by the Chinel Formation. Immediately to the west of the present pit, several apparent faults related to the major Naciminto fault have dropped the Agua-Zarca Formation below economically operable open pit depths. Sulfide mineralization,

Table 8.—Mine production of gold, silver, copper, lead, and zinc in 1971, by types of material processed and method of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode:					
Acid leaching (heap) ore.....			2,090		
Smelting of concentrates from ore.....	10,677	781,891	127,857	2,971	13,959
Direct smelting of—					
Ore.....	4	550	66	--	--
Precipitates.....	--	--	27,406	--	--
Total.....	4	550	27,472	--	--
Grand total.....	10,681	782,441	157,419	2,971	13,959

chalcocite, begins rather abruptly at the water table, with the well-oxidized material above it consisting largely of malachite and azurite. Approximately 30,000 feet were drilled in 79 holes to delineate the ore body in the general mine area. About 63 holes contained ore-grade materials. The total copper-bearing sulfide ore was estimated at approximately 10 million tons averaging 1.67 percent copper. According to the company, minable reserves are estimated to be 5 million tons of 0.9 percent copper. Drilling has indicated a substantial additional tonnage of oxide ores at shallower depths above the sulfide zone. Based on extensive metallurgical work, a 3,000-ton-per-day flotation mill was completed at a cost slightly under \$5 million. The mill will yield concentrate averaging 45 percent copper.

The Nacimiento mine fleet was made up of seven twin-engine Caterpillar 567-B scrapers, five D-9G rippers and pushers, three Wabco B-333 twin-engine self-loading scrapers, a motor grader, and a water truck. Over the life of the open pit project, it is estimated that 25 million cubic yards will be removed. The final pit will be approximately 2,000 by 1,800 feet at the surface and reach a maximum depth of 500 feet. Slopes will range from 1/2:1 to 1:1, with 20-foot berms at 80-foot intervals. The pit will have a minimum life of 6 years based on a mining and milling rate of 1 million tons per year. The operation employs 130 persons, and the total cost of the project, including land acquisition, exploration, mine development, preproduction cost, utilities, and capital costs amounted to \$10,500,000. A 5-year sales contract with American Smelting and Refining Co. (Asarco) concluded in 1970 has assured a

market for the copper concentrate during the productive life of the mine.

At Hurlley, Chino Mines Division of Kennecott Copper Corp. was installing new and improved flotation facilities to replace the existing one. The magnetite pilot plant study initiated in 1970 was completed, indicating that a magnetite concentrate can be produced from mill tailings.

Expansion of the Tyrone copper mine properties by Phelps Dodge Corp. in Grant County continued on schedule during 1971. When completed in 1973, the new mines will be capable of producing about 90,000 tons per year of copper, an increase of 40,000 tons per year. Total costs for the expansion were reported at \$38 million.

Gold.—Production of gold increased by 1,962 troy ounces, or 22.5 percent, when compared with 1970. The value increased to \$440,593, or \$123,308 more than in 1970. Gold was recovered mainly as a byproduct of copper mining. The principal gold production came from operations in Grant County. Output from Hidalgo and Santa Fe Counties provided additional sources.

Iron Ore.—Modest quantities of magnetite ores were consumed in local cement plants. Jones open pit mine in Socorro County was the principal producer in the State.

Lead.—Lead production declined from 3,550 tons in 1970 to 2,971 tons in 1971. The Groundhog mine near Vanadium, operated by the Asarco, was the only producer.

Manganese Concentrate and Manganiferous Ore.—The ore output declined by 38.3 percent, compared with the 1970 output, and there was no production of manganese concentrate during 1971.

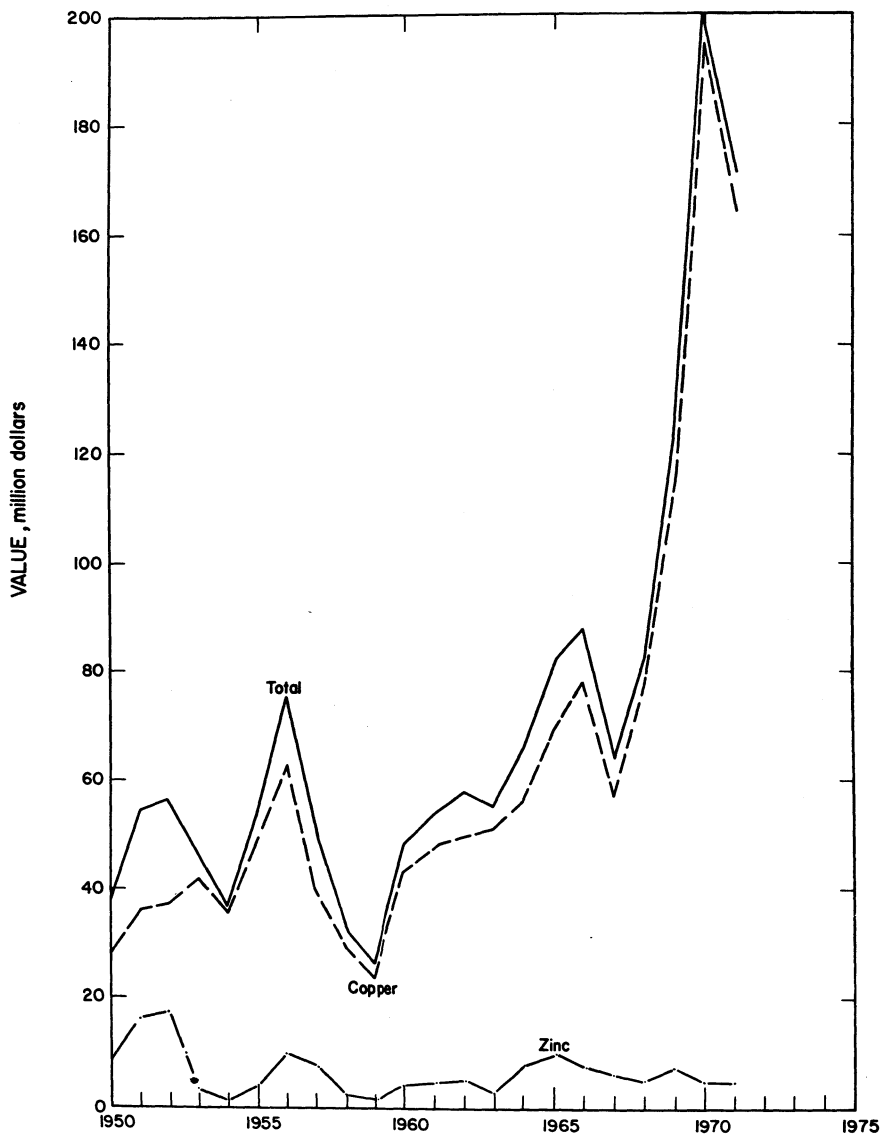


Figure 2.—Value of mine production of copper, lead, and zinc in New Mexico. The value of gold, silver, and lead produced annually has been relatively small.

Table 9.—Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing ¹		Material sold or treated ² (short tons)	Gold		Silver		Total value
	Lode	Placer		Troy ounces	Value	Troy ounces	Value	
1969, total.....	29	1	12,835,019	8,952	\$371,598	465,591	\$333,720	
1970, total.....	19	--	20,756,890	8,719	317,285	781,952	1,384,697	
1971:								
Grant.....	6	--	18,080,954	8,885	366,507	715,454	1,106,092	
Hidalgo.....	1	--	56,701	1,134	46,778	23,376	36,139	
Sandoval, Sierra, Socorro ³	4	--	359,080	--	--	30,338	46,902	
Santa Fe.....	2	--	23,461	662	27,308	13,273	20,520	
Total.....	13	--	18,520,146	10,681	440,593	782,441	1,209,653	
	Copper		Lead		Zinc			
	Short tons	Value	Short tons	Value	Short tons	Value		
1969, total.....	119,956	\$114,039,770	2,368	\$705,427	24,308	\$7,097,936	\$123,048,451	
1970, total.....	166,278	191,884,984	3,550	1,108,979	16,601	5,086,306	199,732,251	
1971:								
Grant.....	153,864	160,018,768	2,971	819,940	13,958	4,494,429	166,805,736	
Hidalgo.....	1,423	1,480,388	--	--	1	209	1,563,514	
Sandoval, Sierra, Socorro ³	1,589	1,652,872	--	--	(⁴)	113	1,699,887	
Santa Fe.....	542	563,576	--	--	(⁴)	64	611,468	
Total.....	⁵ 157,419	163,715,604	2,971	819,940	13,959	4,494,815	170,680,605	

¹ Operations at plants leaching runoff water not counted as producing mines.

² Does not include tonnage of precipitates shipped.

³ Combined to avoid disclosing individual company confidential data.

⁴ Less than $\frac{1}{2}$ unit.

⁵ Data does not add to total shown because of independent rounding.

Molybdenum.—During 1971 molybdenum was produced as a byproduct of copper and uranium beneficiation and from molybdenum ore, and production decreased by 2.3 percent. Molybdenum ore was mined at the Questa mine of the Molybdenum Corp. of America. As a byproduct, molybdenum was also produced at Kennecott Copper Corp. Chino mines in Grant County and in a uranium concentrator located in McKinley County and operated by Kerr-McGee Corp.

Silver.—Silver production reached 782,441 troy ounces, a slight gain over 1970 production. The value of silver produced was \$1,209,653, 12.7 percent less than in 1970. The largest producers were the Tyrone mine of Phelps Dodge Corp. in Grant County, where silver is produced as a byproduct of copper; the Groundhog mine of Asarco and the Continental mine of United States Smelting, Refining & Mining Co. (USSR & M Co.) in Grant County; and the Bonney-Miser's Chest and "85" mines of Federal Resources Corp. in Hidalgo County. Output of silver was from 13 mines in six counties, a decrease from the 15 mines in six counties producing during 1970.

Uranium.—New Mexico continued to lead the Nation in uranium output, producing 43.09 percent of the U.S. total. Nine New Mexico shippers produced 10,567,000 pounds of recoverable uranium oxide in uranium concentrates from 35 operations in three counties. Output was down 8.7 percent from the 11,574,000 pounds produced in 1970. The value of production declined to \$65,517,000 down 6.4 percent compared to 1970.

According to the Atomic Energy Commission (AEC),⁹ at yearend New Mexico had more uranium reserves than any other State with 137,032 tons of uranium recoverable at \$8 per pound in 50 million tons of ore averaging 0.27 percent U₃O₈.

Surface exploration and development drilling decreased from 5.2 million feet in 1970 to 3.0 million feet in 1971, maintaining a third-place ranking among the States (after Wyoming and Texas). Exploratory drilling was performed in some marginal areas, many of which are far from producing mines.

Lands acquired for uranium mining and exploration decreased 12.7 percent from 4.7

⁹ Atomic Energy Commission. Statistical Data of the Uranium Industry. Jan. 1, 1972, 63 pp.

Table 10.—Mine production of gold, silver, copper, lead, and zinc in 1971, by class of ore or other source materials, in terms of recoverable metals

Source	Number of mines ¹	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode ore:							
Dry silver.....	1	45	--	89	1	--	--
Copper.....	11	18,401,080	10,562	639,478	129,534	--	487
Lead-zinc.....	1	119,021	119	142,874	478	2,971	13,472
Total.....	12	18,520,101	10,681	782,352	130,012	2,971	13,959
Other lode material:							
Copper precipitates ² ..	2	34,397	--	--	27,406	--	--
Total lode material..	13	18,554,543	10,681	782,441	157,419	2,971	13,959

¹ Detail may not add to total because some mines produce more than one class of material.

² Operations at plants leaching runoff water not counted as producing mines.

million acres in 1970 to 4.1 million acres in 1971.¹⁰

The AEC reported three uranium ore processing mills in New Mexico having a total nominal capacity of 13,500 tons of ore per day. These mills comprise 42.3 percent of the U.S. capacity expressed in tons per day for mills in operation or under construction.

According to the annual report of Kerr-McGee Corp., the exploratory drilling during 1971 indicated potential for the development of uranium reserves in the Rio Puerco area. Development drilling continued throughout the year on some 38,000 acres of company-held leases in Church Rock area of New Mexico. Work completed on the project at yearend indicated a major new uranium district. In June 1971, the company began construction of the initial concrete-lined 14-foot-diameter and 850-foot-deep mine shaft. Ore production is scheduled to commence in 1974. Furthermore, at Ambrosia Lake initial production from the newly developed Section 35 mine began late in 1971, bringing the company's total number of producing mines in this district to eight. The company's processing mill at Ambrosia Lake, with a capacity of 7,000 tons of ore per day, operated at a rate of approximately 4,400 tons per day during the latter part of the year. Mill throughput was reduced to this rate to correlate production with sales requirements.

The Anaconda Company's production of uranium oxide decreased slightly, from 3,534,000 pounds in 1970 to 3,525,000 pounds in 1971. As deliveries to the AEC were discontinued, all future shipments of

"yellow cake" will be to utilities or power equipment manufacturers. Sales and production from this operation are scheduled at maximum plant capacity over the next several years. The Bluewater uranium mill and Jackpile-Paguete open pit uranium mine were the principal activities of The Anaconda Company in New Mexico.

The Reserve Oil and Minerals Corp. of Albuquerque completed development of its L-Bar property, located approximately 60 miles west of Albuquerque, in the general area of The Anaconda Company's Jackpile-Paguete mine. Reportedly, uranium reserves total 4 million tons of ore with 16 million pounds of uranium oxide. The reserves lie at depths between 250 and 700 feet. A contract to prepare a feasibility study for a \$10 million uranium mill was awarded to Fluor Corp. If the mill were constructed, the Reserves Oil and Minerals Corp. and Standard Oil Co. of Ohio (SOHIO) were to develop the property on a 50-50 basis. At yearend two drilling rigs were operating at the property.

In early fall of 1971, the Reserve Oil and Minerals Corp. and Oklahoma Natural Development Corp. of Tulsa, a nonutility subsidiary of Oklahoma Natural Gas Co., announced plans for their joint exploration (50-50 percent) for uranium on a 12,782-acre tract of Laguna Pueblo land in Valencia County, about 8 miles northeast of the community of Laguna. The primary objective was to confirm the presence of uranium-bearing minerals in the Jackpile sands of the Morrison Formation. The initial phase of the program calls for drilling

¹⁰ Work cited in footnote 9.

and logging a number of exploratory holes to depths ranging from 300 to 600 feet.

Gulf Oil Corp. announced agreement with Bokum Corp. to purchase a major portion of Bokum's uranium properties located in the San Mateo area.

The United Nuclear Corp. presented the highest bid at the first of two uranium lease sales conducted by the Navajo Tribe, offering \$355,000 for uranium leases in the vicinity of Church Rock.

The Earth Resources Co. acquired a lease on 5,100 acres of land on the Navajo Indian Reservation. The uranium lease lies parallel to a strip in the Church Rock district where both Kerr-McGee Co. and United Nuclear Development Co. hold exploitation rights.

Vanadium.—There was no production of vanadium ore in New Mexico during 1971. The vanadium-containing sludge from uranium mills was shipped to Colorado for recovery of vanadium.

Zinc.—In 1971 mine production of zinc was down 16 percent in quantity to 13,959 tons from 16,601 tons a year earlier; the value of production decreased 11.6 percent to \$4.5 million. Grant County remained the principal zinc producer in the State, with Groundhog mine the leading producer. The drop in production resulted from the consolidation and closing of facilities after changes of ownership (Hanover and Osaldo mines). Tables 8, 9 and 10 indicate statistical details of zinc output in New Mexico.

NONMETALS

Nonmetals increased 1.4 percent in value of production to \$115.5 million, representing almost 11 percent of the State's total mineral production. Potassium salts, the most valuable nonmetal, gained 0.9 percent in value while decreasing 4.1 percent in quantity. Sand and gravel, in second place, decreased production and ended the year with a 24.2 percent loss in total value.

Cement.—During 1971 shipments of portland and masonry cement increased in amount and value. Consumption of portland cement, 2,705,000 barrels, was 18.5 percent higher than in 1970. Finished portland cement was used by ready-mix concrete, highway contractors, building-material dealers, and other contractors; small

amounts were used by Federal, State, and local government agencies. The State's only cement plant is located at Tijeras, east of Albuquerque, Bernalillo County, and is operated by Ideal Cement Co., a division of Ideal Basic Industries, Inc.

Clays.—Production of clay increased 16 percent and value increased 40 percent. Seven operations produced clay in the State, and Bernalillo County was the principal producer.

Fluorspar.—Shipments of fluorspar increased by 11 percent, but value decreased by 14 percent in 1971. Two fluorspar mines were under development, and five new mines were registered during 1971.¹¹

Gypsum.—Crude gypsum output decreased by 23 percent, and value decreased 28 percent. Only two producing facilities located in Sandoval County reported statistics to the Bureau during 1971, two fewer facilities than in 1970.

Lime.—Lime was calcined by the Chino Division of Kennecott Copper Corp. at Hurley for use in its copper smelter. The limestone ore is quarried from Lone Mountain west of Hurley. At the request of the operator, quantities and value of lime production are not disclosed.

Mica.—During 1971 Mineral Industrial Commodities of America, Inc., the sole producer, continued to mine scrap mica from its Tojos open pit in Taos County. When compared with production in 1970, output increased by 50 percent but value declined by 48 percent.

Perlite.—The State continued to lead the Nation, with 89 percent of the total production. The State produced 385,746 tons of crude perlite valued at \$4.6 million, a slight increase when compared with 1970. Output came from the open pit mines of United States Gypsum Co. in Valencia County, and from three northern Taos County operations—El Grande mine of Grefco, Inc., No Agua mine of Johns-Manville Perlite Corp., and the open pit mine of Silbrico Corp. of Antonito, Colo.

Potash.—New Mexico remained the leading producer of potash in the Nation, contributing about 89 percent to the total U.S. potash output in 1971. Production of marketable potassium salts declined

¹¹ Hays, William H. Fifty-ninth Annual Report by the State Inspector of Mines to the Governor of the State of New Mexico. Year Ending Dec. 31, 1971, 69 pp.

Table 11.—Crude potassium salts produced, and marketable salts produced and sold or used in New Mexico

(Thousand short tons and thousand dollars)

Period	Crude salts ¹ (mine production)		Marketable potassium salts					
	Gross weight	K ₂ O equivalent	Production			Sold or used		
			Gross weight	K ₂ O equivalent	Value ²	Gross weight	K ₂ O equivalent	Value
1970:								
January-June.....	8,096	1,476	2,164	1,198	\$42,260	2,192	1,224	\$42,377
July-December.....	8,150	1,459	2,123	1,192	43,617	1,774	1,008	35,922
Total ³	16,246	2,935	4,286	2,390	85,877	3,966	2,227	78,299
1971:								
January-June.....	8,293	1,453	2,136	1,210	46,195	2,484	1,404	54,462
July-December.....	7,824	1,338	1,894	1,081	40,494	1,617	914	34,863
Total ³	16,117	2,792	4,030	2,291	86,689	4,101	2,317	89,325

¹ Sylvite and langbeinite.

² Derived from reported value of "Sold or used."

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

slightly over 4 percent to 2.3 million tons of K₂O equivalent. Value increased to \$87 million, or about 1 percent. Eight facilities for the production of potash were active in the State, all in Eddy County, southeastern New Mexico. The moderation of Canadian production in 1970 contributed to the favorable price situation for potash during 1971. At yearend, Canada was reevaluating its position on potash regulation in the Province of Saskatchewan. Therefore, the future economic aspects of the potash mining industry in New Mexico remained uncertain. The rail strike during the summer caused some temporary layoff of personnel by Duval Corp. and National Potash Co., because both companies ship potash ore to their refineries by commercial freight. The United States Potash and Chemical Co., a wholly owned subsidiary of Continental American Royalty Co., announced plans to expand its Carlsbad potash mining facility. The investment of about \$2 million should allow the company to further develop the seventh ore zone with reserves of sylvinitic sufficient to sustain present output for another 40 years. Reportedly, the zone is one of the largest proven potash deposits remaining in the United States.

Pumice.—New Mexico ranked fifth in the Nation in the production of pumice.¹² During 1971 the quantity sold or used in the State amounted to 286,508 short tons, or 41 percent more than in 1970. Value reached \$601,381, or 36 percent more than in 1970. There were 10 pumice-producing

operations in seven counties of New Mexico. Union, Doña Ana and Rio Arriba Counties were the leading producers of pumice.

Pumice operations included the General Pumice Corp. Cullum mine near Espanola, Rio Arriba County; Utility Block Co., Inc., Esquire claims near Ponderosa, Sandoval County; and Copar Pumice Co., Inc., Santa Fe County near Espanola. Volcanic cinder was mined in San Juan County by Garcia & Son near Farmington; and in Doña Ana County by Associated Materials Co., at the Black Bear Mountain mine near Berino, by Morton Bros. at the Volcano 1 mine, and by Volcanic Cinder Co. at the Klinker claim, both near Las Cruces. Scoria output came from Twin Peaks Products Co., Lava Pit mine, near Carrizozo, Lincoln County; Crego Block Co., Inc., La Cienega mine near Santa Fe, Santa Fe County; and Twin Mountain Rock Co., Twin Mountain Rock mine near Des Moines, Union County.

Salt.—Seven operations were located in Eddy and Catron Counties where salt was recovered as a byproduct of potash operations. Leading shippers of rock salt and pressed blocks were The Salt Supply Co., Inc., and New Mexico Salt Co., both of Carlsbad. Pioneer Water Co., Inc., of Eunice recovered brine from potash operations. Principal markets for rock salt were feed dealers, city and State highway depart-

¹² Statistics designated "pumice" include such volcanic materials as scoria, volcanic cinders, and pumice.

ments for use on icy roads, oil refiners, water-softener manufacturers, and oilfield service companies. Some brines were used in oil and gas well drilling. Rock salt, used mainly in New Mexico and Texas, was shipped also to Arizona, Alabama, Arkansas, Colorado, and Oklahoma.

Sand and Gravel.—Shipments of sand and gravel decreased about 17 percent and value decreased 24 percent, from 10.7 million tons valued at \$10.5 million in 1970 to 8.9 million tons valued at \$8.0 million in 1971. Sand and gravel operations in 32 counties totaled 129, down from 164 in 1970. Government-and-contractor operations accounted for 1.3 million tons, 15 percent of the total State output, which represented a sharp drop when compared with 47 percent in 1970; commercial operators shipped the remainder.

Of the 6.8 million tons of gravel, 4.4 million tons were used by commercial and government-and-contractor operations for

road construction and about 1.6 million tons for building construction. The remainder was used for fill and other purposes. Of the 2.1 million tons of sand, a total of 1.1 million tons was used by all operations for building. The remaining 0.8 million tons was used for paving and fill.

Stone.—Stone shipments decreased 6.1 percent in tonnage and increased 32.4 percent in value. The number of quarries in operation decreased from 67 to 43.

Traprock was produced in Colfax, McKinley, Mora, Rio Arriba, and Valencia Counties. Quarries in the following counties sold or used limestone: Chaves, Doña Ana, Eddy, Grant, Lincoln, Luna, Otero, Rio Arriba, San Miguel, Santa Fe, and Valencia. Quartz or quartzite was produced in Colfax and Rio Arriba Counties. Sandstone sold or used by producers was quarried in Colfax, Mora, San Miguel, Sandoval, Santa Fe, Taos, and Valencia Counties.

Table 12—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	511	\$597	1,138	\$1,503
Fill.....	76	76	268	186
Paving.....	276	305	441	452
Other uses ¹	43	50	116	184
Total ²	906	1,028	1,964	2,225
Gravel:				
Building.....	676	867	1,592	2,249
Fill.....	123	112	345	65
Paving.....	3,906	2,776	3,616	1,778
Miscellaneous.....	96	205	W	W
Other uses.....	3	5	55	57
Total ²	4,803	3,965	5,609	4,150
Government-and-contractor operations:				
Sand:				
Fill.....	26	21	28	27
Paving.....	254	324	91	95
Other uses.....	2	2	2	1
Total ²	282	348	121	123
Gravel:				
Building.....	4	9	--	--
Fill.....	98	45	373	191
Paving.....	4,539	5,092	769	1,253
Other uses.....	33	29	34	33
Total ²	4,674	5,175	1,175	1,479
Total sand and gravel ²	10,666	10,516	8,869	7,975

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

¹ Includes other industrial sand (1971).

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

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

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Bernalillo.....	15	1,318	\$1,023	14	2,606	\$2,280
Catron.....	5	285	557	1	42	84
Chaves.....	8	514	431	6	166	162
Colfax.....	7	1,655	1,981	--	--	--
Curry.....	--	--	--	1	35	35
Dofia Ana.....	10	493	269	11	941	526
Grant.....	5	123	W	3	197	267
Guadalupe.....	1	W	W	3	W	166
Hidalgo.....	1	4	6	1	W	W
Lea.....	3	W	W	5	333	461
Lincoln.....	3	W	W	1	13	6
Los Alamos.....	1	1	2	--	--	--
Luna.....	6	W	W	4	164	W
McKinley.....	4	145	77	4	261	141
Mora.....	7	626	519	2	W	W
Otero.....	8	235	165	7	290	83
Quay.....	3	W	W	2	27	42
Rio Arriba.....	13	641	700	7	337	399
Sandoval.....	5	337	W	3	W	W
San Juan.....	10	572	734	9	433	534
San Miguel.....	4	173	241	3	W	W
Santa Fe.....	10	566	641	10	1,079	1,351
Sierra.....	4	W	34	5	W	45
Socorro.....	3	W	W	3	113	33
Taos.....	9	177	234	6	70	79
Valencia.....	6	W	W	4	97	86
Undistributed ¹	13	2,751	2,842	14	1,615	1,142
Total.....	164	10,666	10,516	129	8,869	17,975

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
¹ Includes De Baca, Eddy, Harding (1971), Roosevelt, Torrance, and Union Counties, and some sand and gravel that cannot be assigned to specific counties.
² Data does not add to total shown because of independent rounding.

Tables 14 & 15 give statistical details on stone activities in the State.

Sulfur.—All sulfur production was recovered as a byproduct in the liquid puri-

fication of gas at four natural gas processing plants in two counties. Of the 24,780 long tons of recovered sulfur produced in 1971, 24,190 long tons was shipped at a

Table 14.—Stone sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	1970			1971			Kind of stone produced in 1971
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value	
Bernalillo.....	5	W	W	3	729	W	Limestone, other stone.
Chaves.....	2	W	W	2	34	W	Limestone, quartz.
Dofia Ana.....	1	W	W	1	W	\$2	Other stone.
Eddy.....	3	128	\$213	3	164	306	Limestone.
Grant.....	1	89	W	1	32	W	Do.
Lea.....	6	307	1,236	4	569	959	Limestone, other stone.
McKinley.....	1	54	108	3	W	W	Sandstone, traprock, other stone.
San Juan.....	2	33	65	2	W	W	Limestone.
Undistributed ¹	46	1,991	2,437	24	1,333	4,038	
Total ²	67	3,101	4,060	43	2,917	5,354	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
¹ Includes Catron (1970), Colfax, Curry, Guadalupe (1971), Lincoln, Luna, Mora, Otero, Quay (1971), Rio Arriba, Sandoval, San Miguel, Santa Fe, Socorro (1970), Taos, Torrance (1970), and Valencia Counties and counties for which no county breakdown is available.
² Data may not add to totals shown because of independent rounding.

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

Kind of stone	1970		1971	
	Quantity	Value	Quantity	Value
Dimension:				
Granite.....	(¹)	W	--	--
Marble.....	(¹)	(¹)	--	--
Sandstone.....	(¹)	W	(¹)	W
Crushed and broken:				
Limestone.....	1,282	\$1,675	2,254	\$4,448
Granite.....	9	11	--	--
Sandstone.....	W	318	W	W
Quartz.....	(¹)	(¹)	W	W
Quartzite.....	(¹)	W	--	--
Traprock.....	351	522	W	W
Other stone.....	994	1,501	585	757
Undistributed.....	465	32	79	149
Total²	3,101	4,060	2,917	5,354

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

¹ Less than ½ unit; included with "Undistributed."

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

total value of \$293,962. Shipments in 1970 were 25,457 long tons with a total value of \$357,957.

Because of the difficulty in determining the State of origin of byproduct sulfur recovered at natural gas plants and petroleum refineries, particularly on the eastern seaboard and at gulf ports, the quantity and value of sulfur recovered from these sources are not included in mineral production statistics in table 1.

The modified Claus process was used to recover the high-purity sulfur at the In-

dian Basin plant of Marathon Oil Co. and the Empire Abo plant of Pan American Petroleum Corp., both of Artesia, Eddy County. The Artesia plant of Phillips Petroleum Co. used the standard Claus process, as did the Cities Service Oil Co. in its Bluit plant near Milnesand, Roosevelt County.

Vermiculite.—Vermiculite exfoliated at the Southwest Vermiculite Co. Albuquerque plant was used in concrete aggregate, block insulation, loose-fill insulation, and plaster aggregate.

Table 16.—Principal producers

Commodity and company	Address	Type of activity	County
Carbon dioxide (natural):			
Schwartz Carbonic Co.....	Box 9737 El Paso, Tex. 79987	Well and extraction plant.	Harding.
S.E.C. Corp.....	do.....	do.....	Do.
Cement: Ideal Cement Co., a division of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	Dry process, 2-rotary- kiln plant.	Bernalillo.
Clays:			
El Paso Brick Co.....	Box 12336 El Paso, Tex. 79912	Open pit mine.....	Doña Ana.
Ideal Cement Co., a division of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	do.....	Bernalillo.
Kinney Brick Co., Inc.....	Box 1804 Albuquerque, N. Mex. 87103	do.....	Do.
Coal:			
Kaiser Steel Corp.....	Box 1107 Raton, N. Mex. 87740	Underground mine, crushing plant, dense media-froth flotation cleaning plant.	Colfax.
The Pittsburg & Midway Coal Mining Co.	10 Main Center Kansas City, Mo. 64105	Strip mine, crushing plant, chemical and water treatment plant.	McKinley.
Utah Construction & Mining Co..	Box 155 Fruitland, N. Mex. 87416	Strip mine, crushing plant, dust suppres- sion detergent treatment plant.	San Juan.

Table 16.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Copper:			
Federal Resources Corp. ¹ -----	1370 South Third West Salt Lake City, Utah 84115	3 underground mines and mill.	Hidalgo.
Kennecott Copper Corp., Chino Mines Division. ¹	Hurley, N. Mex. 88043-----	Open pit mine, flota- tion mill, precipita- tion plant, smelter, and refinery.	Grant.
Phelps Dodge Corp., Tyrone Branch. ¹	Tyrone, N. Mex. 88065----	Open pit mine and mill.	Do.
United States Smelting Refining and Mining Co. ¹	136 East South Temple St. Salt Lake City, Utah 84111	Underground mine, open pit-under- ground mine, and flotation mill.	Do.
Fluorspar: Southwest Fluorspar Co.---	Box 1158 Demming, N. Mex. 88001	Open pit mine-----	Dofia Ana.
Gypsum: White Mesa Gypsum Co.----	124 Jackson NE. Albuquerque, N. Mex. 87108	---do-----	Sandoval.
Iron ore: Dotson Minerals Corp.-----	Box 115 Socorro, N. Mex. 87801	---do-----	Socorro.
Lime: Kennecott Copper Corp., Chino Mines Division.	Hurley, N. Mex. 88043-----	Rotary-kiln plant....	Grant.
Manganiferous ore: Luck Mining Co.---	215 Market St. San Francisco, Calif. 94105	Open pit mine-----	Do.
Mica: Mineral Industries Commodi- ties of America, Inc.	Box 2408 Santa Fe, N. Mex. 87501	---do-----	Taos.
Molybdenum:		Dry grinding plant---	Santa Fe.
Kennecott Copper Corp., Chino Mines Division.	Hurley, N. Mex. 88043-----	See Copper-----	Grant.
Kerr-McGee Corp.-----	Kerr-McGee Bldg. Oklahoma City, Okla. 73102	By product of uran- ium mining.	McKinley.
Molybdenum Corporation of America, Questa Division.	280 Park Ave. New York, N.Y. 10017	Open pit mine and flotation mill.	Taos.
Natural gas and petroleum: ²			
Peat: Humus Organic Products-----	506 Rosemont NE. Albuquerque, N. Mex. 87107	Humus bog-----	Sandoval.
Perlite:			
Grefco, Inc., Dicalite Division-----	333 North Michigan Ave. Chicago, Ill. 60601	Open pit mine; crush- ing, screening, and air-separation plant.	Taos.
Johns-Manville Perlite Corp.-----	2500 Miguelito Road Lompoc, Calif. 93436	---do-----	Do.
Potash:			
AMAX Chemical Corp.-----	Box 279 Carlsbad, N. Mex. 88220	Underground mine and refinery.	Eddy.
Duval Corp., Potash Division-----	Box 511 Carlsbad, N. Mex. 88220	2 underground mines and refinery.	Do.
International Minerals & Chemical Corp.	Box 71 Carlsbad, N. Mex. 88220	Underground mine and refinery.	Do.
Kerr-McGee Chemical Corp.-----	Kerr-McGee Bldg. Oklahoma City, Okla. 73102	---do-----	Lea.
National Potash Co.-----	Box 731 Carlsbad, N. Mex. 88220	---do-----	Eddy.
Potash Co. of America, a division of Ideal Basic Industries, Inc.	Box 31 Carlsbad, N. Mex. 88220	---do-----	Do.
United States Potash & Chemical Co.	Box 101 Carlsbad, N. Mex. 88220	---do-----	Do.
Pumice:			
General Pumice Corp.-----	Box 449 Santa Fe, N. Mex. 87501	Open pit mine and crushing and screening plant.	Rio Arriba.
Twin Mountain Rock Co.-----	Box 1009 Sheridan, Wyo. 82801	---do-----	Union.
Volcanic Cinder Co.-----	Box 9977 El Paso, Tex. 79990	---do-----	Dofia Ana.
Salt:			
New Mexico Salt Co.-----	Box 303 Carlsbad, N. Mex. 88220	Potash tailing re- covery and plant.	Eddy.
The Salt Supply Co., Inc.-----	Drawer 55 Carlsbad, N. Mex. 88220	---do-----	Do.

See footnotes at end of table.

Table 16.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel (commercial):			
Albuquerque Gravel Products Co.	Box 829 Albuquerque, N. Mex. 87103	Stationary plant.....	Bernalillo.
Armstrong & Armstrong.....	Box 1873 Roswell, N. Mex. 88201	Pit and portable plant.	Chaves.
Springer Corp.....	Box 572 Albuquerque, N. Mex. 87103	Pit and stationary crushing and screening plant.	Bernalillo.
Universal Constructors, Inc.....	Box 6008, Station B Albuquerque, N. Mex. 87107	Pits and portable plants.	Bernalillo, Colfax, Mora, Rio Arriba.
Silver:			
American Smelting and Refining Co.	120 Broadway New York, N.Y. 10005	See Zinc.....	Grant.
Thomas Consolidated Mines, Inc.	637 Peyton Bldg. Spokane, Wash. 99201	Underground mine....	Catron.
Stone:			
Ideal Cement Co., a division of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	Quarry and plant.....	Bernalillo.
Lea County Highway Depart- ment.	Lovington, N. Mex. 88260..	.....do.....	Lea.
New Mexico State Highway Dept., various contractors.	P.O. Box 1149 Santa Fe, N. Mex. 87501	Quarries.....	Curry, Eddy, Guadalupe, Lea, Lincoln, McKinley, Otero, Quay, Rio Arriba, Santa Fe, Valencia.
Uranium:			
The Anaconda Company, New Mexico Operations.	Box 638 Grants, N. Mex. 87020	Open pit mine and acid-leach process mill.	Valencia.
Kerr-McGee Corp.....	Box 218 Grants, N. Mex. 87020	6 underground mines and acid-leach process mill.	McKinley.
United Nuclear Corp.....	Box 199 Grants, N. Mex. 87020	4 underground mines..	Do.
United Nuclear-Homestake Partners.	Box 98 Grants, N. Mex. 87020	Underground mine....	Valencia.
		6 underground mines and alkaline-leach process mill.	McKinley.
Zinc:			
American Smelting and Refining Co. ³	120 Broadway New York, N.Y. 10005	Underground mine and mill.	Grant.
United States Smelting Refining and Mining Co. ³	136 East South Temple St. Salt Lake City, Utah 84111	See Copper.....	Do.

¹ Also gold and silver.² Most of the major oil and gas companies and many smaller companies operate in New Mexico and several commercial directories contain complete lists of them.³ Also lead.

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 E. Chin ¹

The total value of New York's mineral production was \$299 million, a decrease of \$729 thousand from the previous year. The State ranked first nationally in production of emery, garnet, talc, and wollastonite, and continued to be a major producer of zinc, cement, gypsum, salt, sand and gravel, and stone.

Employment and Injuries.—In 1971, the total labor force in the State was 8.29 million. Total employment was 7.80 million, a decrease of 2 percent compared with total employment in 1970. Employment in the manufacturing, contract construction, and mining sectors totaled 1.91 million. In the mining industry, employment was 7,400,

a decrease of 6 percent compared with 1970 figures. Unemployment was 0.49 million in 1971, with 0.38 million in 1970.

The following companies received certificates of achievement from the National Safety Competition for having an outstanding safety record in 1971: Cayuga Crushed Stone, Inc.; Concrete Materials, Inc.; Eastern Rock Products, Inc.; Fitzgerald Bros. Construction Co., Inc.; Georgia-Pacific Corp., Gypsum Div.; Glens Falls Portland Cement Co.; Interpace Corp., Minerals Div.; Lehigh Portland Cement Co.; Marquette Cement Mfg. Co.; National Gypsum Co., New

¹ Chemist, Division of Nonferrous Metals.

Table 1.—Mineral production in New York ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays..... thousand short tons..	1,707	\$1,897	² 1,588	² \$1,742
Emery..... short tons.....	W	W	1,585	W
Gem stones.....	NA	10	NA	15
Gypsum..... thousand short tons..	425	2,737	415	2,376
Lead (recoverable content of ores, etc.)..... short tons..	1,280	400	877	242
Mercury..... 76-pound flasks.....	28	11	W	W
Natural gas..... million cubic feet..	3,358	1,017	2,202	661
Peat..... thousand short tons.....	15	145	15	196
Petroleum (crude)..... thousand 42-gallon barrels..	1,194	5,397	1,126	5,292
Salt..... thousand short tons.....	5,990	47,254	5,303	43,601
Sand and gravel..... do.....	35,537	38,839	23,221	28,328
Silver (recoverable content of ores, etc.)..... thousand troy ounces..	24	42	18	28
Stone..... thousand short tons.....	37,616	68,118	37,778	73,418
Zinc (recoverable content of ores, etc.)..... short tons.....	58,577	17,947	63,420	20,421
Value of items that cannot be disclosed:				
Abrasive garnet, cement, clay (ball) (1971), iron ore, lime, talc, titanium concentrate (ilmenite), wollastonite, and value indicated by symbol W.....	XX	115,750	XX	122,515
Total.....	XX	299,564	XX	298,835
Total 1967 constant dollars.....	XX	267,960	XX	² 259,628

² Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data. XX Not applicable.

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

² Excludes ball clay; included with "Value of items that cannot be disclosed."

York Trap Rock Corp.; Nytralite Aggregate, Inc.; Penn-Dixie Cement Corp.; and United States Steel Corp.

Environment.—The New York State Department of Environmental Conservation (EnCon) established nine environmental conservation regions in the State to strengthen the Department's services and law enforcement activities at the local level. Each regional headquarters is staffed with environmental specialists in such fields as water and air pollution, and solid waste.

The regions and their boundaries are:

Region 1: Allegany, Cattaraugus, Chautauqua, Erie, Niagara and Wyoming Counties;

Region 2: Chemung, Genesee, Livingston, Monroe, Ontario, Orleans, Schuyler, Seneca, Steuben, Wayne and Yates Counties;

Region 3: Broome, Cayuga, Chenango, Cortland, Madison, Onondaga, Oswego, Tioga and Tompkins Counties;

Region 4: Herkimer, Jefferson, Lewis, Oneida and St. Lawrence Counties;

Region 5: Clinton, Essex, Franklin, Fulton, Hamilton, Saratoga, Warren and

Washington Counties;

Region 6: Albany, Columbia, Delaware, Greene, Montgomery, Otsego, Rensselaer, Schenectady and Schoharie Counties;

Region 7: Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster and Westchester Counties;

Region 8: New York City (Bronx, Kings, New York, Queens and Richmond Counties);

Region 9: Nassau and Suffolk Counties.

The Atmospheric Science Research Center at the State University in Albany conducted research on the beneficial uses of waste water discharged from electric powerplants. The project is funded jointly by EnCon and the Eastern Division of the Niagara Mohawk Electric Co.

The State Government issued a shutdown order for a high-pressure hydraulic salt injection well operated by the Texas Brine Corporation in the vicinity of Dale in Wyoming County. A marked increase in seismic activity in the area was cited as the reason for the shutdown. The State geologist, in cooperation with EnCon and

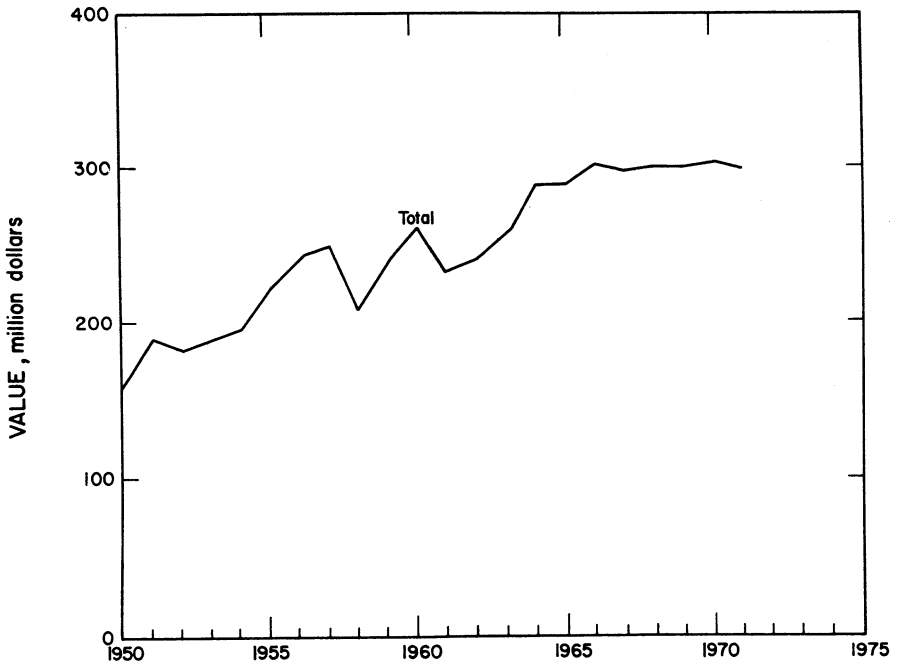


Figure 1.—Total value of mineral production in New York.

Table 2.—Value of mineral production in New York, by county^{1 2}
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Albany	W	\$27,375	Cement, stone, clays, sand and gravel.
Allegany	\$756	W	Sand and gravel.
Bronx	—	W	Do.
Broome	1,210	W	Sand and gravel, clays.
Cattaraugus	W	2,449	Sand and gravel, peat.
Cayuga	W	W	Sand and gravel.
Chautauqua	327	117	Do.
Chemung	1,494	798	Do.
Chenango	299	W	Do.
Clinton	W	W	Stone, sand and gravel.
Columbia	W	W	Cement, stone, sand and gravel clays.
Cortland	W	W	Sand and gravel.
Delaware	1,503	1,402	Stone, sand and gravel.
Dutchess	W	13,761	Do.
Erie	13,241	12,911	Stone, cement, sand and gravel, lime, gypsum, clays.
Essex	W	12,819	Iron ore, ilmenite, sand and gravel, wollastonite, stone, garnet.
Franklin	W	W	Sand and gravel, stone.
Fulton	223	W	Sand and gravel.
Genesee	W	W	Stone, sand and gravel, gypsum.
Greene	19,994	23,936	Cement, stone.
Herkimer	W	W	Stone, sand and gravel.
Jefferson	W	W	Do.
Lewis	W	58	Do.
Livingston	W	W	Salt, sand and gravel.
Madison	W	931	Stone.
Monroe	W	W	Stone, sand and gravel.
Montgomery	W	W	Do.
Nassau	W	W	Sand and gravel, clays.
Niagara	W	W	Stone, lime.
Oneida	W	W	Stone, sand and gravel.
Onondaga	16,702	21,566	Lime, stone, cement, salt, sand and gravel, clays.
Ontario	W	W	Sand and gravel, stone, peat.
Orange	W	W	Do.
Orleans	W	W	Sand and gravel, stone.
Oswego	419	W	Sand and gravel.
Otsego	152	W	Do.
Putnam	W	—	
Rensselaer	W	W	Sand and gravel, stone.
Richmond	—	1	Sand and gravel.
Rockland	9,701	12,609	Stone, sand and gravel.
St. Lawrence	33,671	35,564	Zinc, iron ore, talc, stone, sand and gravel, lead, silver, mercury.
Saratoga	W	W	Stone, sand and gravel.
Schenectady	478	W	Sand and gravel.
Schoharie	W	W	Cement, stone, clays, sand and gravel.
Schuyler	W	W	Salt, sand and gravel.
Seneca	246	W	Stone, peat.
Steuben	W	W	Sand and gravel, stone.
Suffolk	2,143	1,667	Sand and gravel.
Sullivan	W	W	Stone, sand and gravel.
Tioga	604	583	Sand and gravel.
Tompkins	W	W	Salt, stone, sand and gravel.
Ulster	W	W	Cement, stone, clays, sand and gravel.
Warren	W	W	Cement, garnet, stone.
Washington	W	W	Stone.
Wayne	W	W	Stone, sand and gravel.
Westchester	W	W	Stone, emery, peat.
Wyoming	W	W	Salt.
Yates	W	W	Do.
Undistributed ³	196,394	130,291	
Total ⁴	299,564	298,835	

W Withheld to avoid disclosing individual company confidential data.

¹ Hamilton, Kings New York, and Queens Counties are not listed because no production was reported.

² Natural gas and petroleum not listed by counties; value included with "Undistributed."

³ Includes natural gas, petroleum, sand and gravel, and gem stones that cannot be assigned to specific counties, and values indicated by symbol W.

⁴ Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of New York business activity

	1970	1971 ^p	Change, percent
Employment and labor force, annual average: ¹			
Total labor force..... thousands	8,350.0	8,290.0	-0.7
Unemployment..... percent of labor force	4.6	5.9	+28.3
Employment:			
Manufacturing..... thousands	1,769.6	1,684.5	-7.6
Durable goods..... do	828.1	758.2	-8.4
Nondurable goods..... do	932.6	876.2	-6.8
Mining..... do	7.9	7.4	-6.3
Contract construction..... do	266.6	270.7	+1.5
Earnings-average, weekly: ¹			
Manufacturing.....	\$194.59	\$145.84	+8.4
Durable goods.....	\$147.83	\$159.98	+8.2
Nondurable goods.....	\$124.79	\$134.17	+7.5
Personal income: ²			
Total..... millions	\$87,111	\$92,335	+6.0
Per capita.....	\$4,771	\$5,021	+5.2
Construction activity: ³			
Portland cement shipments to and within New York thousand 376-pound barrels	17,868	17,260	-3.4
Mineral production value..... thousands	\$299,564	\$298,835	-0.2

^p Preliminary. ^r Revised.

¹ New York State Department of Labor.

² Survey of Current Business.

³ U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man- days worked (thou- sands)	Man- hours worked (thou- sands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Fre- quency	Severity
1970:								
Peat.....	14	183	3	20	--	--	17.60	2,820
Metal.....	1,345	269	362	2,898	1	50	29.74	2,367
Nonmetal.....	1,955	262	512	4,103	--	68	19.09	590
Sand and gravel.....	1,909	219	419	3,563	3	124	18.61	3,635
Stone.....	3,059	273	834	6,825				
Total.....	8,282	257	2,130	17,409	5	363	21.14	2,573
1971: ^p								
Metal.....	1,315	240	316	2,528	1	74	29.67	3,241
Nonmetal ¹	1,370	259	355	2,858	--	79	27.64	1,064
Sand and gravel.....	1,885	199	375	3,224	--	58	17.99	466
Stone.....	3,000	274	822	6,679	--	106	15.87	544
Total.....	7,575	247	1,868	15,289	1	317	20.80	1,071

^p Preliminary.

¹ Beginning in 1971, data concerning peat operations are included in the nonmetals industry.

the Lamont Doherty Geological Observatory, was conducting an investigation of the earth tremors. An extensive series of

tests was expected to determine any relationship between the salt well operation and the increase in seismic activity.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasives, Manufactured.—The Carborundum Co., Electro Mineral Div., and General Abrasives Co., Div. of U.S. Industries, Inc., in Niagara County operated electric furnaces for producing fused aluminum oxide and silicon carbide. The finished

products were used in abrasives and in refractories and other nonabrasives.

Metallic abrasives consisting of chilled iron shot and grit, annealed iron shot and grit, and cut wire shot, were produced by Cleveland Metal Abrasive Co., Div. of Faner Mfg. Co., and Pellets, Inc., in Erie County.

Calcium-Magnesium Chloride.—Allied Chemical Corp. produced calcium-magnesium chloride at Onondaga as a byproduct of the manufacture of soda ash. Output increased 3 percent.

Cement.—Shipments of all types of cement decreased 1 percent in quantity but increased 12 percent in value. Cement ranked first in value among the State's mineral industries. Portland cement accounted for 97 percent of the cement value; the average price of portland cement was \$3.15 per barrel. Shipments of masonry cement increased in quantity and the average price was \$3.18 per barrel.

Alpha Portland Cement Co. allotted \$2.2 million for air pollution control equipment to be installed at its plants in Jamesville (Greene County) and in Birmingham, Ala.

The Flintkote Co. announced plans for a \$13 million expansion of its Glens Falls portland cement manufacturing plant. The operation of the plant will be converted from wet processing of raw material to dry processing. The project will involve the replacement of existing quarry crushing, raw mill, and kiln departments. The kiln burning capacity of the plant will be increased from 1.66 to 3 million barrels per year. The completion date of the expansion is estimated to be spring of 1973.

Lehigh Portland Cement Co. planned to install additional air pollution controls at its plant in Alsen. Additional air pollution control equipment will be installed by Universal Atlas Cement Division of United States Steel Corp. at its plant in Hudson.

Lehigh Portland Cement Company's silos in Buffalo were purchased by the St. Lawrence Cement Co.

Clays.—Total production of clays was 1,588,012 tons valued at \$1,742,467. Ball clay was mined in Albany County; and common clay was from Erie, Nassau, and Onondaga Counties. Shale clay was mined in Albany, Broome, Columbia, Erie, Onondaga, Schoharie, and Ulster Counties. Clay was used in lightweight aggregate and portland cement and for pottery and abrasive bonding.

Emery.—Virtually all of the United States emery production was from one open-pit mine, DeLuca Emery Mine, Inc., in Westchester County. Output of emery decreased in quantity and in value from 1970. Uses for emery were mainly as aggregate for

heavy-duty nonslip floors and pavements and for general abrasive purposes.

Garnet.—Abrasive garnet production in 1971 decreased 5 percent in quantity and 6 percent in value from that of 1970. Garnet from an open-pit mine in Warren County operated by Barton Mines Corp. was sold for precision uses in coated abrasives, glass grinding and polishing, and metal lapping. Garnet recovered as a byproduct of wollastonite mining by Interpace Corp. in Essex County was sold for use in sandblasting and for general abrasive purposes. New York State ranked first in the Nation in the production of garnet in 1971.

Gem Stones.—The collection of gem stones and mineral specimens was principally by amateurs. The value of gem stone production was estimated to be \$15,000. Based on value, New York ranked 22d in the United States in gem stone production.

Graphite (Manufactured).—Manufactured graphite from petroleum coke and other materials was produced by four firms that operated plants in Niagara County. The principal uses were for anodes, electrodes, electric motor brushes, and crucibles and other refractories. Synthetic graphite powder was used in steelmaking, an additive in nonferrous metallurgy, foundry facings, and lubricants (alone and in greases).

Gypsum.—Output of gypsum decreased 2 percent in quantity and 13 percent in value. Production came from three underground mines—two in Erie County and one in Genesee County. Most of the crude gypsum was calcined at company-owned plants for use in manufacturing building materials. Uses for calcined gypsum other than in building materials included manufacturing plate glass, pottery, molding, and art coating plasters. Some crude gypsum was used as a retarder in portland cement.

Ilmenite.—Ilmenite concentrate was produced from the MacIntyre Development of NL Industries, Inc. (NL), an openpit titaniferous-magnetite deposit near Tahawus, Essex County. Shipments and value were

Table 5.—Crude gypsum production
(Thousand short tons and thousand dollars)

Year	Active mines	Quantity	Value
1967	5	570	\$3,118
1968	5	570	2,925
1969	4	492	2,945
1970	3	425	2,737
1971	3	415	2,376

31 percent less than those of 1970. The output was used principally in the manufacture of titanium dioxide pigment. NL completed the construction of a \$4.5 million magnetite regrind circuit at the MacIntyre Development. The new facilities were designed to liberate additional ilmenite from the ore mined, and also to upgrade the quality of the magnetite iron ore by decreasing the titanium content which would make the magnetite more readily marketable.

Lime.—Production of lime increased 21 percent in quantity and 40 percent in value in 1971. Lime was produced by Allied Chemical Corp. (Onondaga County), Bethlehem Steel Corp. (Erie County), and Union Carbide Corp. (Niagara County). Hydrated lime accounted for about 85 percent of the total lime output. Bethlehem Steel's plant was operated to supply quicklime for the basic oxygen furnaces at Lackawanna.

Perlite.—Crude perlite mined in Western States was expanded at plants of four companies. National Gypsum Co. operated plants in Bronx and Erie Counties, Georgia-Pacific Corp. in Erie County, United States Gypsum in Genesee, Richmond, and Rockland Counties, and Buffalo Perlite Corp. in Erie County. The most important use was in acoustical building plaster. Other uses included loose fill insulation, soil conditioning, lightweight concrete aggregate, and filtering.

Salt.—The output of salt decreased 11 percent in quantity and 8 percent in value. Most of the evaporated salt produced was used for food processing and seasoning. Another large use for evaporated salt was for manufacturing chlorine and other chemicals. The principal use for rock salt was for ice control on highways in the Northeastern States. Other important uses for rock salt were in the chemical and food industries. Salt in brine was used mainly for the manufacture of soda ash; some salt in brine was used for the manufacture of chlorine and other chemicals. Salt for chemical manufacture was used mainly in New York. Rock salt was produced from one mine each in Livingston, Tompkins, and Yates Counties. Brine salt was produced from two operations in Schuyler County, and one operation each in Onondaga and Wyoming Counties.

Cargill, Inc., completed a \$2.0 million modernization program at its Cayuga Rock

Salt mine at South Lansing. A crushing, screening, and grading system and a conveyor system were installed underground to reduce the freshly mined salt chunks to manageable size and to move the salt rapidly to the vertical mine shaft where it is hoisted to the surface. Additional roof bolting equipment was moved underground for increased safety. Cargill expects that the Cayuga mine will be one of the safest, most efficient salt mines in the country.

Morton Salt Co. opened its first rock salt mine at Hemrod, west of Seneca Lake in Yates County. The Morton Salt Seneca Lake mine project was commenced in 1969. The mine is programmed initially to produce 2.5 million tons of rock salt annually with expansion plans to bring production to 4 million tons per year. The mine will employ about 100 miners working in rotation below ground and about the same number above ground in such capacities as screening and packaging. The salt will be transported by commercial carriers, both truck and rail and will be used for Morton's northeastern region, which covers New York, New England, and parts of Pennsylvania, New Jersey, Maryland, and Delaware.

Sand and Gravel.—Production of sand and gravel decreased 35 percent in quantity and 27 percent in value. The average value per ton increased by 13 cents, to \$1.22. There were 230 sand and gravel mining operations within the State. These mines were operated by construction companies and Government operators working on various Federal, State, County, and local government contracts. More than 1 million tons each were reported from Cattaraugus Dutchess, Erie, Essex, Nassau, and Suffolk Counties.

Stone.—Total stone production increased less than 1 percent in quantity and 8 percent in value. Stone was the second most valuable mineral commodity produced in the State. Crushed limestone and dolomite, considered together as carbonate rock, were predominate in the State, accounting for

Table 6.—Salt sold or used by producers
(Thousand short tons and thousand dollars)

Year	Quantity	Value
1967	5,320	\$41,568
1968	5,218	42,488
1969	5,582	45,561
1970	5,990	47,254
1971	5,303	43,601

Table 7.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	9,582	\$12,608	7,829	\$10,841
Fill.....	704	327	1,383	496
Molding.....	139	687	W	W
Paving.....	3,740	4,414	2,731	3,496
Other uses ¹	457	581	560	1,341
Total ²	14,622	18,618	12,503	16,174
Gravel:				
Building.....	4,763	7,591	4,089	6,450
Fill.....	1,789	910	912	771
Paving.....	4,093	4,675	3,156	3,603
Miscellaneous.....	W	W	440	413
Other uses.....	862	965	183	266
Total ²	11,507	14,141	8,781	11,504
Government-and-contractor operations:				
Sand:				
Building.....	43	65	--	--
Fill.....	1,692	561	144	17
Paving.....	905	501	19	10
Other uses.....	67	37	365	219
Total ²	2,707	1,164	528	246
Gravel:				
Building.....			45	51
Fill.....	2,329	1,354	386	76
Paving.....	4,346	3,559	801	255
Other uses.....	26	2	177	22
Total ²	6,701	4,915	1,408	404
Total sand and gravel ²	35,537	38,839	23,221	28,328

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

¹ Includes engine, filtration, foundry, railroad ballast (1971), and other sands.

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

89 percent of the tonnage and 79 percent of the value of all stone produced.

The chief uses for crushed dolomite and limestone were as an aggregate material in various construction applications and for the manufacture of cement and lime. Other uses were agricultural stone, railroad ballast, riprap, asphalt filler, and fluxing stone.

Basalt (traprock) ranked second in quantity of stone production within the State. The chief uses were for concrete aggregate and road metal.

Sandstone, which included quartzite, was quarried as dimension stone and as crushed stone. The chief uses of dimension sandstone were for curbing and flagging, and for architectural applications. Crushed sandstone was used for concrete aggregate and road metal.

Slate was quarried and prepared for uses as flagstone, roofing, structural, and sanitation stone. Granite was quarried and dressed mostly for building stone, while

crushed granite was used for concrete aggregate, road metal, and railroad ballast.

Sulfur.—Ashland Oil, Inc., recovered 3,940 long tons of sulfur at its Buffalo Refinery in Erie County.

Talc.—The output of talc increased 10 percent in quantity and the value increased 11 percent. New York continued to be the leading talc-producing State. Gouverneur Talc Co. and International Talc Co. mined talc from two underground mines in St. Lawrence County. International Talc Co. also mined talc from an open pit operation in St. Lawrence County. Crude talc was ground in company-owned mills and marketed principally for use in ceramics and as a mineral filler in paints. Small quantities were used as a mineral filler in floor and wall tiles, rubber, and miscellaneous products.

Vermiculite.—Crude vermiculite mined in other States was exfoliated at the Construction Products Div. Plant of W. R. Grace

Table 8.—Sand and gravel sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Albany.....	9	320	\$272	11	W	W
Allegany.....	4	507	756	3	W	W
Broome.....	11	604	929	3	556	\$1,088
Cattaraugus.....	11	2,399	3,111	10	1,743	2,407
Cayuga.....	3	206	273	3	W	W
Chautauqua.....	5	397	327	3	233	117
Chemung.....	4	621	1,494	4	698	798
Chenango.....	4	221	299	6	233	W
Delaware.....	2	24	3	3	12	10
Dutchess.....	17	1,526	1,683	10	1,180	1,444
Erie.....	7	645	1,078	7	1,019	2,255
Essex.....	6	1,554	1,187	5	W	W
Franklin.....	5	447	110	4	216	W
Fulton.....	3	342	228	4	140	W
Genesee.....	3	312	382	3	109	216
Herkimer.....	3	W	W	4	114	94
Jefferson.....	14	522	270	2	267	W
Lewis.....	6	410	327	1	106	24
Livingston.....	3	1,102	972	2	W	W
Monroe.....	10	871	1,351	4	568	878
Nassau.....	5	4,529	5,281	2	W	W
Oneida.....	9	741	922	9	926	1,214
Onondaga.....	7	880	635	6	420	457
Ontario.....	14	1,043	1,022	10	846	1,001
Orange.....	8	582	892	10	702	1,015
Orleans.....	4	265	296	4	W	W
Oswego.....	4	259	419	3	W	W
Otsego.....	4	112	152	4	W	W
Rensselaer.....	15	1,295	978	12	882	1,044
Richmond.....	--	W	W	1	68	1
Rockland.....	3	W	W	3	250	658
St. Lawrence.....	12	701	426	8	430	424
Saratoga.....	7	257	369	9	254	465
Schenectady.....	6	340	478	2	W	W
Schuyler.....	3	W	W	1	12	W
Steuben.....	5	751	1,290	8	794	1,328
Suffolk.....	13	1,819	2,143	8	1,777	1,667
Sullivan.....	7	147	228	3	161	279
Tioga.....	5	432	604	5	399	583
Wayne.....	6	145	69	6	146	64
Westchester.....	1	55	93	--	--	--
Undistributed ¹	54	8,152	7,490	24	7,958	8,801
Total².....	330	35,537	38,839	230	23,221	28,328

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

¹ Includes Bronx (1971), Clinton, Columbia, Cortland, Madison (1970), Montgomery, Putnam (1970), Schoharie, Tompkins, Ulster, Washington (1970), and Yates (1970) counties.

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

Table 9.—Crushed and broken limestone and dolomite sold or used by producers, by use
(Thousand short tons and thousand dollars)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Bituminous aggregate.....	2,527	\$5,577	4,301	\$9,596
Concrete aggregate.....	10,795	20,140	7,461	13,745
Dense graded road base stone.....	1,444	2,503	2,868	5,561
Macadam aggregate.....	381	736	564	902
Surface treatment aggregates.....	562	1,245	881	2,047
Unspecified aggregate and roadstone.....	8,051	14,556	6,900	11,656
Agricultural limestone.....	500	1,747	451	1,669
Cement.....	7,172	6,929	7,534	6,902
Railroad ballast.....	198	362	228	432
Riprap and jetty stone.....	144	330	511	1,035
Other uses ¹	1,758	2,593	2,011	4,562
Total².....	33,535	56,718	33,710	58,108

¹ Data includes fluxing stone, stone sand, chemical stone, drain fields, fill, stucco, and other uses in smaller quantities.

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

Co., Weedsport, Cayuga County. The expanded vermiculite was used for loose fill insulation, soil conditioning, ultralight-weight concrete aggregate, and building plaster aggregate.

Wollastonite.—Crude wollastonite was mined and beneficiated at the Willsboro Mine in Essex County operated by INTERPACE. Production of wollastonite increased 6 percent in quantity and 6 percent in value. The refined wollastonite was used as a filler in paints and plastics and as an ingredient in ceramic products.

METALS

Aluminum.—Production of primary aluminum from the Messena plants, St. Lawrence County, of Aluminum Company of America (Alcoa) and Reynolds Metals Co. decreased in both tonnage and value. Alcoa planned to replace three potlines at its smelter with new, highly efficient production equipment of about the same capacity. The new potline will include the patented Alcoa 398 emission control process and will reduce the per pound consumption of electrical energy for that capacity by more than 10 percent.

Iron Ore.—Mine production of magnetite decreased from an underground mine operated by Republic Steel Corp. in Essex County; and two open-pit mines, one by NL Industries, Inc. in Essex County as a byproduct of ilmenite production and one by Jones & Laughlin Steel Corp. in St. Lawrence County. All of the ore was beneficiated and most of the concentrates were agglomerated before shipment. Principal uses for shipments were in the manufacture of pig iron and steel and some in the manu-

facture of cement, for heavy media separation, and for ballast.

In September, Republic Steel Corp. announced that it will close the mine at Port Henry due to the high costs of production. The closing date was not specified and approximately 400 employees were expected to be affected.

Lead.—Lead was recovered as a byproduct of zinc mining at the Balmat mine of the St. Joe Minerals Corp. in St. Lawrence County. Quantity decreased 31 percent and value decreased 40 percent. Lead recovery varies from year to year depending on the proportion of ore coming from that section of the Balmat mine where the vein has a higher lead content. The lead concentrate was shipped to the company lead smelter at Herculaneum, Mo.

Mercury.—Mercury, recovered as a byproduct at the Balmat and Edwards zinc mines of St. Joe Minerals Corp., was recovered at the company smelter in Monaca, Pa.

Silver.—The quantity of silver recovered from lead concentrates shipped from the Balmat mine, St. Joe Minerals Corp., in St. Lawrence County was 25 percent less than that of 1970 and the value decreased 33 percent. Silver recovery usually reflects the demands for silver-free lead rather than the silver content of the concentrate.

Zinc.—New York continued to rank second to Tennessee in U.S. zinc production in both quantity and value. Production, all from the Balmat and Edwards mines of the St. Joe Minerals Corp. in St. Lawrence County, increased 8 percent in quantity and 14 percent in value from 1970.

In September 1971, St. Joe opened its new \$30 million mine and concentrator,

Table 10.—Mine production (recoverable) of silver, lead, and zinc

	1969	1970	1971
Mines producing:			
Lode.....	2	2	2
Material sold or treated:			
Ore..... thousand short tons..	741	742	779
Lead-zinc..... do.....	---	566	607
Zinc..... do.....	741	176	172
Production (recoverable):			
Quantity:			
Silver..... troy ounces..	31,755	23,830	17,928
Lead..... short tons..	1,686	1,280	877
Zinc..... do.....	58,728	58,577	63,420
Value:			
Silver..... thousands..	\$57	\$42	\$28
Lead..... do.....	502	400	242
Zinc..... do.....	17,149	17,947	20,421
Total..... do.....	17,708	18,389	20,691

Balmat No. 4. Due to this expansion at the Balmat-Edwards complex, St. Joe expected to produce more than 200,000 tons of zinc concentrate in 1972, which will be smelted into more than 100,000 tons of metal at the company Josephstown, Pa., smelter. The Balmat-Edwards mine will be the largest single zinc mining operation in the United States.

MINERAL FUELS

Natural Gas.—According to the Geological Survey, New York State Museum and Science Service, the quantity of marketed production of natural gas decreased 34 percent, to 2.2 billion cubic feet. The average wellhead value per million cubic feet produced was 30 cents.

Peat.—Sales of peat in 1971 was 15,000 short tons, valued at \$196,000. Peat use was

mainly in general soil improvement although some peat was used for potting. Orange County was the leading producing area; output was also reported from Cattaraugus, Ontario, Seneca, and Westchester Counties.

Petroleum.—Crude oil production was 1.13 million barrels compared with 1.19 million barrels in 1970, a decrease of 6 percent. Production was from the Allegany and Cattaraugus fields and the Busti oil pool in Chautauqua County. The estimated 1971 value of crude oil produced was \$5,292,000, a decrease in value of \$105,000 from 1970.

New England Petroleum Corp. announced plans to build a plant at Oswego to produce heavy industrial fuel oil and synthetic, pipeline-quality gas. Estimated cost of the project is \$70 million.

Table 11.—Oil and gas well drilling in 1971, by county

County	Oil	Gas	Dry	Total	Footage
Exploratory completions:					
Cattaraugus	--	--	2	2	12,457
Chautauqua	--	1	--	1	5,941
Orange	--	--	1	1	395
Steuben	--	2	2	4	17,523
Sullivan	--	--	1	1	9,993
Wyoming	--	--	1	1	4,975
Total	--	3	7	10	51,284
Development completions:					
Allegany	24	--	1	25	34,756
Cattaraugus	29	--	--	29	37,007
Chautauqua	25	1	--	26	19,932
Erie	--	1	--	1	1,545
Genesee	--	2	--	2	3,109
Steuben	5	--	2	7	12,133
Total	83	4	3	90	108,482
Total all drilling	83	7	10	100	159,766

Source: American Association of Petroleum Geologists.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Artificial:			
The Carborundum Co., Electro Mineral Div.	P.O. Box 423 Niagara Falls, N.Y. 14302	Plant	Niagara.
General Abrasives Co., Div. of U.S. Industries, Inc.	Niagara Falls, N.Y. 14302	do	Do.
Metallic:			
Cleveland Metal Abrasive Co., Div. of Fanner Mfg. Co.	Brookside Park Cleveland, Ohio 44109	do	Erie.
Pellets, Inc.	533 S. Niagara St. Tonawanda, N.Y. 14150	do	Do.
Cement:			
Alpha Portland Cement Co. ¹	15 South Third St. Easton, Pa. 18043	do	Greene.
Alpha Portland Cement Co.	do	do	Onondaga.
Atlantic Cement Co., Inc. ¹	P.O. Box 3 Ravena, N.Y. 12143	do	Albany.
Century Cement Mfg. Co., Inc.	Rosendale, N.Y. 12472	do	Ulster.

See footnotes at end of table.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Cement—Continued			
Glens Falls Portland Cement Co., ²	313 Warren St. Glens Falls, N.Y. 12801	Plant.....	Warren.
Div. of Flintkote Co.	1740 Broadway	----do-----	Ulster.
Hudson Cement Division, ² Colonial Sand & Stone Co., Inc.	New York, N.Y. 10019	----do-----	Erie.
Lehigh Portland Cement Co.-----	718 Hamilton St. Allentown, Pa. 18105	----do-----	Greene.
Lehigh Portland Cement Co. ² -----	-----do-----	----do-----	Do.
Marquette Cement Mfg. Co. ³ -----	20 N. Wacker Dr. Chicago, Ill. 60606	----do-----	Schoharie.
Penn Dixie Cement Corp. ¹ -----	P.O. Box 152 Nazareth, Pa. 18064	----do-----	Columbia.
Universal Atlas Cement Div., ¹ U.S. Steel Corp.	Chatham Center Pittsburgh, Pa. 15230	----do-----	
Clays (miscellaneous):			
Binghamton Brick Co., Inc.-----	P.O. Box 1256 Binghamton, N.Y. 13902	Pit.-----	Broome.
Hudson Lightweight Stone Div., Colonial Sand & Stone Co., Inc.	1740 Broadway New York, N.Y. 10019	Pit.-----	Ulster.
Hudson Valley Lightweight Aggregate Corp.	P.O. Box 9138 Richmond, Va. 23227	Pit.-----	Do.
Jova Brick Mfg. Corp.-----	Kingston, N.Y. 12401	Pit.-----	Do.
Nassau Brick Co., Inc.-----	635 Round Swamp Rd. Old Bethpage, L.I., N.Y. 11804	Pit.-----	Nassau.
New York Trap Rock Corp.-----	162 Old Mill Rd. W. Nyack, N.Y. 10994	Pit.-----	Ulster.
Universal Atlas Cement Div., U.S. Steel Corp.	Chatham Center Pittsburgh, Pa. 15230	Pit.-----	Albany, Columbia.
Emery:			
DeLuca Emery Mine, Inc.-----	926 Constant Ave. Peekskill, N.Y. 10566	Pit.-----	Westchester.
Garnet:			
Barton Mines Corp.-----	North Creek, N.Y. 12853	Pit.-----	Warren.
Gypsum:			
Georgia-Pacific Corp., Gypsum Div. ⁴	P.O. Box 311 Portland, Ore. 97207	Underground mine and cal- cining plant.	Erie.
National Gypsum Co. ⁴ -----	325 Delaware Ave. Buffalo, N.Y. 14202	Calcing plant. Underground mine and cal- cining plant.	Westchester. Erie.
United States Gypsum Co. ⁴ -----	101 S. Wacker Dr. Chicago, Ill. 60606	Calcing plant. Underground mine and cal- cining plant. Calcing plants.	Bronx. Genesee. Richmond, Rockland.
Iron ore:			
Jones & Laughlin Steel Corp.-----	Star Lake, N.Y. 13690	Pit.-----	St. Lawrence.
Republic Steel Corp. ⁵ -----	1629 Republic Bldg. Cleveland, Ohio 44101	Underground	Essex.
Lead: See Zinc.			
Lime:			
Bethlehem Steel Corp.-----	701 E. Third St. Bethlehem, Pa. 18016	Plant.-----	Erie.
Industrial Chemicals Div., Allied Chemical Corp.	P.O. Box 70 Morristown, N.J. 07960	----do-----	Onondaga.
Mercury: See Zinc.			
Peat:			
Sterling Forest Peat Co., Inc.-----	P.O. Box 608 Tuxedo, N.Y. 10987	Bog.-----	Orange.
Petroleum:			
Mobil Oil Corp.-----	Buffalo, N.Y. 14221	Refineries.-----	Do.
Frontier Oil & Refining Co., Div. of Ashland Oil & Refining Co.	Tonawanda, N.Y. 14150	----do-----	Do.
Salt:			
Evaporated:			
International Salt Co.-----	Clarks Summit, Pa. 18411	Well.-----	Schuyler.
Morton Salt Co.-----	110 N. Wacker Dr. Chicago, Ill. 60606	----do-----	Wyoming.
The Watkins Salt Co., Inc. ⁶ ..	Box 150	----do-----	Schuyler.

See footnotes at end of table.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Salt—Continued			
Rock:	Watkins Glen, N.Y. 14891		
Cayuga Rock Salt Co., Inc.	191 Portland Pt. Rd. Myers, N.Y. 14866	Underground . . .	Tompkins.
International Salt Co.	Clarks Summit, Pa. 18411	do	Livingston.
Brine:			
Industrial Chemicals Div., ⁷ Allied Chemical Corp.	P.O. Box 70 Morristown, N.J. 07960	Well	Onondaga.
Sand and gravel:			
Albany Gravel Co., Inc.	N. Pearl St. & Loudonville Rd., Albany, N.Y. 12201	Pit	Albany, Rensselaer.
Alleghany Aggregates, Inc.	P.O. Box 543 Olean, N.Y. 14760	Pit	Cattaraugus.
Colonial Sand & Stone Co., Inc.	1740 Broadway New York, N.Y. 10019	Pit	Nassau, Dutchess.
Country Side Sand & Gravel, Inc.	South Dayton, N.Y. 14138	Pit	Cattaraugus.
Elmira Transit Mix, Inc.	Box 231, Easton, Pa. 18042	Pit	Cattaraugus, Chemung.
Penn Industries, Inc.	136 East 57th St. New York, N.Y. 10022	Pit	Nassau.
Roanoke Marbro Sand & Gravel Corp.	P.O. Box 172 Riverhead, L.I., N.Y. 11901	Pit	Suffolk.
Don C. Russo Sand & Gravel Co.	Bushnell's Basin, N.Y. 14534	Pit	Monroe.
Torrington Construction Co., Inc.	Keeseville, N.Y. 12944	Pit	Essex.
Valley Sand & Gravel Corp.	788 Ridge Rd. West Rochester, N.Y. 14615	Pit	Livingston. Sullivan.
Silver: See Zinc			
Smelters (aluminum):			
Aluminum Co. of America	1501 Alcoa Bldg. Pittsburgh, Pa. 15222	Plant	St. Lawrence.
Reynolds Metals Co.	6601 Broad Street Rd. Richmond, Va. 23215	do	Do.
Stone:			
Basalt (crushed):			
Rockland Materials Corp.	P.O. Box 57, Suffern, N.Y. 10901	Quarry	Rockland.
Granite (dimension):			
Di Rienzo Brothers	107 Main St. Tuckahoe, N.Y. 10707	do	Westchester.
Frank Baratta, P. D'Amato & Angelo Cucchiella, T/A Dunwoodie Stone Quarry, Inc.	941 Midland Ave. Yonkers, N.Y. 10707	do	Do.
Lake Street Granite Quarry, Inc.	Lake Street E. White Plains, N.Y. 10600	do	Do.
Granite (crushed):			
Northern Materials, Inc.	Route 9 Chestertown, N.Y. 12817	do	Warren.
Limestone (dimension):			
Brickyard Falls Farm	R.D. 2 Manlius, N.Y. 13104	do	Onondaga.
Limestone and dolomite (crushed and broken):			
Appalachian Stone Division, Martin Marietta Corp.	Box 120 Mercersburg, Pa. 17236	do	Rockland.
Buffalo Crushed Stone Co.	10 Park Place Morristown, N.J. 07960	do	Erie.
The Buffalo Slag Co., Inc., Federal Crushed Stone Div.	111 Great Arrow Ave. Buffalo, N.Y. 14216	do	Do.
The Callanan Road Improve- ment Co.	So. Bethlehem, N.Y. 12161	do	Albany, Ulster.
Dolomite Products Co. ⁸	1150 Penfield Rd. Rochester, N.Y. 14625	do	Monroe.
Eastern Rock Products, Inc. ⁸	404 Court St. Utica, N.Y. 13504	do	Oneida.
Frontier Stone Products, Inc.	Box 376, Lockport, N.Y. 14094	do	Niagara.
The General Crushed Stone Co.	712 Drake Bldg. Easton, Pa. 18042	do	Cayuga, Genesee, Herkimer, Jefferson, Livingston, Onondaga, Ontario, Wayne.
Industrial Chemicals Div., Allied Chemical Corp.	P.O. Box 70 Morristown, N.J. 07960	do	Onondaga.
Niagara Stone Div. of Great Lakes Color Printing Corp.	Quarry Road Niagara Falls, N.Y. 14304	do	Niagara.

See footnotes at end of table.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone:—Continued			
Marble (crushed):			
Balducci Crushed Stone Co.	Box 153 Gouverneur, N.Y. 13642	Quarry	St. Lawrence.
Universal Marble Products Corp.	Thornwood, N.Y. 10594	do	Westchester.
Miscellaneous (crushed):			
Fitzgerald Bros. Construction Co., Inc.	504 Broadway Troy, N.Y. 12180	do	Rensselaer.
Sandstone (dimension):			
Adirondak Stone Quarries, Inc.	P.O. Box 184 Malone, N.Y. 12953	do	Franklin.
Downsville Stone Co., c/o MSR, Inc.	1 Dock Street Stamford, Conn. 06902	Processor	Delaware.
Finger Lakes Stone Co., Inc.	Box 401 Ithaca, N.Y. 14850	Quarry	Tompkins.
Willis Hankins	Hancock, N.Y. 13783	do	Delaware.
Heldeberg Bluestone & Marble Inc.	East Berne, N.Y. 12059	do	Albany, Delaware.
Johnston & Rhodes Bluestone Co.	East Branch, N.Y. 13756	do	Delaware.
W. R. Strong & Son	43 Wheeler St. Deposit, N.Y. 13754	Processor	Broome. Delaware.
Paul Tompkins Estate	Hancock, N.Y. 13783	do	Do.
Sandstone (crushed and broken):			
Steuben Crushed Div., A. L. Blades & Sons, Inc.	County Route #10 Bath, N.Y. 14810	Quarry	Steuben.
Sullivan Highway Products Corp.	P.O. Box 392 Monticello, N.Y. 12701	do	Sullivan.
Slate (dimension):			
Darius Slate Products	Middle Granville, N.Y. 12849	do	Washington.
A. A. Hadeka Quarry	49 South St. Poultney, Vt. 05764	do	Do.
McCullen Slate Co.	R.D. 1 Granville, N.Y. 12832	do	Do.
The A. B. Potter Slate Co., Inc.	Poultney, Vt. 05764	do	Do.
Ritchie Brothers Slate Co.	Middle Granville, N.Y. 12849	do	Do.
Sheldon Slate Products Co.	do	do	Do.
Vermont Structural Slate Co., Inc.	Prospect St. Fair Haven, Vt. 05743	do	Do.
Western Slate Co.	Box 104 Granville, N.Y. 12832	do	Do.
Williams Bros. Slate Co.	Middle Granville, N.Y. 12849	do	Do.
Talc:			
Gouverneur Talc Co., Inc.	Gouverneur, N.Y. 13642	Underground	St. Lawrence.
International Talc Co., Inc.	420 Lexington Ave. New York, N.Y. 10006	do	Do.
Titanium concentrate: Ilmenite:			
N L Industries, Inc. ⁹	100 Chevalier Ave. So. Amboy, N.J. 08879	Pit	Essex.
Wollastonite:			
Interpace Corp. ¹⁰	Willsboro, N.Y. 12996	Underground	Do.
Zinc:			
St. Joe Minerals Corp. ¹¹	250 Park Ave. N.Y., N.Y. 10017	Mine	St. Lawrence.

¹ Also crushed limestone and shale.² Also crushed limestone.³ Also crushed limestone and clay.⁴ Also expanded perlite.⁵ Also crushed granite.⁶ Also brine.⁷ Also evaporated salt and crushed limestone.⁸ Also sand and gravel.⁹ Also iron ore.¹⁰ Also garnet.¹¹ Also silver and lead and mercury.

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 Office of Earth Resources, North Carolina Department of Natural and Economic Resources for collecting information on all minerals except fuels.

By Roland W. Merwin ¹ and Stephen G. Conrad ²

In 1971, the mineral industry of North Carolina contributed \$112.5 million to the State's economy, an increase of approximately \$14.1 million, or 14 percent above that of the previous year.

Stone was the leading mineral commodity produced, contributing 52 percent of the total mineral production value, followed by sand and gravel, which accounted for 13 percent. Cement, clays, feldspar, lithium minerals, and phosphate rock were also produced. Together, they accounted for 31 percent of the State's 1971 mineral production. The remaining 4 percent was derived from the production of asbestos, fire clay, gem stones, iron ore, kaolin, mica, olivine, talc and pyrophyllite, tungsten, and small quantities of gold, silver, copper, lead, and zinc produced as a byproduct of tungsten recovery.

The leading mineral producers were Ideal Cement Co., Division of Ideal Basic Industries, Inc., Superior Stone Co., Nello L. Teer Co., Texas Gulf Sulphur Co., and Vulcan Materials Co. Together, they accounted for 56 percent of the State's mineral production.

North Carolina ranked first among the States in the production of feldspar, lithium minerals, and mica; second in the production of olivine; third in the production of tungsten; and fourth in the production of asbestos, clays, and phosphate rock.

Legislation and Government Programs.— Pursuant to a constitutional amendment adopted in November 1970, the North Carolina Department of Natural and Economic

Resources was established on Oct. 1, 1971, as the first of 17 new cabinet-level departments of the State government. This action consolidated many previously independent mineral-related agencies under two offices within the Department, each of which contained subsidiary organizations. One, the Office of Earth Resources, was subdivided into the Divisions of Mineral Resources, Mining, Petroleum, and Geodetic Survey, and the State Soil and Water Conservation Committee. The other, the Office of Water and Air Resources, was subdivided into the Divisions of Air Quality, Water Management, Water Quality, Waterways and Seashore, Ground Water, and Planning.

The North Carolina Mining Act of 1971 was enacted and implemented. There were two stated purposes. One provided that the usefulness, productivity, and scenic values of all lands and waters involved in mining within the State will receive the greatest practical degree of protection and restoration. The other stated that from June 11, 1971, no mining shall be carried on in the State unless plans for such mining include reasonable provisions for protection of the surrounding environment and for reclamation of the area of land affected by mining.

The Office of Earth Resources, State Department of Natural and Economic Resources, was actively engaged in geologic and other mineral-related investigations

¹ Mining engineer, Division of Nonmetallic Minerals.

² Director, Office of Earth Resources, North Carolina Department of Natural and Economic Resources.

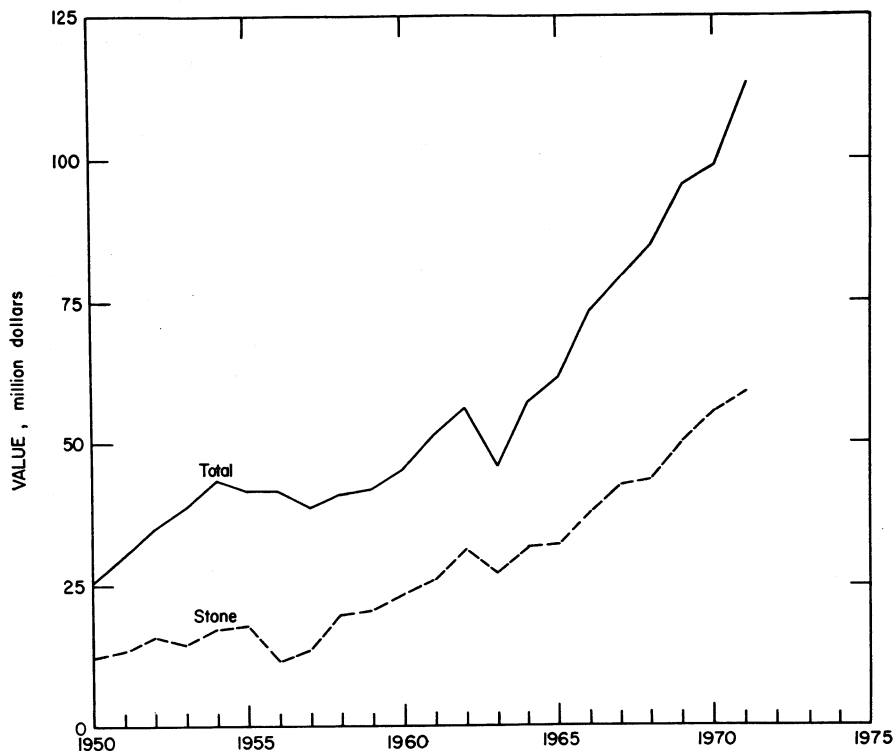


Figure 1.—Value of stone and total value of mineral production in North Carolina.

concerning North Carolina's mineral potential and industry development. One of their publications described the mineral localities of North Carolina by counties.³ Another report described the State topography and geology.⁴ A third publication described the Murphy Marble belt in North Carolina.⁵

The Asheville Minerals Research Laboratory of North Carolina State University continued an active program of metallurgical research related to the processing prob-

lems encountered by the State's mineral industry. A large portion of the research was

³ Patterson, O. F., III, and G. Robert Ganis (rev. by). Mineral Localities of North Carolina. Div. of Miner. Res., North Carolina Dept. of Conservation and Development Inf. Circ. 16, 1971, 128 pp.

⁴ Allen, Eldon P. (rev. by). An Introduction to the Topography, Geology, and Mineral Resources of North Carolina. Div. of Miner. Res., North Carolina Dept. of Conservation and Development, Educational Ser. 2, 1971, 20 pp.

⁵ Power, W. Robert, and Joseph T. Forrest, Stratigraphy and Structure of the Murphy Belt, North Carolina. Carolina Geological Society, Field Trip Guidebook, November 1971, 29 pp.

Table 1.—Mineral production in North Carolina ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ² thousand short tons ..	3,318	\$3,102	3,503	\$3,802
Feldspar..... long tons ..	345,186	5,173	351,617	4,681
Gem stones.....	NA	20	NA	30
Mica:				
Scrap..... thousand short tons ..	64	1,457	67	1,770
Sheet..... pounds ..			8,705	3
Sand and gravel..... thousand short tons ..	12,772	13,277	14,240	14,690
Stone..... do ..	30,363	54,121	30,917	58,026
Talc and pyrophyllite..... short tons ..	92,639	544	85,289	522
Value of items that cannot be disclosed: Asbestos, cement, clays (fire and kaolin), copper (1971), gold (1971), lead (1971), lithium minerals, olivine, phosphate rock, silver (1971), tungsten, and zinc (1971).....	XX	20,671	XX	28,927
Total.....	XX	98,365	XX	112,451
Total 1967 constant dollars.....	XX	87,987	XX	^p 97,697

^p Preliminary. NA Not available. XX Not applicable.

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

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

Table 2.—Value of mineral production in North Carolina, by county ¹
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Alamance.....	W	W	Stone, miscellaneous clay, sand and gravel, talc.
Alexander.....	\$13	\$11	Sand and gravel.
Alleghany.....	W	W	Stone.
Anson.....	W	W	Sand and gravel.
Ashe.....	W	W	Sand and gravel, stone.
Avery.....	757	958	Mica, kaolin, sand and gravel, iron ore, stone.
Beaufort.....	W	W	Phosphate rock, sand and gravel.
Bertie.....	W	W	Sand and gravel.
Bladen.....	226	W	Do.
Brunswick.....	42	10	Do.
Buncombe.....	W	W	Stone, sand and gravel.
Burke.....	W	W	Do.
Cabarrus.....	W	W	Stone, miscellaneous clay, sand and gravel.
Caldwell.....	408	449	Stone, sand and gravel.
Camden.....	4	2	Sand and gravel.
Carteret.....	3	3	Do.
Caswell.....	W	W	Stone, sand and gravel.
Catawba.....	W	W	Stone, sand and gravel, miscellaneous clay.
Chatham.....	W	W	Stone, miscellaneous clay.
Cherokee.....	W	W	Stone, talc.
Chowan.....	5	5	Sand and gravel.
Clay.....	W	W	
Cleveland.....	W	W	Lithium minerals, stone, feldspar, mica, clay, sand and gravel.
Columbus.....	72	36	Sand and gravel.
Craven.....	W	W	Stone, sand and gravel.
Cumberland.....	W	W	Sand and gravel, miscellaneous clay.
Currituck.....	15	9	Sand and gravel.
Dare.....	8	W	
Davidson.....	1,295	874	Stone, sand and gravel, miscellaneous clay.
Davie.....	W	W	Stone, sand and gravel.
Duplin.....	48	W	Sand and gravel.
Durham.....	W	W	Stone, miscellaneous clay.
Edgecombe.....	237	273	Sand and gravel.
Forsyth.....	W	W	Stone, sand and gravel.
Franklin.....	W	W	Sand and gravel.
Gaston.....	W	W	Lithium minerals, stone, sand and gravel.
Gates.....	20	6	Sand and gravel.
Graham.....	W	W	Stone.
Granville.....	W	W	Stone, talc, sand and gravel.
Greene.....	W	55	Sand and gravel, stone.
Guilford.....	4,770	W	Stone, miscellaneous clay, sand and gravel.
Halifax.....	W	W	Miscellaneous clay, stone, sand and gravel.
Harnett.....	W	3,246	Sand and gravel, clay.
Haywood.....	W	W	Sand and gravel, stone.
Henderson.....	545	1,124	Stone, miscellaneous clay.

See footnotes at end of table.

Table 2.—Value of mineral production in North Carolina, by county¹—Continued
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Hertford	W	\$116	Sand and gravel.
Hoke	\$52	6	Do.
Hyde	5	5	Do.
Iredell	W	W	Stone, sand and gravel, miscellaneous clay.
Jackson	464	1,705	Sand and gravel, stone, asbestos.
Johnston	W	W	Stone, sand and gravel.
Jones	W	W	Do.
Lee	W	W	Miscellaneous clay, stone, sand and gravel.
Lenoir	172	W	Sand and gravel, stone.
Lincoln	W	22	Sand and gravel.
McDowell	W	489	Sand and gravel, stone.
Macon	223	W	Stone.
Madison	W	W	Stone, feldspar.
Martin	W	1	Sand and gravel.
Mecklenburg	W	W	Stone.
Mitchell	4,549	4,374	Feldspar, mica, stone.
Montgomery	W	W	Stone, miscellaneous clay, sand and gravel.
Moore	1,413	888	Sand and gravel, stone, talc, miscellaneous clay.
Nash	W	W	Stone, sand and gravel.
New Hanover	W	W	Cement, stone, miscellaneous clay, sand and gravel.
Northampton	W	W	Sand and gravel.
Onslow	W	W	Stone, sand and gravel.
Orange	W	W	Stone, talc.
Familico	7	110	Stone, sand and gravel.
Pasquotank	W	11	Sand and gravel.
Pender	4	8	Do.
Perquimans	4	5	Do.
Person	W	W	Do.
Pitt	W	W	Stone, sand and gravel.
Polk	W	W	Do.
Randolph	W	W	Stone.
Richmond	W	W	Stone, sand and gravel.
Robeson	153	W	Sand and gravel.
Rockingham	1,303	1,106	Stone, miscellaneous clay, sand and gravel.
Rowan	W	2,716	Do.
Rutherford	W	W	Stone, sand and gravel.
Sampson	86	86	Sand and gravel, miscellaneous clay.
Scotland	33	W	Sand and gravel.
Stanly	W	W	Miscellaneous clay, stone.
Stokes	75	W	Stone, sand and gravel.
Surry	W	W	Do.
Swain	W	559	Stone.
Transylvania	255	W	Stone, asbestos.
Union	W	W	Stone, miscellaneous clay, sand and gravel.
Vance	W	W	Stone, tungsten, silver, lead, copper, zinc, gold.
Wake	W	W	Stone, sand and gravel.
Washington	8	9	Sand and gravel.
Watauga	W	W	Sand and gravel, stone.
Wayne	178	212	Sand and gravel.
Wilkes	W	W	Stone, sand and gravel.
Wilson	W	W	Do.
Yadkin	7	2	Sand and gravel.
Yancey	W	1,031	Mica, olivine, sand and gravel, stone, asbestos.
Undistributed	80,912	91,927	
Total ²	98,365	112,451	

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

¹ The following counties are not listed because no production was reported: Tyrrell and Warren.

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

conducted in cooperation with industry groups. A bulletin described the beneficiation and geologic evaluation of North Carolina mica schist.⁶ A comprehensive report described the actual and potential uses of mineral powders as fillers and extenders in a wide variety of industrial and commercial products.⁷

Trends and Developments.—According to the Commerce and Industry Division of the North Carolina Department of Natural and Economic Resources, capital investments in

new and expanded industries in the State in 1971 totaled over \$702 million. These investments created 25,433 new industrial jobs for the people of the State and added

⁶ Lewis, Robert M., Jerry L. Bundy, and Leonard S. Wiener. Beneficiation and Geologic Evaluation of North Carolina Mica Schist. School of Engineering, North Carolina State University Bull. 86, December 1971, 52 pp.

⁷ Harrell, George O., and Daniel E. Harrell. Survey of Mineral Fillers in Selected Industries, Phase I, Plastics and Textiles. School of Engineering, North Carolina State University, April 1971, 105 pp.

Table 3.—Selected indicators of North Carolina business activity

	1970	1971	Change, percent
Employment and labor force, annual average:			
Total labor force..... thousands..	2,276	2,814	+23.6
Unemployment..... do.....	86	91	+5.8
Employment..... do.....	2,190	2,223	+1.5
Construction..... do.....	97	93	-4.1
All manufacturing..... do.....	717	709	-1.1
Total nonfarm wage and salary..... do.....	1,777	1,782	+0.3
Personal income:			
Total..... millions..	\$16,331	\$17,427	+6.7
Per capita..... do.....	\$3,208	\$3,387	+5.6
Construction activity:			
Value of private nonresidential construction..... millions..	\$199	\$254	+27.6
State Highway Commission: Value of contracts awarded..... do.....	\$173	\$166	-4.0
Cement shipments to and within North Carolina..... thousand 376-pound barrels..	8,099	8,555	+5.6
Mineral production value..... millions..	\$98	\$112	+14.3
Export trade..... do.....	\$230	\$186	-19.1
Import trade..... do.....	\$245	\$305	+24.5

Sources: Survey of Current Business, Highlights of U.S. Import and Export Trade, Construction Review, Employment and Earnings, Roads and Streets, Area Trends in Employment, and U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Coal.....	--	--	--	--	--	--	--	--
Peat.....	--	--	--	--	--	--	--	--
Metal.....	168	275	46	370	--	54	146.12	3,607
Native asphalt.....	--	--	--	--	--	--	--	--
Nonmetal.....	1,694	261	443	3,582	1	101	28.47	4,667
Sand and gravel.....	837	250	209	1,998	--	40	20.64	541
Stone.....	2,073	254	527	4,421	1	69	15.83	1,832
Total.....	4,772	257	1,225	10,310	2	264	25.80	2,638
1971: ^p								
Coal.....	--	--	--	--	--	--	--	--
Peat.....	--	--	--	--	--	--	--	--
Metal.....	125	283	36	285	--	30	105.08	1,622
Native asphalt.....	--	--	--	--	--	--	--	--
Nonmetal.....	1,965	259	509	4,108	2	112	27.75	4,677
Sand and gravel.....	910	241	220	2,079	1	38	18.76	3,978
Stone.....	2,010	237	478	4,071	3	55	14.25	4,816
Total ¹	5,015	248	1,242	10,542	6	235	22.86	4,510

^p Preliminary.

¹ Data may not add to totals shown because of independent rounding.

\$136.7 million to the industrial payrolls. In the 10-year period, 1962-72, total investments for new and expanded industry in North Carolina were \$5.4 billion, which is more than any State in the South. During

this 10-year period, announcements were made of the location of 1,624 new manufacturing plants and the expansion of 3,598 of its existing plants.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Asbestos.—Amphibole asbestos was mined by Powhatan Mining Co. in Jackson, Transylvania, and Yancey Counties. Output increased slightly above that of 1970.

Cement.—The production of portland cement at the Castle Hayne plant of Ideal Cement Co., New Hanover County, increased moderately above that in 1970. Three types of portland cement were produced—general use, moderate heat, and

high-early strength. Shipments to ultimate consumers from plant and terminals were predominantly by truck (66 percent) and rail (33 percent), and only nominal quantities were shipped directly by waterways. Sales of portland cement were to building materials dealers, concrete products and ready-mix concrete manufacturers (91 percent), highway contractors and Federal, State, and other Government agencies (6 percent), and miscellaneous users (3 percent). The apparent consumption of cement in North Carolina was 10,210,000 barrels.

Clays.—Miscellaneous clay was mined by 27 companies from 46 mines in 20 counties. Production increased 6 percent in quantity and 23 percent in value over that of 1970. Eighteen mines in Chatham, Lee, Rockingham, Stanly, and Union Counties accounted for 66 percent of the State's production in quantity and 61 percent in value. The leading miscellaneous clay producers by quantity were Boren Clay Products Co., Kendrick Brick and Tile Co., Pine Hall Brick and Pipe Co., Sanford Brick Corp., and Solite Corp. Together, their 14 operations produced 55 percent of the miscellaneous clay by quantity and 52 percent by value. Seventy-one percent of the miscellaneous clay was used in manufacturing heavy building brick. Other major uses, in descending order, were for lightweight aggregate, cement, and sewer pipe.

North Carolina continued as the Nation's leading brick producer, a position held since 1962. In 1971, it manufactured 1,089

million bricks, valued at \$39 million, or approximately 15 percent of the total U.S. production.

Fire clay for the manufacture of refractory firebrick was produced by Boren and Harvey, Inc. at a mine in Harnett County.

Harris Mining Co., with two mines in Avery County, was the sole producer of kaolin. The output increased very substantially from that of 1970, both in quantity and value. The kaolin was used for paint filler, tile, whiteware, pottery, and a number of other miscellaneous end uses.

Feldspar.—North Carolina ranked first in the production of feldspar, accounting for 53 percent of U.S. production in quantity and 47 percent in value. State production increased 2 percent in quantity and decreased 10 percent in value from that of 1970. Six companies operated 9 mines in Cleveland, Madison and Mitchell Counties. Leading producers were International Minerals & Chemical Corp., Lawson-United Feldspar and Mineral Co., and The Feldspar Corp. Production was mainly in the form of flotation concentrate and feldspar silica mix, in that order; there was only minor production of hand-cobbed feldspar.

Ground feldspar shipments decreased 9 percent in quantity and 5 percent in value below those of 1970. The major demand for feldspar was in the glass industry, followed by pottery manufacturing. The main destinations of ground feldspar shipments were Ohio (12 percent), Illinois (9 percent), Tennessee (8 percent), and Texas, and West Virginia (7 percent each). The re-

Table 5.—Common clay and shale sold or used by producers, by county
(Short tons)

County	1970			1971		
	Number of Mines	Quantity	Value	Number of Mines	Quantity	Value
Catawba.....	1	W	W	1	18,328	\$17,400
Chatham.....	5	550,261	\$477,313	4	586,298	588,690
Cumberland.....	1	W	W	1	12,705	27,810
Davidson.....	1	72,000	29,000	1	W	58,500
Guilford.....	2	95,921	76,700	3	98,729	98,729
Henderson.....	1	W	W	2	88,000	W
Iredell.....	1	W	W	1	18,328	17,400
Lee.....	5	462,190	423,727	5	457,538	442,538
Montgomery.....	1	14,000	17,500	1	W	W
Rowan.....	3	189,349	147,820	2	W	W
Sampson.....	1	27,781	22,200	1	37,035	37,035
Stokes.....	1	4,432	2,216	--	--	--
Union.....	1	163,996	327,992	1	211,072	W
Undistributed ¹	21	1,737,851	1,577,046	23	1,974,846	2,513,667
Total.....	45	3,317,781	\$3,101,514	46	3,502,879	\$3,801,769

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

¹ Includes Alamance, Cabarrus, Cleveland (1971), Durham, Halifax, Harnett, Johnston (1970), Moore, New Hanover, Rockingham, and Stanly Counties, and data indicated by symbol W.

maining 57 percent of the shipments went to numerous States, none of which accounted for more than 5 percent each.

Gem Stones.—Amateur collectors of gems and minerals were responsible for the production of rubies, sapphires, emeralds, and semiprecious stones in several areas in the State. The rough 59 carat emerald crystal found near Hiddenite, Alexander County, in 1970, was acquired by Tiffany & Co., New York, and cut to a 13.14-carat gem-quality stone. It was reported to be the largest and most valuable cut emerald ever recovered in North America, and as being of equal quality to those recovered elsewhere in the world.

Lithium Minerals.—Two producing mines in North Carolina accounted for the major portion of U.S. lithium ore production in 1971. State production was moderately more in quantity and substantially more in value than in 1970. Foote Mineral Co. operated a mine and mill at Kings Mountain, Cleveland County. The concentrate was shipped outside the State for further processing. Lithium Corp. of America, Inc., operated a mine and lithium chemicals plant near Bessemer City, Gaston County.

Mica.—The State accounted for 53 percent of the domestic production of scrap mica by quantity and 61 percent by value. State production increased 5 percent in quantity and 21 percent in value over that of 1970. Nine companies reported production of scrap mica from 13 mines in Avery, Cleveland, Mitchell, and Yancey Counties. Leading producers were Deneen Mica Co., Inc., and Harris Mining Co. A small amount of sheet mica was produced at one mine in Mitchell County.

Ground mica was produced by seven companies with nine plants in Buncombe, Cleveland, Macon, Mitchell, and Yancey

Counties. Six plants used dry methods, two used wet methods, and one used both methods. Output increased 1 percent in quantity and 17 percent in value above that of 1970. The major uses, in descending order, for ground mica were roofing, paint, joint cement, and well drilling.

Olivine.—The International Minerals and Chemical Corp. mined and beneficiated olivine in Yancey County. State production was substantially more than in 1970, both in quantity and in value. The material was used for molding sand.

Perlite.—The Carolina Perlite Co., Inc., expanded perlite at Gold Hill, Rowan County, using crude material imported from other States. Output decreased substantially below that of 1970, both in quantity and in value.

Phosphate Rock.—The production of phosphate rock at the Lee Creek fertilizer complex of Texas Gulf Sulphur Co., Beaufort County, decreased slightly in quantity and increased moderately in value over that of 1970. The major portion of the output was used for the production of phosphoric acid. A substantial quantity was also exported as phosphate rock.

The State Board of Water and Air Resources granted Texas Gulf Sulphur Co. a 20-year permit to continue pumping water at the Lee Creek mine at a rate to permit dry open pit mining, including water for processing. The permit was based on a report following a 14-month study by a committee of ground water experts jointly employed by the State and industry.

Sand and Gravel.—Sand and gravel continued to be the second leading mineral commodity produced in the State; both quantity and value were 11 percent greater than that of the previous year. Production was reported by 122 commercial and 111

Table 6.—Ground mica sold or used by producers, by use

Use	1970			1971		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Roofing-----	W	W	W	W	W	W
Paint-----	8,966	\$1,372,275	\$153.05	12,500	\$1,709,394	\$136.75
Rubber-----	4,581	690,124	150.63	5,284	875,534	165.70
Wallpaper-----	438	66,188	151.11	W	W	W
Plastics-----	360	58,480	162.44	344	W	W
Other uses ¹ -----	41,224	1,622,369	39.35	38,053	1,868,996	49.12
Total-----	55,569	3,809,436	68.55	56,181	4,453,924	79.28

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

¹ Includes joint cement, textile coating, well drilling, and other uses, and uses indicated by symbol W.

Table 7.—Sand and gravel sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Alexander	1	28	\$13	1	25	\$11
Ashe	3	161	221	2	W	W
Bladen	2	270	226	5	W	W
Brunswick	1	57	42	4	45	10
Cabarrus	1	4	2	1	W	W
Camden	1	6	4	1	9	2
Carteret	1	12	3	1	10	3
Caswell	—	—	—	1	5	2
Catawba	5	205	184	4	W	W
Chowan	1	19	5	1	19	5
Columbus	1	97	72	4	111	36
Cumberland	5	610	573	8	W	W
Currituck	1	21	15	1	38	9
Dare	1	12	8	—	—	—
Davie	3	98	96	—	W	W
Duplin	5	68	48	5	W	W
Edgecombe	9	269	237	11	333	273
Forsyth	1	56	39	2	63	44
Gaston	9	75	52	8	W	W
Gates	1	28	20	1	23	6
Granville	1	2	3	1	1	(¹)
Greene	2	W	W	2	93	49
Guilford	1	7	4	1	W	W
Halifax	1	62	24	1	64	24
Harnett	4	W	W	8	2,436	3,172
Hertford	2	W	W	2	183	116
Hoke	1	70	52	1	55	6
Hyde	1	19	5	1	19	5
Iredell	4	73	34	5	W	W
Jones	1	21	6	1	21	6
Lenoir	4	218	172	5	W	W
Lincoln	4	31	22	1	30	22
McDowell	3	W	W	5	361	405
Martin	3	W	W	1	4	1
Mecklenburg	1	1	1	—	—	—
Montgomery	1	13	6	1	32	13
Moore	8	608	448	7	307	505
Nash	1	66	53	1	34	2
New Hanover	1	24	10	4	15	3
Onslow	3	W	W	4	8	3
Pamlico	1	9	7	1	12	3
Pasquotank	1	W	W	1	45	11
Pender	1	10	4	4	35	8
Perquimans	1	6	4	1	20	5
Pitt	3	754	361	6	566	248
Polk	1	9	4	4	14	6
Richmond	1	13	8	3	W	W
Robeson	1	205	153	5	W	W
Rutherford	2	W	W	1	153	79
Sampson	6	73	64	6	96	49
Scotland	2	40	33	2	W	W
Stokes	1	98	69	5	90	63
Surry	1	2	3	3	4	7
Transylvania	1	4	5	—	—	—
Union	1	25	23	1	26	23
Vance	1	1	1	—	—	—
Wake	1	3	2	—	3	3
Washington	1	32	8	1	36	9
Wayne	5	223	178	8	355	212
Wilkes	1	3	6	1	4	2
Wilson	2	26	23	2	42	9
Yadkin	1	4	7	1	2	2
Undistributed ²	57	7,915	9,619	60	7,890	9,221
Total ³	197	12,772	13,277	233	14,240	14,690

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

¹ Less than 1/2 unit.

² Includes Alamance, Anson, Avery, Beaufort, Bertie, Buncombe, Burke, Caldwell, Cherokee (1970), Clay (1970), Cleveland, Craven, Davidson, Franklin, Graham (1970), Haywood, Jackson, Johnston, Lee, Northampton, Person (1971), Rockingham, Rowan, Watauga, Yancey, and some sand and gravel that cannot be assigned to specific counties.

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

Table 8.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	3,267	\$3,494	3,912	\$3,945
Fill.....	431	278	381	200
Paving.....	1,946	1,721	1,893	1,709
Gravel:				
Building.....	1,084	1,792	1,438	3,016
Paving.....	1,620	1,917	1,748	2,537
Other sand and gravel ¹	740	1,982	817	1,900
Total ²	9,088	11,184	10,191	13,305
Government-and-contractor operations:				
Sand:				
Building.....	--	--	4	2
Fill.....	432	324	572	57
Paving.....	1,969	1,335	2,237	889
Other.....	830	251	777	258
Total ²	3,231	1,910	3,590	1,207
Gravel:				
Paving.....	452	233	460	178
Other.....	1	1	--	--
Total ²	453	233	460	178
Total sand and gravel ²	12,772	13,277	14,240	14,690

¹ Includes filtration (1970), railroad ballast, other sands, fill, miscellaneous and other gravel (1971).

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

Government-and-contractor operations located in 81 counties. Thirty operations in Anson, Cumberland, Jackson, Harnett, and Moore Counties accounted for 46 percent of the total production by quantity and 56 percent by value.

Commercial sand and gravel comprised 72 percent of the total State production by quantity and 91 percent by value. The six leading commercial sand and gravel producers were Becker Sand & Gravel Co., W. R. Bonsal Co., Inc., Hedrick Gravel and Sand Co., lessees of B. V. Hedrick Sand and Gravel Co., Nello L. Teer Co., and Western Stone Co. Together, their 8 operations accounted for 54 percent of the commercial sand and gravel production by quantity and 63 percent by value. Commercial operations provided essentially all of the sand and gravel used for building purposes and 57 percent of that used for paving. Transportation of commercial sand and gravel was 70 percent by truck and 30 percent by railroad.

Stone.—Stone was again the principal mineral commodity produced in the State. Output increased 2 percent in quantity and 7 percent in value over that of 1970. Production was reported from 63 counties by 42 commercial producers with 111 quarries,

the State Highway Commission's two quarries, and by numerous Government-and-contractor operators with 46 quarries. The commercial producers accounted for 95 percent of the State's stone production by quantity and 96 percent by value. Twenty-three large quarries, with individual outputs of more than 500,000 tons, accounted for 61 percent of the State's total stone production by quantity. A total of 18 operations in Cleveland, Guilford, Mecklenburg, New Hanover, and Wake Counties, produced 35 percent of the stone by quantity and 33 percent by value. The leading stone producers by quantity were Central Rock Co., Inc., Ideal Cement Co., Superior Stone Co., Nello L. Teer Co., and Vulcan Materials Co. Together, their 55 operations accounted for 81 percent of the stone production by quantity and 76 percent by value.

The production of crushed granite at 76 quarries accounted for 77 percent of the State's stone output by quantity, and 72 percent by value. Production decreased 1 percent in quantity, but increased 5 percent in value from that of 1970. Major quantities of other types of crushed and broken stone were produced at 55 limestone and two traprock operations; relatively minor outputs were reported by one

marble, one marl, two quartz, one quartzite, three sandstone, and one miscellaneous rock operations. Combined, they accounted for 22 percent of the State's stone production in both quantity and value. The production of these categories of stone was 14 percent greater in quantity and 20 percent greater in value than in 1970.

The production of dimension stone was reported by 14 granite, two slate, and three individual marble, quartzite, and sandstone quarries. Granite dimension stone accounted for 77 percent of dimension stone by quantity and 83 percent by value. The total tonnage of dimension stone produced was small, amounting to less than 0.2 percent of the State's stone production, but the value accounted for 6 percent of the State total for stone. The quantity produced was 7 percent less than that of 1970, but the value was approximately the same.

The major uses for crushed stone were as roadbase and surfacing material (63 percent), concrete aggregate (17 percent), bituminous and macadam aggregate (15 percent), and other uses (5 percent). Transportation was predominantly by truck (94 percent), railroad (5 percent), and waterway (1 percent).

Talc and Pyrophyllite.—The production of talc and pyrophyllite decreased 8 percent in quantity and 4 percent in value from that of 1970. Talc was produced by Hitchcock Corp. in Cherokee County. The main uses were for toilet preparations and in the textile industry. Pyrophyllite was produced by four companies operating seven mines in Alamance, Granville, Moore, and

Orange Counties. The major part of the production was used, in descending order, by the refractory, ceramic, and insecticide industries. Leading producers were Piedmont Minerals Co., Inc., in Orange County, and Standard Minerals Co., Inc., in Moore County.

Vermiculite.—W. R. Grace & Co. operated an exfoliating plant in Guilford County, and Carolina Wholesale Florist, Inc., operated a plant in Lee County. Both companies used crude vermiculite shipped into the State. The combined output was moderately less than that of 1970, both in quantity and value. The principal uses for the finished product were as insulation (74 percent), aggregate (22 percent), and other uses (4 percent).

METALS

Aluminum.—Primary aluminum was produced by the Aluminum Co. of America (Alcoa) at a plant near Badin, in Stanly County, using imported alumina. The production decreased moderately from that of 1970, both in quantity and in value.

Iron Ore.—Greenback Industries, Inc., operated the Cranberry mine and concentrator in Avery County. The production was in the form of a high-quality magnetite product for special uses.

Tungsten.—Ranchers Exploration and Development Corp. produced tungsten concentrate at a major-sized operation in Vance County. The output increased substantially over that of 1970. A relatively small quantity of byproduct concentrate containing

Table 9.—Crushed granite sold or used by producers, by county
(Short tons and thousand dollars)

County	1970			1971		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Cabarrus.....	1	79,310	\$127	1	73,420	\$73
Clay.....	1	80,133	W	--	--	--
Guilford.....	5	2,840,336	4,689	5	W	W
Iredell.....	3	1,293,716	2,061	2	W	W
Macon.....	1	171,000	224	1	W	W
Mitchell.....	1	3,252	4	2	W	W
Surry.....	1	W	W	3	727,128	1,066
Transylvania.....	1	155,000	250	1	W	W
Undistributed ¹	68	19,628,285	32,386	61	23,159,633	40,407
Total.....	82	24,251,032	39,741	76	23,960,181	41,546

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

¹ Includes Alamance, Alleghany, Ashe, Buncombe, Burke, Caldwell, Caswell, Catawba, Chatham, Cleveland, Davidson, Davie, Forsyth, Gaston (1971), Graham (1971), Granville, Halifax, Haywood, Henderson, Jackson (1971), Johnston, Lee (1971), Lincoln (1970), Madison (1970), Mecklenburg, Moore, Nash, Orange, Pitt, Polk, Randolph, Richmond (1971), Rockingham, Rowan, Rutherford, Stokes (1971), Swain (1971), Union, Vance, Wake, Wilkes, Wilson Counties, and data for which no county breakdown is available.

gold, silver, copper, lead, and zinc was also produced. Operations were suspended in August 1971 because of a sharp decline in tungsten prices and technical difficulties in milling the tungsten ore.

MINERAL FUELS

There was no production of mineral fuels in North Carolina during 1971.

Petroleum and Natural Gas.—Sixteen exploratory wells were completed in North Carolina during 1971, all of which were dry. The depths of the holes ranged from 765

to 6,264 feet, for a total footage drilled of 39,469 feet. Ten of the wells were drilled in Brunswick County, with a total footage of 11,985 feet; two in Dare County, with a total footage of 12,081 feet; one in Gates County, with a depth of 2,140 feet; and three in Tyrrell County, with a total footage of 13,263 feet.

The State granted Cities Service Oil Co. an oil and gas lease on 2.4 million acres of State-owned submerged lands. Terms of the lease agreement required 12,000 feet of exploratory drilling during each 2-year renewal period.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum: Aluminum Company of America.	1501 Alcoa Bldg. Pittsburgh, Pa. 15219	Smelter	Stanly.
Asbestos: Powhatan Mining Co.	Box 231 Windsor Mill Road Baltimore, Md. 21207	Open pit mine	Jackson, Yancey.
Cement: Ideal Cement Co., Div. of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	Plant	New Hanover.
Clays: Kaolin: Harris Mining Co.	Box 628 Spruce Pine, N.C. 28777	Open pit mine and plant.	Avery.
Miscellaneous: Boren Clay Products Co.	Pleasant Garden, N.C. 27313	4 open pit mines and plants.	Chatham, Guilford, Sampson, Stanly.
Carolina Solite Corp.	Box 9138 Richmond, Va. 23227	Open pit mine and plant.	Rockingham.
Pine Hall Brick and Pipe Co.	Box 4325, North Station Winston-Salem, N.C. 27105	4 open pit mines and plants.	Chatham.
Pomona Corp., Pomona Pipe Products Co.	Box 7236 Greensboro, N.C. 27407	3 open pit mines and plant.	Chatham, Lee, Stanly, Rockingham.
Sanford Brick Corp.	Box 38 Gulf, N.C. 27256	Open pit mine and plant.	
Solite Corp.	Box 9138 Richmond, Va. 23227		
Feldspar: The Feldspar Corp. ¹	Spruce Pine, N.C. 28777	3 open pit mines and 2 plants.	Mitchell.
Foote Mineral Co.	Box 792 Kings Mountain, N.C. 28086	Open pit mine and plant.	Cleveland.
International Minerals & Chemical Corp. ¹	Old Orchard Road Skokie, Ill. 60079	Open pit mine and 2 plants.	Mitchell.
Kings Mountain Silica Co., Inc.	Box 709 Kings Mountain, N.C. 28086	2 open pit mines and 2 plants.	Cleveland.
Lawson-United Feldspar and Mineral Co. ¹	Minpro, N.C. 28777	Open pit mine and plant.	Mitchell.
Iron ore: Cranberry Magnetite Division, Greenback Industries.	Box 63 Greenback, Tenn. 37742	Underground mine and plant.	Avery.
Lithium minerals: Foote Mineral Co.	Box 792 Kings Mountain, N.C. 28086	Open pit mine and plant.	Cleveland.
Lithium Corp. of America, Inc.	Box 428 Bessemer City, N.C. 28016	do.	Gaston.
Mica, scrap: Deneen Mica Co., Inc.	Newdale, N.C. 28714	Open pit mine and plant.	Yancey.
The Feldspar Corp.	Box 220 Spruce Pine, N.C. 28777	2 open pit mines and 2 plants.	Mitchell.
Harris Mining Co.	Box 628 Spruce Pine, N.C. 28777	3 open pit mines and 2 plants.	Avery, Mitchell.
Kings Mountain Mica Co., Inc.	Box 709 Kings Mountain, N.C. 28086	2 open pit mines and 2 plants.	Cleveland.
United States Gypsum Co.	101 South Wacker Drive Chicago, Ill. 60606	Open pit mine	Do.
Mica, grinders: Deneen Mica Co.	Newdale, N.C. 28714	Open pit mine and plant.	Yancey.
Diamond Mica Co.	Box 648 Spruce Pine, N.C. 28777	2 plants	Mitchell, Yancey.

See footnote at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Mica, grinders—Continued			
Franklin Mineral Products Co.---	Box 0 Wilmington, Mass. 01887	Plant-----	Macon.
Harris Mining Co.-----	Box 628 Spruce Pine, N.C. 28777	2 open pit mines and 2 plants.	Mitchell.
Kings Mountain Mica Co., Inc.---	Box 709 Kings Mountain, N.C. 28086	Plant-----	Cleveland.
Olivine:			
Northwest Carolina Olivine, Inc.---	Box 672 Spruce Pine, N.C. 28777	Open pit mine and plant.	Yancey.
Perlite, expanded: Carolina Perlite Co., Inc.	Box 741 Hillside, N.J. 07205	Plant-----	Rowan.
Phosphate rock: Texas Gulf Sulphur Co.	200 Park Avenue New York, N.Y. 10017	Open pit mine and plant.	Beaufort.
Sand and gravel:			
Becker Sand & Gravel Co.-----	Box 848 Cheraw, S.C. 29520	3 open pit mines---	Cumberland, Harnett, Moore.
W. R. Bonsal Co., Inc.-----	Box 38 Lilesville, N.C. 28091	Open pit mine-----	Anson.
Grove Stone and Sand, Branch of B. V. Hedrick Gravel and Sand Co.	Swannanoa, N.C. 28778-----	---do-----	Buncombe.
Lessees of B. V. Hedrick Gravel and Sand Co.	Lilesville, N.C. 28091-----	---do-----	Anson.
Nello L. Teer Co.-----	Box 1131 Durham, N. C. 27702	---do-----	Harnett.
Stone:			
Granite, crushed:			
Central Rock Co., Inc.-----	Box 510 Greensboro, N.C. 27409	Quarry-----	Guilford.
Foote Mineral Co.-----	Box 792 Kings Mountain, N.C. 28086	Open pit mine-----	Cleveland.
Superior Stone Co.-----	Box 2568 Raleigh, N.C. 27602	24 quarries-----	Alamance, Catawba, Chatham, Cleveland, Davidson, Guilford, Halifax, Iredell, Mecklen- burg, Moore, Pitt, Randolph, Rocking- ham, Rowan, Union, Wake.
Nello L. Teer Co.-----	Box 1131 Durham, N.C. 27702	5 quarries-----	Granville, Nash, Wake, Wilson.
Vulcan Materials Co.-----	Box 7506, Reynolds Station, Winston-Salem, N.C. 27106	15 quarries-----	Buncombe, Caldwell, Caswell, Davie, Forsyth, Granville, Guilford, Haywood, Henderson, Rocking- ham, Surry, Vance, Wilkes.
Granite, dimension:			
Comolli Granite Co.-----	Elberton, Ga. 30635-----	2 quarries-----	Rowan.
Harris Granite Quarries Co.---	P.O. Box 1038 Salisbury, N.C. 28144	---do-----	Do.
North Carolina Granite Corp.---	Box 151 Mt. Airy, N.C. 27030	Quarry-----	Surry.
Troitino and Brown, Inc.-----	Box 5595 Asheville, N.C. 28803	---do-----	Avery.
Limestone, crushed:			
Fletcher Limestone Co., Inc.---	Box 98 Fletcher, N.C. 28732	---do-----	Henderson.
Ideal Cement Co.-----	420 Ideal Cement Bldg. Denver, Colo. 80202	---do-----	New Hanover.

See footnote at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Limestone, crushed—Continued			
Superior Stone Co.....	Box 2568 Raleigh, N.C. 27602	2 quarries.....	Cleveland.
Marble, crushed and dimension:			
Moretti-Harrah Marble Co..	Box 330 Sylacauga, Ala. 35150	Quarry.....	Cherokee.
Quartz, crushed:			
Thomas & Woody Mining Co.	Box 315 Spruce Pine, N.C. 28777	...do.....	Montgomery.
Slate, dimension:			
Jacob's Creek Stone Co., Inc.	P.O. Box 608 Denton, N.C. 27239	2 quarries.....	Davidson, Montgom- ery.
Sandstone, crushed:			
The Feldspar Corp.....	Spruce Pine, N.C. 28777	2 open pit mines...	Mitchell.
Sandstone, dimension:			
Jacob's Creek Stone Co., Inc.	P.O. Box 608 Denton, N.C. 27239	Quarry.....	Montgomery.
Shell, crushed and broken:			
Superior Stone Co.....	Box 2568 Raleigh, N.C. 27602	3 quarries.....	Craven, New Hanover, Onslow.
Traprock, crushed:			
Ararat Rock Products Co....	223 Willow Street Mt. Airy, N.C. 27030	Quarry.....	Surry.
Nello L. Teer Co.....	Box 1131 Durham, N.C. 27702	...do.....	Durham.
Young Stone Co.....	Box 1142 ¹ Charlotte, N.C. 28209	...do.....	Cabarrus.
Talc and pyrophyllite:			
Pyrophyllite:			
Boren & Harvey, Inc.....	Box 7247 Greensboro, N.C. 27407	Open pit mine.....	Granville.
Glendon Pyrophyllite.....	Box 306 Carthage, N.C. 28327	4 open pit mines and plant.	Alamance, Moore.
Piedmont Minerals Co., Inc..	P.O. Box 7247 Greensboro, N.C. 27407	Open pit mine and plant.	Orange.
Standard Minerals Co., Inc..	Robbins, N.C. 27325	...do.....	Moore.
Talc: Hitchcock Corp.....	Box 35 Murphy, N.C. 28906	Underground mine and plant.	Cherokee.
Vermiculite, expanded:			
Carolina Wholesale Florists, Inc..	Box 537 Sanford, N.C. 27330	Plant.....	Lee.
W. R. Grace & Co.....	62 Whittemore Avenue Cambridge, Mass. 02140	...do.....	Guilford.

¹ Also feldspar grinding.

The Mineral Industry of North Dakota

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

By Joseph B. Huvos¹

The total value of mineral production in North Dakota was \$99.9 million in 1971, a 4-percent increase over that of 1970. The value of all fossil fuel production was \$92.5 million, \$4.3 million more than in 1970. Value increases in 1971, in million dollars, were as follows: crude petroleum, 3.70 and lignite, 0.57.

The total value of nonmetallic mineral production was \$7.4 million, or \$0.5 million less than in 1970. Compared with 1970, sand and gravel decreased in value by \$126,000, and clays, lime, salt, and natural gas liquids increased. Stone production showed an increase. No uranium was recovered from lignite ash in 1971.

The Department of the Interior announced funding of a research project relating to desalting of brackish water

from aquifers in North Dakota. Funding is provided through the North Dakota Water Commission to the engineering experimental station of the University of North Dakota.

Legislation and Government Programs.—The North Dakota State Constitutional Convention approved a measure making all water, both above and below the surface, the property of the people and subject to appropriation for beneficial uses provided by law. Previously the law reserved only the surface water to State ownership.

During 1971, bills signed into law were: SB2269, by which units in unitized oil and gas fields became liable for expenses; and SB2391, by which unitized management

¹ Mineral specialist, Division of Fossil Fuels.

Table 1.—Mineral production in North Dakota¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Coal..... thousand short tons.....	5,639	\$11,009	6,075	\$11,580
Gem stones.....	NA	1	NA	2
Natural gas (marketed)..... million cubic feet.....	34,889	5,722	33,864	5,655
Natural gas liquids:				
LP gases..... thousand 42-gallon barrels.....	1,840	2,944	W	W
Natural gasoline and cycle products..... do.....	504	1,376	W	W
Petroleum (crude)..... do.....	21,998	67,107	21,653	70,805
Sand and gravel..... thousand short tons.....	8,090	6,336	8,196	6,210
Stone..... do.....	103	126	W	W
Value of items that cannot be disclosed: Clays, lime, peat, salt, and values indicated by symbol W.....	XX	1,426	XX	5,649
Total.....	XX	96,047	XX	99,901
Total 1967 constant dollars.....	XX	85,914	XX	86,794 ^p

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

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

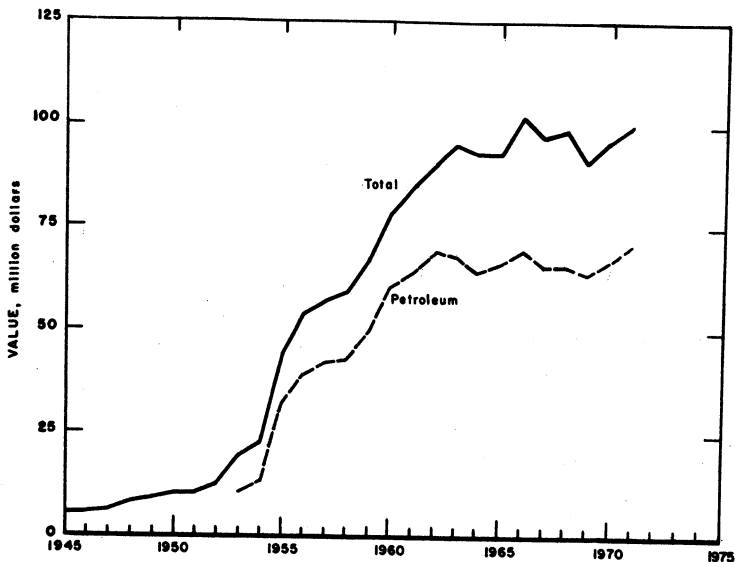


Figure 1.—Value of petroleum and total value of mineral production in North Dakota.

is provided for operation and development of two or more pools or parts thereof separated vertically in one field.

The North Dakota law on reclamation of strip-mined lands, Chapter 38-14, January 1, 1970, was amended on July 1, 1971. North Dakota's plan for water pollution control for 1971 was approved by the Environmental Protection Agency. Additional Federal funds amounting to \$37,000 were approved primarily for expanded inspection and enforcement by the North Dakota Water Pollution Control Board.²

A hearing was held by the Army Corps of Engineers in Bismarck on March 30, to discuss additional hydroelectric power from Missouri River main stream dams.

Federal and State government publications issued in 1971 that could be of inter-

est to the mineral industry include one Report of Investigations, one Information Circular, and two outside publications by the Bureau of Mines;³ one report by the U.S. Geological Survey;⁴ five ground water

² Bismarck Tribune, Sept. 29, 1971.

³ White, E. J., and L. C. Marchant. Evaluation of the Madison Limestone in the Williston Basin From Well Logs and Cores. BuMines RI 7497, 1971, 27 pp.

Staff, Bureau of Mines. Strippable Reserves of Bituminous Coal and Lignite in the United States. BuMines IC 8531, 1971, 148 pp.

Freeman, Philip G., and Walter W. Fowkes. Low-Temperature Ashing of Lignite Using an Oxygen Plasma Process. N. Dak. Acad. Science, v. 24, 1971, pp. 119-124.

Johnson, Bruce Carlyle. A study of the Carbonization and Activation Conditions for the Production of Water Treatment Carbon From North Dakota Lignite. M.S. Thesis, Univ. of North Dakota, 1971, 64 pp.

⁴ Downey, J. S. Ground Water Resources of Walsh County, Northeastern Dakota, 1971. U.S. Geol. Survey Hydrol. Inv. Atlas, HA-431, 1971.

reports by the North Dakota Geological Survey;⁵ and four other publications by the North Dakota Geological Survey.⁶

Employment and Injuries.—Statistics on employment and injuries in the mineral industries, exclusive of the petroleum industry, are presented in table 4. Information for 1970 is final data; that for 1971 is preliminary.

⁵ Downey, J. S. Ground-Water Basic Data, Nelson and Walsh Counties, North Dakota, N. Dak. Geol. Survey Bull. 57, pt. II, and N. Dak. State Water Comm. County Ground Water Studies 17, pt. II, 1971, 459 pp.

⁶ Klausning, R. L. Ground Water Basic Data, McLean County, North Dakota, 1971. N. Dak. Geol. Survey Bull. 60, pt. II, and N. Dak. State Water Comm. County Ground Water Studies 19, pt. II, 1971, 468 pp.

Pettyjohn, W. A., and R. D. Hutchinson. Ground Water Resources of Renville and Ward

Counties, 1971. N. Dak. Geol. Survey Bull. 50, pt. III, and N. Dak. State Water Comm. County Ground Water Studies 11, Part III, 1971, 100 pp.

Randich, P. G. Ground Water Basic Data, Benson and Pierce Counties, North Dakota, 1971. N. Dak. Geol. Survey Bull. 59, pt. II, and N. Dak. State Water Comm. County Ground Water Studies 18, pt. II, 1971, 360 pp.

Trapp, Henry, Jr. Ground Water Basic Data, Hettinger and Stark Counties, North Dakota, 1971. N. Dak. State Water Comm. County Ground Water Studies 16, pt. II, 1971, 455 pp.

⁶ Folsom, Clarence Jr. North Dakota Crude Oil Inventory as of January 1, 1972. N. Dak. Geol. Survey, 1971.

Royce, Chester F., Jr. A Sedimentologic Analysis of the Togue River-Sentinel Butte Interval (Paleocene) of the Williston Basin, Western North Dakota. N. Dak. Geol. Survey Misc. Series 43, 1971.

Bluemle, John P. Topographic Map of Bedrock Surface of North Dakota, 1971. N. Dak. Geol. Survey MM-12, 1971.

Bluemle, John P. Depth to Bedrock in North Dakota, 1971. N. Dak. Geol. Survey MM-13, 1971.

Table 2.—Value of mineral production in North Dakota, by county

County	(Thousands)		Minerals produced in 1971 in order of value
	1970	1971	
Adams.....	\$18	\$61	Sand and gravel, coal.
Barnes.....	227	42	Sand and gravel.
Benson.....	59	56	Do.
Billings.....	W	5,477	Petroleum.
Bottineau.....	8,730	9,337	Petroleum, sand and gravel, peat.
Bowman.....	2,729	3,494	Petroleum, coal, sand and gravel.
Burke.....	W	7,021	Do.
Burleigh.....	439	W	Sand and gravel.
Cass.....	146	W	Do.
Cavalier.....	87	W	Do.
Dickey.....	W	43	Do.
Divide.....	W	879	Petroleum, sand and gravel, clays.
Dunn.....	37	49	Petroleum.
Eddy.....	W	W	Sand and gravel.
Emmons.....	W	27	Do.
Foster.....	W	55	Do.
Golden Valley.....	W	220	Petroleum, sand and gravel, stone.
Grand Forks.....	568	334	Sand and gravel.
Grant.....	W	33	Coal, sand and gravel.
Griggs.....	93	7	Sand and gravel.
Hettinger.....	W	W	Do.
Kidder.....	W	W	Do.
LaMoure.....	W	W	Do.
Logan.....	33	W	Sand and gravel.
McHenry.....	224	W	Petroleum, sand and gravel.
McIntosh.....	27	W	Sand and gravel.
McKenzie.....	12,402	14,136	Petroleum, sand and gravel, stone.
McLean.....	273	W	Sand and gravel, coal.
Mercer.....	6,286	5,515	Coal, sand and gravel.
Morton.....	132	348	Stone, sand and gravel, clays.
Mountrail.....	2,113	W	Petroleum, sand and gravel.
Nelson.....	W	W	Sand and gravel.
Oliver.....	1,453	W	Coal, sand and gravel.
Pembina.....	W	W	Lime, sand and gravel.
Pierce.....	W	30	Sand and gravel.
Ramsey.....	61	W	Do.
Ransom.....	195	136	Do.
Renville.....	5,189	5,581	Petroleum, sand and gravel.
Richland.....	W	371	Sand and gravel.
Rolette.....	W	W	Do.
Sargent.....	W	W	Do.
Sheridan.....	W	W	Sand and gravel.
Sioux.....	W	W	Do.
Slope.....	W	W	Petroleum, sand and gravel.
Stark.....	6,656	6,346	Petroleum, coal, sand and gravel.
Steele.....	W	W	Sand and gravel.
Stutsman.....	W	W	Sand and gravel, stone.
Towner.....	163	W	Sand and gravel.
Trails.....	242	133	Do.

Table 2.—Value of mineral production in North Dakota, by county—Continued
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Walsh.....	\$307	\$183	Sand and gravel.
Ward.....	2,751	3,537	Petroleum, coal, sand and gravel.
Wells.....	W	W	Sand and gravel.
Williams.....	18,264	17,266	Petroleum, salt, sand and gravel, coal.
Undistributed ¹	26,134	19,184	
Total ²	96,047	99,901	

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

¹ Includes gem stones, some sand and gravel, natural gas, and natural gas liquids that cannot be assigned to specific counties and values indicated by symbol W.

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

Table 3.—Indicators of North Dakota business activity

	1970	1971 ^p	Change, percent
Employment and labor force, annual average:			
Nonagricultural employment..... thousands..	162.7	165.2	+1.5
Mining..... do.....	1.6	1.6	--
Construction..... do.....	9.8	10.3	+5.1
Manufacturing..... do.....	9.9	10.3	+4.0
Government..... do.....	r 49.2	49.6	+ .8
Transportation and public utilities..... do.....	12.2	12.2	--
Wholesale and retail trade..... do.....	43.9	44.6	+1.6
Finance, insurance, and real estate..... do.....	7.0	7.3	+4.3
Services..... do.....	r 29.0	29.3	+1.0
Personal income:			
Total..... millions..	r \$1,848.0	\$2,115.0	+14.4
Per capita..... do.....	r \$2,990.0	\$3,383.0	+13.1
Construction activity:			
Highway construction contracts awarded..... millions..	\$32.0	NA	NA
Cement shipments to and within the State thousand 376-pound barrels..	1,536.0	NA	NA
Value of authorized nonresidential construction..... millions..	r \$19.7	\$17.5	-11.2
Number of authorized residential units.....	r 2,883	3,166	+9.8
Farm marketing receipts..... millions..	\$693.1	NA	NA
Mineral production value..... do.....	\$96.0	\$99.9	+4.1

^p Preliminary. NA Not available.

Sources: Construction Review; Farm Income Situation; Streets and Roads; Survey of Current Business; Employment and Earnings; and U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Coal.....	290	253	73	581	1	30	53.34	11,615
Nonmetal.....	47	193	9	73	--	--	--	--
Sand and gravel.....	500	189	95	869	--	14	16.10	434
Stone.....	4	233	1	7	--	--	--	--
Total ¹	841	212	178	1,531	1	44	29.39	4,656
1971:^p								
Coal.....	320	245	78	624	--	36	57.69	1,471
Nonmetal.....	15	84	1	11	--	--	--	--
Sand and gravel.....	535	134	71	648	--	14	21.60	452
Stone.....	5	233	1	7	--	--	--	--
Total ¹	875	174	152	1,290	--	50	38.75	939

^p Preliminary.

¹ Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Lignite).—At the 15 strip mines, each producing more than 1,000 salable short tons annually, production was 6.1 million tons in 1971, valued at an average of \$1.91 per ton, a decrease of 4 cents per ton. The overburden ranged from 10 to 85 feet in thickness above 8- to 24-foot-thick coal seams. These figures omit six minor operating strip mines. In 1971, an estimated 23.3 million cubic yards of overburden was stripped. Two mines, each producing over 1 million tons per year, delivered a total of 2.73 million tons in 1971. Eight mines, producing more than 100,000 tons but less than 1 million tons annually, collectively produced 3.3 million tons. The other five mines, each with less than 100,000 tons, produced the remainder. All production was sold in the open market except the output from a mine in Stark County, which was reportedly used to manufacture briquets in the only lignite-briqueting plant in the United States. Of the total shipments, 3,085,587 tons were by rail, 214,474 tons were by truck, 2,708,681 tons were used at mine-mouth powerplants, and 66,418 tons were shipped by other methods.

Strip-mining equipment included 23 power shovels and 15 draglines, of which 21 units were electric or diesel powered. One shovel and four draglines each had buckets greater than 16-cubic yard capacity. Carryall scrapers totaled 15, of which four were rated at plus 16 cubic yards. Other equipment included six vertical drills, 26 bulldozers, 16 front-end loaders, two monogradors, eight coal drills, and an undetermined number of haulage trucks.

Mercer County produced about half of the State's lignite production.

Construction of Basin Electric Power Cooperative's 450 megawatt addition to the Leland Olds power plant at Stanton was started during 1971. The plant is scheduled to go into commercial operation in 1975, tripling Basin Electric's generating capacity to 650 megawatts. Total cost of construction of the unit is \$93 million.

Lignite fly ash from Basin Electric Power Cooperative's electric generating plant was used in an experimental paving project. A 1-mile section of State Highway 200A in Mercer County was paved with a

mixture of 13 percent fly ash, 83 percent aggregate, and 4 percent lime.

The U.S. Forest Service will not approve any leases for the strip mining of coal in a burning coal vein area in western North Dakota's Slope County. This decision is in compliance with a State request against strip mining in the area of a stand of Columnar Junipers and the State's largest stand of Ponderosa pine. Coal leasing activity was on the increase because of the possibility that coal gasification plants will be built in the State.

Consolidation Coal Company, the Department of Agriculture's Northern Great Plains Research Center at Mandan, and the Soil Conservation Service were working together on an experimental program to reestablish vegetation on spoil banks. Various species of grass seeds and soil treatments have been tried to determine plant and soil conditions for best growth.

Three coal-related bills were signed into law in 1971: SB2378 on the duties of an operator under the Strip Mining Reclamation Act; HB1038 on Repeal of the Native Fuels Act; and HB1261 which places the Mine Inspector's Office under the control of the Workmen's Compensation Bureau.

Natural Gas.—Marketed natural gas totaled 33,864 million cubic feet, 2.9 percent less than in 1970. The average value, at 16.9 cents per thousand standard cubic feet, was unchanged from 1970. Of the total marketable gas, all came from three natural gas processing plants except 148.2 million cubic feet of dry natural gas which came from 28 producing wells, the same number as in 1970. No new gas discoveries were made in 1971. The Signal Oil and Gas Co. was the principal purchaser of natural gas.⁷

Proved reserves of natural gas, totaling 567.4 billion cubic feet at the start of the year, decreased to 503.7 billion at yearend, in part because of revisions.⁸

Natural Gas Liquids.—The production of natural gas liquids, comprising liquid petroleum and natural gasoline and cycle products, declined somewhat in volume but was slightly more in value than in

⁷ Mineral Industry Surveys, Natural Gas Production and Consumption in 1971, U.S. Dept. of the Interior, Bureau of Mines, Sept. 5, 1972.

⁸ Oil and Gas Journal. Breakout by State of Crude Oil and Natural-Gas Reserves in the United States. V. 70, No. 14, Apr. 3, 1972, p. 18.

Table 5.—Lignite production, by type of mine and county
(Excludes mines producing less than 1,000 short tons annually)

County	Number of mines (strip)	Production (thousand short tons)	Value (thousands)
Adams.....	1	4	\$16
Bowman.....	1	177	W
Grant.....	2	6	24
McLean.....	1	19	85
Mercer.....	3	3,104	5,512
Oliver.....	1	1,730	W
Stark.....	2	139	557
Williams.....	1	7	20
Other ¹	3	889	5,366
Total.....	15	6,075	11,580

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

¹ Burke and Ward Counties production combined to avoid disclosing individual county confidential data.

1970. Three natural gas processing plants—Lignite Gasoline Plant at Lignite, North Tioga Gasoline Plant at McGregor, and Signal Oil & Gas Co. at Tioga—continued processing casinghead gas. Sulfur was extracted from the gas at two of these plants, namely the Signal Oil & Gas Co. and the Lignite Gasoline Plant.

The estimated proved recoverable reserves of natural gas liquids at the start of 1971 was 49.3 million barrels, compared with 47.1 million barrels at yearend.

Peat.—In 1971 the Peat Products Co. in Bottineau County produced peat in quantities 60 percent lower and 37.5 percent higher in value than in 1970.

Petroleum.—Crude oil production declined for the fifth consecutive year because development failed to offset the normal depletion of reservoirs. Output was down 1.57 percent below the 1970 level, while the value of the output increased by 5.5 percent.

During 1971, 129 drilling permits were issued, 42 fewer than in 1970; 31 producing wells were abandoned; and only 41 new producing wells were completed. Production continued to drop during the year as the older fields continued their natural decline. The new fields, discovered during 1971, were not sufficiently developed to offset the decline. Lack of new energy supplementation projects to add additional reserves resulted in a reduction of total remaining reserves.

The American Petroleum Institute reported⁹ that 162 new wells, with a total depth of 972,477 feet, were drilled in 1971. Of these, 49 were oil wells totaling 311,790 feet, one was a gas well totaling 13,913 feet, and 109 were dry wells totaling 643,915 feet. Three other wells totaling 2,859 feet were also drilled in 1971. Ex-

ploratory well drilling, 116,912 feet less than in 1970, totaled 572,311 feet for 97 wells. The drilling was distributed between eight oil wells totaling 50,529 feet and 89 dry wells totaling 521,782 feet. Development well drilling, 41,541 feet more than in 1970, totaled 400,166 feet for 62 wells, distributed among 41 oil wells totaling 261,261 feet, one gas well totaling 13,913 feet, and 20 dry wells totaling 122,133 feet.

The total number of exploratory and development wells drilled was 162, five less than the 167 drilled in 1970, and the total footage drilled in these wells in 1971 was 75,371 feet less than the 1,047,848 feet drilled in 1970. According to the Petroleum Information Corp.,¹⁰ development work in North Dakota in 1971 dropped to its lowest level in 19 years, but paradoxically, 10 percent of its new field wildcats were successful to give the State its best exploratory record in 5 years. The patterns of exploration generally paralleled those of the past 2 years. Fringe areas outside the north-central North Dakota concentration of Mississippian fields attracted the largest share of the wildcatting, with relatively untested areas in the southwestern part of the State running close second.

The most dramatic discovery was along the Nesson Anticline. Virtually ignored in 1970, the west flank of this prominent feature was the scene of two new oil discoveries and a respectable amount of development work in 1971. However, a single Red River discovery, in the deep central portion of the Williston Basin, was the State's most significant. This remote discovery,

⁹ American Petroleum Institute. Review of Drilling Statistics—Annual Survey, 1971. V. 5, No. 4, February 1972, p. 35.

¹⁰ 1971 Resume, Oil & Gas Operations in the Mid Continent etc. Petroleum Information Corp., pp. RM 39, 40.

named Poker Jim field, was found at the General American Oil of Texas well 1-9 Burlington Northern, in 9-146N-103W, McKenzie County. The well produced 729 barrels of oil per day pumping from the Red River formation at 12,838 to 12,913 feet. It is 25 miles southeast of the closest Red River Field in eastern Montana. The new producer established the State's 14th Red River producing area. No effort was made to confirm the discovery until late in the year when Target Oil Co. ran pipe to 13,028 feet at a southeast offset. Pipe was set on basis of log evaluation, no cores or drillstem tests were taken.

On the northwest side of the Nesson Anticline, Consolidated Oil and Gas Co. completed a Duperow (Devonian) discovery, 1 Myhre, in 35-160N-96W, Divide County, pumping 68 barrels of oil and 107 barrels of water per day. The well also flowed oil from the Winnipegosis formation at 10,816 to 10,826 feet and was swabbed at a final rate of 162 barrels of oil and 222 barrels of water per day from that formation. Shows were also recorded in the Silurian and Red River Formations. Because the casing was too small to handle two tubing strings with packers for a dual completion, Consolidated applied for approval to come into the two zones. The Industrial Commission disapproved the application and the well was completed in the Duperow formation after attempts to alternate production from the two formations. The Duperow reservoir was named the Hamlet field. It is 3 miles northwest of the Northwest McGregor field.

Another wildcat on the west side of the Nesson Anticline, north of the Keenefield Universal Resources, 1 Norby, 20-153N-95W, was reentered and completed as a Madison discovery. It was originally drilled and abandoned in 1956 at a total depth of 9,201 feet. Universal Resources set the pipe, perforated the Madison between 8,722 and 8,905 feet, and completed the well for a flow of 336 barrels of oil and 67 barrels of water per day. Two south offsets were successful, and wells drilled later by Universal Resources on the north side of Keene field linked the discovery with that field.

Four Mississippian discoveries were made in north-central North Dakota—two in Bottineau County and two in Renville County. The Antler field was discovered at Same-dan Oil's 1 Tennyson, in 24-163N-82W, Bottineau County. It flowed 85 barrels of

oil per day from the Midale zone of the Madison formation at 3,560 to 3,568 feet. A confirmation well flowed 221 barrels of oil per day on 18/64-inch choke. The Antler field is 2½ miles east of North Haas field. Clinton Oil Co. discovered oil in the Mohall zone of the Madison formation at 1 Vedquam, in 27-160N-83W, Renville County. Perforated at 4,398 to 4,405 feet, the well pumped 135 barrels of oil and 98 barrels of water per day. No offsets have been drilled. Depco Inc., continuing its string of Mississippian oil discoveries in north-central North Dakota, completed 1 Bryans, in 2-158N-85W, Renville County, pumping 82 barrels of oil per day from the Sherwood zone. The well is 2½ miles southeast of Lake Darling field, discovered by Depco last year. A southwest offset, 2 Bryans, confirmed the discovery. These wells are within the delineated area of Lake Darling field and will be combined with that field. Depco also found the South Lone Tree field last year, and that Ward County field was the scene of active development throughout most of 1971. Barron Kidd and Ballantine Brothers completed a short-lived Spearfish discovery at 1 Larson, in 28-163N-75W, Bottineau County. It pumped only 1.5 barrels of oil per day from 3,367 to 3,379 and therefore was abandoned. A ¾-mile southwest offset was a dry hole.

Two other Madison discoveries were indicated in 1971, but they were not completed for production during the year. Gemini Corp. recovered oil from the Madison formation during a drillstem test at 1-15 Taralseth, 15-162N-79W, Bottineau County. The apparent Midale discovery is 2½ miles southeast of the Landa field. In the southwest part of the State, Lamar Hunt swabbed oil from the Nesson zone at the rate of 500 barrels per day at 1 Osterhout, in 24-140N-103W, Golden Valley County. It is 4 miles northeast of the Square Butte field.

At yearend there were 2,042 wells capable of producing oil, of which 721 were stripper wells. It is estimated that about 47 percent of the reserves could be recovered from 139 producing pools. Energy supplementation was underway in 29 of these pools. On January 1, 1971, primary plus secondary reserves considered to be recoverable with present equipment and techniques totaled 667.7 million stock tank barrels. At yearend, the total recoverable re-

serves were 667.8 million barrels, of which 352.6 million barrels was classed as primary and 315.2 million barrels was classed as secondary.¹¹

The Mandan refinery of the American Oil Co. completed its 17th year of operation in October. This refinery is the

principal processor of North Dakota crude oil. In 1971 its crude capacity was 52,000 barrels per stream day. The Westland Oil Co. refinery in Williston had a 3,300-barrel-per-streamday capacity.

¹¹ Folsom, Clarence B., Jr. North Dakota Crude Oil Inventory as of January 1, 1972. N. Dak. Geol. Survey Misc. Ser. 46, 1972, p. 1.

Table 6.—Crude oil production, by county
(Thousand 42-gallon barrels and thousand dollars)

County	Quantity		Principal fields in 1971 in order of production
	1970	1971	
Billings.....	1,798	1,675	Fryburg, Medora, Rocky Ridge.
Bottineau.....	2,803	2,844	Newburgh, Wiley, South Westhope.
Bowman.....	749	933	Cedar Creek, Medicine Pole Hills.
Burke.....	1,867	1,800	Rival, North Tioga, Northeast Foothills, Black Slough.
Divide.....	290	255	North Tioga, Stoneview.
Dunn.....	12	15	Lost Bridge.
Golden Valley.....	58	64	Square Butte.
McHenry.....	21	17	Pratt.
McKenzie.....	4,038	4,287	Antelope, Charlson, Blue Buttes, Hawkeye, Clear Creek.
Mountrail.....	678	503	Tioga.
Renville.....	1,675	1,665	Sherwood, Glenburn.
Slope.....	45	129	Eleven Bar.
Stark.....	1,966	1,721	Dickinson, Zenith, West Dickinson.
Ward.....	359	662	Lone Tree, South Lone Tree.
Williams.....	5,639	5,083	Beaver Lodge, Tioga, Grenora, Capa.
Total.....	21,998	21,653	
Value.....	\$67,107	\$70,805	

Source: North Dakota Geological Survey, except for 1971 value for which the U.S. Bureau of Mines is the source.

Table 7.—Oil and gas well drilling completions, by county

County	Proved field wells			Exploratory wells			Other wells	Total	
	Oil	Gas	Dry	Oil	Gas	Dry		Number of wells	Footage
Benson.....	--	--	--	--	--	1	--	1	2,701
Billings.....	1	--	--	--	--	3	--	4	85,011
Bottineau.....	7	--	4	4	--	8	--	23	86,910
Bowman.....	3	--	--	--	--	3	--	6	53,244
Burke.....	5	--	1	--	--	1	--	7	38,240
Divide.....	--	--	1	1	--	2	--	4	33,085
Dunn.....	--	--	--	--	--	2	--	5	29,720
Golden Valley.....	--	--	--	--	--	2	--	2	18,526
Grand Forks.....	--	--	--	--	--	1	2	3	2,866
Grant.....	--	--	--	--	--	3	--	3	19,878
Hettinger.....	--	--	--	--	--	1	--	1	10,090
La Moure.....	--	--	--	--	--	1	--	1	3,130
Logan.....	--	--	--	--	--	3	--	3	6,802
McHenry.....	--	--	--	--	--	5	--	5	20,146
McIntosh.....	--	--	--	--	--	2	--	2	4,705
McKenzie.....	5	--	1	1	--	2	--	9	89,464
McLean.....	--	--	--	--	--	1	--	1	7,450
Mercer.....	--	--	--	--	--	2	--	2	10,312
Morton.....	--	--	--	--	--	6	--	6	31,596
Mountrail.....	--	--	--	--	--	2	--	2	26,112
Nelson.....	--	--	--	--	--	2	--	2	3,572
Oliver.....	--	--	--	--	--	2	--	2	8,236
Pierce.....	--	--	--	--	--	1	--	1	3,191
Renville.....	5	--	5	2	--	9	--	21	95,693
Sheridan.....	1	--	--	--	--	1	--	1	3,527
Slope.....	1	--	--	--	--	1	--	2	16,529
Stark.....	6	--	5	--	--	3	--	14	115,346
Steele.....	--	--	--	--	--	1	1	2	1,147
Ward.....	7	--	3	--	--	9	--	19	125,705
Wells.....	--	--	--	--	--	4	--	4	12,249
Williams.....	1	1	--	--	--	3	--	5	57,274
Total.....	41	1	20	8	--	89	3	162	972,477

Source: American Petroleum Institute.

NONMETALS

Clays.—Compared with 1970, the total production of clays was almost 5 percent greater, and its total value increased by about 20 percent.

Gem Stones.—Total value of gem stones gathered in the State was estimated to have increased in 1971 to double that of 1970. Stones usually produced included agate, chalcedony, jasper, and petrified wood.

Lime.—American Crystal Sugar Co. produced lime in Pembina County for sugar refining. Output increased 5 percent, but was 13 percent below the 1969 record. The lime was consumed in North Dakota.

Salt.—The State's only evaporated salt producer, Dakota Salt and Chemical Co., produced 42 percent less salt by weight and 43 percent less in value than in 1970.

Sand and Gravel.—There were 161 active sand and gravel operations in 1971, 53 less than in 1970. These operations included 118 commercial, seven Federal, 36 county, and six municipal plants. Sand and gravel production increased by 1.3 percent, while its value decreased by 2 percent.

Stone.—Shipments of stone in 1971, decreased in quantity, but increased in value.

Production in four counties came from four quarries. All stone was crushed and broken stone, and 95,800 tons of the total was limestone. All stone produced was shipped by truck.

Sulfur.—Natural gas processing plants at Lignite and Tioga recovered elemental sulfur as a byproduct. The output of sulfur was unchanged from that in 1970, and the value increased by about 29 percent. This commodity is not included in table 1.

Vermiculite.—In 1971, vermiculite continued to be shipped into the State and was exfoliated and sold by the Robinson Insulation Co. at Minot. Uses in decreasing order were loose fill and block insulation, concrete and plaster aggregates, poultry litter, and soil conditioning.

Volcanic Ash (Pumice).—There was no production of volcanic ash in 1971, but there were plans for future production, as described in last year's North Dakota chapter.

Table 8.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	485	\$567	555	\$769
Fill.....	151	138	194	150
Paving.....	221	185	457	332
Other uses.....	--	--	13	16
Total ¹	857	890	1,218	1,327
Gravel:				
Building.....	804	1,095	1,159	1,363
Fill.....	86	87	154	149
Paving.....	5,047	3,746	3,266	2,244
Railroad ballast.....	144	76	--	--
Miscellaneous.....	(²)	1	47	39
Other uses ³	11	14	209	130
Total ¹	6,093	5,019	4,835	3,924
Government-and-contractor operations:				
Sand:				
Building.....	27	13	--	--
Fill.....	--	--	45	8
Paving.....	13	5	126	145
Total ¹	39	19	171	152
Gravel:				
Building.....	107	47	286	39
Fill.....	12	4	99	20
Paving.....	931	357	1,579	743
Other uses.....	--	--	8	1
Total ¹	1,100	408	1,972	806
Total sand and gravel ¹	8,090	6,336	8,196	6,210

¹ Data may not add to totals shown because of independent rounding.

² Less than $\frac{1}{2}$ unit.

³ Includes railroad ballast and "Other uses."

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Baukol-Noonan, Inc.	Noonan, N. Dak. 58765	Open pit mine and plant.	Divide, Morton.
Hebron Brick Co.	Hebron, N. Dak. 58638	Open pit mine	Morton.
Coal:			
Baukol-Noonan, Inc.	Noonan, N. Dak. 58765	Strip mine; crushing plant, thermal drying.	Burke.
Consolidation Coal Co., Western Division.	Box 200 Stanton, N. Dak. 58571	Strip mine. Crushing plant. Strip mine and crushing plant.	Oliver. Mercer. Ward.
Knife River Coal Mining Co.	Bismarck, N. Dak. 58501	do.	Bowman, Mercer.
North American Coal Corp., Lignite Division.	12800 Shaker Blvd. Cleveland, Ohio 44120	do.	Mercer.
Lime: American Crystal Sugar Co.	600 Boston Bldg. Denver, Colo. 80202	Shaft kiln at beet sugar refinery.	Pembina.
Natural gas and petroleum:			
Amerada Hess Corp.	Box 2040 Tulsa, Okla. 74102	Crude oil wells: Fryburg field. Crude oil wells: Lost Bridge field. Crude oil wells: Antelope, Blue Buttes, and Charlson fields. Crude oil wells: Beaver Lodge field.	Billings. Dunn. McKenzie. Williams.
American Oil Co.	910 South Michigan Ave. Chicago, Ill. 60630	Refinery	Morton.
Chevron Oil Co., Western Division.	1700 Broadway Denver, Colo. 80202	Crude oil wells: Glenburn field.	Renville.
Chandler & Associates, Inc.	1401 Denver Club Bldg. Denver, Colo. 80202	Crude oil wells: Sherwood Field.	Bottineau.
Hunt Oil Co. (Hunt Industries)	1401 Elm Dallas, Tex. 75202	Crude oil wells: North Tioga field and gas processing plant.	Burke.
Marathon Oil Co.	539 South Main St. Findley, Ohio 45840	Crude oil wells: Glenburn field.	Renville.
Amoco Production Co.	Box 591 Tulsa, Okla. 74102	Crude oil wells: Black Slough and Rival fields.	Burke.
Petroleum, Inc.	300 West Douglas Wichita, Kans. 67202	Crude oil wells: Sherwood field.	Bottineau.
Shell Oil Co.	50 West 50th St. New York, N.Y. 10020	Crude oil wells: Cedar Creek field.	Bowman.
The Signal Companies, Inc.	1010 Wilshire Blvd. Los Angeles, Calif. 90017	Crude oil wells: Tioga field. Crude oil wells: Beaver Lodge field and gas processing plant.	Mountrail. Williams.
Tenneco Oil Co.	Box 2511 Houston, Tex. 77051	Crude oil wells: Glenburn field.	Renville.
Texaco Inc.	Box 52332 Houston, Tex. 77052	Crude oil wells: Blue Buttes and Charlson fields. Gas processing plant.	McKenzie. Burke.
Union Oil Co. of California	Box 7600 Los Angeles, Calif. 90017	Crude oil wells: Sherwood field.	Renville.
Westland Oil Co.	Box 1549 Minot, N. Dak. 58701	Refinery	Williams.
Salt: Dakota Salt & Chemical Co.	General Carbon Bldg. West Haven Rd. Lawrenceville, Ill. 62439	Well and plant	Do.
Sand and gravel (commercial):			
Bradshaw Gravel Supply	Arvilla, N. Dak. 58214	Pit and 2 plants. Pit and plant.	Grand Forks. Walsh.
Minot Sand & Gravel Co.	Box 116 Minot, N. Dak. 58702	do.	Ward.
Roy Scheffler, Inc.	Box 906 Fargo, N. Dak. 58102	Pit. Pit and plant.	Bottineau. Renville.
Sheyenne Sand & Gravel, Inc.	Box 178 Sheyenne, N. Dak. 58102	Pit. Pit	Richland. Eddy.
Stone:			
Fisher Sand & Gravel	Dickinson, N. Dak. 58601	Quarry and plant	Billings.
McKenzie County Highway Dept.	Watford City, N. Dak. 58854	do.	McKenzie.
Midwest Construction Co.	Box 624 Nebraska City, Nebr. 68410	do.	Morton.

The Mineral Industry of Ohio

By Joseph A. Sutton ¹

Spurred by substantial price increases for lime, coal, and natural gas, the value of mineral production in Ohio rose to a new high of \$652 million, exceeding the previous year, by \$40 million. Aiding in the overall value gain was the record output of natural gas. Accelerated activities in building programs, chemical and other industries were contributing factors for the higher demand for Ohio minerals. With the exception of Fulton County, mineral production was reported in all of the State's 88 counties. Belmont and Harrison Counties, with mineral output values of \$72.1 million and \$51.4 million, respectively, were the foremost mineral-producing areas. Nationally, the State continued as an important producer of clay, bituminous coal, lime, and salt, as well as ferroalloys and iron and steel.

Employment and Injuries.—Final 1970 statistics and preliminary data for 1971 on employment and injuries in the mineral

industry, excluding the petroleum industry, are given in table 4.

Legislation and Government Programs.—A severance tax was placed on mineral production in the State when the Governor signed the budget and tax bill on December 20, 1971. The new law imposes a tax of 4 cents per ton on coal and salt production, 1 cent per ton on sand and gravel, limestone and dolomite, 3 cents per barrel on oil and 1 cent per 1,000 cubic feet of natural gas. Commodities excluded from the tax were clays, gypsum, and peat. Revenue from the tax was to be used to finance environmental protection projects.

A new strip mine reclamation law became effective on April 10, 1972, after more than 1 year of legislative debate. The law establishes new standards for mining and reclamation, tightens up state licensing and bonding requirements for strip miners, and reorganizes the Ohio Reclamation Board of Review.

¹ Physical scientist, Division of Ferrous Metals.

Table 1.—Mineral production in Ohio ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland..... thousand 376-pound barrels..	11,752	\$39,997	15,411	\$54,338
Masonry..... thousand 280-pound barrels..	867	3,116	1,016	3,811
Clays..... thousand short tons..	3,920	10,100	3,973	11,380
Coal (bituminous)..... do..	55,351	262,390	51,431	269,601
Gem stones.....	NA	3	NA	8
Lime..... thousand short tons..	3,951	61,197	4,007	65,258
Natural gas..... million cubic feet..	52,113	14,123	79,903	27,007
Peat..... thousand short tons..	6	95	6	84
Petroleum (crude)..... thousand 42-gallon barrels..	9,864	32,914	8,286	29,801
Salt..... thousand short tons..	5,329	47,498	5,709	46,651
Sand and gravel..... do..	42,069	57,506	40,797	54,044
Stone..... do..	47,244	81,606	46,891	88,372
Value of items that cannot be disclosed: Abrasive stone and gypsum.....	XX	1,721	XX	1,796
Total.....	XX	612,166	XX	652,151
Total 1967 constant dollars.....	XX	547,587	XX	^p 566,589

^p Preliminary. NA Not available. XX Not applicable.

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

Table 2.—Value of mineral production in Ohio, by county ¹
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Adams.....	\$1,571	W	Stone.
Allen.....	W	\$1,627	Stone, sand and gravel.
Ashland.....	W	W	Sand and gravel, clays.
Ashtabula.....	W	3,172	Lime, sand and gravel.
Athens.....	W	W	Stone, sand and gravel, coal.
Auglaize.....	W	W	Stone, sand and gravel, clays.
Belmont.....	69,900	72,142	Coal, stone.
Brown.....	W	W	Sand and gravel, stone.
Butler.....	3,281	3,467	Sand and gravel.
Carroll.....	2,960	2,215	Coal, clays, sand and gravel, stone.
Champaign.....	W	W	Sand and gravel, peat.
Clark.....	W	W	Sand and gravel, stone.
Clermont.....	W	W	Stone, sand and gravel.
Clinton.....	W	W	Do.
Columbiana.....	6,404	6,838	Coal, clays, sand and gravel.
Coshocton.....	W	14,119	Coal, stone, sand and gravel, clays.
Crawford.....	W	W	Stone, sand and gravel.
Cuyahoga.....	W	13,381	Salt, lime, sand and gravel, clays, peat.
Darke.....	W	W	Sand and gravel, clays.
Defiance.....	W	W	Sand and gravel.
Delaware.....	W	W	Stone, lime, clays.
Erie.....	W	W	Lime, stone, sand and gravel.
Fairfield.....	458	495	Sand and gravel.
Fayette.....	522	W	Stone.
Franklin.....	W	10,198	Sand and gravel, stone, lime, clays, peat.
Gallia.....	W	2,068	Coal, stone, sand and gravel.
Geauga.....	2,469	2,583	Sand and gravel, stone.
Greene.....	W	21,473	Cement, stone, sand and gravel, clays.
Guernsey.....	365	W	Coal, stone.
Hamilton.....	4,975	W	Sand and gravel, stone.
Hancock.....	1,134	W	Stone, lime.
Hardin.....	W	W	Stone.
Harrison.....	W	51,391	Coal, stone, clays.
Henry.....	80	W	Sand and gravel, clays.
Highland.....	W	W	Stone.
Hocking.....	W	W	Coal, clays, sand and gravel.
Holmes.....	W	4,587	Coal, clays, stone, sand and gravel.
Huron.....	210	249	Sand and gravel, stone.
Jackson.....	5,382	7,527	Coal, clays, stone.
Jefferson.....	24,131	27,986	Coal, clays.
Knox.....	W	W	Sand and gravel, stone.
Lake.....	W	30,104	Salt, lime, sand and gravel, stone.
Lawrence.....	7,724	7,051	Cement, coal, clays, sand and gravel, stone.
Licking.....	W	1,287	Sand and gravel, clays, stone.
Logan.....	W	W	Stone, sand and gravel, peat.
Lorain.....	W	W	Lime, stone, sand and gravel, abrasives.
Lucas.....	W	W	Cement, stone, sand and gravel, clays.
Madison.....	705	775	Stone, sand and gravel.
Mahoning.....	W	8,284	Stone, coal, clays, sand and gravel, peat.
Marion.....	W	W	Stone, sand and gravel, clays.
Medina.....	W	W	Sand and gravel, clays.
Meigs.....	W	1,604	Sand and gravel, salt, coal.
Mercer.....	W	W	Stone.
Miami.....	W	W	Stone, sand and gravel.
Monroe.....	W	W	Coal, stone, sand and gravel.
Montgomery.....	W	W	Sand and gravel, stone.
Morgan.....	W	3,642	Coal, sand and gravel, stone.
Morrow.....	W	73	Sand and gravel.
Muskingum.....	W	44,885	Coal, cement, stone, sand and gravel, clays.
Noble.....	11,824	W	Coal, stone.
Ottawa.....	W	W	Stone, lime, gypsum.
Paulding.....	W	12,174	Cement, stone, clays.
Perry.....	W	W	Coal, stone, clays.
Pickaway.....	W	W	Sand and gravel, stone.
Pike.....	1,207	1,103	Stone, sand and gravel.
Portage.....	4,416	4,127	Sand and gravel.
Preble.....	W	W	Do.
Putnam.....	W	W	Stone, sand and gravel, clays.
Richland.....	W	W	Sand and gravel, clays, peat.
Ross.....	W	W	Sand and gravel, stone.
Sandusky.....	W	25,119	Lime, stone.
Scioto.....	2,429	1,962	Stone, clays, sand and gravel, coal.
Seneca.....	W	W	Lime, stone, clays.
Shelby.....	W	W	Sand and gravel, stone.
Stark.....	W	14,557	Cement, coal, sand and gravel, stone, clays, peat.
Summit.....	W	27,362	Salt, lime, stone, cement, sand and gravel.
Trumbull.....	W	W	Sand and gravel.
Tuscarawas.....	14,239	15,393	Coal, clays, sand and gravel, stone.
Union.....	369	W	Stone, sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Ohio, by county 1—Continued

County	(Thousands)		Minerals produced in 1971 in order of value
	1970	1971	
Van Wert.....	W	W	Stone, clays.
Vinton.....	W	W	Coal, stone, clays.
Warren.....	\$1,657	\$2,054	Sand and gravel.
Washington.....	W	W	Coal, sand and gravel, stone.
Wayne.....	W	13,154	Salt, sand and gravel, stone, coal, clays.
Williams.....	W	W	Sand and gravel, peat.
Wood.....	2,169	2,074	Stone.
Wyandot.....	W	W	Stone, lime, sand and gravel, clays, peat.
Undistributed 2.....	441,517	189,500	
Total	612,166	1 652,151	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
 1 Fulton County is not listed because no production was reported. Natural gas and petroleum values are not listed by counties as data are not available; included with "Undistributed."

2 Includes natural gas, petroleum, and gem stones that cannot be assigned to specific counties and values indicated by symbol W.

3 Data may not add to total shown because of independent rounding.

Table 3.—Indicators of Ohio business activity

	1970 r	1971 p	Change, percent
Employment and labor force, annual average: 1 2			
Total labor force.....	4,541.4	4,515.7	-0.6
Unemployment.....	191.3	236.3	+20.5
Employment (nonagricultural).....	3,880.7	3,828.3	-1.4
Manufacturing.....	1,407.4	1,328.6	-5.6
Transportation and public utilities.....	225.2	224.4	-.4
Wholesale and retail trade.....	773.6	779.7	+0.8
Finance, insurance, and real estate.....	158.5	162.4	+2.5
Services.....	572.7	588.2	+2.7
Government.....	565.5	577.8	+2.2
Contract construction.....	156.8	146.5	-6.6
Mining.....	20.9	20.6	-1.4
Personal income: 3			
Total.....	\$42,382	\$44,775	+5.6
Per capita.....	\$3,965	\$4,154	+4.8
Construction activity: 4 5			
Number of housing units authorized.....	58,776	86,196	+46.6
Value of private nonresidential construction.....	\$529.7	\$592.9	+11.9
Cement shipments to and within the State.....	17,176	17,942	+4.5
Mineral production value 6.....	\$612.2	\$652.2	+6.5

p Preliminary. r Revised.

1 Area Trends in Employment and Unemployment, U.S. Department of Labor.

2 Employment and Earnings, U.S. Department of Labor.

3 Survey of Current Business, U.S. Department of Commerce.

4 Construction Review, U.S. Department of Commerce.

5 U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Coal.....	8,512	249	2,122	16,849	8	550	33.12	3,805
Peat.....	21	109	2	16	--	--	--	--
Nonmetal.....	2,081	262	545	4,343	--	113	26.02	845
Sand and gravel.....	2,001	232	465	3,944	--	60	15.21	1,125
Stone.....	5,382	272	1,464	12,032	--	230	19.12	563
Total 1.....	17,997	255	4,597	37,184	8	953	25.84	2,124
1971: p								
Coal.....	8,800	239	2,088	16,729	4	635	38.08	2,536
Nonmetal 2.....	1,960	261	511	4,116	1	109	26.72	2,310
Sand and gravel.....	2,040	228	466	4,019	3	64	16.67	7,265
Stone.....	5,065	274	1,390	11,262	3	181	16.34	2,170
Total 1.....	17,815	250	4,455	36,126	11	989	27.63	2,923

p Preliminary.

1 Data may not add to totals shown because of independent rounding.

2 Beginning in 1971, data concerning peat operations are included in the nonmetals industry.

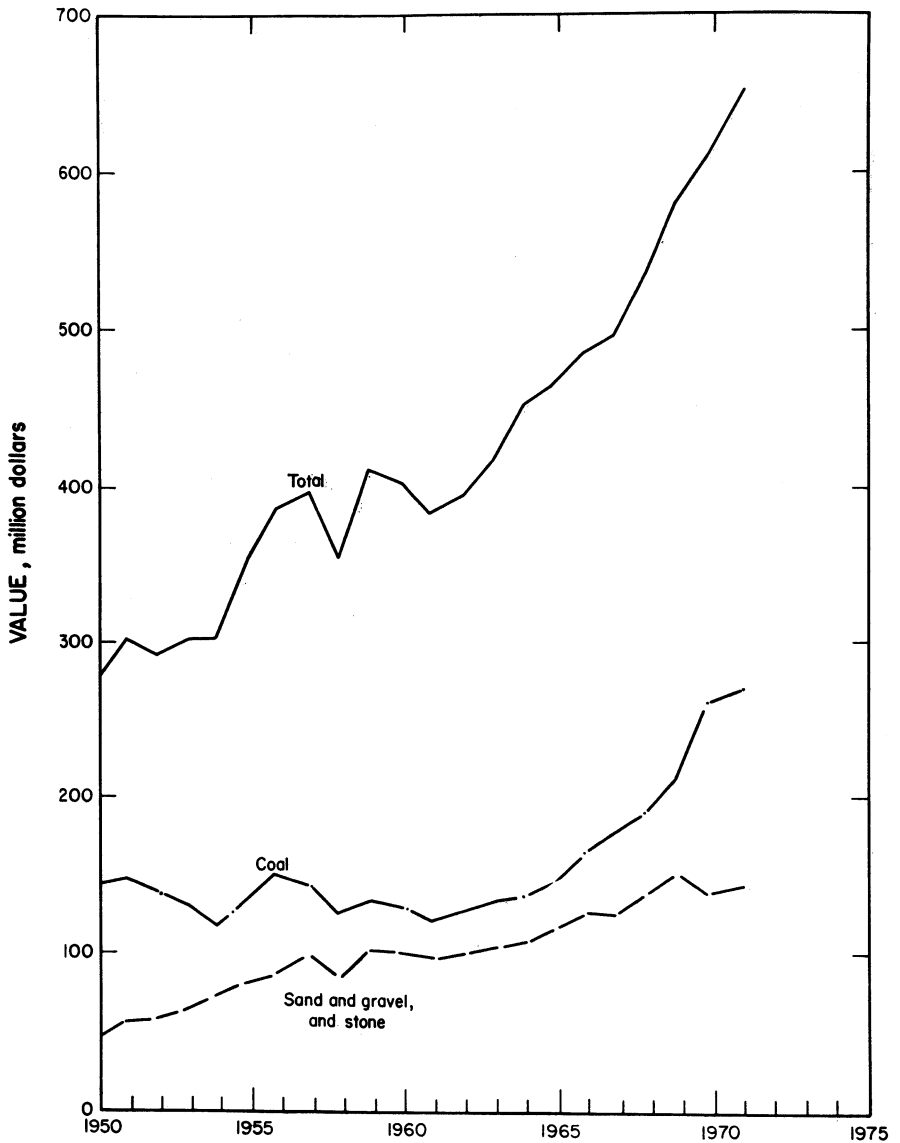


Figure 1.—Value of coal, sand and gravel, and stone, and total value of mineral production in Ohio.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Stones.—Abrasive stones (grindstones) were produced in Lorain County. Output and value were below those of 1970.

Cement.—Shipments of portland and masonry cement, respectively, were 31 and 17 percent above that of the previous year. The average value per barrel of portland and masonry cement was unchanged at \$3.53 and \$3.75, respectively. Total apparent plant capacity decreased from 19.8 million to 16.7 million barrels. Companies operated at 84.6 percent of capacity compared with 78.6 percent in 1970. Cement consumption in the State totaled 17.9 million barrels of portland cement and 1.5 million barrels of masonry cement. Ohio cement producers supplied 86 percent of the portland cement and 69 percent of the masonry cement consumed in the State. Yearend stocks were 502 million barrels less than at the end of 1970. In terms of value of shipments, Greene, Muskingum, and Paulding were the leading cement-producing counties.

Distribution of portland cement shipments by type of customers were as follows: Ready-mix concrete companies, 9 million barrels; concrete products manufacturers, 2.6 million barrels; highway contractors, 2.2 million barrels; building materials dealers, 0.8 million barrels; and other uses, 0.8 million barrels. Over 1.2 million barrels of portland cement was shipped by truck, 14 million barrels by rail, and 0.2 million barrels by barge. Bulk shipments predominated; only 6 percent was shipped in containers, mainly paper bags.

The closing of the 69-year-old Alpha Portland Cement Co. Ironton plant in September 1970 reduced the number of active plants in the State to eight and the num-

ber of kilns to 22. The eight active plants in the State used over 4.1 million tons of limestone and cement rock, 478,294 tons of clay and shale, 127,205 tons of gypsum, and 84,937 tons of sand as primary raw materials. Fuel used for power generation was predominantly bituminous coal, but quantities of natural gas and fuel oil also were consumed. Producers used 302 million kilowatt-hours of electrical energy, of which 26 percent was generated by the producers and the remainder was purchased from public utility companies.

The Barborton Mine of PPG Industries, Inc., was again awarded the Certificate of Achievement in Safety in the Underground Nonmetal Group of the National Safety Competition. The mine operated 171,424 man-hours in 1971 without any lost-time injuries.

Columbia Cement Co., Div. of PPG Industries, plans to install electrostatic precipitators at its plant in Zanesville, with completion scheduled for 1973. General Portland Cement Co. was modernizing its plant at Paulding. Universal Atlas Cement Div. of United States Steel Corp. announced additional air pollution control equipment will be installed at its plant in Fairborn. The Flintkote Co. combined two subsidiaries—The Diamond Portland Cement Co., Middlebranch, Ohio and Kosmos Portland Cement Co., Louisville, Ky., as the Diamond-Kosmos Cement Division. An electrostatic precipitator was installed at the Middlebranch plant.

Clays.—Total clay production (common clay-shale, fire clay and kaolin) increased 1 percent above that of 1970. Of the total, 77 percent was common clay-shale used chiefly for manufacturing heavy clay products, 17 percent was fire clay used chiefly for refractory products, and the remainder was kaolin used mostly for floor and wall

Table 5.—Portland cement salient statistics
(Thousand 376-pound barrels and thousand dollars)

	1970	1971
Number of active plants.....	19	8
Rated clinker capacity, Dec. 31.....	16,129	16,738
Production.....	11,898	14,966
Shipments from mills:		
Quantity.....	11,752	15,411
Value.....	\$39,997	\$54,338
Stocks at mills, Dec. 31.....	1,989	1,487

¹ One plant ceased operations in September 1970.

tile. Clays used in manufacturing heavy clay products (mainly brick) was 51 percent greater than that of 1970. Clay output for refractories decreased to 650,257 tons. Clay used for pottery and other uses totaled 260,217 tons. Of the 32 common clay-shale producing counties, Tuscarawas, Cuyahoga, Greene, Mahoning, and Perry Counties were the leading areas, accounting for 59 percent of the common clay-shale tonnage. Among the 11 fire clay producing areas, Columbiana, Jackson, and Lawrence led in production and accounted for 60 percent of the fire clay tonnage. Of the six kaolin producing areas, Stark County accounted for 66 percent of the kaolin production.

The average value for clays sold in 1971 was \$0.28 above that of 1970. Average unit value per ton of various types of clays was common clay \$1.57; shale \$2.03; undifferentiated clay-shale \$3.50; common clay-shale \$1.83; fire clay \$5.42; and kaolin \$8.54.

Gem Stones.—Gem stones (mineral specimens) were recovered from mines and quarries throughout the State by members of mineral and lapidary clubs. Specimens collected included calcite, celestite, flint, and jasper. Flint, the State's official gem stone, was recovered chiefly at Flint Ridge in southeastern Licking County and the adjacent area in Muskingum County.

Graphite (Synthetic).—Quantities of synthetic graphite were produced from petroleum coke at the Cleveland plant of Ohio Carbon Co. The graphite was shaped for use in electrical motor brushes, hermetic sealing, and pitch coke.

Gypsum.—Production and value of crude gypsum were greater than in 1970. Output

from one underground mine and one open pit in Ottawa County was calcined at nearby plants for use in manufacturing building products. National Gypsum Co. in Lorain County also calcined gypsum from crude material shipped from outside the State.

Lime.—Eighteen companies produced lime at 19 plants in 13 counties for steel furnaces, alkalies, refractories, and other uses. Output increased 1 percent but was 4 percent below the 1969 record. Leading counties were Sandusky, Lake, and Summit. Leading companies were PPG Industries, Inc., Diamond Shamrock Chemical Co., and Standard Lime and Refractories Co. The lime was consumed in Ohio, Pennsylvania, Michigan, and other States. Ohio supplied 20 percent of the national lime output and continued as the leading lime-producing State. Total consumption of lime in Ohio was 3,244,110 tons.

Perlite (Expanded).—Expanded perlite was produced at four plants, one each in Cuyahoga, Hamilton, Lorain, and Ottawa Counties. Crude perlite shipped from Western States was processed chiefly for plaster and concrete aggregate, insulation, and soil conditioning. Production was about equal to that of 1970.

Salt.—Total output of salt in Ohio reached 5.7 million tons in 1971. Output rose 7 percent above that of the previous year low of 5.3 million tons, while value decreased about \$0.8 million, to \$46.7 million. Salt in the forms of brine, evaporated from brine and rock, sold or used totaled 44.3 million tons, 1.4 million tons less than in 1970. Rock salt recovered from underground mines in Cuyahoga, and Lake

Table 6.—Lime sold or used by producers, by use

(Short tons)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Steel, BOF.....	1,037,546	\$15,125,901	1,307,425	\$20,095,932
Refractory dolomite.....	741,196	13,154,114	553,369	10,311,108
Glass.....	320,546	4,324,039	339,865	4,982,770
Construction.....	162,253	4,377,861	181,226	4,724,599
Water purification.....	102,790	1,413,718	94,729	1,417,481
Steel, electric.....	W	W	81,236	1,379,830
Steel, open-hearth.....	121,068	1,664,926	69,172	955,590
Other chemicals.....	185,449	2,492,853	43,735	749,826
Agriculture.....	13,846	274,946	8,241	203,844
Other uses ¹	1,265,864	18,368,460	1,327,506	20,437,186
Total.....	3,950,558	61,196,868	4,006,504	65,258,166

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

¹ Includes alkalies, calcium carbide, magnesite, other metallurgy (1970), paper and pulp (1970), sugar refining, whitening, sewage, silica brick (1970), fertilizer (1971), rubber (1971), paint (1971), and uses indicated by symbol W.

Counties was sold mainly for highway ice control and chemical applications. Evaporated salt produced in Cuyahoga, Meigs, Summit, and Wayne Counties was sold for a wide variety of uses. Lake County with two operations continued to rank first in production. Ohio continued as a leading area for salt production, ranking fourth in national output.

Sand and Gravel.—Production of sand and gravel decreased 3 percent below that of 1970. Value was 6 percent lower and totaled \$54 million. Output was 1.3 million tons less than that of the previous year. The decrease was attributed mainly to lower demand for structural and paving material and industrial sands. Commercial sand and gravel used in building and highway construction totaled 35.7 million tons, 0.7 million tons less than in 1970. Production and value of industrial sand declined 43 and 31 percent, respectively. Most of the industrial sand was marketed for molding, furnace construction, and repair.

Sand and gravel was produced in 66 counties. Hamilton, Franklin, Butler, Portage, and Montgomery Counties, each with

output in excess of 2 million tons, were the leading areas. In addition, seven other counties had production exceeding 1 million tons. Commercial producers processed 99 percent of the total tonnage by washing, screening, sizing, or crushing. Over 39 million tons of sand and gravel was shipped to consumers by truck and the remainder by rail or water. The number of commercial operations totaled 360. Of the total, 116 operations produced less than 25,000 tons and accounted for 32.3 percent of the commercial tonnage. Three operations had output exceeding 1 million and 12 operations produced from 500,000 to 1 million tons.

Slag (Iron-Blast-Furnace).—Production of iron-blast-furnace slag was 5.6 million tons valued at \$12.2 million, according to the National Slag Association. Output was 5 percent below that of 1970; average unit price increased from \$2.11 to \$2.17 per ton, well above the national average of \$2.00. Eighty-one percent of the total processed slag was screened air-cooled materials; the remainder consisted of granulated and lightweight (expanded) slag. The air-cooled slag was used chiefly as aggregate

Table 7.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	6,608	\$8,506	6,788	\$8,595
Fill.....	1,284	1,079	1,364	1,218
Molding.....	464	2,146	207	719
Paving.....	8,427	9,999	7,814	9,620
Other uses ¹	976	3,442	771	1,589
Total².....	17,759	25,172	16,946	21,741
Gravel:				
Building.....	7,192	9,905	7,065	10,007
Fill.....	1,520	1,224	1,485	1,206
Paving.....	13,970	19,243	13,802	19,047
Other uses ³	1,402	1,735	1,242	1,789
Total².....	24,085	32,111	23,593	32,050
Government-and-contractor operations:				
Sand:				
Paving.....	89	93	89	93
Total².....	89	93	89	93
Gravel:				
Building.....	3	5	3	5
Fill.....	—	—	5	1
Paving.....	134	125	162	154
Total².....	137	130	169	160
Total sand and gravel².....	42,069	57,506	40,797	54,044

¹ Includes railroad ballast, blast, engine, filtration, fire or furnace, and other sands.

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

³ Includes miscellaneous, railroad ballast, and other gravel.

Table 8.—Sand and gravel sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Ashland.....	6	W	W	6	197	\$199
Ashtabula.....	6	145	\$157	6	187	148
Auglaize.....	8	373	438	6	328	332
Butler.....	15	2,736	3,281	16	2,770	3,467
Clark.....	10	1,350	1,513	11	1,458	1,665
Clinton.....	1	17	20	1	W	W
Columbiana.....	6	56	73	4	W	16
Coshocton.....	7	385	454	7	415	534
Crawford.....	1	35	41	1	W	W
Cuyahoga.....	7	416	529	5	365	459
Erie.....	7	115	232	5	136	W
Fairfield.....	4	319	453	4	330	495
Franklin.....	16	4,647	6,723	14	4,503	6,641
Gallia.....	4	124	254	4	W	277
Geauga.....	9	964	1,512	8	1,012	1,591
Greene.....	12	638	674	10	865	1,025
Hamilton.....	20	4,157	4,975	17	W	W
Knox.....	6	885	2,448	5	557	753
Lake.....	3	W	W	4	216	369
Lawrence.....	3	193	231	3	W	W
Licking.....	12	856	930	7	1,083	1,244
Logan.....	4	W	W	4	122	W
Lorain.....	3	353	512	3	317	516
Lucas.....	5	474	263	6	715	613
Madison.....	3	W	W	3	W	265
Mahoning.....	1	56	102	1	W	W
Marion.....	5	245	247	4	243	293
Medina.....	3	641	821	6	615	845
Miami.....	8	806	1,094	8	668	839
Montgomery.....	17	2,545	3,249	17	2,550	3,273
Morrow.....	1	W	W	1	63	73
Pike.....	5	360	516	4	282	488
Portage.....	24	2,873	4,416	22	2,640	4,127
Preble.....	5	222	292	3	W	W
Putnam.....	1	46	63	1	W	W
Richland.....	15	800	868	6	761	807
Ross.....	5	560	680	5	656	644
Shelby.....	6	368	454	6	353	395
Stark.....	12	1,551	2,524	12	1,419	2,177
Summit.....	14	984	1,154	12	680	829
Trumbull.....	1	W	W	1	227	W
Tuscarawas.....	13	1,377	1,817	11	1,198	1,649
Warren.....	13	1,377	1,657	12	1,646	2,054
Washington.....	7	444	497	6	356	398
Wayne.....	4	540	680	4	519	655
Wyandot.....	6	319	381	5	223	271
Undistributed ¹	66	6,711	10,199	56	10,165	13,620
Total ²	415	42,069	57,506	363	40,797	54,044

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

¹ Includes Allen, Athens, Brown, Carroll, Champaign, Clermont, Darke, Defiance, Henry, Highland (1970), Hocking, Holmes, Huron, Meigs, Monroe, Morgan, Muskingum, Perry (1970), Pickaway, Sandusky (1970), Scioto, Union, and Williams Counties, and some sand and gravel that cannot be assigned to specific counties.

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

for concrete and bituminous construction, highway and airport construction, and as railroad ballast. Most of the granulated slag was used in highway construction and fill. The chief use for expanded slag was as an aggregate in concrete-block. The State continued to rank second in production of processed slag, accounting for 23 percent of the national output.

Stone.—Total value of stone (limestone and sandstone) increased by nearly \$6.9 million but production decreased 1 percent below that of 1970. Lower demand for crushed limestone (including dolomite) used as aggregate was the major contribut-

ing factor for the decrease. Production of crushed limestone was 5.3 percent greater than that of 1970 and accounted for 88 percent of the State's total stone output. Production and value of dimension limestone (including dolomite) were also below that of 1970. Most of the output was used mainly for flagging purposes. Production was from quarries in Lucas, Miami, and Seneca Counties. Of the 56 limestone producing counties, Erie County was the leading area with output of 3.4 million tons. Lucas, Mahoning, Ottawa, and Wyandot Counties also were important limestone producing areas.

Production of dimension sandstone declined but value increased. Output was 76,082 tons valued at nearly \$4.1 million compared with 77,904 tons and \$3.5 million in 1970. Most of the sandstone was fabricated for dressed architectural applications but quantities also were sold as rough architectural blocks, curbing, and flagging stone. Crushed and broken sandstone (including quartzite) production in-

creased by 50 percent and value was \$4.4 million above that of 1970. The stone was marketed mainly for glass manufacturing, riprap, aggregate, and flux stone. Sandstone was quarried in 16 counties; Lorain, Geauga, Coshocton Counties were the leading areas for dimension stone and Lorain, Lake, and Summit Counties for crushed and broken stone.

Table 9.—Crushed and broken limestone and dolomite sold or used by producers, by use
(Thousand short tons and thousand dollars)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Bituminous aggregates.....	2,255	\$3,647	2,317	\$3,898
Concrete aggregates.....	3,045	11,490	7,702	11,667
Dense graded road base stone.....	5,090	7,705	5,288	8,027
Macadam aggregates.....	4,725	7,196	6,707	10,618
Surface treatment aggregates.....	1,122	1,862	1,237	1,912
Unspecified aggregate and roadstone.....	7,171	11,810	4,338	6,930
Agricultural purposes.....	1,808	3,513	1,654	3,051
Cement.....	3,998	6,386	4,462	7,314
Dead-burned dolomite.....	1,578	2,505	1,205	2,121
Flux.....	3,911	6,084	3,567	5,824
Lime.....	2,621	5,631	2,569	5,903
Railroad ballast.....	991	1,337	750	1,077
Riprap and jetty stone.....	339	459	553	773
Other uses ¹	2,466	5,383	2,906	8,235
Total ²	46,120	75,538	45,258	77,428

¹ Includes stone sand, chemical and refractory stone, asphalt and other filler, mine dusting, dam construction, glass manufacture and other stone in smaller quantities; also, acid neutralizers and flour (1970); building products and filter stone (1971).

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

Sulfur (Recovered Elemental).—Production, shipments, and value of elemental sulfur recovered at the Toledo refinery of Sun Oil Co. were below those of 1970. The company recovered sulfur by the catalytic oxidation of hydrogen sulfide.

Vermiculite (Exfoliated).—The Cleveland Gypsum Co., Division of Cleveland Builders Supply Company, processed crude vermiculite shipped from out-of-State at its Cleveland plant. Production and sales were below those of 1970. The exfoliated vermiculite was sold for fertilizer, soil conditioners, mill mixes, and other applications.

MINERAL FUELS

Coal (Bituminous).—Bituminous coal continued as one of the State's principal mineral commodities in terms of production and value. Production, however, decreased 7.1 percent and was 3.9 million tons less than the 55.3 million tons recorded in 1970. Strip mines supplied 73.1 percent of the total tonnage; underground mines supplied 25.0 percent and auger

mines 1.9 percent. The average value per ton of coal was \$5.24, an increase of \$0.50 compared with that of the previous year. A total 302 mines producing 1,000 tons or more were active, four less than the total in 1970. Underground mines decreased by nine to a total of 35; strip mines increased by 20 and auger mines declined by 15.

Strip-mined tonnage was nearly 1.8 million tons above that of 1970 and totaled 37.6 million tons valued at \$199 million. Average value per ton increased from \$4.41 in 1970 to \$4.75. Production was reported in 25 counties; Belmont, Muskingum, Harrison, and Jefferson Counties, in decreasing order of tonnage, were the leading strip mining areas.

Nearly 12.9 million tons of coal was recovered from underground mines, 5.2 million tons less than in 1970. Average value per ton increased by \$1.29 to \$6.75. Production was reported in 12 counties, but more than half of the underground tonnage came from Belmont and Harrison Counties.

Table 10.—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	
Athens.....		2	--	2		11	--	11	W
Belmont.....	10	27	2	39	5,170	7,951	151	13,272	\$71,960
Carroll.....	--	5	1	6	--	435	16	451	2,055
Columbiana.....	3	24	8	35	122	799	189	1,110	5,614
Coshocton.....	1	7	4	12	436	1,719	81	2,236	12,824
Gallia.....	1	6	1	8	3	370	5	378	1,220
Guernsey.....	1	4	--	5	412	532	--	944	5,078
Harrison.....	5	11	--	16	3,672	5,465	41	9,178	51,078
Hocking.....	--	4	--	4	--	170	--	170	737
Holmes.....	--	6	--	6	--	785	--	785	3,695
Jackson.....	6	9	--	15	240	1,059	24	1,323	5,941
Jefferson.....	3	31	8	42	639	4,468	250	5,357	27,503
Lawrence.....	--	3	--	3	--	200	--	200	905
Mahoning.....	--	9	1	10	--	438	18	456	2,191
Meigs.....	--	1	--	1	--	1	--	1	W
Monroe.....	1	--	--	1	47	--	--	47	W
Morgan.....	--	1	--	1	--	549	--	549	W
Muskingum.....	1	9	--	10	36	5,674	--	5,710	30,063
Noble.....	--	5	--	5	--	2,165	--	2,165	10,295
Perry.....	1	15	1	17	1,853	1,150	33	3,036	15,396
Scioto.....	--	1	--	1	--	1	--	1	W
Stark.....	--	11	--	11	--	729	--	729	3,124
Tuscarawas.....	2	32	4	38	231	1,944	166	2,341	11,645
Vinton.....	--	12	--	12	--	723	--	723	3,366
Washington.....	--	1	--	1	--	228	--	228	W
Wayne.....	--	1	--	1	--	30	--	30	W
Undistributed ¹	--	--	--	--	--	--	--	--	4,911
Total.....	35	237	30	302	12,861	37,596	974	51,431	269,601

W Withheld to avoid disclosing individual company confidential data.

¹ Includes value indicated by symbol W.

Coal tonnage recovered from auger mines totaled 974,000 tons, 31.6 percent below that of 1970. Average value per ton increased \$0.17 above the \$4.18 reported the previous year. Auger-mined coal was produced in 11 counties; Jefferson and Columbiana Counties were the leading areas for production.

Twenty coal cleaning plants were active, two more than in 1970. Producers cleaned 10.9 million tons of coal of which only 85,000 tons was cleaned by pneumatic methods and the remainder was cleaned by washing. Of the total tonnage cleaned, 77.5 percent was from underground mines, 21.6 percent from strip mines, and the remainder was from auger mines. Nearly 2 million tons of coal was dried. At mines having crushing facilities, 28.0 million tons of coal was crushed. Production at captive mines totaled 4.5 million tons compared with 6.6 million tons in 1970. Of the State's total coal output, 30.1 million tons were shipped by rail or water, 15.4 million tons by truck, and the rest was consumed locally.

Preliminary employment data indicates that an average of 8,800 men worked 16.7 million man-hours in 1971. Four fatalities

were recorded compared with eight in the previous year. Of the four fatalities, three were at underground mines—one each caused by a haulage accident, a machinery accident, and a miscellaneous cause; an electricity accident occurred at a mechanical cleaning plant. The number of nonfatal injuries were nearly 15 percent above the 1970 figure of 550. The State's fatal injury rates of 0.24 per million man-hours and 0.08 per million short tons were the lowest in the Nation and were well below the national average of 0.71 and 0.35, respectively. In National Safety Competition, the West Farms No. 22 Mine operated by Consolidation Coal Company was the winner of the surface group competition. The mine was worked 219,012 man-hours without any disabling injuries.

Coke and Coal Chemicals.—Production of oven-coke decreased 15 percent below that of 1970 and totaled 7.6 million tons valued at \$228 million.

Peat.—Shipments and value of peat were below those of 1970. Output was from nine counties; Cuyahoga County with one operation ranked first in tonnage. Of the total sales, 38 percent was moss peat, 51 percent humus, and 11 percent was reed-sedge

peat. Most of the peat was sold in bulk and used chiefly for soil conditioning.

Petroleum and Natural Gas.—Production and value of petroleum declined, but natural gas output and value increased above that of 1970. According to the American Petroleum Institute, total well completions and footage drilled decreased from 1,350 to 1,157 and 5,510,395 to 4,577,483, respectively. A total of 1,130 development and 27 wildcat completions were reported. Development wells were drilled in 41 counties; Tuscarawas, Muskingum, Guernsey, Stark, and Licking Counties were the leading areas. Wildcat completions were reported in 16 counties; Columbiana, Gallia, and Richland with three each were the leading areas for wildcat activity. The number of wildcat completions decreased from 36 in 1970 to 27 (seven gas and 20 dry) in 1971. Most drilling

operations in Ohio used cable tool equipment.

Reserves on December 31, 1971, were 1,068,372 million cubic feet of natural gas (14.73 pounds per square inch absolute, at 60°F) and 129 million barrels of crude petroleum, according to the American Gas Association and American Petroleum Institute. Compared with the end of 1970, reserves of natural gas and crude petroleum increased by 74,914 million cubic feet and 1,232 million barrels, respectively. Of the natural gas reserves, 452,895 million cubic feet were held in underground storage.

Six petroleum refineries were active, total crude oil capacity as of January 1, 1971, was 513,500 barrels per calendar day, 68,400 barrels more than in 1970. Cracking, reforming, coking, and alkylation capacity expressed in terms of gasoline output, totaled 285,162 barrels per calendar day com-

Table 11.—Oil and gas well drilling in 1971, by county

County	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Ashland.....	12	--	--	--	--	1	13	16,063
Ashtabula.....	7	43	2	--	1	1	54	191,650
Athens.....	1	1	2	--	--	1	5	13,859
Belmont.....	--	--	1	--	--	--	1	2,196
Carroll.....	29	2	1	--	--	2	34	174,724
Columbiana.....	--	10	--	--	1	2	13	76,260
Coshocton.....	14	8	4	--	--	--	26	84,777
Cuyahoga.....	2	--	--	--	--	--	2	2,352
Delaware.....	--	--	2	--	--	--	2	6,118
Fairfield.....	5	1	2	--	--	--	8	20,037
Gallia.....	--	1	1	--	--	3	5	13,867
Geauga.....	--	--	--	--	1	1	2	4,917
Guernsey.....	29	86	9	--	--	--	124	609,475
Hocking.....	21	1	4	--	--	--	26	78,212
Holmes.....	16	20	5	--	--	--	41	144,526
Jackson.....	--	--	1	--	--	2	3	8,075
Jefferson.....	--	--	1	--	--	--	1	1,900
Knox.....	11	1	3	--	--	--	15	39,675
Lawrence.....	1	--	3	--	--	--	4	11,036
Licking.....	58	1	9	--	--	1	69	180,286
Lorain.....	--	1	--	--	--	--	1	1,314
Mahoning.....	1	17	1	--	--	1	20	105,789
Medina.....	2	8	4	--	--	--	14	50,167
Meigs.....	--	6	5	--	1	--	12	37,583
Monroe.....	2	5	2	--	--	--	9	15,817
Morgan.....	1	41	3	--	--	1	46	133,897
Morrow.....	3	4	20	--	--	--	27	77,715
Muskingum.....	51	100	13	--	1	--	165	682,394
Noble.....	2	35	4	--	--	--	41	208,021
Perry.....	43	11	10	--	--	--	64	202,036
Pike.....	--	1	--	--	--	--	1	555
Portage.....	1	1	--	--	--	--	2	9,558
Richland.....	--	2	5	--	1	2	10	31,006
Scioto.....	--	3	--	--	--	--	3	959
Stark.....	52	15	3	--	--	--	70	339,778
Summit.....	1	2	--	--	--	--	3	12,485
Trumbull.....	--	3	--	--	--	--	3	12,390
Tuscarawas.....	14	148	5	--	--	--	167	841,881
Vinton.....	2	--	2	--	--	2	4	8,147
Washington.....	4	17	3	--	--	2	26	57,609
Wayne.....	6	6	7	--	1	--	20	66,993
Wyandot.....	--	--	1	--	--	--	1	1,384
Total.....	391	601	138	--	7	20	1,157	4,577,483

Source: American Petroleum Institute.

pared with 276,832 barrels the previous year. Other products recovered at the refinery included asphalt, coke, lubricant, and paraffin. Refineries were operated at Canton, Findlay, Cincinnati, Cleaves, Lima, and Toledo (three plants).

METALS

Aluminum.—Compared with 1970, output of primary aluminum produced at the Hannibal reduction plant of Ormet Corp. declined but value increased because of higher unit prices. Ormet Corp., jointly owned by Olin Corp. (formerly Olin-Mathieson Chemical Corp.) and Revere Copper and Brass, Inc., reduced alumina obtained by barge from a company-owned plant at Burnside, La.

Beryllium.—Beryllium metal, alloys, and compounds were produced from beryllium hydroxide by the Brush Beryllium Corp., at Elmore. Bertrandite ore mined at the corporation's Roadside mine near Delta, Utah, was processed into beryllium hydroxide and shipped to the Elmore plant. Production was mostly beryllium and beryllium-copper master alloy.

Ferroalloys.—Ohio continued as the leading producer among the 16 ferroalloy-producing States. Production of plants in Ohio consisted mainly of ferroalloys of boron, chromium, columbium, manganese, silicon, and silvery pig iron. Due to the low level of steel business, shipments of ferroalloys for the State of Ohio in 1971 were 15 percent below those of the previous year.

Iron and Steel.—According to the American Iron and Steel Institute, raw steel production was 7 percent below that of 1970 and was at its lowest level in 4 years. Production of pig iron was 13.7 million tons, 2.6 million tons below that of 1970.

Foreign iron ore imported at the port of Cleveland in 1971 totaled 6,026,000 long tons, about 15 percent of the total U.S. imports for consumption. Ohio steel plants received 20.3 million short tons of iron ore in 1971, including 14.1 million short tons of pellets. Total Ohio receipts of iron ore was approximately one-third of the total U.S. receipts.

Blast furnaces consumed 3.5 million tons of domestic and 7.0 million tons of foreign iron ore as well as 16.8 million tons of agglomerates. In addition, 1.8 million tons of limestone and 1 million tons of dolomite were consumed as fluxing material. Ton-nages of other material consumed were coke and coke breeze 8.9 million, home and purchased scrap 598,000, slag scrap 89,000, mill cinder and roll scale 753,000, open-hearth, basic oxygen and Bessemer slag 643,000, and flue dust 10,000. Over 3.7 million tons of slag and 160,000 tons of scrap iron were produced at blast furnaces, and 160,000 tons of flue dust was recovered. Steel producers also consumed substantial quantities of supplemental fuels in blast furnaces including natural and coke-oven gas, bunker oil, and oxygen.

Titanium.—The RMI Company formerly known as Reactive Metals, Inc., produced titanium sponge metal by sodium reduction of titanium tetrachloride at its Ashtabula plant. Operations at the company's Niles plant for melting and processing titanium sponge were closed by strike on September 30 and had not reopened at year-end. The Ashtabula plant, normally fed by Niles, operated on industrial stocks until December when it was forced to close. The Sherwin-Williams Co. and the Cabot Titanium Corp., both at Ashtabula, continued to produce titanium pigments (titanium dioxide) used in manufacturing paint.

Zirconium.—Zirconium sponge was produced at the Ashtabula plant of the RMI Company. The company shipped the sponge to Niles for production of ingots. The Chas. Taylor Sons Company of Cincinnati produced zircon- and zirconia-base refractories. Zirconium Corporation of America of Cleveland produced zirconium oxide as well as zirconia refractories. Foote Mineral Co. processed zircon to produce zirconium alloys at Cambridge, and Ohio Ferro-Alloys Corp. produced zirconium-base alloys at Brilliant. In Cleveland, the Sherwood-Refractor Co. produced milled zircon and ceramics, and TRW Inc. sold milled zircon and refractories. Continental Minerals Processing Corp. milled zircon at Sharonville for use by the iron and steel foundries.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Metallic:			
Cleveland Metal Abrasive Co., Div. of Fanner Mfg. Co.	Brookside Park Cleveland, Ohio 44109	Plant.....	Cuyahoga.
Do.....		.....do.....	Lucas.
Globe Steel Abrasives Co.....	P.O. Box 1247, P.O. Annex Mansfield, Ohio 44903	.....do.....	Richland.
Metal Blast, Inc.....	871 East 67th St. Cleveland, Ohio 44103	.....do.....	Cuyahoga.
The National Metal Abrasive Co.	3560 Norton Rd. Cleveland, Ohio 44111	.....do.....	Do.
Steel Abrasives, Inc.....	Hamilton, Ohio 45010	.....do.....	Butler.
Cement:			
Alpha Portland Cement Co. ¹	15 South Third St. Easton, Pa. 18043	.....do.....	Lawrence.
Columbia Cement Co. ²	P.O. Box 1513 Zanesville, Ohio 43701	.....do.....	Muskingum.
The Diamond Portland Cement Co., ³ Div. of The Flintkote Co.	Middle Branch, Ohio 44652	.....do.....	Stark.
Peninsular Portland Cement Div., General Portland Cement Co. ⁴	709 Clay St. Ft. Wayne, Ind. 46802	.....do.....	Paulding.
Marquette Cement Mfg. Co. ⁵	20 North Wacker Dr. Chicago, Ill. 60606	.....do.....	Lawrence.
Medusa Portland Cement Co. ⁶	P.O. Box 5668 Cleveland, Ohio 44101	.....do.....	Lucas.
PPG Industries, Inc. ⁷	P.O. Box 31 Barberton, Ohio 44203	.....do.....	Summit.
Southwestern Portland Cement Co. ⁴	P.O. Box 191 Fairborn, Ohio 45324	.....do.....	Greene.
Universal Atlas Cement Div., ⁴ U.S. Steel Corp.	Chatham Center, Box 2969 Pittsburgh, Pa. 15230	.....do.....	Do.
Clays:			
Fire clay:			
AFC Corporation.....	P.O. Box 157 Canfield, Ohio 44406	Pit.....	Mahoning.
Cedar Heights Clay Co.....	P.O. Box 363 Oak Hill, Ohio 45656	4 pits.....	Jackson.
Glen-Gery Corporation ⁸	P.O. Box 1656 East Canton, Ohio 44730	2 pits.....	Carroll.
Glen-Gery Corporation.....		2 pits.....	Hocking and Stark.
Metropolitan Industries, Inc.....	306 Market Ave. North Canton, Ohio 44702	Pit.....	Columbiana.
H. K. Porter Co., Inc.....	Porter Bldg. Pittsburgh, Pa. 15219	2 underground mines	Columbiana and Jefferson.
Common clay and shale:			
Amvit Corp., AMVIT Div.....	24480 Lakeland Blvd. Euclid, Ohio 44123	2 pits.....	Columbiana and Tuscarawas.
Belden Brick Co. ⁸	P.O. Box 910 Canton, Ohio 44701	7 pits.....	Holmes and Tuscarawas.
The Claycraft Co.....	P.O. Box 866 Columbus, Ohio 43216	3 pits.....	Franklin, Tuscarawas, Wyandot.
Cleveland Builders Supply Co.....	2100 West Third St. Cleveland, Ohio 44113	2 pits.....	Cuyahoga.
General Wadsworth Brick Corp.	Box 340 Wadsworth, Ohio 44281	Pit.....	Medina.
Hydraulic Press Brick Co.....	705 Olive St. St. Louis, Mo. 63101	Pit.....	Cuyahoga.
Marion Brick Corp.....	Box 548, Marion, Ohio 43301	Pit.....	Marion.
The Richland Brick Co.....	Box 328 Mansfield, Ohio 44901	2 pits.....	Richland.
Coal (bituminous):			
B & N Coal Company.....	Box 100 Dexter City, Ohio 45727	2 strip mines.....	Noble.
Boich Mining Company.....	R.D. 1 Bloomington, Ohio 43910	.....do.....	Jefferson and Muskingum.
Central Ohio Coal Company.....	Box 98 Cumberland, Ohio 43732	Strip.....	Morgan and Muskingum.
Cravat Coal Company.....	Box 157 Holloway, Ohio 43985	3 strip mines.....	Belmont and Harrison.
Do.....		Underground.....	Belmont.
Cross Creek Coal Co.....	Box 167 New Philadelphia, Ohio 44663	Strip.....	Tuscarawas.
Hanna Coal Company, Division of Consolidation Coal Company.	Cadiz, Ohio 43907	5 strip mines.....	Belmont, Jefferson, Harrison.

See footnotes at end of table.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Coal (bituminous)—Continued			
Hanna Coal Company, Division of Consolidation Coal Company.	-----	Auger-----	Belmont, Jefferson, Harrison.
Do	-----	Underground-----	Harrison.
Hardy Coal Company	Berlin, Ohio 44610	4 strip mines	Coshocton, Holmes, Tuscarawas.
The North American Coal Corporation.	12800 Shaker Boulevard Cleveland, Ohio 44120	3 underground mines.	Belmont and Jefferson.
Do ⁹	-----	do-----	Monroe and Belmont.
Oglebay Norton Company	P.O. Box 6508 Cleveland, Ohio 44101	2 underground mines.	Belmont.
Ohio River Collieries Co.	Route 1 Bloomington, Ohio 43910	Strip-----	Do.
Do	-----	Auger-----	Do.
Peabody Coal Company	301 North Memorial Drive St. Louis, Mo. 63102	2 strip mines	Coshocton and Perry.
Do	-----	Underground-----	Perry.
R. & F. Coal Company	Box 218, Cadiz, Ohio 43907	5 strip mines	Belmont Harrison, Noble, Belmont.
Simco-Peabody Coal Company	301 North Memorial Drive St. Louis, Mo. 63102	do-----	Coshocton.
Do	-----	Underground-----	Do.
The Youghioheny & Ohio Coal Company.	4614 Prospect Ave. Cleveland, Ohio 44103	3 underground mines.	Belmont and Harrison.
Ferroalloys:			
Foote Mineral Co.	Dept. 602 Route 100 Exton, Pa. 19341	2 plants	Guernsey and Jefferson.
Interlake Steel Corp.	210 South Michigan Ave. Chicago, Ill. 60604	do-----	Washington.
Ohio Ferro-Alloys Corp.	837 30th Northwest Canton, Ohio 44709	do-----	Jefferson and Muskingum.
Union Carbide Corp.	270 Park Ave. New York, N.Y. 10017	do-----	Ashtabula and Washington.
Graphite (synthetic):			
The Ohio Carbon Co.	12508 Berea Rd. Cleveland, Ohio 44111	do-----	Cuyahoga.
Gypsum:			
Crude:			
The Celotex Corporation ¹⁰	1500 North Dale Mabry Tampa, Fla. 33607	Pit-----	Ottawa.
United States Gypsum Co. ¹⁰	101 South Wacker Dr. Chicago, Ill. 60606	Underground	Do.
Calcined: National Gypsum Company.	325 Delaware Ave. Buffalo, N.Y. 14202	Plant-----	Lorain.
Lime:			
Basic Incorporated	845 Hanna Bldg. Cleveland, Ohio 44115	do-----	Seneca.
Cuyahoga Lime Company	Menlo Park, N.J. 08817	do-----	Cuyahoga.
Diamond Shamrock Chemical Co., Unit of Diamond Shamrock Corp.	300 Union Commerce Bldg. Cleveland, Ohio 44115	do-----	Lake.
The National Lime & Stone Co.	First National Bank Bldg. Findlay, Ohio 45840	do-----	Wyandot.
Huron Lime Co.	P.O. Box 428 Huron, Ohio 45840	do-----	Erie.
Ohio Lime Co.	Woodville, Ohio 43469	do-----	Sandusky.
Pfizer, Inc.	336 National Bank Bldg. Toledo, Ohio 43604	do-----	Do.
PPG Industries, Inc.	Barberton, Ohio 44203	do-----	Summit.
Republic Steel Corp.	Box 6773 Cleveland, Ohio 44101	do-----	Lake.
Standard Lime & Refractories Co., Div. Martin-Marietta Corp.	Executive Plaza II Hunt Valley, Md. 21030	do-----	Sandusky.
Union Carbide Corp., Chemicals & Plastics.	P.O. Box 299 Marietta, Ohio 45750	do-----	Ashtabula.
United States Gypsum Co.	101 South Wacker Dr. Chicago, Ill. 60606	do-----	Ottawa.
U.S. Steel Corp.	600 Grant St. Pittsburgh, Pa. 15230	do-----	Lorain.
Peat:			
Corell Peat Moss	Box 340, Rt. 1 Beach City, Ohio 44608	Bog-----	Stark.
The Humus Co.	2628 South Michigan Street South Bend, Ind. 46614	Bog-----	Wyandot.
Lingvai Peat Co.	Rte. 2, Box 82 Edgerton, Ohio 43517	Bog-----	Williams.
Dan E. Poljack	19675 Sheldon Rd. Cleveland, Ohio 44130	Bog-----	Cuyahoga.

See footnotes at end of table.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Peat—Continued			
Reynolds Farms, Inc.-----	Route 1 Shelby, Ohio 44875	Bog-----	Richland.
Sphagnum Peat Moss Products-----	Rt. 1 West Liberty, Ohio 43357	Bog-----	Champaign.
W. C. Utzinger & Sons-----	6268 Jackson Pike Grove City, Ohio 43123	Bog-----	Franklin.
Perlite (expanded):			
The Cleveland Gypsum Co., Div. The Cleveland Builders Supply Co. ¹¹	2100 West Third St. Cleveland, Ohio 44113	Plant-----	Cuyahoga.
National Gypsum Co.-----	325 Delaware Ave. Buffalo, N.Y. 14202	---do-----	Lorain.
Philip Carey Corporation-----	320 South Wayne Ave. Cincinnati, Ohio 45215	---do-----	Hamilton.
Petroleum refineries:			
Ashland Oil and Refining Co.-----	1409 Winchester Ave. Ashland, Ky. 41101	3 plants-----	Hancock, Licking, Stark.
Chevron Asphalt Company-----	555 Market St. San Francisco, Calif. 94105	Plant-----	Hamilton.
Gulf Oil Corp.-----	Pittsburgh, Pa. 15219-----	2 plants-----	Hamilton and Lucas.
Standard Oil Company of Ohio-----	Midland Bldg. Cleveland, Ohio 44115	---do-----	Allen and Lucas.
Sun Oil Company ¹² -----	1608 Walnut St. Philadelphia, Pa. 19103	Plant-----	Lucas.
Salt:			
Brine:			
Diamond Shamrock Chemical Co., a Unit of Diamond Shamrock Corp.	300 Union Commerce Bldg. Cleveland, Ohio 44115	Well-----	Lake.
PPG Industries, Inc. ¹³ -----	P.O. Box 31 Barberton, Ohio 44203	---do-----	Summit.
Evaporated:			
Diamond Crystal Salt Co. ¹⁴ -----	916 South Riverside St. Clair, Mich. 48079	---do-----	Do.
Excelsior Salt Works, Inc.-----	P.O. Box 267 Pomeroy, Ohio 45769	---do-----	Meigs.
Morton Salt Co., Div. of Mor- ton International, Inc.	110 North Wacker Dr. Chicago, Ill. 60606	---do-----	Wayne.
Rock:			
International Salt Co. ¹⁵ -----	Clarks Summit, Pa. 18411-----	Underground-----	Cuyahoga.
Morton Salt Co., Div. of Mor- ton International, Inc.	110 North Wacker Dr. Chicago, Ill. 60606	---do-----	Lake.
Sand and gravel:			
American Aggregates Corp.-----	Garst Avenue at Avenue B Greenville, Ohio 45331	9 pits-----	Champaign, Clark, Darke, Franklin, Licking, and Montgomery.
Do-----	-----	Dredge-----	Clark.
American Materials Corp.-----	P.O. Box 154 Hamilton, Ohio 45010	2 pits-----	Butler.
Do-----	-----	Pit-----	Hamilton.
The F. H. Brewer Co.-----	P.O. Box 128 Lancaster, Ohio 43130	2 pits-----	Athens and Fairfield.
Canton Aggregate Co.-----	1243 Raff Rd. S.W. P.O. Box 1387 Station C Canton, Ohio 44708	3 pits-----	Stark.
Hilltop Concrete Corp.-----	Lane Avenue Cincinnati, Ohio 45214	2 pits-----	Greene and Montgomery.
The Middletown Sand and Gravel Co.	2100 South Main St. Middletown, Ohio 45042	3 pits-----	Butler.
Moraine Materials Co.-----	2500 East River Road Dayton, Ohio 45409	2 pits-----	Montgomery.
Morrow Gravel Company-----	3535 Round Bottom Road Cincinnati, Ohio 45244	Pit-----	Warren.
Ohio Gravel Co., Div. of Dravo Corp.	5253 Wooster Road Cincinnati, Ohio 45226	7 pits-----	Butler, Hamilton, Warren.
R. W. Sidley, Inc.-----	R.F.D. 1 Thompson, Ohio 44086	2 pits-----	Geauga.
Edgar Spring, Inc.-----	Box 507 New Philadelphia, Ohio 44663	6 pits-----	Columbiana, Holmes, Tuscarawas.
The Standard Slag Co.-----	1200 Stambaugh Bldg. Youngstown, Ohio 44501	3 pits-----	Pike and Scioto.
Stocker Sand and Gravel Co.-----	Gnadenhutten, Ohio 44629-----	2 pits-----	Tuscarawas.
Tri-State Materials Corp.-----	Box 1933 Parkersburg, W. Va. 26100	Pit-----	Meigs.

See footnotes at end of table.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Smelters:			
Aluminum: Ormet Corp	-----	Plant	Monroe.
Titanium sponge: Reactive Metals, Inc.	-----	do	Ashtabula.
Zinc: American Zinc Company	-----	do	Franklin.
Stone:			
Dolomite (crushed and broken):			
Ohio Lime Co.	Woodville, Ohio 43469	Quarry	Sandusky.
Standard Lime & Refractories Co., Div. Martin-Marietta Corp.	2000 First National Bank Bldg. Baltimore, Md. 21203	do	Do.
White Rock Quarry	Clay Center Ohio 43408	do	Ottawa.
Dolomite (dimension): E. R. Lintner Co.	Route 3, Flat Rock Rd. Bellevue, Ohio 44811	do	Seneca.
Limestone (crushed and broken):			
American Aggregates Corp	Garst Avenue at Avenue B Greenville, Ohio 45331	4 quarries	Montgomery.
Armco Steel Corp	P.O. Box 911 Piqua, Ohio 45356	Quarry	Miami.
Basic Incorporated	845 Hanna Bldg. Cleveland, Ohio 44115	do	Seneca.
Bessemer Cement Co., Subsidiary of Louisville Cement Co. ⁸	510 Hanna Bldg. Cleveland, Ohio 44115	do	Mahoning.
Carbon Limestone Co.	Lowellville, Ohio 44436	do	Do.
Cedarville Limestone Co.	Box 4 Cedarville, Ohio 45314	do	Greene.
D & K Construction Inc.	P.O. Box 397 McConnellsville, Ohio 43756	do	Morgan.
Davon, Inc.	Box 5765 Columbus, Ohio 43221	2 quarries	Adams.
The France Stone Co.	1800 Toledo Trust Bldg. Toledo, Ohio 43604	4 quarries	Lucas, Sandusky, Seneca, Wood.
Kelstone, Inc.	Kellys Island Ohio 43438	Quarry	Erie.
Marble Cliff Quarries Co.	2100 Tremont Center Columbus, Ohio 43221	3 quarries	Delaware, Franklin, Preble.
Maumee Stone Co.	P.O. Box 369 Maumee, Ohio 43537	4 quarries	Lucas, Paulding, Wood.
The Melvin Stone Co.	R.R. 4 Wilmington, Ohio 45177	do	Clinton.
National Lime & Stone Co.	First National Bank Bldg. Findlay, Ohio 45840	8 quarries	Allen, Auglaize, Crawford, Delaware, Hancock, Marion, Putnam, Wyandot.
Sandusky Crushed Stone Co., Inc.	P.O. Box 527 Sandusky, Ohio 44870	Quarry	Erie.
Standard Slag Co.	1200 Stambaugh Bldg. Youngstown, Ohio 44501	2 quarries	Mahoning and Ottawa.
Toledo Stone & Glass Sand Co.	1800 Toledo Trust Bldg. Toledo, Ohio 43604	Quarry	Lucas.
Wagner Quarries Co.	East Market St. Sandusky, Ohio 44870	do	Erie.
Woodville Lime & Chemical Co.	Box 218 Woodville, Ohio 43469	do	Sandusky.
Wyandot Dolomite, Inc.	Carey, Ohio 43316	do	Wyandot.
Limestone (dimension):			
Armco Steel Corp	P.O. Box 911 Piqua, Ohio 45365	do	Miami.
Gregory Stone Co., Inc.	1860 N. Gettysburg St. Ludlow Falls, Ohio 45339	do	Do.
Quartzite (crushed):			
Cambria Clay Products Co.	Black Fork, Ohio 45615	do	Pike.
A. P. Green Refractories Co., Durex Division.	P.O. Box 255 Oak Hill, Ohio 45656	3 quarries	Do.
Sharon Silica Co.	Rte. 2 Jackson, Ohio 45640	Quarry	Do.
R. W. Sidley, Inc.	R.F.D. 1 Thompson, Ohio 44086	do	Do.
R. W. Sidley, Inc.	R.F.D. 1 Thompson, Ohio 44086	do	Geauga.
Sandstone (crushed and broken):			
Cannon Sand & Rock Co., Inc.	Box 65 Twinsburg, Ohio 44087	do	Summit.

See footnotes at end of table.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Sandstone (crushed and broken)—			
Continued			
Walter C. Best, Inc.-----	Box 87 Chardon, Ohio 44024	Quarry-----	Geauga.
PPG Industries, Inc.-----	P.O. Box 31 Barberton, Ohio 44203	---do-----	Summit.
Sperry Road Sand & Gravel Co., Inc.	R.D. 4, Hobart Rd. Willoughby, Ohio 44094	---do-----	Lake.
Sandstone (dimension):			
Briar Hill Stone Co.-----	Glenmont, Ohio 44628-----	10 quarries-----	Coshocton, Holmes, Knox.
Cleveland Quarries Co. ¹⁵ -----	Amherst, Ohio 44001-----	7 quarries-----	Erie and Lorain.
Stutzman Stone Co.-----	R.D. #1 Dover, Ohio 44622	Quarry-----	Tuscarawas.
The Taylor Stone Co.-----	McDermott, Ohio 45652-----	---do-----	Scioto.
The Waller Brothers Stone Co.-----	-----	3 quarries-----	Do.

¹ Also cement rock. ² Also shale and limestone. ³ Also clay, shale, and limestone. ⁴ Also clay and limestone.
⁵ Also clay and cement rock. ⁶ Also sand, shale, and limestone. ⁷ Also limestone.
⁸ Also shale. ⁹ One operation in two counties. ¹⁰ Also calcined. ¹¹ Also exfoliated vermiculite.
¹² Also byproduct sulfur. ¹³ Also evaporated salt. ¹⁴ Also brine. ¹⁵ Also grindstones and crushed and broken sandstone.

The Mineral Industry of Oklahoma

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

By L. G. Southard,¹ K. S. Johnson,² and J. F. Roberts²

Value of minerals produced in Oklahoma in 1971 was \$1,190 million, a net gain of 4.5 percent over that of 1970. This was the fifth consecutive year in which value of minerals exceeded \$1 billion. Fossil fuels remained the State's dominant mineral product, accounting for 94.1 percent of the mineral output. Natural gas, natural gas liquids, and petroleum registered gains in value of 10.1, 5.0, and 1.9 percent, while coal and helium decreased in value 1.4 and 7.5 percent, respectively. Overall non-metallic mineral output value increased

17.1 percent and value of all nonmetals amounted to 5.6 percent of the State's gross mineral value. The total value of metals declined 16.2 percent, but gains were registered in copper and silver. Mining operations for lead and zinc were discontinued in late 1970. Metals accounted for only 0.2 percent of the total mineral value in 1971.

¹ Mineral specialist, Division of Fossil Fuels.

² Geologist, Oklahoma Geological Survey, Norman, Okla.

Table 1.—Mineral production in Oklahoma¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ² thousand short tons	769	\$1,120	845	\$1,255
Coal (bituminous)..... do	2,427	15,211	2,234	15,004
Gypsum..... do	874	2,616	1,022	3,073
Helium:				
High-purity..... million cubic feet	149	5,214	123	4,305
Crude..... do	245	2,940	270	3,240
Lead (recoverable content of ores, etc.)..... short tons	797	249		
Natural gas..... million cubic feet	1,594,943	248,811	1,684,260	273,945
Natural gas liquids:				
Natural gasoline and cycle products				
thousand 42-gallon barrels	14,813	39,933	14,197	40,856
LP gases..... do	28,029	52,975	27,540	56,732
Petroleum (crude)..... do	223,574	712,419	213,313	725,611
Salt..... thousand short tons	13	78	W	W
Sand and gravel..... do	5,675	7,258	5,713	8,259
Stone..... do	18,177	23,701	19,449	27,125
Zinc (recoverable content of ores, etc.)..... short tons	2,650	812	(³)	(³)
Value of items that cannot be disclosed: Bentonite, cement, copper, lime, silver, tripoli, volcanic ash, and value indicated by symbol W	XX	24,935	XX	30,111
Total.....	XX	1,138,272	XX	1,189,516
Total 1967 constant dollars.....	XX	1,018,184	XX	1,033,452

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

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

² Excludes bentonite; included with "Value of items that cannot be disclosed."

³ Less than $\frac{1}{2}$ unit.

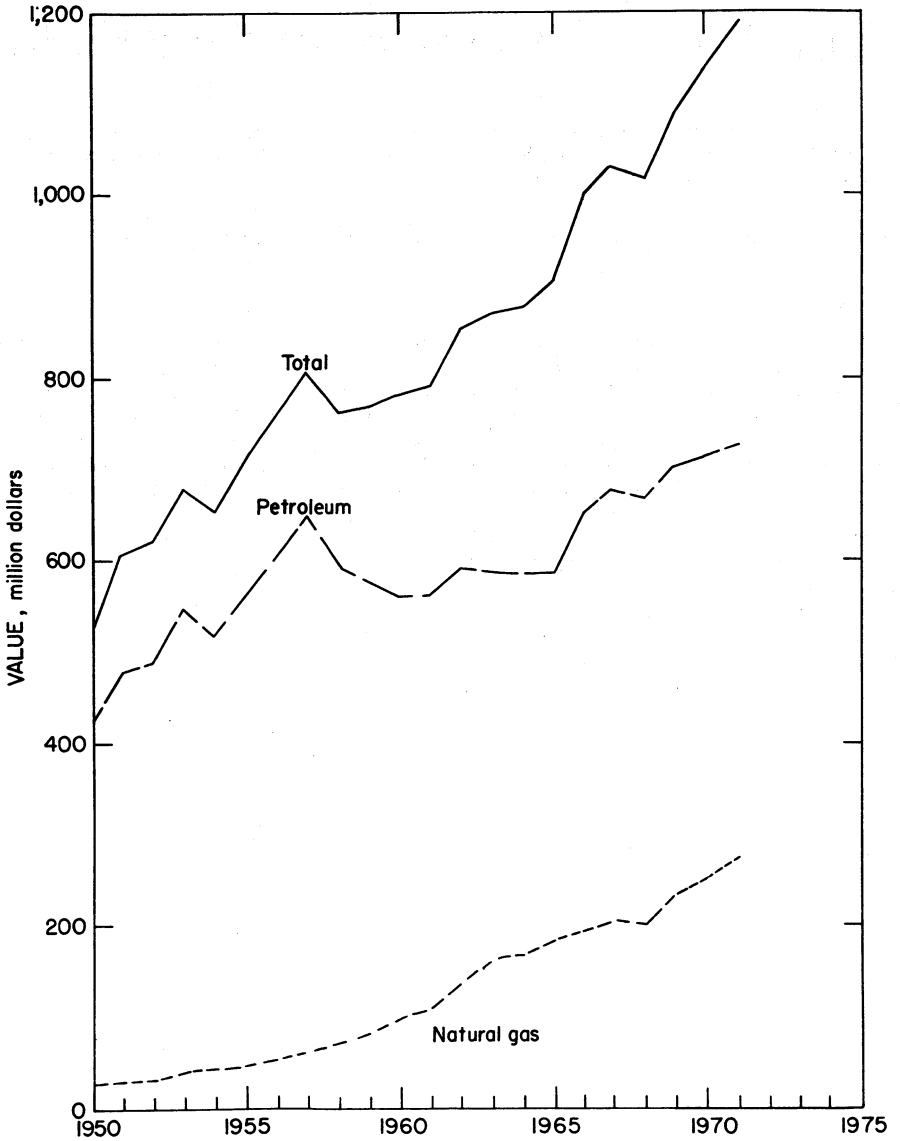


Figure 1.—Value of natural gas, petroleum, and total value of mineral production in Oklahoma.

Table 2.—Value of mineral production in Oklahoma, by county ¹
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Alfalfa	\$6,903	\$7,033	Petroleum, natural gas, natural gas liquids, sand and gravel.
Atoka	W	W	Stone, natural gas, petroleum, sand and gravel.
Beaver	57,440	53,906	Natural gas, petroleum, natural gas liquids, pumice.
Beckham	8,425	9,467	Natural gas, natural gas liquids, petroleum.
Blaine	20,745	18,903	Natural gas, petroleum, gypsum, natural gas liquids.
Bryan	2,370	3,010	Petroleum, stone, natural gas, sand and gravel.
Caddo	22,116	22,136	Petroleum, natural gas, stone, gypsum, natural gas liquids.
Canadian	5,435	7,017	Natural gas, petroleum, sand and gravel, clays, gypsum.
Carter	74,577	81,588	Petroleum, natural gas liquids, natural gas, stone, sand and gravel.
Cherokee	W	W	Stone.
Choctaw	W	W	Sand and gravel, stone.
Cimarron	18,039	16,994	Helium, petroleum, natural gas, natural gas liquids, stone.
Cleveland	16,373	15,426	Petroleum, natural gas, natural gas liquids.
Coal	2,790	2,021	Petroleum, natural gas, stone, sand and gravel.
Comanche	W	3,800	Stone, gypsum, petroleum, natural gas.
Cotton	W	W	Petroleum, sand and gravel, natural gas.
Craig	W	W	Coal, stone, natural gas, petroleum.
Creek	35,550	34,731	Petroleum, natural gas liquids, stone, natural gas, sand and gravel, clays.
Custer	5,744	5,636	Natural gas, petroleum, clays, volcanic ash.
Dewey	24,429	23,818	Natural gas, petroleum, natural gas liquids, clays.
Ellis	9,390	9,435	Natural gas, petroleum.
Garfield	32,935	30,373	Petroleum, natural gas, natural gas liquids, sand and gravel.
Garvin	71,187	77,748	Petroleum, natural gas liquids, natural gas, stone, sand and gravel.
Grady	22,512	36,211	Petroleum, natural gas, natural gas liquids.
Grant	5,723	4,941	Do.
Greer	486	252	Stone, petroleum, clays, natural gas liquids.
Harmon	W	W	Salt.
Harper	23,608	23,968	Natural gas, natural gas liquids, petroleum, sand and gravel.
Haskell	W	11,290	Natural gas, coal, stone.
Hughes	6,395	15,791	Natural gas, petroleum, sand and gravel.
Jackson	3,566	4,372	Copper, sand and gravel, petroleum, gypsum, silver, natural gas, zinc.
Jefferson	2,426	2,270	Petroleum, natural gas, sand and gravel.
Johnston	W	W	Sand and gravel, stone.
Kay	15,921	15,383	Petroleum, natural gas liquids, natural gas, sand and gravel.
Kingfisher	62,205	70,373	Petroleum, natural gas, natural gas liquids, sand and gravel.
Kiowa	1,910	1,709	Stone, petroleum, sand and gravel, natural gas.
Latimer	24,660	W	Natural gas, petroleum.
Le Flore	10,591	8,058	Natural gas, coal, clays.
Lincoln	10,110	10,023	Petroleum, natural gas, natural gas liquids.
Logan	7,401	7,749	Petroleum, natural gas, natural gas liquids, sand and gravel.
Love	8,027	6,029	Petroleum, natural gas liquids, natural gas.
McClain	23,761	25,477	Petroleum, natural gas, natural gas liquids, sand and gravel.
McCurtain	W	W	Stone, sand and gravel.
McIntosh	W	W	Natural gas, stone, petroleum.
Major	23,432	41,206	Petroleum, natural gas, natural gas liquids, sand and gravel, stone.
Marshall	6,808	6,543	Petroleum, natural gas liquids, natural gas, sand and gravel.
Mayes	W	W	Cement, stone, clays, sand and gravel, petroleum.
Murray	6,982	6,939	Petroleum, stone, natural gas.
Muskogee	1,328	1,575	Petroleum, sand and gravel, stone, coal.
Noble	6,083	6,089	Petroleum, natural gas, natural gas liquids.
Nowata	2,238	1,625	Petroleum, stone, natural gas liquids.
Oklfuskee	4,558	4,227	Petroleum, natural gas, natural gas liquids.
Oklahoma	20,462	20,912	Petroleum, natural gas liquids, natural gas, sand and gravel, clays, stone.
Okmulgee	3,331	3,615	Petroleum, natural gas.
Osage	45,766	43,581	Petroleum, natural gas, stone, sand and gravel.
Ottawa	2,321	W	Stone, tripoli.
Pawnee	5,149	5,910	Petroleum, stone, sand and gravel, natural gas.
Payne	7,781	10,010	Petroleum, stone, natural gas, sand and gravel.
Pittsburg	8,664	8,315	Natural gas, stone, clays, sand and gravel.
Pontotoc	21,198	23,296	Petroleum, cement, stone, sand and gravel, natural gas, clays, natural gas liquids.
Pottawatomie	9,905	8,692	Petroleum, natural gas.
Pushmataha	1	1	Sand and gravel.
Roger Mills	3,089	W	Natural gas, petroleum.

See footnotes at end of table.

Table 2.—Value of mineral production in Oklahoma, by county ¹—Continued
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Rogers.....	\$16,521	\$14,431	Cement, coal, stone, petroleum, clays.
Seminole.....	31,214	32,714	Petroleum, natural gas liquids, stone, natural gas, sand and gravel, clays.
Sequoyah.....	W	5,267	Lime, natural gas, stone, sand and gravel.
Stephens.....	98,530	100,440	Petroleum, natural gas liquids, natural gas, sand and gravel.
Texas.....	89,064	90,657	Petroleum, natural gas, natural gas liquids, sand and gravel, stone.
Tillman.....	918	2,178	Petroleum, sand and gravel.
Tulsa.....	8,620	7,562	Petroleum, stone, clays, sand and gravel, natural gas.
Wagoner.....	347	392	Petroleum, sand and gravel, stone, natural gas.
Washington.....	4,149	3,769	Petroleum, stone, natural gas.
Washita.....	630	W	Natural gas, petroleum, gypsum.
Woods.....	12,301	11,702	Natural gas, petroleum, sand and gravel, stone, salt.
Woodward.....	10,837	11,931	Natural gas, natural gas liquids, petroleum, sand and gravel, stone.
Undistributed ²	36,294	43,494	
Total.....	³ 1,138,272	1,189,516	

¹ Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

² Adair and Delaware Counties are not listed because no production was reported.

³ Includes some stone, sand and gravel, and petroleum that cannot be assigned to specific counties and values indicated by symbol W.

⁴ Data does not add to total shown because of independent rounding.

Table 3.—Indicators of Oklahoma business activity

	1970	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force.....	thousands... ^r 1,048.6	1,062.4	+1.3
Unemployment.....	do... ^r 46.1	53.0	+15.0
Employment:			
Construction.....	do... ^r 37.4	38.9	+4.0
Manufacturing.....	do... ^r 134.7	132.3	-1.8
Mining.....	do... ^r 38.9	36.8	-5.4
Other ¹	do... ^r 559.3	572.4	+2.3
Personal income:			
Total.....	millions... \$3,488	\$9,151	+7.8
Per capita.....	do... \$3,300	\$3,506	+6.2
Construction activity:			
Building permits:			
Number of new units authorized.....	21,918	29,042	+32.5
Value of authorized nonresidential construction.....	millions... \$263.5	\$239.8	-9.0
Value of nonbuilding contracts awarded.....	do... \$192.5	\$265.0	+37.7
Cement shipments to and within Oklahoma.....	thousand 376-pound barrels... ^r 6,573.0	6,470.0	-1.6
Mineral production value.....	millions... ^r \$1,133.3	\$1,189.5	+4.5

^p Preliminary. ^r Revised.

¹ Includes services; wholesale and retail trade; finance, insurance, and real estate; transportation and public utilities; and government.

Sources: Handbook of Oklahoma Employment Statistics, Volume III, 1958-1971; Oklahoma Business Bureau; University of Oklahoma; Survey of Current Business; and U.S. Bureau of Mines.

Employment and Wages.—The Oklahoma Employment Security Commission announced a continued decline in employment in the mineral industry. Average employment during 1971 was 36,800 persons compared to 38,900 persons in 1970. The decrease in employment by 2,100 persons was in the petroleum industry. Employment in other mining remained the same as in 1970. The average hourly wage paid in the mineral industry was \$3.58.

Legislation and Government Programs.—A law passed by the State Legislature in 1970 that required oil operators to post

bond to cover the cost of plugging a well was repealed because bonding firms refused to write bonds for operators. Under a new law, an operator would have to file a financial statement twice a year that he has \$10,000 in holdings in Oklahoma.

The Oklahoma State Senate adopted a resolution urging Congress and the U.S. Army Corps of Engineers to undertake construction of a waterway from the Arkansas River to Lake Eufaula. This would be the first step in the Central Oklahoma Navigation and Water Supply Project.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Coal.....	561	257	144	1,120	2	52	48.21	13,970
Metal.....	176	279	49	393	--	18	45.74	1,937
Nonmetal.....	463	255	119	933	1	25	27.86	7,657
Sand and gravel.....	364	246	89	762	--	18	23.62	934
Stone.....	1,291	267	345	2,849	--	76	26.68	673
Total ¹	2,860	261	747	6,058	3	189	31.69	4,322
1971: ^p								
Coal.....	600	242	145	1,143	3	50	46.38	17,372
Metal.....	170	240	41	325	--	14	43.07	1,864
Nonmetal.....	480	259	125	1,000	--	39	39.00	1,426
Sand and gravel.....	375	242	91	807	--	16	19.84	216
Stone.....	1,395	270	378	3,113	1	90	29.23	4,622
Total ¹	3,025	258	779	6,387	4	209	33.35	5,706

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

A bill to increase the gross production tax on oil and gas from the existing 5 percent to 7 percent was passed by the Oklahoma Legislature. The bill allows exemption of \$3 per month for wells that produce 3 barrels of oil or less per day, or 1.5 million cubic feet of gas or less per month. Provisions in the original bill to increase taxes on asphalt, zinc, lead, copper, gold and other mineral substances from 0.75 percent to 1 percent were eliminated.

The Mining Lands Reclamation Act of 1971 included provisions for the treatment of lands affected by underground as well as surface mining. The act modified the conditions for permitting mining and the posting of bonds to assure performance of reclamation specified with the application for permit. Legal means for enforcement were strengthened from those of the previously existing law.

The Bureau of Mines Bartlesville Energy Research Center conducted research in five categories: Petroleum production and environmental research; properties and flow of reservoir fluids research; thermodynamics research; petroleum chemistry and refining research; and fuel combustion research.

Environmental Activities.—Senate Bill 164 creating a Pollution Control Coordinating Board within a Department of Pollution Control was passed by the State legislature. The new Department, designed to include all types of pollution, supplanted

the Pollution Control Board, whose primary function related to water pollution. Individual agencies will retain immediate control of existing pollution problems and the board will act as a coordinator and advisor in treatment and distribution of individual pollution complaints.

The Air Pollution Control Division of the State Health Department prepared an air quality control implementation plan that outlined a program to control air pollution in the State. A preliminary survey has shown that Tulsa and Oklahoma City are the worst areas of air pollution. The level of oxidants and ozones in the air of the two cities exceeds Federal standards and conditions are similar to those that produce smog in other areas.

The State Health Department adopted solid waste disposal regulations which will prohibit all open burning and promiscuous dumping in all Oklahoma communities by 1973.

The State's first continuous air monitoring station was established in Oklahoma City by the Oklahoma City-County Health Department in cooperation with the State Health Department's Air Pollution Control Division and the U.S. Environmental Protection Agency. The station will measure carbon monoxide, nitrogen dioxide, hydrogen sulfate, sulfur dioxide, aldehydes, ammonia, total oxidants, soiling index, suspended particles in the air, and wind speed and direction.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

According to American Petroleum Institute (API) statistics the number of oil and gas wells drilled in Oklahoma in 1971 declined 16 percent. Total footage decreased 20 percent below that drilled in 1970. There were 2,255 wells drilled with a total of 11,247,143 feet as compared to 2,685 wells and 13,996,891 feet drilled in 1970.

A breakdown of the 2,255 wells drilled showed 1,174 oil wells, 238 gas wells and 843 dry holes. A total of 415 exploratory wells were drilled in 1971, down from the 458 drilled in 1970. There were 42 oil discoveries, 27 gas wells completed, and 346 dry holes.

Average footage per well drilled in 1971 was 4,988 feet compared with the average footage per well in 1970 of 5,213 feet.

Drilling continued at the Lone Star Producing Co.'s world record setter in Beckham County en route to 30,050 feet. The well set a new State depth record with each foot drilled when it passed the 24,453-foot mark set by Glover-Hefner-Kennedy Oil Co., in 1969.

The most concentrated drilling activity in Oklahoma during 1971 was along the Marchand sandstone trend in west-central Grady County and northeastern Caddo County. Although the discovery well was completed in 1967, development was slow until additional discoveries were made in 1969, 1970, and early 1971 in the 20-mile-long north-northwesterly trend. Fields in the trend include Northeast Verden (into which Dutton and Dutton Townsite fields have been combined), Northwest Chickasha, Northwest Norge, and Southwest Norge.

The name "Marchand" had been applied earlier to a productive sandstone of Middle Pennsylvanian (Missourian) age in the Cement field to the southwest in Caddo County, in a similar stratigraphic position. However, no one sand is a continuous reservoir in the area, deposition having occurred in what has been interpreted as a deltaic complex.

Depth to the Marchand reservoir is 10,000 to 11,000 feet. Well spacing has been established as 160-acre units. Initial-flow potentials range up to 1,675 barrels of oil per day.

The following is a comparison of production statistics for the Marchand trend as of December 31, 1970, with those as of December 31, 1971, given in barrels:

Number of wells		Daily average production		Cumulative production	
1970	1971	1970	1971	1970	1971
36	126	3,372	32,315	1,811,168	8,450,592

These figures show increases during 1971 of 90 producing wells, daily average production of 28,943 barrels, and cumulative production of 6,639,364 barrels. The daily average production per well for December 1971 was 256 barrels. Production has been high because of the combination of high-discovery allowables and 150- and 200-percent allowable factors.

At yearend 17 wells were in various stages of completion, seven rigs were drilling, and five locations had been announced.

Kerr-McGee Corporation announced the closing of its Cushing refinery in 1971 because of general rising costs and the declining production in Oklahoma of special lube-quality crude oil required as a charge stock for the refinery.

Bell Oil and Gas Co. completed a multimillion-dollar expansion project at its refinery at Ardmore. The main objective of the program was to decrease pollution and upgrade the production of no-lead and low-lead gasoline.

Carbon Black.—Continental Oil Co. continued producing carbon black from liquid hydrocarbons at its Ponca City plant in Kay County. Quantity of furnace carbon black produced in 1971 increased 2.6 percent above 1970 production while value increased 8.8 percent. Carbon black is used by the rubber industry in the manufacture of tires, shoe soles and heels, gaskets, conveyor belts, and other products.

Coal.—Production of bituminous coal decreased to 2,234 thousand short tons in 1971 compared to 2,427 thousand short tons in 1970. This 8-percent loss could be attributed to a strike called by the United Mine Workers at the expiration of the union national contract and the closing of the Howe No. 1 mine.

Three mine fatalities occurred in the Howe No. 1 coal mine, Le Flore County, in 1971. Two were caused by rockfalls

while the other was an electrocution sustained while repairing a switch for a sump pump. In each case the investigation indicated the accidents were unforeseen and at least partly due to impracticability.

In September the Howe No. 1 mine was closed for reevaluation because of consistent failure over the previous three years to cover the cost of mining. Some of the miners were temporarily reemployed at the company's developmental slope mine at Bokoshe. Later, management removed equipment and sealed the Howe No. 1 mine.

Sierra Coal Corp. of Claremore applied for a permit to build a barge-loading facility on the Arkansas River waterway near Webbers Falls. This loading facility would be the shipping point for coal bound to the Tennessee Valley Authority generating plant in Memphis, Tenn. The Sierra Coal Corp. has a contract to deliver 14 million tons of coal over a period of 5 years to this plant.

Kerr-McGee Corporation made the first shipment of coal on the Arkansas-Verdigris River Navigation System in July. The coal was shipped from the Carl Albert Port at Keota to St. Louis, Mo.

McNabb Coal Co. of Catoosa placed a 63-ton Caterpillar earthloading machine into service. The machine, which can scoop up 15 tons of earth at a time, is used to remove overburden at McNabb's strip mining operations.

The State signed a \$300,000 contract with Gulf General Atomic, Inc., San Diego, and Stone & Webster Engineering Corp., Boston, for a 2-year feasibility study aimed at establishing a coal gasification plant in Eastern Oklahoma. Under consideration is the concept of utilizing low-grade coal in a newly designed nuclear reactor to produce pipeline gas. The Oklahoma Geological Survey initiated a study of the type, quality, and quantity of the State's coal resources to determine the adequacy to supply the proposed plant over a period of 20 years. Financing of the resources study, totaling \$156,000 for a period of 18 months, was provided by the Ozark Regional Commission. A sum of \$300,000 was inserted as a line item in the U.S. Department of the Interior budget to support a cooperative coal gasification feasibility study in Oklahoma. This plant, if under-

taken, would be the first of its kind in the world.

Helium.—Helium extracted from natural gas at the Bureau of Mines Keyes, Okla., plant amounted to 393 million cubic feet. High-purity (Grade-A) helium output was 123 million cubic feet valued at \$4.3 million. Crude helium output was 270 million cubic feet valued at \$3.2 million. All helium produced is measured at 14.7 PSIA at 70° F.

Natural Gas.—Oklahoma ranked third in the Nation in natural gas production in 1971, having produced 1,684,260 million cubic feet. This was an increase over the 1970 production by 5.6 percent. Gas was produced from 8,507 wells in 61 countries.

As of December 31, 1971, the American Gas Association estimated natural gas reserves to be 15,713 billion cubic feet, a decrease of 1,241 billion cubic feet from the previous year's total. Reserves equaled approximately 9.3 cubic feet of gas for each cubic foot produced, compared to 10.6 cubic feet of reserve for each cubic foot produced in 1970. New field discoveries and new reservoir discoveries in old fields added 107,870 million cubic feet to the reserve during the year.

Operators in the Northwest Norge field in Grady County started construction of a gas gathering and compressing system to process the large volumes of gas produced with the oil from the Marchand Sand.

The Federal Power Commission (FPC) authorized the Natural Gas Pipeline Co. of America to increase its underground gas storage facilities at Sayre in Beckham County sufficiently to allow daily peak withdrawal of 202 million cubic feet, more than double the previous peak withdrawal capacity.

Arkansas Louisiana Gas Co. was authorized by the FPC to build a 24- to 30-inch gas pipeline across Oklahoma. The line will extend from the Anadarko Basin in western Oklahoma and the Texas panhandle eastward to Wilburton in southeastern Oklahoma, where it will connect with the existing Arkansas-Louisiana gas pipeline.

Cities Service Gas Co. began construction of a 16-inch natural gas transmission line. The 27.3-mile pipeline west of Enid in the Kingfisher-Garfield-Alfalfa County area will connect with a pipeline that extends from the Texas panhandle to Blackwell, Okla. Lone Star Gas Co. applied to the FPC to

build a 94-mile gas pipeline in southeast Oklahoma and northeast Texas.

An application filed in the name of Dan R. Dunnett, Conservation Director of the Oklahoma Corporation Commission, asked the Commission to fix a minimum price of 20 cents per thousand cubic feet at the wellhead for natural gas produced in Oklahoma. The application contended that the Corporation Commission has jurisdiction to fix minimum gas prices under its general conservation powers and its authority to prevent waste—including economic waste.

Natural Gas Liquids.—Output of natural gas liquids decreased in 1971 with the recovery of 41,737 million barrels of liquefied petroleum gases (LPG) and natural gasoline and cycle products. LPG accounted for 66 percent of the volume and 58 percent of the value. The State ranked third in the Nation in the production of natural gas liquids, following Texas, and Louisiana. The American Gas Association estimated reserves of natural gas liquids 338.4 million barrels, a decrease of 20.2 million barrels from the previous year's estimate.

Petroleum.—Oklahoma's crude petroleum output in 1971 decreased 10.3 million barrels to 213.3 million barrels. Production

was obtained from 75,572 wells compared to 78,212 wells in 1970. Average daily production from all producing wells amounted to 7.7 barrels per day compared to 7.8 barrels per day in 1970. Indicated demand for Oklahoma crude oil remained strong at 215 million barrels. Stocks of crude oil originating in Oklahoma at the beginning of the year was 17.6 million barrels, while at the end of the year stocks had declined to 15.9 million barrels. Oklahoma retained its rank of fourth in the Nation in crude oil production, having been exceeded only by Texas, Louisiana, and California.

Stephens County led the State's 64 oil-producing counties with a total of 27.5 million barrels, followed by Carter and Garvin Counties with production of 22.8 million and 19.2 million barrels in 1971. Osage County was the site of the most drilling activity with 171 wells, 164 production and seven exploratory.

Oklahoma's crude oil reserves were estimated by the API at yearend to be 1,404,608 thousand barrels, an increase of 53,255 thousand barrels above the 1970 estimate. The State ranks fifth in the Nation in crude oil reserves, exceeded by Texas, Alaska, Louisiana, and California.

Table 5.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

Commodity	Proved reserves Dec. 31, 1970	Changes in proved reserves due to extensions and discoveries in 1971	Proved reserves Dec. 31, 1971 (production deducted)	Change from 1970 (percent)
Crude oil.....thousand 42-gallon barrels..	1,351,353	260,757	1,404,608	+3.9
Natural gas liquids.....do.....	358,608	17,119	338,353	-5.6
Natural gas.....million cubic feet..	16,954,267	423,253	15,712,818	-7.3

Source: American Petroleum Institute and American Gas Association.

Table 6.—Crude oil production, indicated demand, and stocks, in 1971, by month
(Thousand 42-gallon barrels)

Month	Production	Indicated demand	End of month stocks originating within Oklahoma
January	18,031	18,490	17,130
February	16,048	16,898	16,285
March	18,695	18,298	16,682
April	17,967	18,193	16,456
May	18,146	17,881	16,721
June	17,785	16,835	17,671
July	18,099	18,985	16,785
August	18,271	18,961	16,095
September	17,409	17,735	15,769
October	17,586	17,822	15,533
November	17,186	17,284	15,435
December	18,090	17,652	15,873
Total:			
1971	213,313	215,029	XX
1970	223,574	224,289	XX

XX Not applicable.

Table 7.—Oil and gas well drilling completions, by county

County	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Alfalfa	12	1	3	---	---	2	18	113,366
Atoka	---	---	1	---	---	2	3	5,448
Beaver	34	16	16	1	1	5	73	479,389
Beckham	---	---	1	---	1	2	4	40,004
Blaine	2	12	13	---	---	3	30	273,537
Caddo	70	4	8	2	1	21	106	369,525
Canadian	4	12	4	1	2	6	29	305,292
Carter	65	---	29	2	---	7	103	376,683
Cimarron	10	3	5	---	---	3	21	87,905
Cleveland	3	---	2	1	---	9	15	113,996
Coal	---	---	---	---	---	1	1	5,632
Comanche	20	---	2	1	---	4	27	30,095
Cotton	2	---	---	---	---	9	11	27,296
Creek	47	6	19	1	1	8	82	209,902
Custer	---	1	---	---	2	1	4	64,763
Dewey	19	10	11	1	3	6	50	494,200
Ellis	1	2	8	---	2	9	22	201,566
Garfield	12	---	10	2	---	7	31	169,641
Garvin	13	---	17	3	---	27	60	315,754
Grady	72	3	14	3	2	13	107	1,122,910
Grant	6	---	2	---	---	3	11	55,328
Greer	---	---	---	---	1	4	6	9,759
Harper	1	16	14	---	---	2	33	209,160
Haskell	---	1	1	---	---	1	3	17,652
Hughes	11	8	9	---	1	3	32	87,859
Jackson	---	---	---	---	---	2	2	7,622
Jefferson	2	---	6	---	---	3	11	17,745
Kay	22	1	16	1	---	14	54	174,111
Kingfisher	119	10	12	4	1	3	149	1,249,979
Kiowa	6	2	13	---	1	6	28	34,352
Latimer	---	2	2	---	---	---	4	29,618
Le Flore	---	8	5	---	---	2	15	117,950
Lincoln	29	2	5	1	---	9	46	169,620
Logan	7	---	4	2	---	9	22	128,519
Love	6	---	6	2	---	7	21	128,606
McClain	5	---	5	4	---	10	24	206,795
McCurtain	---	---	---	---	1	---	1	10,019
McIntosh	---	5	1	---	---	---	6	25,611
Major	55	14	26	1	2	9	107	857,068
Marshall	---	---	---	---	---	2	2	17,053
Murray	---	---	1	---	---	9	10	36,597
Muskogee	4	---	---	---	---	4	8	15,483
Noble	8	1	10	---	---	8	27	88,116
Nowata	16	---	7	1	---	2	26	20,262
Oklfuskee	7	1	4	---	---	4	16	53,330
Oklahoma	6	---	---	1	---	4	11	66,722
Okmulgee	27	1	7	---	---	2	37	64,898
Osage	125	2	37	1	---	6	171	371,432
Pawnee	23	2	5	---	---	3	33	96,129

Table 7.—Oil and gas drilling completions, by county—Continued

County	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Payne.....	10	1	7	3	--	9	30	100,849
Pittsburg.....	--	14	8	--	2	4	28	172,741
Pontotoc.....	22	--	3	--	--	2	27	79,761
Pottawatomie.....	15	--	10	--	--	7	32	124,363
Pushmataha.....	--	--	--	--	--	1	1	4,922
Roger Mills.....	--	--	--	--	--	4	4	54,393
Rogers.....	25	--	--	--	--	--	25	10,335
Seminole.....	45	--	27	--	--	6	78	306,332
Sequoyah.....	--	2	1	--	--	--	3	20,447
Stephens.....	46	5	22	3	--	11	87	266,739
Texas.....	17	8	5	--	--	8	38	206,679
Tillman.....	8	--	--	--	--	2	10	30,108
Tulsa.....	14	2	8	--	--	--	24	33,860
Wagoner.....	11	1	11	--	--	2	25	24,240
Washington.....	36	--	7	--	--	--	43	46,918
Washita.....	--	--	--	--	--	1	1	1,952
Woods.....	10	11	18	--	2	4	45	275,518
Woodward.....	2	21	8	--	1	9	41	318,387
Total.....	1,132	211	497	42	27	346	2,255	11,247,143

Source: American Petroleum Institute.

Table 8.—Crude petroleum production, by field
(Thousand 42-gallon barrels)

Field ¹	1970	1971	Cumulative to Dec. 31, 1971
Allen.....	3,013	2,920	118,875
Bowlegs.....	1,976	2,260	153,956
Burbank.....	6,067	5,240	491,902
Cement.....	2,500	2,370	133,884
Cushing.....	4,757	4,300	453,808
Edmond, West.....	812	730	153,076
Eola-Robberson.....	4,881	4,850	95,395
Fitts.....	1,240	1,420	144,474
Glenn Pool.....	2,714	2,430	303,342
Golden Trend.....	12,770	12,330	372,124
Healdton.....	4,070	4,600	273,892
Hewitt.....	4,256	5,660	199,733
Oklahoma City.....	1,799	1,750	723,158
Seminole Greater.....	1,391	1,640	195,975
Sho-Vel-Tum.....	23,425	36,500	901,086
Sooner Trend.....	17,624	15,240	150,464
St. Louis.....	1,567	1,350	212,523
Other fields.....	123,712	107,673	NA
Total.....	223,574	213,313	NA

NA Not available.

¹ Based on Oil and Gas Journal data adjusted to Bureau of Mines total.

NONMETALS

Nonmetallic mineral production value at about \$66.5 million was reported during 1971, a 17.1 percent increase over 1970 value. All nonmetallic mineral production increased in value. Nonmetallic minerals production accounted for 5.6 percent of the State's total mineral output value.

Cement.—Shipments of portland cement increased 10.3 percent and masonry cement shipments increased 26 percent in 1971. Portland and masonry cement was produced at three plants. Average mill value of portland cement was \$3.42 per barrel while average value of masonry cement was \$3.23

per barrel. Portland and masonry cement consumed in Oklahoma totaled 6,470,000 376-pound barrels and 377,000 280-pound barrels, respectively. Raw materials used in making portland cement included limestone, clay and shale, sand, gypsum, and iron-bearing materials.

The Ideal Cement Co. estimated that expenditures of \$22 million will be made in the period 1971 to 1974 to bring its cement-producing operations into conformity with air and water pollution control regulations. Another objective will be to maximize returns by operating a number of efficient plants at full capacity. Ideal's

plant located in Ada, Okla., will come under this program.

Clays.—Common clay and shale was mined by 14 companies in 12 counties. Output in quantity, excluding bentonite, increased 10 percent and value 12 percent in 1971. It was used for building brick, vitrified sewer pipe, cement, lightweight aggregate, and pottery. Bentonite was mined in Dewey County and used as a desiccant.

Gypsum.—Gypsum production in 1971 totaled 1,022,000 short tons compared to 874,000 short tons in 1970. This was an increase of 17 percent. Gypsum was strip mined and processed for use in wallboard, plaster, portland cement, and soil conditioner products. Production was reported by eight companies with operations in Blaine, Caddo, Canadian, Comanche, Jackson, and Washita counties in western Oklahoma.

The U.S. Gypsum Co. was the first gypsum company in Oklahoma to utilize the McClellan-Kerr Arkansas River Navigation System to transport gypsum. The company trucked a thousand tons of gypsum fines from a mine at Southard in Blaine County to the Port of Muskogee, at which point they were transhipped by barge to a wallboard plant in New Orleans.

Lime.—St. Clair Lime Co., the only producer of lime in the State, expanded its Marble City facility in Sequoyah County by adding a new rotary kiln with a capacity of 450 tons per day. This raises the company's total capacity for lime production at Marble City and Sallisaw to nearly 1,000 tons per day. Production increased 28 percent above that of 1970 and set a new annual record output.

Pumice.—Pumice was produced in Beaver County by Axtell Mining Corp. and volcanic ash was produced in Custer County by Custer City Mining Corp., which reopened its volcanic ashpit and resumed operations during 1971.

Salt.—The quantity and value of salt produced in Oklahoma during 1971 declined sharply; production was by solar evaporation in Harmon and Woods Counties.

Western Salt Co. continued construction of its plant and preparation of evaporating pans for production of solar salt in Greer County. Brine will be piped to the plant from a salt plain 6 miles away in Harmon County. Salt that was produced by the company this year in evaporating pans adjacent to the salt plain has been stockpiled and will be marketed next year when the new plant is expected to be in operation.

Sand and Gravel.—Production of over 5.7 million tons of sand and gravel was reported from 41 counties at 51 commercial operations. Value of the output increased 13.8 percent in 1971 compared to that of 1970.

Ball Corp., headquartered at Muncie, Ind., installed a 135-foot-high concrete batch silo at its Okmulgee glass plant, involving an expenditure in excess of \$800,000. The principle ingredient for their flint-glass furnace is glass sand from the Mill Creek area in Johnson County, Okla. The plant produces numerous glass containers ranging from two ounces to a gallon jug.

Stone.—Stone production increased 7.0 percent and value increased 14.4 percent in 1971. Stone output included dolomite, granite, limestone, sandstone, and chat.

Owners of Anchor Stone Co. and Amulco Asphalt Co. of Tulsa formed two new corporations, Anchor Concrete Co. and Amulco Concrete Co., utilizing the purchased assets of Bagby-Harris Concrete Co. and the Bagby-Harris Sand Co. Bagby-Harris, one of the larger construction materials companies in Oklahoma, operated 115 ready-mix concrete trucks and a number of sand-hauling trucks in 11 Oklahoma cities.

Sulfur.—Pioneer Gas Producing Co. recovered 1,114 long tons of sulfur from sour natural gas at their plant in Marshall County.

Tripoli.—Tripoli, which is used in abrasives, buffing compounds, oil well drilling mud, and in foundry processes, was recovered from two mines in the northeastern part of the State, in Ottawa County. Production in 1971 was 14 percent above that in 1970.

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

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,737	\$1,899	2,158	\$2,398
Fill	254	141	271	106
Paving	717	826	1,508	1,813
Other uses ¹	1,086	2,902	757	2,685
Total ²	3,794	5,768	4,694	6,998
Gravel:				
Building	42	54	62	93
Paving	37	50	102	279
Miscellaneous ³	5	20	6	9
Total ²	84	123	171	382
Government-and-contractor operations:				
Sand:				
Building	323	304	408	516
Fill			9	9
Paving	1,020	386	267	143
Other uses	9	7	7	1
Total ²	1,353	697	690	669
Gravel:				
Building	25	37	115	201
Paving	420	634	44	15
Total ²	446	671	159	216
Total sand and gravel ²	5,675	7,258	5,713	8,259

¹ Includes ground and unground, railroad ballast, and other sands.

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

³ Includes fill and other gravel.

Table 10.—Stone sold or used by producers, by kind
(Thousand short tons and thousand dollars)

Kind of stone	1970		1971	
	Quantity	Value	Quantity	Value
Dimension:				
Limestone	2	\$23	2	\$29
Granite	9	1,014	4	417
Total	110	1,037	6	446
Crushed and broken:				
Limestone ²	16,393	20,907	17,961	25,075
Other stone ³	1,773	1,757	1,482	1,604
Total	18,166	22,664	19,443	26,679
Grand total	18,177	23,701	19,449	27,125

¹ Data does not add to total shown because of independent rounding.

² Data includes dolomite.

³ Data includes sandstone; 1971 data also includes quartz and quartzite.

METALS

The Gardner-Denver Co. along with the Oklahoma Ordinance Works Authority announced plans for the company to build a \$20 million iron and steel foundry at the Mid-America Industrial District in Pryor, Okla. The company plans to install ten electric melting furnaces, an automatic sand conveying system, and automatic

mold and mold handling equipment, with maximum safeguards against air, water, and noise pollution. Construction is expected to be completed in 2 to 2½ years. The foundry would supply castings to Gardner-Denver plants in Coffeyville, Kans., Denver, and Dallas.

Copper.—According to Oklahoma's Chief Mine Inspector, 269,064 tons of copper-bearing shale was strip mined in Jackson

County in 1971 compared to 213,526 tons in 1970. Copper metal produced by Eagle-Picher Industries, Inc., increased 26 percent in quantity and 14 percent in value above totals of the previous year.

Gallium.—Gallium metal, oxide, and trichloride was produced by Eagle-Picher Industries Inc., at its Quapaw plant.

Germanium.—Eagle-Picher Industries, Inc., is the only producer of primary germanium from domestic sources

Lead.—There was no lead production in Oklahoma in 1971; operations ceased late in 1970 after a marked decline from the previous year's production. Mines and mills of the Picher field, one of the great mining districts of the world, closed after having produced 1.3 million tons of lead and 5.2 million tons of zinc since mining started in 1891.

Silver.—The value of silver recovered as a byproduct from smelting copper concentrate produced by Eagle-Picher Industries, Inc., in Jackson County increased 23.1 percent above that of 1970.

Zinc.—A minor amount of zinc was recovered by Eagle-Picher Industries, Inc., in smelting copper concentrate from Jackson County, although in almost every year from 1918 through 1945 Oklahoma had been the leading producer of zinc in the United States.

Custom Mills and Smelters.—Horizontal retort zinc smelters were operated by American Metal Climax, Inc., at Blackwell, and National Zinc Co. Inc., at Bartlesville. Both companies treated zinc concentrates that were shipped into Oklahoma from other States.

Frontier Steel Co. of Muskogee launched the first Oklahoma-constructed barge on The Arkansas River Navigation System. The huge barge, measuring 110 by 52 feet, has a capacity of about 2,500,000 pounds.

Standard Magnesium Corp., Div. of Kaiser Aluminum and Chemicals Corp., installed a new extrusion press of 2,400 tons; this almost doubles the plant's extrusion capacity. The press is completely automated and is the newest equipment of this type in the country.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Carbon Black: Continental Carbon Co.	P.O. Box 22085 Houston, Texas 77027	Furnace.....	Kay.
Cement:			
Dewey Rocky Mountain Cement Co. ¹	1210 Fourth Nat'l. Bank Tulsa, Okla. 74119	Quarry and plant.	Rogers.
Ideal Cement Co., Div. Ideal Basic Industries, Inc. ¹	420 Ideal Cement Bldg. Denver, Colo. 80202	....do.....	Pontotoc.
Oklahoma Cement Co. Div. OKC Corp. ¹	P.O. Box 68 Pryor, Okla. 74861	....do.....	Mayes.
Clays:			
Acme Brick Co.....	P.O. Box 425 Fort Worth, Tex. 76101	Mine and plant..	Custer, Oklahoma, Tulsa.
Chandler Materials Co.....	Box 627 Tulsa, Okla. 74101	....do.....	Rogers, Oklahoma.
Filtrol Corp.....	3250 East Washington Los Angeles, Calif. 90023	....do.....	Dewey.
Mangum Brick Co.....	Box 296 Mangum, Okla. 73554	....do.....	Greer.
Oklahoma Brick Corp.....	Box 37 Union City, Okla. 73090	....do.....	Canadian.
Sapulpa Brick & Tile Corp.....	Box 460 Sapulpa, Okla. 74066	....do.....	Creek.
Superior Clay Products, Inc.....	Box 1501 Ada, Okla. 74820	....do.....	Pontotoc.
United Clay Pipe Co.....	Box 552 Seminole, Okla. 74868	....do.....	Seminole.
Wewoka Brick and Tile Co.....	415 West 10th Street Wewoka, Okla. 74884	....do.....	Do.
Coal:			
Bills Coal Co., Inc.....	Route 1 Welch, Okla. 74369	Strip mine.....	Craig.
Evans Coal Co.....	Box 126 McCurtain, Okla. 74944	Strip and auger mine.	Haskell.
Garland Coal & Mining Co.....	Box 186 Fort Smith, Ark. 72901	Strip mine.....	Do.
Howe Coal Co.....	Box 99 Heavener, Okla. 74937	Underground mine.	Le Flore.
Kerr-McGee Corp.....	Kerr-McGee Bldg. Oklahoma City, Okla. 73102	....do.....	Haskell.

See footnote at end of table.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Coal—Continued			
McNabb Coal Co.....	Box C Catoosa, Okla. 74105	Strip mine.....	Rogers.
Peabody Coal Co.....	301 North Memorial Drive St. Louis, Mo. 63102	.....do.....	Do.
Copper and silver: Eagle-Picher Industries Inc.	P.O. Box 910 Miami, Okla. 74354	.....do.....	Jackson.
Gypsum:			
Republic Gypsum Co.....	1100 Mercantile Bank Bldg. Dallas, Tex. 75201	Quarry and plant..	Do.
United States Gypsum Co.....	101 South Wacker Drive Chicago, Ill. 60606	.....do.....	Blaine.
Universal Atlas Cement, Div. of United States Steel Corp.	600 Grant St. Box 2969 Pittsburgh, Pa. 15230.	Quarry.....	Do.
Lime: St. Clair Lime Co.....	Box 894 Oklahoma City, Okla. 73101	Plant and quarry..	Sequoyah.
Salt:			
Blackmon Salt Co.....	Freedom, Okla. 73842	Solar evaporation	Woods.
Western Salt Co.....	Route 2 Erick, Okla. 73645	.....do.....	Harmon.
Sand and gravel:			
Bagby-Harris Sand Co.....	P.O. Box 926 Jenks, Okla. 74037	Dredge.....	Tulsa.
Joe Brown Sand & Gravel Co.....	Box 102 Sulphur, Okla. 73086	Stationary.....	Murray.
The Dolese Co.....	13 Northwest 13th St. Oklahoma City, Okla. 73103	.....do.....	Canadian, McClain, Kingfisher, Logan, Garfield.
McMichael Concrete Co.....	Box 9486 Tulsa, Okla. 74107	Dredge.....	Tulsa.
Midcontinent Glass Sand Co.....	Roff, Okla. 74865	Stationary.....	Pontotoc.
Mohawk Rock & Sand Co.....	1340 East 16th St. Tulsa, Okla. 74120	Dredge.....	Tulsa.
Pennsylvania Glass Sand Corp. of Okla.	Berkeley Springs, W. Va. 25411	Stationary.....	Johnston.
Sand Products, Inc.....	3405 East Reno Oklahoma City, Okla. 73117	Stationary and dredge.	Oklahoma.
Tulsa Sand Co.....	Box 1954 Tulsa, Okla. 74101	Stationary.....	Pawnee, Tulsa.
Yahola Sand & Gravel Co.....	323 Merchants Bank Bldg. Ft. Smith, Ark. 72901	.....do.....	Muskogee.
Stone:			
Anchor Stone Co.....	Box 1630 Tulsa, Okla. 74106	Quarry.....	Tulsa.
Arkholand Sand & Gravel Co.....	323 Merchants Bank Bldg. Ft. Smith, Ark. 72901	.....do.....	Cherokee.
Dolese Brothers Co.....	13 Northwest 13th St. Oklahoma City, Okla., 73103	.....do.....	Caddo, Car- ter, Coal, Comanche, Kiowa, Murray, Pittsburg, Seminole.
Eagle-Picher Industries, Inc.....	P.O. Box 910 Miami, Okla. 74354	.....do.....	Ottawa.
The Quapaw Company.....	Box 72 Drumright, Okla. 74030	.....do.....	Creek, Okmulgee.
Sooner Rock and Sand Co.....	2835 Northeast 23rd Oklahoma City, Okla. 73111	.....do.....	Murray.
Standard Industries, Inc.....	P.O. Box 15670 Admiral Station Tulsa, Okla. 74115	.....do.....	Osage, Tulsa.
Trinity Concrete Products Co.....	Box 1290 Dallas, Tex. 75221	.....do.....	Atoka.
Tulsa Rock Co.....	Box 15691 Admiral Station Tulsa, Okla. 74115	.....do.....	Tulsa.
Tripoli: The Carborundum Co., American Tripoli Div.	Seneca, Mo. 64865	Open pit.....	Ottawa.
Volcanic ash: Axtell Mining Corp.....	Laverne, Okla. 73848	.....do.....	Beaver.
Helium: U.S. Bureau of Mines.....	P.O. Box 46 Keyes, Okla. 73947	Helium process- ing.	Cimarron.
Smelters:			
American Metal Climax, Inc., Blackwell Zinc Co.	Blackwell, Okla. 74631	Zinc.....	Kay.
Kaiser Chemicals, Inc.....	Tulsa, Okla. 74100	Magnesium.....	Tulsa.
National Zinc Co.....	Bartlesville, Okla. 74003	Zinc.....	Washington.

See footnote at end of table.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Petroleum refineries:			
Allied Materials Corp.....	Stroud, Okla. 74079.....	Refinery.....	Lincoln.
Apco Oil Corp.....	Cyril, Okla. 73029.....	do.....	Caddo.
Bell Oil and Gas Co.....	Ardmore, Okla. 73401.....	do.....	Carter.
Champlin Petroleum Co.....	Enid, Okla. 73701.....	do.....	Garfield.
Continental Oil Co.....	Ponca City, Okla. 74601.....	do.....	Kay.
Kerr-McGee Corp.....	Cushing, Okla. 74023.....	do.....	Payne.
Do.....	Wynnewood, Okla. 73098.....	do.....	Garvin.
Midland Cooperatives, Inc.....	Cushing, Okla. 74023.....	do.....	Payne.
Okmulgee Refining Co.....	Okmulgee, Okla. 74447.....	do.....	Okmulgee.
Sun Oil Co., DX Div.....	Duncan, Okla. 73533.....	do.....	Stephens.
Do.....	Tulsa, Okla. 74100.....	do.....	Tulsa.
Texaco Inc.....	do.....	do.....	Do.
Tonkawa Refining Co.....	Arnett, Okla. 73832.....	do.....	Ellis.
Natural gas liquids:			
Champlin Petroleum Co.....	Fort Worth, Tex. 76100.....	Natural gas liquids processing.	Garfield, Oklahoma.
Cities Service Oil Co.....	Bartlesville, Okla. 74003.....	do.....	Garfield, Kay, Oklahoma, Texas.
Humble Oil & Refining Co.....	Tulsa, Okla. 74100.....	do.....	Dewey, Kingfisher.
Mobil Oil Corp.....	Taloga, Okla. 73667.....	do.....	Dewey, Grady, Stephens, Texas, Woodward.
Phillips Petroleum Co.....	Bartlesville, Okla. 74003.....	do.....	Garvin, Oklahoma.
Skelly Oil Co.....	Oklahoma City, Okla. 73100.....	do.....	Beckham, Carter, Dewey.
Signal Oil & Gas Co.....	Ardmore, Okla. 73401.....	do.....	Carter.
Shell Oil Co.....	Tulsa, Okla. 74100.....	do.....	Stephens.
Sun Oil Co.....	do.....	do.....	Cleveland, Grant, Harper, Kay, Lincoln, McClain.
Texaco, Inc.....	do.....	do.....	Beaver, Caddo, Lincoln, Love.
Union Texas Petroleum, Div. of Allied Chemical Corp.....	do.....	do.....	Major.
Warren Petroleum Corp.....	do.....	do.....	Beaver, Garvin, Grady, Stephens.

¹ Also crushed and broken limestone, and clays.

The Mineral Industry of Oregon

By John D. Corrick ¹

The value of mineral production in Oregon increased 14 percent in 1971 to \$77.9 million, compared with the 1970 value of \$68.1 million. This was the second year showing an increase. Gains in the value of production of nickel, lime, clay, stone, and sand and gravel contributed to the increase and offset losses in the value of production of mercury and diatomite.

In the metals industries, nickel ranked first among metals produced in the State. Output of nickel increased 6.9 percent over that produced in 1970. Reynolds Metals Co. announced closure of its Troutdale aluminum reduction plant on November 30, 1971, laying off about 450 men. Oregon Metallurgical Corp., located in Albany, closed its titanium sponge production plant in 1971, resulting in 150 layoffs, which was one-half the work force. The closures were attrib-

uted to slowdowns in the Nation's economy and more specifically to cutbacks in the aircraft industry.

The Atomic Energy Commission (AEC) Licensing Board approved construction of a \$235 million nuclear generating station 30 miles northwest of Portland. When completed in 1974, the plant will generate 1.1 million kilowatts of electricity.

Nonmetals accounted for 90 percent of the total mineral value produced in Oregon in 1971. Sand and gravel production increased 15 percent in 1971, and stone production increased 3 percent compared with that of 1970. Stone and sand and gravel accounted for 79 percent of the total value of nonmetals produced in 1971. Output of clay and shale increased 17 percent over

¹ Physical scientist, Division of Ferrous Metals.

Table 1.—Mineral production in Oregon ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays..... thousand short tons..	² 134	² \$180	157	\$255
Copper..... do.....	W	W	3	3
Diatomite..... do.....	500	5	70	1
Emery..... do.....	--	--	1	W
Gem stones.....	NA	750	NA	755
Gold (recoverable content of ores)..... troy ounces..	256	9	244	10
Lead (recoverable content of ores)..... short tons..	(³)	(³)	--	--
Lime..... thousand short tons..	96	1,777	106	1,989
Mercury..... 76-pound flasks..	274	112	W	W
Nickel (content of ores and concentrates)..... short tons..	15,933	W	17,036	W
Pumice and volcanic cinder..... thousand short tons..	^r 939	^r 1,221	868	1,239
Sand and gravel..... do.....	17,532	25,978	20,230	28,707
Silver (recoverable content of ores)..... thousand troy ounces..	4	6	4	6
Stone..... thousand short tons..	13,439	20,948	13,794	26,708
Value of items that cannot be disclosed: Bauxite (1970), cement (portland and masonry), clay (fire) (1970), talc, tungsten (1971), and values indicated by symbol W.....	XX	^r 17,095	XX	18,212
Total.....	XX	^r 68,081	XX	77,885
Total 1967 constant dollars.....	XX	60,898	XX	^p 67,666

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

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

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

³ Less than ½ unit.

Table 2.—Value of mineral production in Oregon, by county
(Thousands)

County	1970	1971	Minerals produced in 1971, in order of value
Baker.....	r \$6,211	\$8,249	Cement, stone, sand and gravel, pumice, clays, gold, silver, copper, tungsten.
Benton.....	1,080	434	Sand and gravel, stone, clays.
Clackamas.....	11,433	12,495	Cement, sand and gravel, stone, clays.
Clatsop.....	505	W	Stone, sand and gravel.
Columbia.....	W	W	Sand and gravel, stone.
Coos.....	814	634	Stone, sand and gravel.
Crook.....	196	353	Stone, sand and gravel, clays.
Curry.....	582	W	Stone, sand and gravel.
Deschutes.....	r 772	852	Pumice, stone, sand and gravel.
Douglas.....	W	10,294	Nickel, stone, sand and gravel, mercury.
Gilliam.....	W	W	Stone, sand and gravel.
Grant.....	538	1,011	Stone, sand and gravel, gold.
Harney.....	W	W	Stone.
Hood River.....	W	W	Stone, sand and gravel.
Jackson.....	975	1,700	Sand and gravel, stone.
Jefferson.....	W	W	Do.
Josephine.....	799	2,076	Sand and gravel, stone, talc, gold.
Klamath.....	r 2,855	2,228	Stone, sand and gravel, pumice, clays.
Lake.....	239	656	Stone, pumice, sand and gravel, diatomite.
Lane.....	3,046	5,233	Sand and gravel, stone, clays.
Lincoln.....	701	1,033	Stone, sand and gravel.
Linn.....	1,233	833	Sand and gravel, stone, emery.
Malheur.....	W	1,360	Stone, lime, sand and gravel.
Marion.....	550	1,120	Sand and gravel, clays, stone.
Morrow.....	W	W	Stone, sand and gravel.
Multnomah.....	7,402	7,940	Lime, sand and gravel, stone, clays.
Polk.....	709	422	Sand and gravel, stone.
Sherman.....	612	46	Stone.
Tillamook.....	409	308	Stone, sand and gravel, clays.
Umatilla.....	593	2,008	Stone, sand and gravel.
Union.....	632	1,676	Do.
Wallowa.....	513	474	Do.
Wasco.....	869	W	Sand and gravel, stone.
Washington.....	2,276	2,131	Stone, sand and gravel, clays.
Wheeler.....	W	60	Sand and gravel.
Yamhill.....	580	456	Sand and gravel, stone, clays.
Undistributed ¹	r 21,002	11,746	
Total ²	r 68,081	77,885	

¹ Revised. W Withheld to avoid disclosing individual company confidential data.

² Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

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

that produced in 1970.

Considerable interest and activity occurred during 1971 regarding Oregon's jurisdiction in Federal wilderness areas. Oregon's Environmental Quality Commission held public hearings during the year on tough antipollution standards designed to prevent mining activities in wilderness areas. The imposition of strict State standards on Federal recreation areas was first tried as a means of blocking the U.S. Pumice Co. from mining pumice claims in the Rock Mesa and Three Sisters Wilderness areas.

Employment, Trade, and Markets.—The 1971 estimated average employment in Oregon was 888,700 out of a work force of 948,400, compared with 872,600 out of 927,900 in 1970, according to figures published by the Oregon Department of Employment. Total unemployment dropped

from 6.0 to 5.6 percent of Oregon's labor force between October and November, bringing Oregon's unemployment rate below that of the Nation for the first time since May 1966. However, 1971 closed on an adverse note when unemployment increased from 5.6 percent in November to 5.9 percent in December. Average unemployment was estimated at 6.3 percent for 1971, compared with an average 5.6 percent for 1970. Contributing to this increased unemployment rate was the closure of a major smelter and unfavorable markets, which resulted in a decrease of 400 in the metals industries employment during December. Oregon's seasonally adjusted wage and salary employment index² was reported as 113.6 in December 1971, compared with 109.4 in December 1970. This compared

² This index and all others used in the text assume a base of 1967 = 100.

Table 3.—Indicators of Oregon business activity

	1970	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force..... thousands.....	927.9	948.4	+2.2
Unemployment..... do.....	55.3	59.7	+8.0
Employment:			
Construction..... do.....	28.2	30.4	+7.8
Lumber and wood products..... do.....	66.9	67.3	+ .6
Food products..... do.....	23.9	24.1	+ .8
Mining..... do.....	1.3	1.4	+7.7
Manufacturing..... do.....	171.6	174.4	+1.6
Personal income:			
Total..... millions.....	^r \$7,777	\$8,460	+8.8
Per capita..... do.....	\$3,700	\$3,920	+5.9
Construction activity:			
Number of authorized private and public residential units.....	^r 16,980	26,065	+53.5
Value of nonresidential construction..... millions.....	^r \$101.4	\$148.1	+46.1
Value of highway contracts awarded..... do.....	\$99.3	NA	NA
Cement shipments to and within Oregon, thousand 376-pound barrels.....	3,423.0	3,746.0	+9.4
Cash receipts from farm marketings..... millions.....	\$560.1	NA	NA
Mineral production value..... do.....	\$68.1	\$77.9	+14.4

^p Preliminary. ^r Revised. NA Not available.

Sources: Survey of Current Business; Construction Review; Farm Income Situation; Oregon Labor Force Trends; Employment and Earnings and Monthly Report on the Labor Force; Roads and Streets; and U.S. Bureau of Mines.

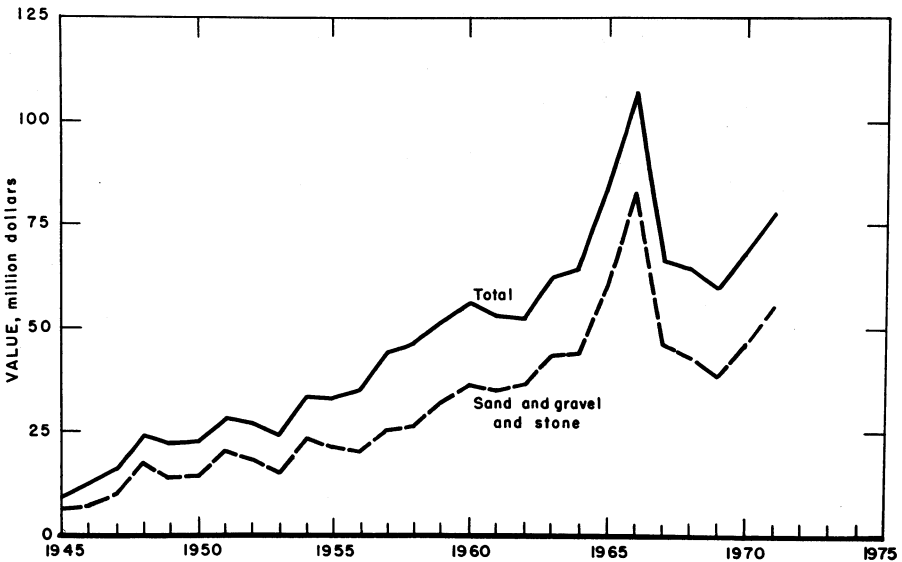


Figure 1.—Value of sand and gravel and stone, and total value of mineral production in Oregon.

favorably with the National pattern of 109.9 in December of 1971 and 107.4 in December 1970.

The downward trend in Oregon's economy, which began in 1969, continued

through 1971. Part of the business downturn could be traced to a west coast dock strike of long duration. The wage and salary index continued to increase during 1971 peaking at yearend near 114. Hourly

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Coal.....	4	57	(¹)	2	--	--	42.15	42,206
Metal.....	112	185	21	166	1	6	19.89	268
Nonmetal.....	115	218	25	201	--	4	24.07	6,285
Sand and gravel.....	1,271	218	277	2,202	2	51	33.94	4,984
Stone.....	1,425	217	309	2,475	1	83		
Total ²	2,927	216	632	5,046	4	144	29.33	6,587
1971: ^p								
Coal.....	5	48	(¹)	2	--	--	6.10	1,831
Metal.....	120	169	20	164	--	1	9.01	162
Nonmetal.....	80	171	14	111	--	1	25.85	3,386
Sand and gravel.....	1,360	204	277	2,321	1	59	32.24	613
Stone.....	1,395	228	319	2,605	--	84		
Total ²	2,965	213	630	5,202	1	145	28.06	1,879

^p Preliminary.¹ Less than 500.² Data may not add to totals shown because of independent rounding.

earnings in manufacturing rose 8.3 percent above the amount reported for a similar period in 1970; average weekly hours worked in December 1971 were 39.2, compared with 38.6 the previous December. Gains in average weekly hours worked in lumber and wood products, furniture and fixtures, fabricated metal products, and machinery more than offset the slight decline that occurred in the primary metals industry between December 1970 and December 1971. Labor turnover rates for December indicated a moderate slowdown in employment activity. Separation and accession rates, after seasonal adjustments, declined significantly during December. However, analysis of more frequently used economic indicators, new hires, and quits and layoffs, indicated a continuing overall improvement in the demand for factory labor. During the latter half of 1971 labor statistics had moved gradually toward levels of the more prosperous, prerecession period of 1969. Most manufacturing industries reversed a downward trend in hiring rates during December. Principal exception to

this reversal was in the metals industry where product demand remained slow, resulting in a more than normal reduction in new hires. Yearend factory separation data were encouraging. Quit rates at yearend were 2.4 per 100 employees, highest since January 1970 (2.9) and reflected workers assessment of availability of new job opportunities. The December layoff rate of 1.6 per 100 employees was down 0.4 from November and 1.0 from 1970. In combination, these two indicators gave an optimistic view of the general labor situation in Oregon at yearend.

During the last 2 decades Oregon has played an increasingly more active role in international trade. Foreign trade was and is one of Oregon's fastest growing economic activities. Data from Oregon's Executive Department for 1969 showed a combined value of imports and exports of more than \$1 billion; \$655 million from exports and \$361 million from imports. This represented an increase of 249.2 percent in imports and 77.6 percent in exports for the period 1960-69.³

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Output of portland cement increased for the second consecutive year. Production in 1971 exceeded that of 1970 by 1 percent. Oregon's only cement producer, Oregon Portland Cement Co., oper-

ated two plants, one at Lime, Baker County, and the other at Oswego, Clackamas County.

Combined shipments from three plants

³ Van der Ster, Wim. International Business Promotion in Oregon. Oregon Business Review, v. XXX, No. 9, September 1971, p. 1.

located in Oregon and Nevada totaled 4.5 million barrels (376-pounds each) of finished portland cement in 1971; these same plants shipped 4.1 million barrels in 1970. Average value of portland cement shipped from these plants in 1971 increased over that of the previous year.

Clays.—Output of clay and shale increased 17 percent in 1971 over that produced in 1970. Seventeen mines were responsible for the 156,980 tons of clay and shale produced during 1971. Eleven counties accounted for Oregon's clay and shale production in 1971 with the major portion being produced in Washington, Baker, and Multnomah Counties. Value of production increased 42 percent compared with that of the previous year. Increased consumption of clay and shale occurred principally in the manufacture of light-weight aggregate; decreased consumption occurred principally in heavy building bricks, heavy drain tile, and cement.

Lime.—Ash Grove Cement Co., Amalgamated Sugar Co., and Pacific Carbide & Alloys Co. produced 106,000 tons of lime in Malheur and Multnomah Counties for sugar refining, paper and pulp, calcium carbide, and other uses. Output increased 10 percent but was 12 percent below the 1968 record. The lime was consumed principally in Oregon and Washington.

Oregon Portland Cement Co. completed in early 1971 new lime storage and loading facilities at the Lake Oswego manufacturing plant. The new plant equipment provided more efficient materials handling for bulk delivery. During the year the company acquired a considerable quantity of dolomitic lime and 20,000 tons of dolomite ready for distribution, along with an additional 3 million ton reserve.

Pumice and Volcanic Cinder.—Output of pumice decreased 8 percent during 1971, compared with that of 1970. The major portion of the 868,361 tons produced in 1971 was for roads. Other uses for pumice were in concrete aggregate, concrete admixture (pozzolan), landscaping, and miscellaneous uses.

A public hearing was held at Bend early in 1971 on State Senate Bill 1784 for restricting mining in the Three Sisters Wilderness area. U.S. Pumice Co. of California held 10 mining claims covering 1,460 acres of Rock Mesa, a volcanic area 4 miles southwest of South Sister Mountain. Validity of

pumice claims in the Rock Mesa area was being investigated by a volunteer team from the University of Oregon. The group hoped to raise questions regarding the economic value of the claims and thereby force a contest of the claims by the U.S. Forest Service.

Sand and Gravel.—Output of sand and gravel increased for the third consecutive year. Production in 1971 amounted to 20,230,000 tons valued at \$28,707,000, an increase of 15 percent in quantity and 11 percent in value over that of 1970. Output for preceding years was 19.6 million tons in 1967, 18.3 million tons in 1968, 15.7 million tons in 1969, and 17.5 million tons in 1970.

All but Harney and Sherman Counties reported production of sand and gravel in 1971. A total of 195 mines and pits were in operation during the year. Principal production came from Multnomah, Clackamas, and Lane Counties.

The State of Oregon filed a lawsuit against Corvallis Sand and Gravel Co. to halt gravel mining from the Willamette River bed and to recover \$600,000 for gravel removed since 1959. The river shifted course in 1909 following a series of floods and covered a farm to which Corvallis had title and was mining. The State claimed title to the land since it is presently the bed of a navigable river.

Stone.—Production of stone in Oregon during 1971 increased 3 percent from that of the previous year. Major uses of stone were in dense graded roadbase stone, unspecified aggregate and roadstone, concrete aggregate, and surface treatment aggregate. Increased consumption of stone in concrete aggregate (141 percent) and unspecified aggregate and roadstone (21 percent) more than offset decreased consumption in surface treatment aggregate (63 percent) and bituminous aggregate (8 percent).

Clatsop County commissioners held a public hearing December 15 on Rock Island Constructors Corp.'s application for renewal of its rock quarry permit. The commissioners claimed the company permitted toxic sludge from organic and inorganic deposits to pollute Big Creek. Rock Island denied that its operations harmed fish life in the stream. A decision on permit renewal had not been reached by the end of 1971.

A deposit containing approximately 250 million tons of 98-percent pure calcite (limestone) was slated for development by

Table 5.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	1,213	\$1,780	1,960	\$2,594
Fill.....	368	311	727	569
Paving.....	819	997	535	738
Other uses ¹	247	296	116	165
Total ²	2,648	3,384	3,338	4,067
Gravel:				
Building.....	2,951	3,918	4,802	6,716
Fill.....	875	594	969	896
Paving.....	4,775	6,360	7,113	11,523
Miscellaneous.....	90	106	360	538
Other uses ³	819	944	295	238
Total ²	9,510	11,922	13,537	19,911
Government-and-contractor operations:				
Sand:				
Building.....	--	--	28	84
Fill.....	6	3	--	--
Paving.....	217	347	77	77
Other uses.....	6	4	--	--
Total ²	228	354	105	161
Gravel:				
Building.....	155	89	148	224
Fill.....	37	19	100	77
Paving.....	4,954	10,208	3,001	4,268
Total ²	5,147	10,317	3,250	4,568
Total sand and gravel ²	17,532	25,978	20,230	28,707

¹ Includes railroad ballast, engine, and other sands.

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

³ Includes railroad ballast and other gravel.

Oregon Calcite Corp., a subsidiary of California Time Petroleum Inc. A 100-million-ton section of the ore body was exposed on three sides making it readily amenable to open pit mining. However, on September 3, 1971, the Federal Bureau of Land Management declared void mining claims held by Oregon Calcite Corp. near Oregon Caves National Monument. The claims were voided on the basis of a 1907 order, a prelude to a proclamation by the President in 1909 creating the Oregon Caves National Monument. An appeal filed by Oregon Calcite Corp. with the Board of Land Appeals of the Department of the Interior was dismissed on November 2, 1971, when the company failed to file a statement of reasons for appealing within the 30-day time limit.

Matterhorn Mountain, highest peak in the Eagle Cap Wilderness, Wallowa-Whitman National Forest, was being purchased from limestone claim holders by the U.S. Forest Service. The entire mountain had

been held for more than 40 years by private individuals; however, no mining had taken place.

METALS

Aluminum.—Aluminum production declined 18 percent in 1971, compared with that of 1970. The principal reason for the decline in production was closure by Reynolds Metals Co. of its Troutdale smelter. By the end of November, Reynolds had shutdown two 48,000-ton potlines and laid off approximately 450 employees. Layoff actions since December 1970 have affected about 1,000 employees. The Troutdale closure cut Reynolds' world-wide production to about 70 percent of capacity. Company officials expected the facilities to be reactivated when economic conditions in the United States and abroad improved. A newly added 30,000-ton capacity potline was not placed in operation because of market conditions and the plant's closure.

Table 6.—Stone sold or used by producers, by use
(Thousand short tons and thousand dollars)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Bituminous aggregate.....	1,290	\$1,957	1,185	\$2,062
Concrete aggregate.....	688	1,488	1,658	5,956
Dense graded roadbase stone.....	3,794	5,241	4,529	7,116
Macadam aggregate.....	381	562	439	699
Surface treatment aggregate.....	3,820	5,653	1,402	2,167
Unspecified aggregate and roadstone.....	2,472	4,278	2,992	5,954
Abrasives.....	23	118	W	W
Ferrosilicon.....	10	92	W	W
Fill.....	W	W	94	72
Railroad ballast.....	W	W	375	513
Riprap and jetty stone.....	307	471	500	1,045
Other ¹	655	1,088	621	1,125
Total ²	13,439	20,948	13,794	26,708

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

¹ Includes building stone (dimension); stone used at cement, paper and chemical plants; sugar refineries; agricultural and building purposes, drain fields, flux, glass and for miscellaneous unspecified purposes; also, lime and roofing aggregates (1970) and terrazzo (1971).

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

AMAX Pacific Corp., a subsidiary of American Metals Climax, Inc. (AMAX), announced a 1-year delay in starting construction of its planned \$120 million aluminum reduction plant near Warrenton. Construction of two potlines having a combined capacity of 150,000 tons per year of aluminum will not be started until spring 1972 with completion scheduled for 1974. Company officials stated that its decision to delay construction was made in order to give Governmental authorities time to investigate environmental concerns. AMAX Pacific Corp. signed technology contracts with Kaiser Aluminum & Chemical Corp. and Kaiser Technical Services in late 1971. Kaiser will provide technical criteria, plans, and specifications for the plant. AMAX will use Kaiser pots, carbon plant, and air pollution abatement facilities.

Anodizing, Inc., of Portland installed one of the largest aluminum hard-anodizing facilities in the United States. The new facility will be capable of hard-anodizing aluminum in 30-foot lengths. The treated aluminum will have a surface hardness equal to hardened steel. Aluminum thus treated can be used in applications with heavy-duty wear requirements such as air-cylinders, bearing surfaces, tooling plate, molds, gears, and dies.

Rem Metals Corp., long-known for expertise in zirconium and titanium metallurgy, reached agreements with two German firms, W. C. Heraeus GmbH and Honsel-Werke AG, to become the exclusive U.S. agent for Heraeus' and Honsel-Werke's alu-

minum and magnesium products. Honsel-Werke was the largest producer of aluminum and magnesium castings in West Germany.

Gold and Silver.—A total of 244 ounces of gold, valued at \$10,065, was produced from 3 placer and 2 lode mines in 1971. Silver recovered from ores amounted to 3,790 ounces, valued at \$5,859. The average annual price was \$41.25 per ounce for gold and \$1.55 per ounce for silver.

Company officials of Nuclear Exploration and Development Corp. reported that gold mining operations had resumed at Bald Mountain gold mine, 9 miles southwest of Sumpter. Approximately 25 tons of gold and silver ore was shipped daily to the American Smelting and Refining Co.'s smelter at Tacoma, Wash. E. R. Wells of Elgin reported exposing a silver-bearing vein, which has an average width of 2½ feet, for a distance of 1,000 feet. Wells and associates proposed construction of a 40-ton-per-day stamp mill near the McCully mine, Mt. Joseph, Wallowa County. Concentrates were to be shipped to the Bunker Hill smelter at Kellogg, Idaho.

Iron and Steel.—During 1971, production at Midland-Ross Corp.'s Oregon facilities were interrupted for equipment modifications and by receipt of ore that did not meet specifications. Research conducted by Midland-Ross resulted in the installation of new equipment that reduced production costs and increased the versatility of the company's iron pellets.

Mercury.—Mercury production in Oregon

during 1971 decreased significantly from that produced in 1970. Only two mines operated during 1971, compared with five mines in 1970. Alcona Mining, Inc.'s Elkhead mine, located in Douglas County, produced the major portion of mercury in the State.

Nickel.—Hanna Mining Co. processed 1,234,499 tons of nickel laterite ore containing 1.38 percent nickel from the Nickel Mountain mine in Douglas County. The ore contained 17,036 tons of nickel, 13,073 tons of which were recovered in 25,634 tons of ferronickel. This represented a 3.4-percent increase in nickel recovered over 1970. Hanna announced plans to expand nickel production capacities at Riddle and foreign affiliates to some 43 million tons annually by 1973. Ferronickel produced by Hanna contained nearly equal parts of nickel and iron and was used to produce stainless and other nickel-bearing alloy steels.

Titanium.—Oregon Metallurgical Corp. (Oremet) of Albany increased prices for titanium alloy ingots on March 16. The increase ranged from 4 to 8 percent on selected alloys. Oremet's action raised the base price of alloy 6 Al-4 V standard-grade (300,000 pound lots and over) from \$1.45 per pound to \$1.53 and alloy 6 Al-4 V premium-grade from \$1.65 to \$1.73. Oremet closed its titanium sponge production plant at midyear, resulting in layoffs of 150 employees or approximately one-half the work force. The plant's closure was attributed to cutbacks in the aircraft industry. Oremet, the smallest of three domestic producers of titanium, had a capacity of approximately one-third that of the largest producer, Titanium Metals Corp. of America (TMCA).

Zirconium Technology Corp. (Zirtech), manufacturer of seamless titanium and zirconium tubing for nuclear and aerospace applications, announced appointment of Kawecki Berylco Industries (KBI) as its exclusive sales agent. The agreement should improve Zirtech's sales coverage as KBI has a worldwide sales organization with annual sales in excess of \$60 million. Spokesman for KBI stated that the company was interested in possible development of columbium and tantalum tubing products utilizing Zirtech's facilities.

Rem Metals Corp., which entered the titanium powder metal business in 1970 by

purchasing the assets of Fansteel, Inc., Harbor City, Calif., operation, continued to diversify by purchasing McCormack Engineering Co., Inc., of Lake Oswego. McCormack Engineering is a producer of refrigeration products. The acquisition was part of Rem Metal's plans to maintain a balance between commercial and aerospace markets.

A new company, Space-Age Metals of Albany, was formed during 1971 to produce titanium castings.

MINERAL FUELS

Geothermal Power.—The First Northwest Conference on Geothermal Power held May 21 at Olympia, Wash., had over 200 people in attendance. Sessions dealt with expected shortages of electrical power in the Northwest, environmental problems, the need for geothermal power, operation of geothermal plants, new developments in geothermal exploration, and implementation of the Geothermal Steam Act of 1970. Oregon enacted a law giving the Department of Geology and Mineral Industries authority to regulate and supervise operations involving location, drilling, redrilling, operating, and abandonment of wells for production of geothermal resources.

Several ranchers in Klamath and Lake Counties agreed to lease portions of their lands for geothermal exploration. A partnership was formed to exploit geothermal resources on the 20,000-acre O'Connor Ranch lying north and south of Klamath Falls in Klamath County.

Nuclear.—Portland General Electric Co., representing a consortium including the city of Eugene, and Pacific Power and Light Co., applied for and was granted a license by AEC's Licensing Board for construction of a \$235 million nuclear generating station 30 miles northwest of Portland. A work force of 129 men began working at the plant site during 1971. The installation, known as the Trojan Nuclear Power Plant, will generate 1.1 million kilowatts of electricity when completed in 1974.

Pacific Power and Light Co. purchased 17 parcels of land in the One Horse Slough area of Golden Valley near Lebanon. The land may be used for a nuclear power plant. Pacific Power and Light and Portland General Electric Co. pledged \$3.2 million in financing over a 10-year period toward a national effort to develop a new

type of breeder reactor demonstration plant.

Petroleum.—Standard Oil of California negotiated with Oregon for oil exploration leases on 15,288 acres of State-owned land in eastern Oregon. The State Board approved a 5-year lease that will return an annual rental of \$0.50 per acre to the State. In case of oil production, Oregon would receive a 12½-percent royalty on production. Standard also filed to renew its exploration permit on State-owned submerged lands along Oregon's coast.

Early in 1971, Texaco, Inc., obtained a State permit to drill a 10,000-foot exploration hole. The site was on Federal land 65 miles east of Bend and 6 miles south-

west of Paulina. Drilling started about the middle of September and was abandoned on November 21, after reaching a depth of 8,000 feet. Three other drill holes in the area, completed several years ago, were dry.

Other companies showing interest in Oregon's petroleum potential were Ray Geophysical of Houston, Tex., and Conestoga Oil Co. of Colorado. Ray made a geophysical survey in the vicinity of Burns and expected to sell results of the survey to oil companies interested in taking up leases in the area. Conestoga was reported seeking land leases in the Golden Valley area, northeast of Lebanon, and was expected to explore for oil and gas.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
NONMETALS			
Cement:			
Oregon Portland Cement Co....	111 Southeast Madison St. Portland, Ore. 97214	Plant.....	Baker and Clackamas.
Clays:			
Central Oregon Bentonite Co....	Bear Creek Route Prineville, Ore. 97754	Pit and plant....	Crook.
Ceramco, Inc.....	P.O. Box 5 McMinnville, Ore. 97128	-----do-----	Yamhill.
Columbia Brick Works.....	1320 Southeast Water St. Portland, Ore. 97214	-----do-----	Multnomah.
Corvallis Brick & Tile Works, Inc.....	P.O. Box 327 Corvallis, Ore. 97330	-----do-----	Benton.
Empire Lite-Rock, Inc.....	9255 Northeast Halsey St. Portland, Ore. 97220	-----do-----	Washington.
Klamath Falls Brick & Tile Co....	P.O. Box 573 Klamath Falls, Ore. 97601	-----do-----	Klamath.
Mandrones Mining Co., Inc.....	Rt. 1, Box 337 Molalla, Ore. 97038	Pit.....	Clackamas.
McMinnville Brick Co.....	451 College Ave. McMinnville, Ore. 97128	Pit and plant....	Yamhill.
Monmouth Brick & Tile Co.....	Rt. 1, Box 22 Monmouth, Ore. 97361	-----do-----	Polk.
Monroe Clay Products Co.....	P.O. Box A Monroe, Ore. 97456	-----do-----	Benton.
Needy Brick & Tile Co.....	Rt. 1, Box 102 Hubbard, Ore. 97032	-----do-----	Clackamas and Marion.
Oregon Portland Cement Co....	111 Southeast Madison St. Portland, Ore. 97214	Pit.....	Baker.
Scholls Tile Co.....	Rt. 2, Box 208 Hillsboro, Ore. 97123	Pit and plant....	Washington.
Tillamook Clay Works.....	6690 Brickyard Rd. Tillamook, Ore. 97141	-----do-----	Tillamook.
Willamina Clay Products Co., Inc.....	9780 Southwest Hunziker St. Tigard, Ore. 97223	-----do-----	Yamhill and Lane.
Diatomite:			
A. M. Matlock.....	P.O. Box 3307 Eugene, Ore. 97402	Mine and plant...	Lake.
Lime:			
Amalgamated Sugar Co.....	Nyssa, Ore. 97913	Plant.....	Malheur.
Ash Grove Cement Co.....	101 West 11th St. Kansas City, Mo. 64105	-----do-----	Multnomah.
Pacific Carbide & Alloys Co....	P.O. Box 17008 Portland, Ore. 97200	-----do-----	Do.
Perlite (expanded):			
Supreme Perlite Co.....	P.O. Box 66 North Portland, Ore. 97043	-----do-----	Do.
Pumice:			
Central Oregon Pumice Co.....	5 Greenwood Ave. Bend, Ore. 97701	Mine and plant...	Deschutes.
Graystone Corp.....	Box 1087 Bend, Ore. 97701	-----do-----	Do.
Chester Hiatt.....	147 North 12th St. Redmond, Ore. 97756	-----do-----	Do.

Table 7.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
NONMETALS—Continued			
Pumice—Continued			
Oregon Portland Cement Co.	111 Southeast Madison St. Portland, Oreg. 97214	Mine	Baker.
Jed Wilson & Son	Box 125 La Pine, Oreg. 97739	Mine and plant	Lake.
Roofing Granules:			
Flintkote Co.	P.O. Box 2744 Portland, Oreg. 97208	Plant	Multnomah.
Sand and gravel:			
Albany Rock Products Co.	Rt. 1, Box 232K Albany, Oreg. 97321	Pit and Plant	Linn.
Baker Rock Crushing	2030 East Main St. Hillsboro, Oreg. 97123	....do.....	Washington.
Bethel-Danebo Sand & Gravel ..	150 Bertelsen Rd. South Eugene, Oreg. 97402	....do.....	Lane.
Copeland Sand & Gravel	695 Southeast J St. Grants Pass, Oreg. 97526	....do.....	Josephine.
Delta Sand & Gravel	999 Division Ave. Eugene, Oreg. 97402	....do.....	Lane.
Eugene Sand & Gravel	Box 1067 Eugene, Oreg. 97401	....do.....	Do.
Glacier Sand & Gravel	5975 East Marginal Way Seattle, Wash. 98134	Pit and plant	Multnomah.
McKenzie Sand & Gravel	Box 347 Eugene, Oreg. 97400	....do.....	Lane.
M. P. Materials	645 Seventh St. Salem, Oreg. 97300	....do.....	Marion.
Milwaukie Sand & Gravel	1635 Southeast McLoughlin Blvd. Milwaukie, Oreg. 97222	Dredge and plant ..	Clackamas.
Morse Brothers	Lebanon, Oreg. 97355	Pit and plant	Benton and Linn.
Chas. T. Parker Construction ..	6457 Northeast Columbia Blvd. Portland, Oreg. 97203	....do.....	Multnomah and Columbia.
Portland Sand & Gravel	10717 Southeast Division Ave. Portland, Oreg. 97266	....do.....	Multnomah.
Rich Valley Top Soil Co.	Box 30 Oregon City, Oreg. 97045	....do.....	Clackamas.
Rock Creek Sand & Gravel	Clackamas, Oreg. 97015 .....	....do.....	Multnomah.
Roseburg Sand & Gravel	Box 1207 Roseburg, Oreg. 97470	....do.....	Douglas.
Ross Island Sand & Gravel	4129 Southeast McLoughlin Blvd. Portland, Oreg. 97200	Dredge and plant ..	Multnomah.
Umpqua River Navigation Co. ..	Box 25 Reedsport, Oreg. 97467	....do.....	Douglas.
Willamette Hi-Grade Concrete Co.	Foot North Portsmouth Ave. Portland, Oreg. 97203	....do.....	Multnomah.
Stone:			
L. V. Anderson	Box 757 Oakridge, Oreg. 97463	Quarry and plant ..	Lane.
Beaver State Sand & Gravel, Inc.	Winchester, Oreg. 97495	Quarry	Douglas.
Boise Cascade Corp.	La Grande, Oreg. 97850	Quarry and plant ..	Union, Umatilla, Wallowa.
L. H. Cobb	3275 Southwest 145th Ave. Beaverton, Oreg. 97005	....do.....	Washington.
Eckman Creek Quarries	Box 15 Waldport, Oreg. 97394	....do.....	Lincoln.
Goodat Crushed Rock	P. O. Box 488 Longview, Wash. 98632	Quarry	Columbia.
L. W. Govro	Rt. 4, Box 253-W Albany, Oreg. 97321	Quarry and plant ..	Linn.
Grant Construction Co.	Hayden Lake, Idaho	Quarry	Various.
Roy L. Houck Sons	1153 Chemeketa Northeast Salem, Oreg. 97301	Quarry and plant ..	Coos, Various.
Peter Kiewit Sons Co.	Box 1777 Vancouver, Wash. 98663	....do.....	Various.
Materne Bros	Box 0—Rosewood Station Spokane, Wash. 99208	....do.....	Do.
Oregon Portland Cement Co.	111 Southeast Madison St. Portland, Oreg. 97214	....do.....	Baker.
Pacific Crushing Co.	610 Irving Drive Eugene, Oreg. 97402	....do.....	Klamath, Lane.
Pioneer Construction Co.	7881 Northwest St. Helens Rd. Portland, Oreg. 97229	....do.....	Multnomah.
Quality Rock Co.	Rt. 2, Box 608 Beaverton, Oreg. 97005	....do.....	Washington.
Rogue River Paving Co., Inc.	1133 South Riverside Medford, Oreg. 97501	....do.....	Coos, Douglas, Jackson, Josephine.

Table 7.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
NONMETALS—Continued			
Stone—Continued			
Roseburg Sand & Gravel Co.	Box 1207 Roseburg, Ore. 97470	Quarry and plant.	Coos, Douglas, Lane.
Sunset Crushed Rock	Clatsop Airport Astoria, Ore. 97103	-----do-----	Clatsop.
Talc and Soapstone:			
John H. Pugh	2891 Elk Lane Grants Pass, Ore. 97526	Mine	Josephine.
Vermiculite (exfoliated):			
Supreme Perlite Co.	P.O. Box 66 North Portland, Ore. 97043	Plant	Do.
Vermiculite-Northwest, Inc.	P.O. Box A Auburn, Wash. 98002	-----do-----	Do.
METALS			
Aluminum:			
Reynolds Metals Co.	Troutdale, Ore. 97060	Plant ¹	Multnomah.
Ferroalloys:			
Hanna Nickel Smelting Co.	Riddle, Ore. 97469	-----do-----	Douglas.
Union Carbide Corp., Ferro- alloys Div. ²	Portland, Ore. 97200	-----do-----	Multnomah.
National Metallurgical Co.	Springfield, Ore. 97477	-----do-----	Lane.
Gold and Silver:			
Baker Assets Co.	Baker, Ore. 97814	Mine and mill	Baker.
Cornucopia Placer Co.	Halfway, Ore. 97834	Placer	Do.
Mercury:			
Alcona Mining, Inc.	366 South 79th St. Springfield, Ore. 97477	Mine	Douglas.
Nickel:			
Hanna Mining Co.	Riddle, Ore. 97469	-----do-----	Do.
Steel:			
Cascade Steel Rolling Mills, Inc.	McMinnville, Ore. 97128	Plant	Yamhill.
Oregon Steel Mills	Portland, Ore. 97200	-----do-----	Multnomah.
Titanium:			
Oregon Metallurgical Corp.	Albany, Ore. 97321	-----do-----	Linn.
Rem Metals Corp.	P.O. Box 829 Albany, Ore. 97321	-----do-----	Do.
Tungsten:			
Frank Ramsey	3445 Court St. Baker, Ore. 97814	Mine	Baker.
Zirconium:			
Wah Chang Albany Corp.	Albany, Ore. 97321	Plant	Linn.

¹ Closed November 30, 1971.² Produces ferromanganese and silicomanganese.

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 the mineral production from mines, quarries, and wells.

By Franklin D. Cooper ¹

Pennsylvania mineral production reached a record output value of \$1,149.1 million, a \$53.4 million increase above that of 1970. Compared with 1970, increases in value were attained by cements, bituminous coal, copper, gem stones, lime, and sand and gravel. Output value decreases were noted for anthracite, clays excluding kaolin, natural gas, peat, crude petroleum, stone, and

zinc. The value of all natural gas liquids was 16 percent less than in 1970.

Compared with the 1970 figures, the average f.o.b. mine value of anthracite increased \$1.03 per ton and that of bituminous coal advanced \$1.24 per ton. Collectively, solid-fuels production ac-

¹ Physical scientist, Division of Fossil Fuels.

Table 1.—Mineral production in Pennsylvania ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland.....thousand 376-pound barrels..	40,909	\$121,100	41,753	\$140,460
Masonry.....thousand 280-pound barrels..	2,804	8,324	2,994	11,247
Clays ².....thousand short tons..	2,665	15,845	2,325	8,940
Coal:				
Anthracite.....do..	9,729	105,341	8,727	103,469
Bituminous.....do..	80,491	585,057	72,835	620,196
Copper.....short tons..	2,539	2,930	3,349	3,483
Gem stones.....do..	NA	4	NA	9
Lime.....thousand short tons..	1,887	29,279	1,760	30,008
Mica, scrap.....do..	1	60	W	W
Natural gas.....million cubic feet..	76,841	21,439	76,451	20,770
Natural gas liquids:				
Natural gasoline and cycle products				
thousand 42-gallon barrels..	19	50	W	W
LP gases.....do..	34	87	W	W
Peat.....thousand short tons..	44	517	38	461
Petroleum (crude).....thousand 42-gallon barrels..	4,093	18,500	3,798	17,699
Sand and gravel.....thousand short tons..	18,504	33,915	19,668	36,162
Stone.....do..	66,241	120,187	64,467	118,469
Zinc (recoverable content of ores, etc.).....short tons..	29,554	9,055	27,438	8,835
Value of items that cannot be disclosed: Clays (kaolin, cobalt, gold, iron ore, pyrites, sericite- schist (1970), silver, tripoli and values indicated by symbol W.....	XX	24,053	XX	28,899
Total.....	XX	1,095,743	XX	1,149,107
Total 1967 constant dollars.....	XX	980,142	XX	P 998,344

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

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

² Excludes kaolin which is included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Pennsylvania, by county ¹
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Adams.....	W	W	Stone, lime, clays.
Allegheny.....	\$35,582	\$47,246	Coal, cement, sand and gravel, clays, stone.
Armstrong.....	W	54,037	Coal, sand and gravel, clays, stone.
Beaver.....	W	W	Sand and gravel, coal, clays.
Bedford.....	W	W	Stone, sand and gravel, coal.
Berks.....	W	32,734	Cement, iron ore, stone, clays, sand and gravel, pyrites, cobalt.
Blair.....	2,110	W	Stone, sand and gravel.
Bradford.....	W	W	Sand and gravel.
Bucks.....	W	W	Stone, sand and gravel, clays.
Butler.....	W	21,022	Coal, cement, stone, lime, sand and gravel.
Cambria.....	W	W	Coal, clays, stone.
Carbon.....	5,318	4,304	Coal, sand and gravel, stone.
Centre.....	23,581	22,025	Lime, coal, stone, clays.
Chester.....	W	W	Lime, stone, clays.
Clarion.....	22,723	30,485	Coal, stone, sand and gravel, clays.
Clearfield.....	34,372	47,923	Coal, clays.
Clinton.....	W	W	Do.
Columbia.....	W	3,776	Coal, sand and gravel, stone, peat.
Crawford.....	740	585	Sand and gravel.
Cumberland.....	W	W	Stone, sand and gravel, clays.
Dauphin.....	W	2,145	Stone, coal.
Delaware.....	W	W	Stone.
Elk.....	W	W	Coal, stone.
Erie.....	W	W	Sand and gravel, peat.
Fayette.....	17,482	16,146	Coal, stone, clays.
Forest.....	W	312	Sand and gravel.
Franklin.....	W	W	Stone, sand and gravel.
Fulton.....	W	W	Stone, sand and gravel, coal.
Greene.....	102,235	80,060	Coal.
Huntingdon.....	W	W	Sand and gravel, stone, clays.
Indiana.....	60,525	73,014	Coal.
Jefferson.....	W	W	Coal, clays, stone.
Lackawanna.....	W	W	Coal, peat.
Lancaster.....	10,499	9,868	Stone, clays, sand and gravel.
Lawrence.....	W	32,345	Cement, coal, stone, sand and gravel, clays, peat.
Lebanon.....	W	W	Iron ore, lime, copper, stone, cobalt, pyrites, gold, silver.
Lehigh.....	32,842	29,111	Cement, zinc, stone.
Luzerne.....	35,212	37,585	Coal, stone, sand and gravel, peat, clays.
Lycoming.....	W	W	Stone, sand and gravel, coal, tripoli.
McKean.....	W	W	Clays, stone.
Mercer.....	W	W	Coal, sand and gravel, stone.
Mifflin.....	W	W	Sand and gravel, stone, lime.
Monroe.....	W	W	Stone, sand and gravel, clays, peat.
Montgomery.....	W	W	Stone, cement, lime, clays.
Montour.....	W	W	Stone, lime.
Northampton.....	63,992	77,694	Cement, stone, sand and gravel.
Northumberland.....	W	11,372	Coal, stone, clays, sand and gravel.
Perry.....	W	W	Stone, sand and gravel.
Philadelphia.....	W	W	
Potter.....	93	101	Stone.
Schuylkill.....	W	W	Coal, stone, clays.
Snyder.....	W	W	Stone.
Somerset.....	27,348	30,957	Coal, stone, clays, sand and gravel.
Sullivan.....	964	1,116	Coal.
Susquehanna.....	606	553	Stone.
Tioga.....	W	4,376	Coal, sand and gravel.
Union.....	W	W	Stone, clays.
Venango.....	W	W	Coal, sand and gravel.
Warren.....	933	1,115	Sand and gravel.
Washington.....	W	W	Coal, stone, clays.
Wayne.....	W	W	Stone, peat, sand and gravel.
Westmoreland.....	24,375	28,249	Coal, sand and gravel, stone.
Wyoming.....	W	W	Sand and gravel.
York.....	W	26,408	Cement, stone, lime, clays, sand and gravel, mica.
Undistributed ²	594,213	422,445	
Total ³	1,095,743	1,149,107	

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

¹ Cameron, Juniata, and Pike Counties are not listed because no production was reported.

² Values of natural gas, natural gas liquids, petroleum, gem stones and some stone unspecified by counties, and counties indicated by symbol W.

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

counted for 63 percent of the total mineral production value in both 1970 and 1971.

Although the production of bituminous

coal was 9.5 percent less than in 1970 because of a 44-day work stoppage, the value was 6.0 percent greater.

Table 3.—Indicators of Pennsylvania business activity

	1970	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force.....thousands..	5,041.0	5,035.8	-0.1
Unemployment.....percent of work force..	4.0	5.2	+30.0
Employment:			
Manufacturing.....thousands..	1,523.4	1,429.7	-6.2
Construction.....do.....	195.4	192.7	-1.4
Mining.....do.....	39.6	38.7	-2.3
Transportation and public utilities.....do.....	266.8	263.8	-1.1
Services.....do.....	685.1	698.5	+2.0
Wholesale and retail trade.....do.....	827.9	840.1	+1.5
Government.....do.....	618.7	627.9	+1.5
Finance, insurance, and real estate.....do.....	190.6	194.4	+2.0
Personal income:			
Total.....millions..	\$46,329	\$49,025	+5.8
Per capita.....	\$3,921	\$4,127	+5.2
Construction activity:			
Value of nonresidential construction.....millions..	\$416.0	\$316.8	-23.8
Number of new residential units authorized.....	41,185	54,977	+33.5
Cement shipments to and within Pennsylvania thousand 376-pound barrels..	17,259	18,059	+4.6
Mineral production value.....millions..	\$1,095.7	\$1,149.1	+4.9

^p Preliminary. ^r Revised.

Sources: Survey of Current Business, Area Trends in Employment and Unemployment, Construction Review, Employment and Earnings, and U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man- days worked (thou- sands)	Man- hours worked (thou- sands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non- fatal	Fre- quency	Severity
1970:								
Bituminous coal.....	22,369	248	5,544	44,661	31	1,208	27.74	5,813
Anthracite.....	5,938	234	1,332	10,224	5	503	49.69	4,598
Metal.....	1,351	303	409	3,273	1	20	6.42	2,172
Nonmetal.....	1,085	252	274	2,213	--	77	34.80	1,880
Sand and gravel.....	1,131	242	273	2,373	2	80	34.55	3,337
Stone.....	7,901	275	2,176	18,066	5	273	15.39	2,720
Peat.....	55	231	13	90	--	4	44.34	3,303
Total ¹	39,830	253	10,081	80,899	44	2,165	27.31	4,785
1971:^p								
Bituminous coal.....	21,100	250	5,260	42,074	32	1,085	26.60	5,873
Anthracite.....	5,800	239	1,385	10,099	4	450	44.95	3,891
Metal.....	1,195	315	377	3,014	2	33	11.61	4,896
Nonmetal ²	1,170	253	297	2,401	--	91	37.90	848
Sand and gravel.....	1,075	235	252	2,243	--	83	37.00	934
Stone.....	7,495	277	2,073	17,132	2	280	16.46	1,449
Total ¹	37,810	255	9,644	76,964	40	2,022	26.82	4,289

^p Preliminary.

¹ Data may not add to totals shown because of independent rounding.

² Beginning in 1971, data concerning peat operations are included in the nonmetals industry.

Leading producing counties, with primary commodities in parentheses, were Washington, Greene, Indiana, Armstrong, and Cambria Counties (bituminous coal), Northampton (cement), and Schuylkill (anthracite). Counties reporting no mineral production were Cameron, Juniata, and Pike.

Pennsylvania led the Nation in production of stone and cobalt; was second in lime, cement, and pyrites; third in coal; and fourth in tripoli.

Legislation and Government Programs.

—Major conservation legislation passed in 1971 by the House and Senate during the 1971-72 session of the General Assembly and signed by the Governor included—

H/B 568-Pr. 620.—An amendment to the Bituminous and Anthracite Acts of 1961 that created an Anthracite and Bituminous Coal and Clay Mine Subsidence Fund.

H/B 843-Pr. 1785.—An Act that enabled the Governor to use up to \$2 million for emergency mine subsidence relief.

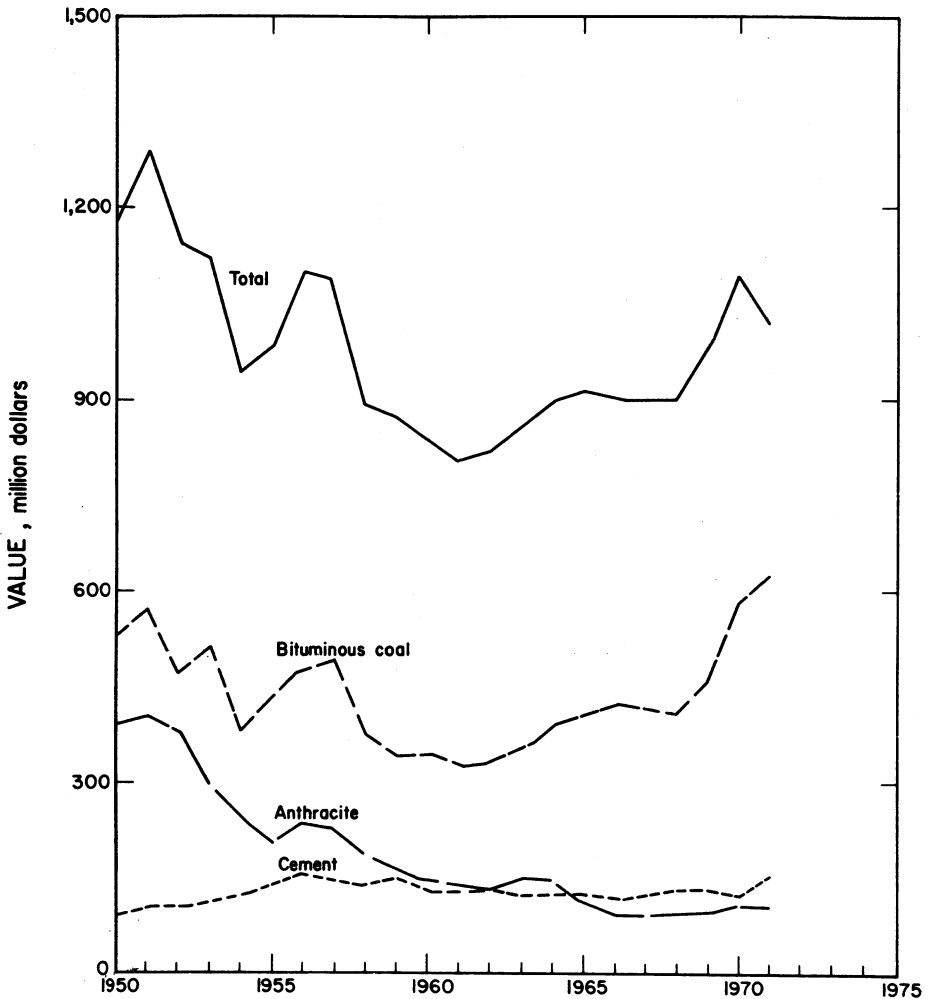


Figure 1.—Value of bituminous coal, anthracite, cement, and total value of mineral production in Pennsylvania.

S/B 135-Pr. 996.—Act 147 of 1971, entitled Surface Mining Conservation and Reclamation Act, was signed into law November 30, 1971, and became effective January 1, 1972. This Act provided for the conservation and improvement of land areas affected by the surface mining of anthracite and bituminous coal, and metallic and nonmetallic minerals. It requires surface mining operators to be licensed and to post bonds assuring compliance, except in the case of quarries expected to be in existence more than 10 years. Before ob-

taining a mining permit the surface mining operator must file with the Department of Environmental Resources (DER) detailed plans, including maps and other data, showing how the landscape will be restored. Other objectives were to protect wildlife, to enhance land values for taxation, to decrease soil erosion, to prevent pollution of water resources, to reduce hazards to health and safety, to prevent the combustion of unmined coal, and to improve the use and enjoyment of surface-mined lands.

The Environmental Quality Board supplemented Act 147 by regulations that required applicants for all surface mining operations to submit a valid certificate of insurance for a minimum \$100,000 total coverage of public liability, personal injury, and property damage. A minimum bond of \$5,000 was required for each operation.

On January 19, Pennsylvania under Act 275 took a major step in unifying State environmental programs with the establishment of the Department of Environmental Resources (DER). This one department is responsible for all land and water management programs as well as for environmental control and regulation of mining in the State. The former departments of Mines and Mineral Industries and of Forests and Waters were abolished. The new DER also assumed all the environmental control functions previously conducted by the State Health Department and its two agencies, the Air Pollution Commission and the Sanitary Water Board.

The Bureau of Topographic and Geologic Survey, by a 1970 act, was transferred on January 19, 1971, to the Department of Environmental Resources.

The Bureau of Mines Energy Research Center in Pittsburgh developed a process for the conversion of bituminous coal containing 3.4 weight-percent sulfur into a viscous fuel containing 0.3 weight-percent sulfur, hydrogen sulfide, and an oil for carrying more raw coal to the process. In the process, a mixture of high-sulfur content coal, coal tar, and hydrogen was pressurized and blown with high turbulence through a bed of cobalt molybdate catalyst.

The Lummus Co., a Combustion Engineering Inc. subsidiary, received a contract from the Bureau of Mines to build a \$6 million prototype coal-to-gas pilot plant at Bruceton. The 70-ton-per-day unit will demonstrate the Bureau's new Synthane process, which reportedly is capable of processing any type of coal, including those with coking properties; has a high methane yield, which decreases process costs; and has a special catalytic step to boost the heating value of the product gas to more than 900 Btu per cubic foot.

In early November, the Department of the Interior awarded Bituminous Coal Research, Inc. (BCR), a \$24.8 million con-

tract to build and operate a pilot plant at Homer City, Pa., for making gas from coal. The contract covered construction costs and 4 years of operation. The Government will pay two-thirds of the cost, and the American Gas Association will pay the rest as part of a continuing joint effort to develop coal gasification processes. BCR sub-contracted with The Koppers Co., Inc. for design and engineering work on the plant, based on Government-funded research performed by BCR during the past 5 years. The Homer City plant was expected to become operative in early 1973. The facility will convert 120 tons of coal per day into 2 million to 3 million cubic feet of pipeline-quality gas using the Bi-Gas process, which requires about 1,500 pounds per square inch pressure and a temperature of about 2,500°F.

The first grant under an Environmental Protection Agency (EPA) program was made on June 17, 1971, for a \$676,000 project on the Tioga River. The project will demonstrate the effects of varying amounts of agricultural limestone and digested primary and secondary sewage sludges as soil conditioners on restoration work at strip pits; stream channel reconstruction and lining; and restoration and grading of subsidence areas.

A 3-year demonstration project was started by Africa Engineering Associates, Inc., to clean up acid mine drainage by the installation of limestone barriers at six locations in Trough Creek near Huntingdon. The State DER provided funds to build the barriers. Additional funds for the 3-year monitoring of results were supplied by EPA.

The Applied Science Laboratories, at State College, Pa., investigated the partial freezing method to purify acid mine water. The study, made for EPA, attained an 85- to 90-percent reduction of acid and mineral components.

Full-scale field operations were initiated in July 1971 for a study of the water resources of the Clarion River and Redbank Creek drainage basins. This study was a cooperative project by the State Bureau of Topographic and Geologic Survey and the Bureau of Engineering and the U.S. Geological Survey.

Resource Control, Inc., New Haven, Conn., a producer of pollution control equipment, was awarded a \$119,473 con-

tract for a demonstration project in the Wilkes-Barre area to remove metallic pollutants from coal mine drainage water. The total cost of the project, which uses an electrochemical process, will be \$140,576. The DER will contribute part of the funds and EPA the remainder.

Pennsylvania State University operated an experimental 500,000-gallon-per-day acid mine water treatment plant to evaluate performance and costs. The water was treated in the presence of iron-oxidizing bacteria. The project, at Hollywood, was co-sponsored by EPA.

Under a \$223,105 Bureau of Mines grant, employees of the Central Pennsylvania Coal Producers' Association, in October, started a new training program featuring formal instruction in the safe handling of standard mining machinery. The program was presented in an above-ground facility, built to simulate an underground coal mine, on the property of the Florence Mining Co. at Seward.

Because the release of phenolics by coke plants into streams and rivers is a major pollution problem, The University of Pennsylvania, on a \$215,000 grant from the National Science Foundation, began an investigation of an enzyme group called polyphenolic oxidases. These enzymes reportedly permit the elimination of phenolic-type pollutants by catalytically converting phenolics into harmless, biodegradable compounds.

A Federal-State project to measure the level and acidity of water in abandoned anthracite mines was approved by the Department of the Interior. Contracts to build and equip the monitoring stations were awarded as sites were approved.

The Pennsylvania State University completed an 18-month study designed to help economists identify effective means for minimizing total costs in dealing with subsidence. The study was funded by a \$14,837 grant awarded by the Bureau of Mines in early 1970.

In October, the U.S. Army Corps of Engineers began a 6-month survey to map and locate all waste discharges into the Allegheny, Monongahela, and Ohio Rivers. The aerial survey technique employed was developed by Grumman Eco-Systems. The survey represented phase 2 of a program which required that all wastes could be

discharged only after receipt of a Federal permit under the 1899 Waste Refuse Act.

Pennsylvania was one of four charter members of the newly organized Interstate Mining Compact Commission when it formally came into existence at a meeting in Raleigh, N.C., on April 27, 1971. The objective of the Commission was to coordinate and exchange surface mining information among the States.

On April 29, the DER dedicated the Smith Township mine drainage treatment plant near Burgettstown, Washington County. The plant will augment the Smith Township Water Authority's nearby Dinsmore reservoir by providing as much as 500,000 gallons per day. The plant was the Nation's first municipal water installation to use the ion-exchange method for the demineralization of acid mine drainage to produce potable water. Full-scale operation began in late January.

In 1971, the Swindell-Dressler Co. was constructing an ion-exchange plant near Philipburg in Clearfield County for the DER to convert 500,000 gallons per day of mine water into potable water.

Five contracts totaling \$4,328,775 of conservation bond issue funds were approved by the DER in 1971 for Operation Scarlift mine area restoration projects. The largest contract was for the Altoona mine drainage treatment plant that will add 5 million gallons per day of water to Altoona's water supply. Two contracts specified the use of fly ash to fill abandoned mine voids to provide surface stabilization in Allegheny County, and a similar project was awarded in West Mifflin Borough. The fifth contract was to control and extinguish a subsurface mine fire in West Mifflin by pumping fly ash slurry through 60 boreholes.

The following Operation Scarlift projects were completed in 1971:

	Projects	Actual cost, dollars
Stream pollution abatement:		
Anthracite.....	4	\$828,923
Bituminous.....	10	2,424,484
Underground mine fires:		
Anthracite.....	1	45,991
Bituminous.....	2	107,624
Mine subsidence:		
Bituminous.....	3	59,080
Total:		
Anthracite.....	5	874,914
Bituminous.....	15	2,591,188

In May 1971, the State canceled a contract awarded in 1970 to the Westinghouse Electric Corp. to build a \$5.5 million plant to treat acid mine water near Buttonwood in the Wilkes-Barre area.

The DER received bids on December 16 for four projects to eliminate acid mine drainage from the Shaw mine-complex in Somerset County. The projects included strip mine backfilling, sealing deep mines with concrete and clay, filling underground voids with dry fly ash, and grading, contouring, and planting the entire area.

The Bureau of Mines Liaison Office for Pennsylvania was established in Harrisburg, on October 3, 1971.

Pursuant to the Appalachian Regional Development Act of 1965, as amended, mining area restoration projects completed or in progress during 1971 and their final cost or estimated value of contracts in force included 11 mine-fire control projects; two of these were completed in two counties at a cost of \$181,340, while nine projects, costing \$8,610,448, were in progress in six counties. One subsidence control project costing \$1,480,055 was also completed. All of these projects had 75 percent Federal funding and 25 percent State funding. No surface mine or well-sealing projects were completed or in progress; however, two well-sealing projects and one subsidence project were approved by the Appalachian Regional Commission for a total Federal-State expenditure of \$1,868,000. Work funded equally by Federal and State Governments was in progress under Public Law 162 on mine-water-monitoring stations, all in the anthracite region, at a total cost of \$120,241.

Eleven Bureau of Mines publications released in 1971 discuss problems relating to the mineral industry of Pennsylvania.² The U.S. Geological Survey issued five publications concerning Pennsylvania,³ and there were four Pennsylvania Geological Survey releases⁴ and five miscellaneous releases.⁵

The total cost of projects underway or authorized for the Interstate highway system in Pennsylvania in 1971 totaled \$835.8 million, \$55.7 million more than in 1970, while projects for primary, secondary, and urban highway extensions totaled \$461.4 million, \$59.3 million more than in 1970. The total cost of Interstate highway proj-

ects completed in 1971 was \$59.9 million, while the total cost of primary, secondary, and urban highway extensions completed was \$48.6 million. Interstate highway mileage opened to traffic since July 1, 1956 increased 22.75 miles to 1,384.08 miles; at

² Cochran, William. Mine Subsidence—Extent and Cost of Control in a Selected Area. BuMines IC 8507, 1971, 32 pp.

Dierks, H. A., R. H. Whaite, and A. H. Harvey. Three Mine Fire Control Projects in Northeastern Pennsylvania. BuMines IC 8524, 1971, 53 pp.

Eckerd, James W., and John D. Spencer. Anthracite Preparation—Past and Present. Presented at 100th Ann. Meeting, AIME, New York, Mar. 1-4, 1971, AIME Preprint 71-F-57, 9 pp.

Frohne, K. H. Increasing Oil Production From the Venango Second Sand. A Reappraisal of Two In Situ Combustion Tests. BuMines RI 7536, 1971, 16 pp.

Gait, G. B. Microfilming Maps of Abandoned Anthracite Mines. Mines in the Western Middle Anthracite Field. BuMines IC 8519, 1971, 11 pp.

McNay, Lewis M. Coal Refuse Fires, An Environmental Hazard. BuMines IC 8515, 1971, 50 pp.

Raufaste, Noel J., Jr. An Attitudinal Survey of Area Residents Toward Indiscriminate Trash Dumping and Possible Causes of Anthracite Mine Fires. Pennsylvania Anthracite Region. Volume 1: Analysis. Prepared for BuMines by Resource Management Corp., December 1970, 59 pp. (OFR 7-71).

Raufaste, Noel J., Jr. An Attitudinal Survey of Area Residents Toward Indiscriminate Trash Dumping and Possible Causes of Anthracite Mine Fires. Pennsylvania Anthracite Region. Volume 2: Appendices. Prepared for BuMines by Resource Management Corp., December 1970, 244 pp. (OFR 7-71).

Sawyer, W. K., C. I. Pierce, and R. B. Lowe. Electrical and Hydraulic Flow Properties of Appalachian Petroleum Reservoir Rocks. BuMines RI 7519, 1971, 22 pp.

Sheffer, H. W., E. C. Baker, and G. C. Evans. Case Studies of Municipal Waste Disposal Systems. BuMines IC 8498, 1971, 36 pp.

U.S. Bureau of Mines. Strippable Reserves of Bituminous Coal and Lignite in the United States. IC 8531, 1971, 148 pp. (For Pennsylvania data, see pp. 47-48, 141-142.)

³ Berryhill, H. L., Jr., S. P. Schweinfurth, and B. H. Kent. Coal-Bearing Upper Pennsylvanian and Lower Permian Rocks, Washington Area, Pennsylvania. U.S. Geol. Survey Prof. Paper 621, 1971, 47 pp.

Growitz, D. J., and O. B. Lloyd, Jr. Relationship Between Ground-Water Levels and Quality in Shallow Observation Wells, Muddy Creek Basin, Southeastern York County, Pennsylvania. U.S. Geol. Survey Prof. Paper 750-D, 1971, pp. D178-D181.

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Roen, J. B. Preliminary Geologic Map of the Midway Quadrangle, Southwestern Pennsylvania. U.S. Geol. Survey Misc. Field Studies Map MF-319, December 1971.

⁴ Glass, Gary B. Computer Program for Coal Analyses. Pennsylvania Geology (Pennsylvania Geological Survey), v. 2, No. 2, April 1971, pp. 7-9.

yearend, 77.05 miles was under construction and 79.98 miles was in the design stage.⁶

The Pennsylvania Department of Transportation (Penn DOT) in calendar year 1971 awarded contracts for highway construction in the amount of \$225.6 million. Contract expenditures by the State in 1971 for highway construction totaled \$389.6 million and was distributed as follows: Interstate, \$109.7 million; primary, \$44.6 million; secondary, \$28.1 million; urban, \$41.7 million; Appalachian, \$21.5 million; and "100 percent State," \$144.0 million. The total expenditure for highway construction was \$27.4 million less than in 1970. As of January 1972, Penn DOT had 374 active construction contracts with a total value of \$1,279,534. In January 1971 there were 522 active construction contracts with a total value of \$1,533,181. As of January 1972, the State Highway system totaled 44,237 miles, while the total of all public roads in the Commonwealth (State system, roads and streets under the jurisdiction of cities, boroughs and townships, and State Park and U.S. National Forests roads) totaled 115,259 miles. The State Highway system increased 140 miles during 1971.

In 1971, the Pennsylvania Industrial Development Authority gave tentative approval for five loan projects and final approval for 10 loan projects, all of which were directed to manufacture products, of mineral origin. Five of the projects in four counties had loans and commitments totaling \$5,142,800, and will produce refractory coatings, fiberglass for reinforced plastics, glass for automobiles, concrete blocks, and slag breakers. Nine other projects in seven counties had total loans and commitments equaling \$2,771,300, and their principal products will be steel mill machinery, steel products and fasteners, specialty valves, and titanium wire.

Environment.—Air Pollution.—The Allegheny County Bureau of Air Pollution Control was developing a computerized air monitoring system. In 1971, the automatic telemetering network comprised a central station and seven remote monitoring stations having a total of 53 sensors. Five of the stations were located in river valleys where the major industrial sources of air pollution were located.

The Allegheny Bureau of Air Pollution Control's emission inventory for 1971 distributed pollutants as follows:

Source	Total weight (tons)	Percent of total weight
Mobile sources.....	1,220,219	72.0
Power generation.....	284,953	16.8
Industrial processes.....	163,249	9.6
Domestic and commercial heating.....	22,643	1.3
Solid waste incineration.....	4,317	.3
Total.....	1,695,381	100.0

The Allegheny County Bureau of Air Pollution Control received and evaluated 525 permit applications. Of the total, 12 applied to metallurgical equipment comprising six annealing and forging furnaces and six electric, induction, and open hearth furnaces.

In Allegheny County, the operation of single-chamber incinerators was prohibited after July 1971. Prior to this date, such incinerators annually discharged into the atmosphere approximately 1,200 tons of particulates, 1,200 tons of carbon monoxide, and 900 tons of hydrocarbons.

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⁵ Bituminous Coal Research, Inc. Studies on Description of Coal Mine Drainage Sludge. A Description of Research Conducted by Bituminous Coal Research, Inc., with the Cosponsorship of the Environmental Protection Agency and the Pennsylvania Department of Environmental Resources. September 1971, 113 pp.; report available from the National Coal Association, Washington, D.C.

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⁶ Federal Highway Administration. Quarterly Reports on the Federal-Aid Highway Program, Dec. 31, 1970 and Dec. 31, 1971. Press Release FHWA-563, Feb. 17, 1971; FHWA-29-72, Mar. 6, 1972.

In Philadelphia County, fuels were limited in percent of sulfur content as shown:

No. 2 and lighter oils.....	0.3
No. 4 oil .....	.7
No. 5 and No. 6 oils	1.0
Bituminous coal, Jan. 1-June 30, 1971	2.0
Bituminous coal, July 1-Dec. 31, 1971	1.0
Anthracite .....	.7

The combustion of noncommercial fuels such as coke-oven and petroleum refinery gases was limited to 640 parts per million (by volume) sulfur dioxide content adjusted to 12 volume-percent carbon dioxide in the stack emissions. Processes other than combustion were limited to 1,000 parts per million (by volume) sulfur dioxide in stack emissions.

In 1971, the Bureau of Air Quality and Noise Control of DER, did not limit the

sulfur content of fuels or the quantity of sulfur dioxide released during their combustion in the 65 counties supervised by the Bureau. Table 5 summarizes the extent and cost of air pollution abatement in Pennsylvania in 1971.

Water Pollution.—Jones & Laughlin Steel Corp., at its Vesta No. 5 mine, on April 23, was confronted with having 150,000 gallons per day of clean water, discharged from a borehole during the past 17 years, abruptly turn acidic and bright red. A pollution control system costing \$30,000 was put into operation by May 1. The system included the construction of a 6-acre lake and the installation of 4,000 feet of plastic pipe to carry decanted water from the lake to an existing neutralization plant.

As a result of underground coal mining by the Barnes and Tucker Co., near Ebsenburg, 36 homes in the Barr and

Table 5.—Air pollution abatement compliances

Industry and county	Number of process compliances	Emission reduction ¹ (tons per year)	Estimated cost of equipment and controls	
			Thousands	Dollar per-ton emission-reduction per year
Ferrous metals:				
Allegheny	4	107	\$60	\$561
Philadelphia				
All other ²	10	9,319	2,200	236
Total	14	³ 9,426	2,260	240
Nonferrous metals:				
Allegheny	2	450	500	1,111
Philadelphia	1	18	40	2,222
All other ²				
Total	3	³ 468	540	1,154
Nonmetallics:⁴				
Allegheny	17	510	945	1,853
Philadelphia	3	602	540	897
All other ²	24	17,158	559	33
Total	44	³ 18,270	2,044	112
Coal and petroleum:				
Allegheny	2	⁵ 25,975	9,818	378
Philadelphia	3	⁶ 4,096	9,400	2,295
All other ²	10	³ 8,067	2,506	311
Total	15	38,138	21,724	570
Total:				
Allegheny	23	26,592	10,823	407
Philadelphia	8	5,148	10,440	2,028
All other ²	45	34,562	5,305	163
Grand total	76	66,302	26,568	401

¹ Rated design capacity applicable to varied numbers of operating days per year.

² Sixty-five counties controlled by the Pennsylvania Department of Environmental Resources, Bureau of Air Quality and Noise Control.

³ Principally particulates.

⁴ Rock products, plantmix asphalt, glass, enamel, and fertilizer plants.

⁵ Particulates and sulfur dioxide.

⁶ Comprises 365 tons of particulates, 1,260 tons of sulfur dioxide, and 2,471 tons of hydrocarbons.

Blacklick Townships lost their supply of well water. The company agreed to pay \$66,000 toward the cost of a new plant to treat water from deep mines in the area. The treated water was piped to the homes through a system built by the two townships.

In April, the Commonwealth Court in Harrisburg ordered the Barnes and Tucker Co. to resume operation of a \$350,000 acid mine water treatment plant at its Lancashire No. 15 mine and to share the costs with the State until a final verdict was rendered. At issue was the question whether or not the owner of an abandoned coal mine was responsible for water pollution that occurred after the mine had been abandoned. The treatment plant used lime to neutralize 7 million gallons per day of acidic water from the firm's Lancashire No. 15 mine that was shutdown in 1969.

The Industry-Conservation Council in Pittsburgh sought Federal help on a proposed project to treat 20 million gallons per day of acid mine water in a \$6 million reverse-osmosis plant. The water source would be a 100-billion-gallon pool in a 42-square-mile underground mine-complex in Westmoreland County. Reportedly, the Army Corps of Engineers could handle the project and was enthusiastic about it. The State's participation depended largely on whether the project would significantly reduce stream pollution in the area. The treated water would be suitable for domestic and industrial uses.

Solid Wastes.—The Franklin Institute in Philadelphia converted incinerator refuse into slag, which was crushed for use as highway aggregate. Although the product was not competitive economically with conventional materials, it may become so as landfilling of incinerator refuse becomes more expensive and deposits of natural aggregate are exhausted.

The Pennsylvania Joint Legislative Air and Water Pollution Control and Conservation Committee studied the abandoned auto problem in an effort to develop an efficient and practical recycling program.

The State Department of Health gave technical assistance to the Pennsylvania State University field study to determine possible subsurface water pollution caused by sanitary landfills in limestone areas. The University of Pennsylvania was deter-

mining the feasibility of grinding solid waste materials and transporting them with water through a pipeline. The Franklin Institute in Philadelphia was experimenting with a solid waste shredding process.

The Warner Co. of Philadelphia had a landfill project, in Bucks County, which eventually will be used as a ski resort. Alternate layers of sand and refuse were compacted until the desired height was reached. The ski slope will shield a residential development tract from a presently visible steel mill.

The Westinghouse Research and Development Center, at Pittsburgh, installed a test section of road, which in its first 12 months had an excellent performance record. The road construction material contained 5 percent compacted household refuse in addition to asphalt, sand, and crushed stone. Reportedly, the road material was as durable as asphalt and more resistant to cracking.

Strip Mine Reclamation.—Responsibility for the control of coal refuse disposal was transferred to the DER's Division of Solid Waste Management late in 1971. The coordination of the review of permit applications, to assure compliance with the Commonwealth's Clean Streams, Air Pollution Control, and Coal Refuse Disposal Act, became a function of the solid waste program. In calendar year 1971, the Division issued 381 bituminous and 69 anthracite licenses, 351 mine drainage permits, and 863 strip mining permits. Bonds totaling \$8.3 million applied to 15,000 acres bonded while bonds released totaled \$4,428,000. The Division reported acreage mined as 12,000 bituminous and 350 anthracite.

In 1971, according to a State Forest spokesman, bituminous coal strip mine operators restored 17,200 acres, of which at least three-fourths were contour graded. Seven million trees were planted on 7,069 acres on which no fertilizer was applied. Grass was planted on 3,190 acres to which, based on soil tests by the State, an average of 200 pounds per acre of 5-20-20 fertilizer and 2 tons of ground limestone were applied to insure a fair stand of grass.

In the anthracite-producing region strip mine operators restored 411 acres on which 528,090 trees were planted. No fertilizer was used. An 80- to 85-percent survival was

considered good. About 100 square feet were planted with grass on a trial basis.

A "thinning cut" in a 9-year-old planting of hybrid poplar on reclaimed spoil banks of the Hoffman Coal Co., of Karthaus, provided about 11 cords of pulpwood worth about \$40 per acre.

To reclaim strip mined land, some of Pittsburgh's garbage and trash was compacted by a process developed by the Aloe Coal Co. and the Swindell-Dressler Engineering Co. and trucked about 18 miles to a clay-lined portion of Aloe's coal strip-ping operation near the Pittsburgh airport. The city's contract for this means of solid waste disposal cost \$1.1 million annually, or \$6.85 per ton compared with a cost of

\$25 per ton at an old incinerator.

A 9-year project was started to level and plant 1,200 acres on the Secham Limestone Industry property near Portersville. Developers of the Lake Arthur Estates planned to use 285 acres of the reclaimed area for a mobile home court.

The National Science Foundation granted funds to six Pennsylvania State University undergraduates for an unprecedented study of the effectiveness of strip mine contour backfilling in the Clarion and Kittanning coalfields. The study included mapping, moisture retention, vegetation, and wildlife populations of recently backfilled areas and a comparison with areas backfilled 30 or more years earlier.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Anthracite).—The 8,727,000 short tons produced was 10.3 percent less than in 1970 and was the smallest in nine consecutive years. However, its \$103,469,000 value was only 1.7 percent less than the 1970 value because of an increase in average value of \$1.03 to \$11.86 per ton.

Commercial exports, principally to Canada and Western Europe, totaled 671,000 tons, 118,499 tons less than in 1970, and were valued at \$10,104,000. Exports of anthracite through Philadelphia totaled 440,619 tons. The Federal Government continued purchasing anthracite to supply most of the solid-fuel needs of the U.S. Armed Forces in West Germany. Such shipments in 1971 totaled 718,000 tons compared with 692,000 tons in 1970.

The U.S. consumption in thousand tons was as follows: Residential and commercial heating 3,850; electric utilities 1,646; industrial and miscellaneous uses 1,037; coke plants 451; sintering and pelletizing 339; and colliery fuel 15.

Production originated from 155 underground mines having 1,555 employees, 180 strip mines having 2,229 employees, 81 culm banks having 441 employees, and eight dredges employing an unknown number of employees. Production and value by county are shown in table 6. Schuylkill, Luzerne, and Northumberland Counties accounted for 82 percent of the total State production.

Production, excluding that from dredging operations, totaled 8,337,000 tons and was processed by 103 breakers and washer-

Table 6.—Anthracite production and value, by county

County	Production (thousand short tons)				Total value (thousands)
	Under-ground	Strip	Bank	Total ¹	
Carbon.....	14	191	108	313	\$3,535
Columbia.....	20	195	18	233	3,250
Dauphin.....	53	(²)	21	74	781
Lackawanna.....	(²)	319	³ 122	³ 441	5,899
Luzerne.....	391	1,598	629	2,618	34,219
Northumberland.....	160	441	316	917	10,264
Schuylkill.....	649	1,612	1,355	3,615	41,682
Sullivan.....	--	122	4	126	1,116
Total.....	1,287	4,478	2,573	8,337	100,736
Dredged production, total ⁴	--	--	--	390	2,733
Grand total.....	1,287	4,478	2,573	8,727	103,469

¹ Data may not add to totals shown because of independent rounding.

² Less than 1 unit.

³ For Lackawanna and Susquehanna Counties.

⁴ For Berks, Dauphin, Lancaster, Northumberland, and Snyder Counties.

ies employing 1,591 persons. Nearly all of the washing and cleaning was performed using dense-medium vessels, cyclones, and Wemco-type cones. The average value of this production was \$12.08 per ton. Dredging operations produced 390,000 tons having an average value of \$7.01 per ton.

Of the total salable production, 3,739,000 tons valued at \$12.30 per ton, was shipped by railroad and 4,973,000 tons valued at \$11.92 per ton was shipped by truck. Colliery fuel totaled 15,000 tons and was valued at \$14.59 per ton.

Underground mine production was 26 percent less than in 1970 and equaled less than 15 percent of the State's total production. No significant changes were made in mining practices.

Run-of-mine material containing 670,000 tons of salable product and equaling 52 percent of the total underground production was mechanically loaded. Underground loading on the basis of tons of contained salable product comprised 319,000 tons by 95 scraper loaders, 151,000 tons by 18 mobile loaders, and 200,000 tons by a total of 91 duckbills and other self-loading conveyors, and pit-car loaders.

Underground mining consumed 763,250 pounds of permissible explosives and 88,512 pounds of dynamites. Two fatalities and 289 nonfatal accidents occurred at underground anthracite mines.

Reportedly, the State spent \$120,000 for electricity to power six pumps that removed approximately 43 million gallons per day of acidic water from the former Delaware colliery shaft. The water was discharged into Mill Creek, a tributary of the Susquehanna River. On exposure to the air the water developed a red-ochre tint. The State took over the pumping operations through default of the former mine operators.

Strip mining and culm bank operations collectively used 61 power shovels, of which 43 were diesel-powered and 18 were electric-powered; 122 draglines, of which 86 were diesel-powered and 36 were electric-powered; 77 front-end loaders; and an unknown number of haulage trucks, scraper loaders, and bulldozers. Strip mining consumed 23,413,432 pounds of permissible explosives and 16,148,387 pounds of dynamites. Strip mining resulted in 189 nonfatal accidents.

Anthracite productivity data for 1971 as well as for 1969 and 1970 are compared in table 7.

According to an official of the United Gas Improvement Corp., of Kingston, no construction was started in 1971 on a proposed 300-megawatt steam-electric plant in the Northern anthracite field. The construction delay was caused by legal difficulties in acquiring title to the site because the subsurface rights were owned by 2,200 individuals. Should the title problem be resolved soon, the plant could be operable by January 1977. Future plans include the construction of a 300-megawatt plant in the Southern anthracite field. The plants will be fueled with upgraded culm bank material burned in Ignifluid combustor furnaces.

In early January a \$4.5 million contract was awarded to the Dixon Construction Co., Inc., of Mount Carmel, to extinguish a culm bank fire near Forrestville in Schuylkill County. State officials mysteriously ordered a "hold" payment on the contract in September, and on October 7 the contractor sued the State for \$1 million.

The DER warned operators to eliminate air pollution from silt basins or face the loss of mining permits. The pollution was caused by extremely fine silt from washeries and plants that cleaned and prepared small sizes of anthracite. The air pollution was particularly noted in the Shenandoah-Mahanoy City area in Schuylkill County.

Bituminous Coal.—New coal mines that started operation in the State in 1971 eventually will produce 1.95 million tons per year.

The development of the No. 1 and No. 2 underground mines by Greenwich Collieries Co., a subsidiary of the Pennsylvania Power & Light Co., north of Barnesboro in Cambria County, will eventually produce 4 to 5 million tons annually, using continuous miners to block out areas for longwall production from the 42-inch B and D seams. The maximum production is based on a 2-1/2-shift basis during a projected 30-year period. The coal preparation facilities include two 54-inch feed belts, one from each mine; a screening house; cleaning equipment including jigs, sieve bends to obtain separation at 28 mesh, centrifuges, and cyclones; an overland belt conveyor; a radial stacker; and unit train

Table 7.—Anthracite productivity data, 1969-71

Activity	Production (short tons)				Man-days ¹				Productivity (tons per man-day) ¹				Percent change in 1969-71 period
	1969	1970	1971	1969	1970	1971	1969	1970	1971	1969	1970	1971	
Deep mined:													
Extraction	2,150,664	1,666,694	1,245,326	485,091	452,660	304,298	4.94	3.68	4.09	4.94	3.68	4.09	-17.2
Preparation	2,189,994	1,658,809	1,245,326	88,783	66,658	55,437	24.10	24.89	22.46	24.10	24.89	22.46	-6.8
Total or average	2,150,664	1,666,694	1,245,326	523,874	519,318	359,735	4.11	3.21	3.46	4.11	3.21	3.46	-15.8
Strip mined:													
Extraction	4,696,128	4,624,610	4,450,457	466,756	515,182	581,960	10.06	8.98	8.37	10.06	8.98	8.37	-16.8
Preparation	4,696,128	4,624,610	4,450,457	194,832	185,837	198,119	24.10	24.89	22.46	24.10	24.89	22.46	-6.8
Total or average	4,696,128	4,624,610	4,450,457	661,588	701,019	780,079	7.10	6.60	6.10	7.10	6.60	6.10	-14.1
Culm bank:													
Extraction	3,319,018	2,956,707	2,492,178	80,874	87,464	79,044	41.04	33.80	31.53	41.04	33.80	31.53	-23.2
Preparation	2,647,899	2,495,087	2,093,906	109,857	100,263	93,214	24.10	24.89	22.46	24.10	24.89	22.46	-6.8
Total or average	3,319,018	2,956,707	2,492,178	190,731	187,727	172,258	17.40	15.75	14.47	17.40	15.75	14.47	-16.8
State total: ²													
Extraction	10,165,805	9,248,011	8,187,961	982,721	1,055,306	915,302	10.34	8.76	8.95	10.34	8.76	8.95	-13.4
Preparation	9,484,016	8,778,506	7,789,689	393,472	352,758	346,770	24.10	24.89	22.46	24.10	24.89	22.46	-6.8
Total or average	10,165,805	9,248,011	8,187,961	1,376,193	1,408,064	1,262,072	7.89	6.57	6.49	7.89	6.57	6.49	-12.2

¹ Includes personnel engaged in maintenance, haulage, stripped land surface reclamation, etc.

² Excludes dredged coal.

³ Includes production without preparation, comprising 10,670 tons from deep mines and 671,119 tons from culm banks.

⁴ Includes production without preparation, comprising 7,885 tons from deep mines and 461,620 tons from culm banks.

⁵ Includes production without preparation, comprising 398,272 tons from culm banks.

Note: All data in this table were derived from annual reports, published by the Anthracite and Bituminous Division of the Pennsylvania Department of Environmental Resources, that summarize mandatory monthly reports submitted by the anthracite industry.

loading facilities. The prepared coal is shipped to the power company's eastern Pennsylvania generating stations. Two Alpine miners, in May 1971, started cutting extremely hard bottom rock in the No. 1 and No. 2 mines. New Kennametal U-44 bits used on these miners resulted in low cutter cost.

Consolidation Coal Co., Pittsburgh Coal Co. Division, announced plans for a \$6 million coal mine near Reels Corner, Pa., in Somerset County. The mine will employ about 200 men when completed in 1973.

U.S. Natural Resources, Inc., acquired Twilight Industries, Inc., of Belle Vernon, through an exchange of stock. Twilight's operations in southwestern Pennsylvania expected a 1.2-million-ton production in 1971.

Gulf Resources & Chemical Corp. through its newly-formed subsidiary, Vantage Coal Corp., expanded the strip mining of steam-grade coal in Clarion County.

Consolidated Natural Gas Supply Corp., a Consolidated Natural Gas Co. subsidiary, acquired options to purchase coal mining rights on a substantial acreage in western Greene County and adjoining Marshall and Wetzel Counties in West Virginia.

The Bethlehem Steel Corp. acquired the Ehrenfield No. 8 mine near Johnstown from Colt Industries, Inc. The principal properties also included about 10,000 acres of coal reserves in Cambria County and a preparation plant. The low-volatile metallurgical coal produced will go to Bethlehem's steel plants.

Raise Drillers, Inc., of Amarillo, Tex., completed a 12-foot-diameter, 678-foot-deep ventilation shaft for the Helen Mining Co., a subsidiary of the North American Coal Co., at the Homer City mine. The 12-inch-diameter pilot hole was drilled through shale and sandstone at 14.5 feet per hour, and the 12-foot-diameter raise hole was drilled at 3.4 feet per hour.

A 12-foot-diameter, 593-foot-deep exhaust shaft was drilled in approximately 17 days by Raise Drillers, Inc., at the Lancashire No. 20 mine of the Barnes and Tucker Co. in Cambria County. Reportedly, the cost per foot for the 12-foot shaft was in the range of \$280 to \$300 per foot. Lining, when needed, was extra. Guniting cost about an additional \$70 per foot.

The first longwall system applied in the Pittsburgh coal seam in the State began

mining in November 1970 at the Jones & Laughlin Steel Corp. Gateway mine near Clarksville, Greene County. The system comprised one Eickhoff double-drum shearer, 110 Gullick-Dobson 510-ton yield, 6-leg chocks, one Eickhoff single-strand face conveyor, and one stage loader. Two mine-built bridges straddle the stage loader and move with it to carry electric switchgear and pumps. A wetting agent was used in the spray water.

Experimental rescue equipment was put into service on March 27, by the Westinghouse Electric Corp., in an attempt to reach two miners trapped inside the burning Nemaocolin mine of the Buckeye Coal Co. in Greene County. The equipment included sound detection devices and two oil rig drills, one which could drill a 28-inch diameter shaft. The rescue attempt failed, and in late August, pumping was in progress to flood portions of the mine in an effort to extinguish the fire and to recover the bodies of the two miners.

In late November, more than 7,000 miners were idled in Armstrong, Cambria, Indiana, Somerset, and Westmoreland Counties by roving pickets who expressed dissatisfaction with the new 3-year wage contract. The picketing also halted all pollution control and backfilling operations being conducted in the area.

The United Mine Workers Union was ordered by a Federal judge on December 22 to pay \$420,000 in damages to the Solar Fuel Co. of Hooversville. The judgment was the result of an antitrust suit in which the company claimed disruptive union organizing activities that cut the output of two coal mines in 1967 and 1968, property damage, and the discouragement of suppliers and customers from doing business with the company.

Three Pennsylvania coal mines of the Bethlehem Steel Corp. won the National Safety Council's Award of Honor for outstanding safety performance during 1971. The award winning mines were the Nanty Glo Mine 31 and Cambria Slope Mine 33 in the Cambria Division and the Somerset Mine 60 in the Ellsworth Division. The National Safety Council's Award of Merit for noteworthy safety achievement during 1971 was awarded to the Revloc Mine 32 in the Cambria Division and the Marianna Mine 58 in the Ellsworth Division.

Near Armagh, the Oneida No. 4 mine of

the Oneida Mining Co., a subsidiary of North American Coal Corp., was the first Pennsylvania coal mine to use the raise drilling method for shaft development. Two ventilation exhaust shafts 12 feet in diameter and 358 and 375 feet deep were completed in May 1971. The mine also was the first in the State to use two F6-A Alpine continuous miners, also termed roadheaders, for the development of roadways driven in coal and/or rock. The miners were designed for selective cutting and maneuvering in tight places. Each crawler-mounted miner had a chain conveyor, a movable tail boom, a gathering arm loading head, and a 2-foot diameter, 3-foot-long cutterhead mounted on a boom and turret that provided for cutting places 14-1/2 feet wide and 11 feet, 2 inches high. The conical-shaped cutter was designed so that only one bit was cutting at one time. The machines were able to cut hard materials with less bit wear than American-built continuous miners.

Sales of Alpine hard rock miners in the United States by the Alpine Equipment Corp., of State College, Pa., comprised four to Pennsylvania coal mines, three to coal mines in other States, two to uranium mines, and two for construction work.

Exports of bituminous coal through Philadelphia totaled 65,694 short tons.

The first interstate shipments of large tonnages of fuel coal will occur in 1974 when North American Coal Corp. begins shipments from southern Ohio to the Duquesne Light Co.'s Bruce Mansfield plant, under construction near Shippingport, Pa.

The National Bituminous Coal Wage Agreement of 1971 between the Bituminous Coal Operators' Association, Inc., and the United Mine Workers of America became effective November 12, 1971. The agreement provided for increased standard daily wage rates effective November 12 of 1971, 1972, and 1973. The bituminous coal industry resumed operations about mid-November after 44 days of idleness.

As of January 1, 1968, the State's strippable reserves of bituminous coal totaled 752 million tons, 70 percent of which contained over 2-weight-percent sulfur. The remainder of the reserves contained 1-to 2-weight-percent sulfur. One-fourth of the strippable reserves was in the Upper Freeport seam with lesser amounts in the Lower Freeport and Lower Kittanning

seams. The Pittsburgh seam had less than 38 million tons of economically strippable reserves. Butler County led in strippable reserves, followed by Clearfield and Washington Counties.

The Willowbrook Mining Co., at Slippery Rock, doubled coal production at its Jackson Center mine by installing a specially manufactured diesel-electric generator on a straight electric Marion 7400 dragline. The use of the 1,400-horsepower, 1,000-kilowatt-capacity generator in this application was believed to have been the first for a 14-cubic-yard dragline.

Shipments of new equipment to the State's deep mines in 1971 included two mobile loaders, 78 continuous mining machines, one longwall unit, 93 shuttle cars, 82 gathering and haulage belt conveyors, and unknown numbers of rubber-tired tractors, mine cars, and roof drills.

The Joy Manufacturing Co., in its Franklin, Pa., plant, produced its 10,000th shuttle car for the coal mining industry. This car, with two 50-horsepower traction motors and a 330-cubic-foot capacity, was shipped to a mine in Colorado. The first car introduced by the company in 1938 had a capacity of 140 cubic feet.

Washington, Greene, Indiana, Cambria, and Armstrong Counties produced 35.1 million tons, or 79 percent, of the total deep mined coal. Clearfield, Clarion, Somerset, Armstrong, and Indiana Counties produced 16.6 million tons, or 59 percent, of the total strip mined coal. Armstrong, Indiana, Clearfield, Jefferson, and Elk Counties produced approximately 73 percent of the total auger mined coal. Collectively, Washington, Greene, Indiana, Armstrong, and Cambria Counties produced 42.2 million tons, or 58 percent, of the State's total coal production. Pennsylvania had six of the 50 largest bituminous coal mines in the United States in 1971. Collectively, five deep mines and one strip mine produced 12.69 million tons, or 10.1 percent of the 125.84 million tons produced by the 50 largest producing mines in the United States.

Active mines producing more than 1,000 tons per year totaled 765; 181 were deep mines, 17 less than in 1970; 527 were strip mines, 28 less than in 1970; and 57 were auger mines, three more than in 1970.

The 1971 production is distributed among geological beds in table 9, while

detailed productivity data for 1969, 1970, and 1971 are compared in table 10.

The 72.8-million-ton total production in 1971 was valued at \$620.2 million, compared with the 80.5 million tons produced and valued at \$585.1 million in 1970. The average f.o.b. mine value increased to \$8.52 from \$7.27 in 1970. Open market sales totaled 47.7 million tons and averaged \$7.47 per ton at the mine, and 25.1 million tons of captive coal averaged \$10.50 at the mine.

Approximately 50.0 million tons was transported by rail or water; 7.7 million tons by conveyor belt; and 14.8 million tons by truck. Unit-train shipments totaled 19.1 million tons, 10.3 percent less than in 1970. The remainder of the total production was distributed as follows: 403,000 tons for local domestic uses, 12,000 tons for heat and power at mines, and 383,000 tons for beehive coke production.

Sixty-eight mechanical cleaning plants, six fewer than in 1970, produced 42.63 million tons of salable coal and 14.59 million tons of refuse. The percentages of cleaned coal by origin were: Deep mines, 83.35; strip mines, 16.64; and auger mines, 0.01. Wet washing equipment by types and their production of cleaned coal in million tons were, tables, 4.98; launders, 1.34; froth-flotation, 1.66; dense medium, 16.35; classifiers, 0.72; and jigs, 10.11. Pneumatic-type equipment produced 7.47 million tons of clean coal.

Bituminous coal cleaning facilities contracted for in 1971 by five purchasers had a total capacity of 1,617 tons per hour. At 7 hours per day and 220 days operation per year, this new equipment was capable of producing 2.49 million tons per year of cleaned coal.

Seven companies operated 11 thermal drying units to produce 6.06 million tons. Of the 48.53 million tons of coal crushed in 188 plants, 40.87 million tons was cleaned at plants performing crushing.

Thirteen companies in seven counties operated 26 plus-500,000-ton-per-year deep mines whose total production was 26.60 million tons, or 60 percent of the total underground production.

The 1971 DER Annual Report of the Anthracite and Bituminous Coal Divisions listed 202 deep mine operations producing 44.36 million tons: 16 were shaft mines with 12.87 million tons production; 36

were slope mines with 17.68 million tons production; 149 were drift mines with 13.77 million tons production, and one operation, listed as an underground mine, produced 39,800 tons of salable product by processing mine refuse. Sixty-six deep mines were classed as gaseous and 136 as nongaseous. The numbers and types of lamps used in deep mines comprised 10 open flame, 4,721 safety flame, and 19,926 electric. Underground mining and its supporting services employed 18,624 persons. The 32 fatalities incurred by the bituminous coal industry equaled one per 2,236,000 tons of production, or 5.91 per million man-days. Nonfatal injuries totaled 970, equal to one per 76,031 tons of production or 173.53 per million man days. Underground mines used 785,045 total pounds of permissible explosives, four mines used both permissible explosives and Airdox to produce 2,359,000 tons of coal, and three mines used Airdox as the sole breaking agent to produce 546,766 tons of coal. A small number of deep mines classed as hand loaded employed 10 shot firers, 43 pick miners, and 38 miners to perform hand loading and operate mechanical loaders. All deep mines had 8,050 employees operating mechanical loading machines.

Continuous mining machines totaled 501, 37 more than in 1970, and produced 37.57 million tons of coal, 8.55 million tons less than in 1970. These machines comprised ripper, boring, oscillating-disc-head, and rotary drum types. Because 21 machines were not designed to perform loading, 34 mobile loaders were teamed with these 21 continuous mining machines to load 1.64 million tons from the mine floor. Seventy continuous mining machines mined and loaded 3.40 million tons onto feeder-conveyors, and 410 machines mined and loaded 32.53 million tons into shuttle cars.

Nine longwall systems produced approximately 1,925,000 tons of coal, 6,000 tons more than the 1,919,000 tons produced by 10 longwall systems in 1970. In 1971, one planer-type installation produced 197,294 tons and eight shearer-type installations produced 1,727,749 tons. The longwall installations were operated in coal seams ranging from 43 to 78 inches in thickness under 200 to 800 feet of cover. The blocks of coal mined ranged from 400 to 600 feet in face length and 2,550 to 2,880 feet in

panel depth. The number of men for one crew shift ranged from seven to 10, and the run-of-mine coal production during one crew shift ranged from 700 to 1,277 tons.

Seventeen mobile loaders discharged 270,920 tons into mine cars or onto conveyors, and 4,301,477 tons were loaded into shuttle cars and rubber-tired mine cars by 69 mobile loaders. The remainder of the mechanically loaded coal, totaling 51,683 tons, was loaded by 10 duckbill or scraper conveyors. Coal loaded by hand totaled 169,000 tons.

A total of 135 cutting machines, 19 fewer than in 1970, were used to cut 4,776,317 tons. Coal shot from the solid totaled 17,964 tons.

Coal drilling by 80 hand-held or post-mounted drills, 48 fewer than in 1970, was used to produce 1,543,456 tons of coal, and 38 mobile drills, 26 more than in 1970, were used to produce 3,250,299 tons of coal.

Roof bolting employed 276 rotary drills, five more than in 1970, and 265 percussion drills, 26 less than in 1970. Roof or rock drills used for other purposes included 38 rotary drills, 15 more than in 1970, and 32 percussion drills, 12 less than in 1970.

Equipment used for the haulage of run-of-mine coal, rock, operating supplies, and personnel in deep mines included 1,022 trolley locomotives, 47 more than in 1970; 68 battery-powered locomotives, 18 more than in 1970; 12,576 seven-ton-capacity rail mine cars, 1,442 fewer than in 1970; 473 miles of mainline track and 287 miles of other track; and 619 gathering and haulage conveyor belts, 57 more than in 1970, averaging 1,921 feet in length and totaling 225.1 miles compared with 199.6 miles in 1970. Considerable intermediate haulage was done by 1,060 cable reel shuttle cars and 61 battery-powered shuttle cars, six shuttle buggies, 218 rubber-tired tractors, 848 rubber-tired trailers, and 65 rubber-tired mine cars.

Seventy-seven mines installed 8,580,814 roof bolts, all new, as either the sole method of roof support or in conjunction with other roof support materials. These 77 mines produced approximately 43 million tons of coal including approximately 35 million tons produced under roof supported only by bolts. The State produced approximately 14 percent of the total bitu-

minous coal produced under bolted roof in the United States and installed approximately 17 percent of the total roof bolts used in such production.

Strip mining equipment included 467 power shovels, 103 less than in 1970, and 326 draglines, 38 less than in 1970. Approximately 90 percent of the shovels and drag lines were diesel-powered and 73 percent were rated at less than 5-cubic-yard capacity. Of the 38 carryall scrapers in operation, 28 more than in 1970, 11 were rated at less than 15-cubic-yard capacity. Other strip mining equipment included 849 bulldozers, 32 horizontal drills, 116 vertical drills, 328 front-end loaders, 11 wheel excavators, five power brooms, 51 motor graders, and five coal drills. No data were available for the truck haulage of run-of-mine coal. The 28.0-million-ton strip mined production averaged \$6.41 per ton f.o.b. mine, compared with a \$5.38 average f.o.b. mine value for the 24.4-million-ton production in 1970. The C & K Coal Co. was the largest producer of strip mined coal with 2,375,235 tons from 15 operations, all in Clarion County.

Strip and auger mining consumed 31,271 pounds of permissible explosives, 9,375,890 pounds of dynamites, and 104,312,481 pounds of processed and unprocessed ammonium nitrate.

Active equipment for auger mining included 58 augers, 45 bulldozers, two carryall scrapers, one diesel shovel rated at less than 5-cubic-yard capacity, and seven front-end loaders. The 544,211-ton auger mined production averaged \$6.04 per ton at the mine, compared with a \$5.52 per ton average f.o.b. mine value for the 661,000-ton production in 1970.

Coke.—Nine companies operated 12 oven-coke plants, two classified as merchant and 10 as furnace, and received 22,721,000 tons of coal. Kentucky supplied 1,262,000 tons; Pennsylvania, 12,081,000 tons; Virginia, 600,000 tons; and West Virginia, 8,778,000 tons. Collectively these 12 plants carbonized 21,883,647 tons of bituminous coal and 98,147 tons of anthracite to produce 15,260,638 tons of breeze-free metallurgical coke, 97.3 percent of which was blast furnace grade valued at \$32.62 (average) per ton. The 12 plants also produced 751,239 tons of coke breeze, and byproducts comprising fuel gas, nitrogen fertilizers,

Table 8.—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) ¹
	Under-ground	Strip	Auger	Total	Under-ground	Strip	Auger	Total	
Allegheny	8	6	--	14	3,281	730	--	4,011	\$36,162
Armstrong	19	57	17	93	4,679	2,628	163	7,470	50,785
Beaver	1	5	2	8	W	W	W	W	W
Bedford	2	--	--	2	4	--	--	4	W
Butler	6	27	2	35	577	876	36	1,489	9,453
Cambria	23	17	--	40	5,581	757	--	6,338	80,286
Centre	2	16	--	18	W	W	W	--	7,284
Clarion	1	42	--	43	2	4,198	--	4,200	29,789
Clearfield	11	93	6	110	1,100	5,697	62	6,859	45,818
Clinton	--	5	--	5	--	406	--	406	2,549
Elk	1	7	3	11	W	W	W	W	W
Fayette	4	49	2	55	657	890	14	1,561	13,058
Fulton	--	1	--	1	--	3	--	3	18
Greene	15	16	--	31	7,474	906	--	8,380	80,060
Indiana	35	34	7	76	6,111	1,375	78	7,564	73,014
Jefferson	7	35	7	49	161	1,198	59	1,418	10,408
Lawrence	--	12	5	17	--	744	28	772	3,792
Lycoming	--	2	--	2	--	83	--	83	333
Mercer	--	4	--	4	--	407	--	407	2,614
Somerset	27	46	3	76	1,135	2,678	27	3,840	28,844
Tioga	--	2	--	2	--	986	--	986	4,333
Venango	--	8	--	8	--	369	--	369	1,947
Washington	12	16	3	31	11,231	1,217	33	12,481	114,158
Westmoreland	7	27	--	34	1,743	645	--	2,388	20,846
Undistributed ²	--	--	--	--	553	1,209	44	1,806	4,695
Total	181	527	57	765	44,289	28,002	544	72,835	620,196

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

¹ Value received or charged for coal f.o.b. mine. Includes a value for coal not sold but used by producers if such coal has been sold commercially.² Includes production and values indicated by symbol W.

Table 9.—Bituminous coal production by coalbed

(Thousand tons)

Coalbed (Geological name)	Thickness, inches	Under-ground	Strip	Auger	Total	
Bakerstown	18-28	XX	101	XX	101	
Bloss, Morgan and Seymour	22-28	XX	873	XX	873	
Brookville	24-54	737	1,589	XX	2,326	
Clarion	18-50	XX	2,252	XX	2,252	
Clarion-Brookville	26-52	XX	158	XX	158	
Clarion-Kittanning	28-48	XX	1,671	XX	1,671	
Freeport	30-55	XX	277	XX	277	
Freeport, Lower	22-100	3,984	1,061	92	5,137	
Freeport, Upper	20-48	4,962	2,810	104	7,876	
Freeport, Lower and Upper	28-56	XX	2,257	16	2,273	
Freeport, Double	84-86	1,686	XX	XX	1,686	
Freeport, Middle	30	XX	XX	7	7	
Freeport, Thick	78-108	1,583	XX	XX	1,583	
Freeport, Kittanning	12-56	XX	1,649	XX	1,649	
Kittanning	16-20	XX	286	28	314	
Kittanning, Lower	20-60	8,955	3,089	134	12,178	
Kittanning, Middle	16-34	258	1,728	113	2,099	
Kittanning, Upper	38-96	1,311	676	XX	1,987	
Kittanning, Lower and Middle	10-60	XX	1,382	32	1,414	
Mahoning	42-43	3	30	XX	33	
Mercer	6-36	XX	20	XX	20	
Pittsburgh	36-108	19,831	2,724	14	22,569	
Redstone	24-40	2	428	XX	430	
Sewickley	42-60	1,004	218	XX	1,222	
Uniontown	32-36	XX	70	XX	70	
Waynesburg	36-72	XX	1,245	19	1,264	
Other	20-48	140	262	XX	102	
Total		XX	44,356	26,656	559	71,571

XX Not applicable.

¹ Listed as underground production although obtained by the reprocessing of refuse dump material.² Comprises production from five beds: "A" Rider, 7; Brush Creek, 40; Cannel, 1; Clay Rider, 11; and Fulton Barnet, 3.

NOTE.—All data shown in this table were derived from information contained in the Annual Report, published by the Anthracite and Bituminous Division of the Pennsylvania Department of Environmental Resources, which summarizes mandatory monthly reports submitted by the bituminous industry.

Table 10.—Bituminous coal productivity data, 1969-71

Activity	Production (thousand short tons)			Man-days (thousands) ¹			Productivity (tons per man-day) ¹			Percent change in 1969-71 period
	1969	1970	1971	1969	1970	1971	1969	1970	1971	
Underground:										
Captive (mined and cleaned):										
Mining.....	28,870	28,822	21,857	2,198.3	2,415.8	2,023.6	12.01	11.93	10.80	-16.3
Cleaning.....	28,870	28,822	21,857	2,206.3	212.7	161.6	137.52	185.51	135.25	-1.7
Total or average.....	28,870	28,822	21,857	2,404.6	2,628.5	1,185.2	11.80	10.97	10.00	-15.3
Noncaptive (mined and cleaned):										
Mining.....	16,108	18,941	16,480	1,011.2	1,282.0	1,893.2	15.93	15.87	12.45	-21.8
Cleaning.....	16,108	18,941	16,480	124.9	121.7	101.1	128.97	155.64	163.01	+26.4
Total or average.....	16,108	18,941	16,480	1,136.1	1,353.7	1,424.3	14.13	13.99	11.57	-18.4
Noncaptive (mined and crushed):										
Mining.....	11,577	7,579	6,019	708.9	603.3	492.6	16.33	12.56	12.22	-25.2
Crushing.....	11,577	7,579	6,019	35.4	34.0	29.5	327.03	222.91	204.03	-87.6
Total or average.....	11,577	7,579	6,019	744.3	637.3	522.1	15.55	11.89	11.53	-25.9
Strip:										
Noncaptive (mined and cleaned):										
Mining.....	6,760	9,261	10,241	294.5	395.6	480.6	22.95	23.41	23.78	+3.6
Cleaning.....	6,760	9,261	10,241	59.4	60.7	66.5	113.80	152.57	154.00	+35.3
Total or average.....	6,760	9,261	10,241	353.9	456.3	497.1	19.10	20.30	20.60	+7.9
Noncaptive (mined and crushed):										
Mining.....	14,893	14,900	16,415	648.8	686.4	690.5	22.95	23.41	23.77	+3.6
Crushing.....	14,893	14,900	16,415	45.6	66.9	80.4	326.60	222.72	204.17	-87.5
Total or average.....	14,893	14,900	16,415	694.4	703.3	770.9	21.45	21.19	21.29	-0.7
Auger:										
Noncaptive (mined and cleaned):										
Mining.....	61	42	59	2.1	1.1	1.6	29.05	33.18	36.88	+27.0
Cleaning.....	61	42	59	.5	.3	.4	122.00	140.00	147.50	+20.9
Total or average.....	61	42	59	2.6	1.4	2.0	23.46	30.00	29.50	+25.7
Noncaptive (mined and crushed):										
Mining.....	416	548	500	14.6	13.9	13.4	28.49	39.42	37.31	+31.0
Crushing.....	416	548	500	1.3	2.5	2.5	320.00	219.00	200.00	-87.5
Total or average.....	416	548	500	15.9	16.4	15.9	26.16	33.41	31.45	+20.2
Total captive and noncaptive:										
Mining.....	78,185	80,093	71,571	4,878.4	5,293.1	4,975.5	16.03	15.12	14.38	-10.3
Cleaning.....	61,239	57,066	48,637	391.1	395.4	329.6	131.17	144.32	147.56	+12.5
Crushing.....	26,886	23,027	22,934	82.3	103.4	112.4	326.68	220.70	204.04	-87.5
Total or average.....	78,185	80,093	71,571	5,351.8	5,796.9	5,417.5	14.61	13.82	13.21	-9.6

¹ Includes personnel engaged in maintenance, haulage, stripped land surface reclamation, etc.

Note: All data in this table were derived from annual reports, published by the Anthracite and Bituminous Division of the Pennsylvania Department of Environmental Resources, that summarize mandatory monthly reports submitted by the bituminous industry.

tar, naphthalene, pitch, and crude light oil and its derivatives.

Pennsylvania ranked first in oven-coke production, with 27 percent of the total production in the United States.

Exports of coke through Philadelphia totaled 154,556 short tons.

Ten iron and steel works operated by seven companies had integral coke plants with a total of 3,361 slot-type ovens, 1,375 of which were in the world's largest coke plant at Clairton. The two merchant coke plants had 132 slot-type ovens.

Four beehive coke plants operated by four companies in Armstrong, Fayette, and Indiana Counties produced 248,930 tons of coke, all of which was blast furnace grade. The four beehive plants collectively used 431,272 tons of bituminous coal, of which 383,214 tons came from Pennsylvania mines. The average coke yield for the four plants was 57.72 percent.

Two unpublished papers relating to coke oven gas purification were presented at the Annual Joint Meeting of the Eastern States and the Western States Blast Furnace and Coke Plant Associations in Pittsburgh, October 8, 1971. The papers were titled: The Past, Present and Future of H₂S Removal Systems; and U.S. Steel's Keystone Project.

In March, the Koppers Co. started to supply industrial coke to the foundry market from 58 recently activated ovens owned and operated by Interlake, Inc., in Erie, Pa. This new 12,000-ton-per-month output replaced that from Kopper's recently closed coke plant at Kearny, N.J.

Experimental work to produce coke pellets has been conducted by Consolidation Coal Co. since 1960 in a 15- to 30-ton-per-day pilot plant at Library at a total cost of \$7 million. Based on the results of the work, a \$20 million, 500-ton-per-day demonstration plant will be built at Sparrows Point, Md. Engineering work was underway in 1971 for the plant, which is scheduled to begin operations in 1974. Companies backing the project include Bethlehem Steel Corp., Consolidation Coal Co., Granite City Steel Co., National Steel Corp., and Republic Steel Corp. The main objective of the venture will be to provide the engineering data necessary, if the process proves technically successful, to construct production size pelletizing plants with capabilities of 2,000 to 5,000 tons per day. The process is designed to use either

coking-grade or weakly coking-grade coal. Other objectives are to curtail gas and dust emissions at coke works, to stretch the supply of low-volatile coal by using a single high-volatile coal, and to use surplus gas from the process, after cleaning, in steel plants and for power generation.

The Bethlehem Steel Corp. received U.S. Patent 3,623,973 for breaking coal tar residues into useful chemical compounds. In the process covered by the patent, hydrocracking produces two- and three-ring compounds that, in the presence of hydrogen, are converted into one- and two-ring aromatics such as naphthalene, benzene, and benzene homologs.

The State's Air Pollution Commission filed a suit claiming that beehive coke ovens operated by the Bortz Coal Co., in Fayette County, produced air polluting emissions in excess of legal limits. The case was dismissed because the expert witness had not employed any of the instruments available for testing emissions.

The EPA in May sought an injunction through the Department of Justice under the River and Harbor Act of 1899 to stop pollution of the Monongahela River by the Monessen plant of the Wheeling-Pittsburgh Steel Co. Reportedly, water samples taken in February showed that the plant discharged a daily average of 2,270 pounds of phenolics, 179 pounds of cyanide, and 30,301 pounds of suspended solids.

A spokesman for DER stated that the United States Steel Corp. proposed a plan whereby 2.5 million gallons per day of waste water would be discharged from the Clairton Coke Works to the Allegheny County Sanitary Authority (Alcosan). The plan would require additional treatment facilities and create some maintenance problems at the Alcosan plant. Reportedly, the daily waste water discharged from the Clairton works included 21,000 pounds of phenolics, 20,000 pounds of free ammonia, 40,000 pounds of fixed ammonia, 2,100 pounds of cyanide, 15,000 pounds of cyanate, and 125,000 pounds of dissolved solids.

The United States Steel Corp. was sued by Allegheny County and the Commonwealth to compel the company to curb pollution outside and inside the Clairton Coke Works. The suit asked that the firm be ordered to stop quenching coke with contaminated water, reduce SO₂ emissions,

prevent pollutants from leaking out of coke ovens, reduce employee exposure to coal tar fumes, and begin significant research to find new ways to decrease the quantity of air pollutants emitted at Clairton.

Natural Gas Liquids.—The total quantity of natural gas liquids produced was less than in 1970, but the average value per barrel was greater than in 1970. Proved reserves of natural gas liquids totaled 817,000 barrels at yearend compared with 896,000 barrels at yearend 1970.

At the start of the year, two natural gas processing plants with a daily gas capacity of 8.0 million cubic feet had a 3.3-million-cubic-foot daily throughput. The average daily production of liquids comprised 3,000 gallons of propane, 1,200 gallons of normal butane, and 2,100 gallons of debutanized natural gasoline. The Mars Co. operated these two plants, the Lamont plant in the Kane field in Elk County and the Van plant in the Strong field in Venango County near Oil City.⁷

Peat.—Ten operations in seven counties reported a total production of 38,850 short tons, 21.2 percent less than in 1970. The total production comprised 1,200 tons that were shredded and kiln dried and 37,650 tons that were shredded only. Luzerne County was the leading producer with 16,770 tons, followed by Lackawanna County. The other producing counties were Columbia, Erie, Lawrence, Monroe, and Wayne.

Sales totaling 38,186 tons, at an average value of \$12.08 per ton, were 12.8 percent less and averaged 38 cents per ton more than in 1970. Sales of bulk peat for general soil improvement totaled 22,145 tons and averaged \$11.03 per ton. Total sales and average value by type comprised 8,382 tons of moss at \$12.98 per ton; 18,510 tons of reed-sedge at \$10.59 per ton; and 11,294 tons of humus at \$13.87 per ton.

Petroleum and Natural Gas.—Crude petroleum production was 7.2 percent less than in 1970 despite the startup of several waterflood projects. The average value, \$4.66 per barrel at the well, was 14 cents per barrel greater than in 1970. Compared with the 31.4-million-barrel production in 1891, the Pennsylvania-grade crude petroleum production in 1971 totaled 3,733,000

42-gallon barrels valued at \$17.49 million, or \$4.68 per barrel, with an additional 65,000 barrels of Corning-grade crude oil valued at \$209,300, or \$3.22 per barrel, and produced in Crawford and Erie Counties from the Medina (Lower Silurian) Sandstone. The Corning production was off 442 barrels from that of 1970.

The number of producing wells, all of which were strippers, decreased from 36,801 in 1970 to 34,029 in 1971. Estimated proved recoverable reserves of crude oil at yearend totaled 47.0 million barrels, a decrease of 4.3 million barrels from that of yearend 1970. Indicated reserves of crude oil economically available by fluid injection totaled 32.8 million barrels.⁸

Natural gas production totaled 76.5 billion cubic feet, a decrease of 0.5 percent from that of 1970. A total of 63.6 billion cubic feet of gas was produced from the shallow (Upper Devonian or younger) reservoirs, while production from the deep (Middle Devonian or older) reservoirs totaled 12.9 billion cubic feet. The estimated number of producing gas wells increased from 16,548 in 1970 to 16,586 in 1971. Estimated proved reserves of natural gas totaled 1,396 billion cubic feet including 616 billion cubic feet in storage at yearend. This was an increase of 31 billion cubic feet from that of 1970.

According to the American Gas Association, underground natural gas storage facilities in Pennsylvania on December 31, 1971, comprised 66 pools serviced by 2,135 wells and equaled about 17 percent of the U.S. reservoir capacity.

According to the Bureau of Topographic and Geologic Survey, 693 new wells were drilled and 88 wells were deepened during 1971. Of these, 387 were oil, 182 gas, 60 service, 32 gas storage, and 32 dry holes. Of the old wells drilled deeper, 21 were gas, three oil, 48 gas storage, and 16 dry. Total footage of all wells (781) drilled was 1,440,689. Of 641 well completions, 22 were exploratory (18 percent successful) and 619 were development (95 percent successful). Deep drilling (Middle Devonian or older) increased from 90 wells in 1970 to 106 wells in 1971, including 48

⁷ Oil and Gas Journal. V. 69, No. 28, July 12, 1971, pp. 84, 96.

⁸ Oil and Gas Journal. Slump in Drilling Again Trims U.S. Oil and Gas Reserves. V. 70, No. 14, Apr. 3, 1972, pp. 18-20.

wells drilled deeper. As in 1970, the majority of the deep development drilling was in the Medina gas area of Crawford County where nine gas wells were drilled in the Indian Springs field. Three of these nine wells produced Corning-grade crude oil along with the gas, with initial oil productions ranging from 10 to 50 barrels of oil per day. Most of the activity in the shallow gas fields was in the following counties: Indiana—95 gas wells, Jefferson—17, and Armstrong—16. The majority of the shallow oil development was carried on in the following counties: Warren—144 oil wells with Glade sand production, Venango—142 wells producing from the Red Valley and Venango Second sandstones, McKean—48 wells producing from the Bradford and associated sandstones, and Forest—41 wells with production from the Red Valley and Venango Second sandstones. Seismic activity was at an alltime high during the year with most of it being the vibroseis (shock wave) type. Seismic crews logged 147 crew-weeks during 1971 compared with 45 crew-weeks during 1970, an increase of 227 percent. The seismic surveys were made in Bedford, Blair, Bradford, Cambria, Cameron, Centre, Clearfield, Clinton, Crawford, Elk, Erie, Forest, Fulton, Greene, Indiana, Jefferson, Lackawanna, Lawrence, Lycoming, McKean, Mercer, Pike, Potter, Susquehanna, Tioga, Venango, Warren, Washington, Wayne, and Wyoming Counties. A total of 2,778 acres in Pike County were leased to bidders by the Pennsylvania Game Commission during the year. The bonus bid was \$21,588.17 with a rental of \$1.00 per acre and a royalty of \$0.04 per thousand cubic feet (Mcf). At the end of 1971, the Commission had 28 active leases totaling 14,680.9 acres. Thirty-six wells were producing on the 28 leases. No wells were drilled on the leases during 1971. Through competitive bidding, 3,840 acres in Bedford County, 5,022 acres in Cameron County, and 7,542 acres in Cameron and Potter Counties of State Forest and Park lands were leased during 1971. The total bonus or first-year rental received for these tracts was \$230,075.33. The average of all sales was \$7.43 per acre. After the first year, the rental is \$1 per acre per year with royalties equal to one-eighth or better of all production. The income relative to oil and gas exploration and development from

State Forest and Park lands was \$509,370 which royalty payments amounted to \$139,658 for 1,407,463 Mcf of gas produced on the lands and \$369,712 for tract rentals, gas storage, right of ways, etc. At yearend, there were 157,085 acres (59,109 acres for gas storage) of State Forest and Park lands under lease for oil and gas exploration and development.

American Petroleum Institute data for oil and gas exploratory and development drilling are shown in table 11.

Some average characteristics of the Bradford oilfield are depth to sand, 1,000 to 2,000 feet; thickness, 50 feet; porosity, 15 percent; permeability, 10 millidarcys; oil saturation, 30 to 60 percent; water saturation, about 10 percent; about 100 cubic feet of gas produced per barrel of 45.5 API gravity crude produced; and a low original reservoir pressure of about 350 pounds per square inch (no good figure available). In the 1870-1970 period, production in the Bradford field totaled 646.8 million barrels, comprising 273.1 million barrels by primary recovery and 373.7 million barrels by secondary recovery methods. Of the total oil produced in Pennsylvania to the end of 1970, which amounted to 1,269.5 million barrels, over 43 percent was produced from the Pennsylvania part of the Bradford field. If the Marathon Oil Co.'s Maraflood, or some other tertiary recovery process proves economically feasible, the field could produce as much oil as it has in the past. If waterflooding continues to be the main recovery method, production will continue to decline and the life of the field will be terminated in the not too distant future.⁹

Active rotary-drill weeks totaled 484. Only six rotary drills were active in the weeks ending January 6, March 15 and 22, and December 13 and 27. The maximum activity was in the week ending May 3, when 14 rotary drills were in operation.

A pilot Maraflood project was completed in a section of the Bradford field in McKean County. The project had 16 injection wells and 25 producers on a 45-acre tract. The oil was produced in the Bradford Third Sandstone at an 1,800-foot depth. In May 1971, a second Maraflood project was

⁹ Pennsylvania Geology (Pennsylvania Geological Survey), Bradford, The First Giant Oil Field. V. 2, No. 4, August 1971, pp. 34-36.

started in the water-wet First Venango Sandstone at a 500-foot depth in the Goodwill Hill area of Warren County. This project consisted of a 10-acre tract with nine injection wells and 12 producers.

The sandstone in this area had been gas driven but never water flooded.

In June, there were four aboveground liquefied natural gas (LNG) facilities in Pennsylvania, as follows:

Company and plant site	Liquefaction plant capacity (million cubic feet per day)	Storage capacity		Initial year of operation
		Million cubic feet	Thousand barrels	
Philadelphia Electric Co., West Conshohocken	6.6	1,200	348	Under construction
Philadelphia Gas Works, Philadelphia	16.0	4,000	1,200	1969
Do ¹	--	250	73	1971
UGI Corp. Reading Division, Reading	--	250	73	1971

¹ Sole supplier to UGI Corp., Reading Division at Reading, Pa.

Source: Pipeline and Gas Journal, v. 198, No. 7, June 1971, pp. 44-46.

The Statistical Committee of the Natural Gas Processor's Association in its 1971 liquefied petroleum gas (LPG) storage survey reported the State's total capacity for underground LPG storage as 1,091,000 barrels. One company in Delaware County had storage capacity for 500,000 barrels of butane, 400,000 barrels of propane, and 75,000 barrels of propylene. In Westmoreland County, one company had capacity for 116,000 barrels of n-butane. One gas works in Philadelphia County had 54 aboveground tanks for storing 1,620,000 barrels of LPG.¹⁰

Marketed production of natural gas averaged 209 million cubic feet per day at 27.7 cents per thousand cubic feet at the wellhead.

Of the 26,000 square miles in the Plateaus Province, only one-half of the stratigraphic interval had been evaluated for oil and gas in 40 percent of the area at year-end. In the remainder of the area, more than 10,000 feet of favorable section associated with a wide array of structures has not been explored. The total volume of the Appalachian Plateaus Province sediments is roughly 90,000 cubic miles of which only an estimated 17 percent has been drilled adequately.¹¹

On May 10, the Federal Power Commission affirmed a January 8 decision that denied the Pennsylvania Gas and Water Co. of Wilkes-Barre the direct purchase of 23,845,000 cubic feet of gas daily from the Transcontinental Gas Pipe Line Corp. (Transco), of Houston, Tex. Transco continued to deliver this amount of gas to Pennsylvania Gas for the account of Manufacturers Light and Heat Co. of Pittsburgh. Transco said it did not have suffi-

cient gas supplies to provide the same amount to both Manufacturers and Pennsylvania Gas.

The Philadelphia Gas Works awarded a \$19,956,000 contract for two 583,000-barrel-capacity prestressed-concrete LNG storage tanks designed by the Preload Engineering Co. The unique tanks will have a second prestressed concrete wall designed to the same criteria as the primary liquid-containing tank wall, plus a 10-foot-wide concrete berm in the protective system.

On June 1, the Federal Power Commission authorized the Consolidated Gas Supply Corp., of Clarksburg, W.Va., and Transcontinental Gas Pipe Line Corp. and Texas Eastern Transmission Corp., both of Houston, Tex., to jointly develop the Tamarack and Leidy gas storage fields in north-central Pennsylvania at an estimated cost of \$6,530,500. The three firms will re-complete six existing wells and drill five new wells in the Tamarack pool. Additionally, the three firms will build about 4 miles of 12-inch gathering line and related well lines and will add engine controls and other equipment at the Leidy station. The Commission conditioned its authorization by requiring semiannual reports on the operation of the Tamarack facilities until the maximum 11.2-billion-cubic-foot storage limit is reached.

Construction of a new LNG plant for the Philadelphia Electric Co. progressed satisfactorily, with preliminary operation

¹⁰ Oil and Gas Journal, V. 69, No. 10, Mar. 8, 1971, pp. 87-92.

¹¹ Kelley, Dana R., William S. Lytle, Walter R. Wagner, and Louis Heyman. The Petroleum Industry and the Petroleum Province in Pennsylvania, 1970. Pennsylvania Geological Survey, Fourth Series. Miner. Res. Bull. M65, 1970, 39 pp.

expected in early 1972. When completed in 1972, the plant will store up to 1.2 billion cubic feet of natural gas and will be capable of providing 200 million cubic feet of gas per day during periods of peak demand.

Pennzoil United, Inc. completed the IASCS unit in Section D, Elders Ridge Quadrangle, Kiskiminitas Township, that flowed 2.6 million cubic feet of gas per day from Chert and Oriskany-Devonian rocks at 7,305 and 7,442 feet, respectively.

Consolidated Gas Supply Co.'s No. 1 discovery well, located 4 miles northeast of Emporium, in the Department of Forests and Waters Tract 153, had a final flow of 13.93 million cubic feet of gas per day following fracture of Oriskany-Devonian rocks at 6,653 to 6,683 feet.

Two Onondoga reef discoveries in New

York State stimulated the leasing of land in Pennsylvania's Potter and Tioga Counties. The Natural Fuel Gas Co., the Weaver Oil & Gas Corp., and the Amoco Production Co. leased several million acres in 17 Pennsylvania counties and in 10 New York counties and planned to drill at least five wells in 1972 and eight wells in 1973. A discovery gas well in the newly discovered East Emporium field of Cameron County had an initial production of 14 million cubic feet per day. A deep wildcat in Pike County was being drilled to a depth in excess of 12,000 feet. Exploratory drilling during the year led to the discovery of a small oil pool, a small shallow gas pool, and an Oriskany gasfield.

The crude petroleum feed capacity and lubricating oil production capacity of the State's 12 refineries were—

Type of feed	Interstate and foreign asphalt base		Pennsylvania grade	
	1-1-71	1-1-72	1-1-71	1-1-72
Crude capacity:				
Barrels per calendar day	616,100	616,300	32,970	34,520
Barrels per stream day	644,500	646,520	34,940	36,495
Total feed	224.9	225.0	12.0	12.6
Lubricating oil production capacity:				
Barrels per stream day	21,200	17,000	11,495	12,578
Estimated annual production	7.4	5.9	3.9	4.3

Sources: (Oil and Gas Journal. V. 69, No. 12, Mar. 22, 1971, pp. 114-115.
(Oil and Gas Journal. V. 70, No. 13, Mar. 27, 1972, pp. 152-154.)

The Atlantic Richfield Co. started a \$45 million program at its Philadelphia refinery to make fuel products only instead of a full line of products such as waxes, solvents, and process oils. The program will cut employment at the refinery from a current 2,200 jobs to about 900. A 35-long-ton-per-day Pan Am sulfur plant was completed in the same refinery by Pan Am Engineers, and construction was in progress on a new 30,000-barrel-per-day catalytic reformer.

The Sun Oil Company, at Marcus Hook, was constructing facilities using refinery streams to produce 1,000 barrels per day of benzene, 2,800 barrels per day of toluene, 1,000 barrels per day of mixed xylenes, 340 million pounds per year of propylene, 450 barrels per day of propylene tetramer, 1,000 barrels per day of propylene trimer, 350 tons per day of ammonia, 30 long tons per day of sulfur, and 130 barrels per day of naphthenic acids.

A 4,000-barrel-per-day vacuum addition was completed in December at the Kendall

Refining Co.'s Bradford refinery. This addition increased the plant's capacity to 10,000 barrels per day of crude feed.

In midyear, the Foster Wheeler Corp. completed a 2,500-barrel-per-day lube-oil hydrocracking unit for Pennzoil United Inc., at Oil City.

A hydrofluoric acid alkylation 8,700-barrel-per-day unit was being constructed by the Foster Wheeler Corp. for the BP Oil Corp. at Marcus Hook. At the same refinery construction was in progress on petrochemical facilities to convert petroleum fractions and refinery gas into aliphatic aromatic solvents, 12 million pounds per year of paraxylene, 52 long tons per day of sulfur, 400 barrels per day of toluene, and 1,000 barrels per day of xylene solvents.

In December, the Gulf Oil Corp. announced a 3-year, \$30 million program to make its refinery at Philadelphia one of the most pollution-free units of its type in the world. The program will include a new waste water treatment plant, equipment to eliminate 137 tons per day of car-

bon monoxide and to trap particulates from two catalytic cracking units, and the installation of vapor seals on hundreds of valves, pumps and loading facilities, and floating roofs on scores of storage tanks. The program will be financed by \$25 million from bonds issued by the Philadelphia Authority for Industrial Development and \$5 million financed by the corporation.

The Pennsylvania Refining Co., at Karns City, completed a 1,050-barrel-per-stream-day facility to produce hydrotreated petroleum products using the Gulf Research and Development Co. process.

The Firestone Plastics Co., a division of the Firestone Tire & Rubber Co., had petrochemical facilities under construction at Pottstown to produce 80,000 tons per year of polystyrene butadiene latexes and vinyl resins from vinyl chloride monomer and petroleum base stocks.

Petrochemical production facilities were being built at the Neville Island, Pa., plant of the Neville Chemical Co., where solvents and thermoplastic resins will be made from unsaturated petroleum fractions, and at the Clairton and West Elizabeth, plants of the Pennsylvania Industrial Chemical Corp., where petroleum base stocks, aromatic olefins and diolefins, and nitrites will be converted into a variety of

resins, emulsions, polymers, copolymers, and plasticizers.

The Rohm and Haas Co. was constructing facilities at Bristol and at Philadelphia, where 25 million pounds per year of formaldehyde will be made from natural gas at each location.

Power Generation.—At yearend, the installed capacity of the State's 108 utility generating plants in megawatts (MW) by type was: Hydro, 1,651; steam, 17,377; gas turbine, 1,809; internal combustion, 109; and total, 20,946. Two nuclear-powered generating plants accounted for 130 megawatts of the 17,377-MW total capacity listed as steam powered. At yearend, the State had four mine-mouth generating stations: The Hatfield's Ferry station in Greene County, and the Conemaugh, Homer City, and Keystone stations in the Chestnut Ridge area. Only the Keystone station was operating at full capacity. The Conemaugh, Homer City, and Keystone stations have a combined design capacity of 4,880 megawatts.

The Montour station, under construction by the Pennsylvania Power & Light Co. (PP&L) near Washingtonville in Montour County, will have two 790-megawatt-capacity generating units fueled by coal delivered from Cambria County by PP&L unit trains.

Table 11.—Oil and gas well drilling completions, by county

County	Proved field wells ¹			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Armstrong.....	--	21	3	--	--	1	25	69,214
Butler.....	1	--	--	--	--	--	1	1,322
Cambria.....	--	1	2	--	--	--	3	17,688
Cameron.....	--	--	--	--	--	1	1	6,153
Clarion.....	3	4	--	--	--	1	8	15,518
Clearfield.....	--	10	--	--	--	3	13	43,995
Crawford.....	4	6	3	--	--	1	14	45,636
Elk.....	7	1	1	--	--	--	9	16,868
Erie.....	--	3	--	--	--	--	3	10,046
Fayette.....	--	4	--	--	2	--	6	18,237
Forest.....	41	3	--	--	--	2	46	47,874
Fulton.....	--	--	--	--	--	1	1	2,870
Indiana.....	--	111	10	--	1	1	123	402,375
Jefferson.....	--	18	1	--	--	1	20	59,710
Lackawanna.....	--	--	1	--	--	--	1	4,233
McKean.....	48	3	--	--	--	1	52	93,436
Potter.....	4	--	--	--	--	1	5	12,065
Somerset.....	--	1	--	--	--	--	1	8,636
Venango.....	142	--	2	--	--	2	146	115,108
Warren.....	143	1	3	1	--	1	149	135,491
Washington.....	--	1	3	--	--	--	4	2,734
Westmoreland.....	--	7	1	--	--	--	8	21,265
Wyoming.....	--	1	--	--	--	1	2	5,799
Total.....	393	196	30	1	3	18	641	1,156,273

¹ Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

The Montour, Conemaugh, Homer City, and Keystone stations will consume about 500 million tons of coal during their anticipated 30-year lifetime. This supply of coal will be mined in the Chestnut Ridge area, which reportedly contains more than 12 billion tons of bituminous coal reserves. Mines under contract to produce coal for the four stations are operated by the Florence Mining Co., the Greenwich Collieries Co., the Helen Mining Co., and the Oneida Mining Co., an affiliate of the North American Coal Co.

Ground was broken in midyear for a \$350 million coal-fueled electric generating station on the Ohio River near Shippingport. The new Bruce Mansfield plant will have two 880-MW generating units, of which the first is expected to be in operation in 1975 and the second in 1976. The North American Coal Corp. signed a contract in October calling for annual shipments of 4.3 to 5.2 million tons of coal beginning in 1974 from reserves in southern Ohio. In November, the Central Area Power Coordination Group (CAPCO), which will own the plant, announced plans for a third coal-fueled unit at the plant. This unit is scheduled for completion about 1980. CAPCO members comprise the Ohio Edison Co., the Pennsylvania Power Co., the Duquesne Light Co., the Toledo Edison Co., and the Cleveland Electric Illuminating Co. The first two companies will build and operate the plant.

On September 26, the Duquesne Light Co. announced plans to build a second 847-MW nuclear powerplant at Shippingport. Westinghouse Electric Corp. will supply the turbine generator, reactor, and nuclear fuel for the plant. Construction is scheduled to start in 1973, and the plant is to be in service by 1978. Duquesne Light Co. will operate the plant, which will be jointly owned by five members of CAPCO. The plant will be the third nuclear plant at Shippingport, where a similar 847-MW station was under construction and was expected to start operation in 1973. The original Shippingport plant, a 30-MW station, began operation in 1957 and was enlarged to a 90-MW capacity in 1967.

Philadelphia Electric Co.'s 90-MW prototype helium-cooled No. 1 unit at the Peach Bottom generating station completed its fourth year of commercial operation.

Work proceeded on two additional nuclear units under construction at Peach Bottom. By yearend, Unit No. 2 was about 85 percent complete and Unit No. 3 was about one-half complete. Each unit will consist of a boiling water reactor and a 1,065-MW turbine generator, the first scheduled for commercial operation early in 1973 and the second a year later. The company solely will be responsible for the operation of the two units, although their ownership and output will be shared by three other electric utilities.

Electric utility plants in 1971 received 1,670,000 tons of anthracite and 30,331,000 tons of bituminous coal. These plants consumed 32,238,568 total tons of anthracite and bituminous coal, 26,286,865 42-gallon barrels of oil, and 9,747,916,000 cubic feet of gas for producing 87,361,121,000 kilowatt-hours of electricity. Hydropowered generation produced 771,007,000 kilowatt-hours of electricity.

NONMETALS

Cement.—Portland cement shipments from 20 plants in eight counties were 2 percent greater in quantity than in 1970, and 16 percent greater in value because of an average increase of 40 cents per 376-pound barrel. Masonry cement shipments from 15 plants in eight counties were 7 percent greater in quantity than in 1970, and 35.1 percent greater in value because of an average value increase of 79 cents per 280-pound barrel.

Eighteen of the 20 producing plants owned 56 kilns collectively capable of producing 47,282,000 376-pound barrels of clinker on a 11-operating-month basis. Two of the plants performed grinding only. Raw materials used by the 18 producing plants comprised 4,236,367 short tons of limestone, 7,213,312 tons of cement rock, and 1,439,757 tons of clay, shale, bauxite, sand, gypsum, blast furnace slag, iron ore, and mill scale. The State's cement industry used 40 million cubic feet of natural gas, 478,000 42-gallon barrels of fuel oils, 1,672,000 tons of bituminous coal, 46,000 tons of anthracite, and 1,149,079,000 kilowatt-hours of electrical energy, of which 97.9 percent was purchased.

Of the total portland cement shipped, 90.3 percent was Type I and II (general use and moderate heat) and the remainder was Type III, comprising high-early-

strength, white, slag-pozzolan, block, and expansive.

Northampton and Lawrence Counties collectively accounted for 61 percent of the total portland cement shipments and 56 percent of the total masonry cement shipments.

The Medusa, Coplay, Louisville and Lone Star companies were the leading producers of portland cement. The Coplay, Louisville, Penn-Dixie, and Keystone companies were the largest producers of masonry cement.

For the purpose of cement surveys Pennsylvania is divided into western and eastern producing districts, which are separated by the eastern boundaries of Potter, Clinton, Centre, Huntingdon, and Franklin Counties. The five plants in the western district shipped 10,943,740 barrels of all types of portland cement at an average value of \$3.21 per 376-pound barrel, an 8-cent increase above the 1970 value; and 1,058,754 barrels of all types of masonry cements at an average value of \$3.63 per 280-pound barrel, a 71-cent increase above the 1970 value. No white cement was produced in the western district, although some was received from the eastern district.

The 15 plants in the eastern district shipped 30,809,027 barrels of all types of portland cement at an average value of \$3.42 per 376-pound barrel, 52 cents more than in 1970; and 1,934,892 barrels of all types of masonry cement at an average value of \$3.83 per 280-pound barrel, an 84-cent increase above the 1970 value. White cement was produced by two plants in the eastern district.

The distribution by use in percent of the portland cement shipped was as follows:

Use	Shipping district	
	Western	Eastern
Ready-mixed concrete	62.2	50.7
Concrete products	14.3	21.9
Building materials		
vendors	7.2	20.3
Highways	14.1	6.2
Contractors and		
other uses	2.2	0.9

The destinations and methods of shipments of portland cement only on the basis of 376-pound barrels were as follows:

Destination;	<u>Bulk</u>	<u>Container</u>
Terminal to		
consumers	4,111,536	234,765
Plants to		
consumers	32,337,595	5,068,871
Total	36,449,131	5,303,636
Transport method;		
Railroad	6,203,231	828,713
Truck	30,245,278	4,473,273
Other	622	1,650
Total	36,449,131	5,303,636

The total consumption of portland and masonry cements in the State totaled 6,323,000 barrels in the western district and 11,736,000 barrels in the eastern district.

Yearend stocks of portland cement were 1,645,000 barrels in the western district and 1,827,000 barrels in the eastern district.

Air cleaning systems were installed on the blending and storage silos, and additional gas cleaning equipment was being installed on the kilns in the Penn Hills Borough plant of the Universal Atlas Cement Co.

The Whitehall Cement Manufacturing Co., at its Whitehall, Pa. plant, started the installation of a glass-fiber baghouse to replace the electrostatic precipitator installed on the preheater kiln in 1956.

Clays.—Excluding kaolin, the total production of all other clays and shales was 12.8 percent less in tonnage and 44 percent less in value than in 1970. The average value per short ton decreased to \$3.84 from \$5.94 in 1970. The clay industry operated 88 mines in 28 counties. Production and value data excluding confidential data for kaolin are shown:

Type of clay	Producing counties	Production (1,000 short tons)	Value (thou- sands)	Average value per short ton
Common clay	12	567	\$1,690	\$2.98
Shale	19	1,098	2,749	2.50
Undifferentiated clay and shale	1	101	328	3.25
Fire clay	11	559	4,173	7.47
Total	--	2,325	8,940	3.85

Jefferson and Lawrence Counties produced 61 percent of the common clay; Lawrence, Clearfield, Armstrong, Jefferson, Berks, and York Counties produced 51 percent of the shale; Chester County produced all of the undifferentiated clay and shale; and Armstrong, Clearfield, Fayette, and Somerset Counties produced 93 percent of the fire clay.

Kaolin was produced at three mines operated by three companies in Clinton, Cumberland, and Lancaster Counties. Compared with 1970, the total kaolin production was 55 percent greater and its average value per short ton increased 70 percent.

**Table 12.—Clays sold or used
by producers, by use¹**
(Thousand short tons)

Use	1970	1971
Building brick.....	1,475	1,358
Firebrick and block.....	645	498
Vitrified sewer pipe.....	W	132
Drain tile.....	25	24
Mortar.....	2	3
Other uses ²	518	310
Total.....	2,665	2,325

W Withheld to avoid disclosing individual company confidential data.

¹ Excludes kaolin; includes common clay and fire clay.

² Includes foundries and steelworks, high-alumina brick (1971), other refractories (1971), floor and wall tile, cement, pottery, lightweight aggregate, and other uses.

Diamond, Synthetic.—On November 16, 1971, E. I. du Pont de Nemours & Co., Wilmington, Del., reportedly exploded 7 tons of explosives in a 50-foot deep borehole charged with unidentified chemicals. The operation, in an uninhabited area west of Shamokin, Pa., was a test to determine the feasibility of a technique designed to produce synthetic diamonds. Full data were not released by Dupont officials, who stated the test results were being evaluated.

Gem Stones.—Minerals collected in early 1971 at the Cedar Hill serpentinite quarry at Talmage in Lancaster County included huntite (magnesium-calcium carbonate), penninite (a member of the chlorite family), tan crystals of zircon, white crystals of fluorapatite, and grains of magnetite. The rare hydrous nickel arsenate (erythrite) and cobalt arsenic sulfide (cobalite) were found in Triassic sediments near a diabase.

Unusual minerals found in the Showalter quarry near Blue Ball in Lancaster County included pale-yellow celestite, pale-blue celestite, blue and purple fluorite, calciostrontianite, pink calcite, flesh-colored dolomite, and rutile.

Chrysocolla was found near Hummelstown, uranium silicate (coffinite) and rare-earth silicate (chevkinite) were found near Bethlehem, magnetite crystals were found in Mud Lake limonite pits, and pumpellyite, a complex aluminosilicate of calcium, magnesium, and iron, was found in the Bunker Hill volcanics near Jones-town, in Lebanon County.

Minerals found near Shenandoah Heights, Schuylkill County, at the Kehley Run mine, a burning anthracite strip mine, included native sulfur, ammonium chloride (sal ammoniac), crytohalite and bararite (both of which are forms of ammonium silicon fluoride), mascagnite (ammonium sulfate), galena, kaolinite, quartz, and hematite.

The quartz crystal locality at Kunkle-ton, Monroe County, was again opened to mineral collectors, who obtained permission to enter the site from the Universal Atlas Cement Co., P.O. Box 29, Northampton, Pa. Fee collecting areas included the Cedar Hill Quarry, Route 1, Lancaster, Pa., and the Kibblehouse Quarry at Perkiomenville.

Native selenium was discovered in July 1971 in Luzerne and Dauphin Counties. The mineral occurred as black metallic hexagonal crystals, many of which were in the form of hollow tubes, metallic hairs, and gray metallic balls of amorphous selenium mixed with sulfur and enclosed by crystals of crytohalite. The selenium was formed by sublimation under the artificially induced fumarolic conditions of burning anthracite beds and culm banks.

Glass.—Pittsburgh Plate Glass Industries (PPG) with manufacturing facilities at Creighton, Ford City, Greensburg, Meadville, and Tipton, began construction on November 24, of the first of two float glass melting furnaces and the installation of related equipment at Mt. Holly Springs in Cumberland County. The first float glass production was expected in April 1972, with full production in mid-1972. The \$50 million facility will employ 800 persons and will be capable of producing about 200 million square feet of float glass

per year. The Mt. Holly float glass units, the fifth and sixth operated by PPG, will mark the nearly complete conversion by the firm from the plate glass to the float glass process.

In mid-December, the Anchor Hocking Corp., at its Connellsville plant, produced nearly one-half million amber-colored bottles during a 30-hour trial run. The trial run used the firm's own raw material to which was added 10 tons of a glass product extracted by the Bureau of Mines from the residue of a refuse incinerator in Alexandria, Va. The firm reported that the residue glass did not affect the strength or durability of the bottles, although they did have visual flaws because of a trace of slag left on the residual glass during incineration. The trial run culminated 1 year of preparatory effort by the Bureau and the corporation in the fields of environmental improvement and conservation of national resources.

The General Electric Co., at Bridgeville, installed a baghouse at its glass furnaces to reduce the emission of lead from 28 pounds per hour to less than 0.1 pound per hour.

Graphite.—Synthetic graphite powders and shapes were produced by two companies in St. Marys and one company in Easton. The output, in the form of anodes, electrodes, crucibles and vessels, cloth, fibers and motor brushes and brush stock, and miscellaneous items, was produced from raw materials including petroleum coke, lamp black, pitch cokes, black oil, and gaseous hydrocarbons. Compared with 1970, the quantity of production was 1.7

percent less and its value was 2.2 percent less.

The development of a radically new form of graphite was achieved in the laboratories of Pfizer—Minerals, Pigments and Metals Division, Easton, Pa. Scientists in the laboratories produced graphite in the form of a flat sheet or continuous ribbon only 0.0003 inch thick. The new material was strong and stiff in all directions, it was lighter than aluminum, and it withstood temperatures above 5,000°F.

Gypsum.—Gypsum was calcined by the United States Gypsum Co. in Philadelphia County. The production was estimated to have been 0.5 percent more and its value 0.4 percent greater than in 1970.

Lime.—Nine companies in nine counties operated 11 plants, of which seven sold or used both quick and hydrated lime and four produced quicklime only. The total production of quicklime and hydrated lime decreased 6.7 percent in tonnage but increased 2.5 percent in value compared with the 1970 figures. The average value of all production increased from \$15.52 per ton in 1970 to \$17.05 per ton in 1971. The average value of quicklime increased from \$15.19 to \$16.47 per ton, and that of hydrated lime increased from \$17.09 to \$19.56 per ton. The steel industry consumed most of the total production. The remainder of the production was distributed among refractories, construction, water and sewage treatment, paper, agricultural, and other uses. Of the total lime sold or used, approximately 70 percent was consumed in Pennsylvania. New Jersey accounted for 5 percent and other States 25 percent. Centre

Table 13.—Lime sold or used by producers, by use

(Short tons)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Steel, BOF	771,292	\$11,355,774	732,469	\$11,607,437
Steel, open-hearth	234,922	3,196,740	W	W
Water purification	90,205	1,361,479	134,276	2,380,343
Construction	116,870	1,987,000	125,159	2,423,938
Steel, electric	119,896	1,670,100	95,533	1,449,320
Sewage	85,784	1,490,800	70,652	1,254,383
Paper and pulp	75,422	1,039,400	42,248	664,190
Agriculture	66,055	1,066,710	20,161	341,111
Tanning	8,956	141,100	9,933	173,700
Other uses ¹	317,110	5,970,184	529,666	9,703,332
Total	1,886,512	29,279,287	1,760,097	30,007,754

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

¹ Includes refractory dolomite, other chemicals, acid mine water neutralization, (1971), chrome (1971), other metallurgy, insecticides, magnesite (1971), silica brick, ore concentration, sand-lime brick, wire drawing, sugar refining, food, paint, petroleum refining, glass (1970), alkalies, and uses indicated by symbol W.

County led in production with three large plants, each of which produced quicklime and hydrated lime. Leading producing companies were Bethlehem Mines Corp., Warner Company, and Standard Lime & Refractories Co.

Through December 1971, the lime plant of the Bethlehem Mines Corp., Annville, Pa., had operated during a record 2.24 million man-hours without a disabling injury.

Mica.—Residual crude mica occurring as a deposit in schist was mined and processed using dry grinding by the Micalith Mining Co., Inc., at its Hokes mine near Glenville in York County. The air-separated mica was used in paints, roofing, greases, electrically insulated welding rods, and rubber and textile coatings. The demand for roofing mica decreased because of the greater use of higher density talc and sand in roofing formulations.

Compared with 1970, the quantity and value of mica sold by the single producer was substantially less. The State was eighth in the national production of mica.

A muscovite mine was being developed on Pequea Creek near Lancaster. Drilling and trenching was performed in 1970, and drill holes were extended to 250 feet in 1971. The 77-acre property reportedly contained 35 million tons of fine flake mica, which, after wet grinding, reportedly could be sold for \$175 per ton.

Mullite.—The Remmey Division of A. P. Green Refractory Co., in Philadelphia, produced synthetic mullite that was 23.1 percent greater in quantity and 47 percent greater in value than in 1970.

Perlite.—Crude perlite was shipped into the State and expanded in nine plants operated by seven companies in eight counties.

Compared with 1970, the total quantity sold or used by seven reporting companies was 27 percent greater and its total value was 23 percent more. The average price in 1971 was \$55.32 per short ton compared with \$55.98 in 1970. Expanded perlite was sold or used chiefly for building plaster, with other uses being loose fill insulation, concrete aggregate, filler, soil conditioning, filter, cryogenic applications, charbase, refractories, castable insulation, bonding mortar, fire extinguishing powder, a carrier for pesticides, and oil absorbent.

Pyrites.—The State's production and

value of pyritic concentrates were second in national rank. The pyritic concentrates were produced at the magnetic-iron-ore beneficiating plants at the Grace and Cornwall underground mines of the Bethlehem Steel Corp. in Lebanon and Berks Counties.

Some of the Cornwall plant's output was a chalcopyrite concentrate from which copper, gold, and silver were recovered by a midwestern smelter. The larger portion of the pyritic concentrates production was shipped to the corporation's Sparrows Point, Md., steelworks. There, the sulfur content was converted into sulfuric acid and the residual iron oxides were processed to recover copper and cobalt as a concentrated sulfate solution. The extracted iron oxides were sintered and used as portion of the raw materials charged into the blast furnaces at Sparrows Point, Md.

Shipments of all concentrates averaged 47.7 percent sulfur content and were 4.7 percent more in quantity and 6.1 percent more in value than in 1970.

Quartz Crystal.—The P. R. Hoffman Co. in Carlisle synthesized quartz crystals for its own uses and for sale to other quartz crystal cutters. The quartz crystals were grown in autoclaves at pressures in the range of 1,500 to 20,000 pounds per square inch at temperatures ranging from 250° to 450° C, using soda ash solution as the process solvent and Brazilian lasca and defective quartz crystals as the nutrient material. The growth of crystals occurred on natural or manufactured quartz seed plates in a predetermined crystallographic plane. Pennsylvania was one of the large producers of cut quartz crystals for the electronic industry.

Sand and Gravel.—Commercial operators used 70 stationary plants, 18 portable plants, and 10 dredges to produce sand and gravel. The quantities of sand and gravel in million tons transported from the producing operations comprised 16.40 by truck, 0.56 by railroad, and 2.70 by waterway. Leading producing counties were Bucks, Beaver, Erie, Westmoreland, Luzerne, and Wyoming.

Compared with the 1970 situation, the total production of sand and gravel increased 6.3 percent, and its value increased 6.6 percent because of a 0.6-cent-per-ton average increase in value.

The total sand production in 1971 was 2.6 percent greater and its value was 5.3 percent greater owing to a 5.2-cent-per-ton average increase in value. Sand used for building and paving purposes decreased 6.7 percent in tonnage but increased 14.7 cents per ton in value in 1971. Ground and unground sands for industrial uses classed as molding, fire and furnace, glass, grinding and polishing, blast, engine, filtration, hydrofrac, enamel, fillers, foundry, pottery, and miscellaneous totaled 3,211,000 short tons and were valued at \$7,727,000, compared with 2,328,000 tons valued at \$6,491,000 in 1970. The average value of all industrial sands was 43.8 cents per ton less than in 1970.

The total production of gravel increased 11.1 percent, although its value was only 8.5 percent greater than in 1970 because of a 4.1-cent-per-ton average decrease in value. All but 10 percent of the total gravel production was used for construction purposes.

Based on the total production of all sand and gravel, sand in 1971 accounted for 54.3 percent of the total tonnage and 58.2 percent of the total value compared with 56.2 percent of the total tonnage and 58.9 percent of the total value in 1970.

In the 1971 National Sand and Gravel Association safety contest, covering the period from July 1, 1970, to June 30, 1971,

Pennsylvania had three plants reporting no accidents. The companies and their plants awarded the Certificate of Achievement in Safety were Appalachian Stone Div., Martin Marietta Corp., Mercersburg, Milton and Burlington plants; George R. Pettinos, Inc., Bala Cynwyd, New Freedom plant.

Stone.—Pennsylvania was the country's leading stone producer. Major stone producing counties, accounting for 51 percent of the total product and 55 percent of the total value, were Northampton, Montgomery, Bucks, Lancaster, Adams, York, and Berks.

Total production was 2.5 percent less, and its value was 1.4 percent lower than in 1970 despite a 2.3 cent-per-ton average increase in value.

Dimension stone produced at 32 operations in nine counties accounted for 1.6 percent of the total stone production and 4.5 percent of its total value. The average value per short ton of all dimension stone increased to \$49.20 from \$48.19 in 1970. The number of companies producing dimension stone by type was as follows: Sandstone, 15; slate, eight; granite, two; other stone, two; and traprock, two. Dimension quartzite, sandstone, traprock (basalt), and other stone were used primarily for irregular shapes and sawed stone; granite for rubble; and slate for blackboard and flagging. Slate accounted

Table 14.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	4,700	\$7,749	4,651	\$8,352
Fill	85	113	135	250
Fire or furnace	36	123	W	W
Molding	102	401	W	W
Paving	3,158	5,088	2,678	4,700
Other uses ¹	2,328	6,491	3,211	7,727
Total ²	10,409	19,965	10,675	21,029
Gravel:				
Building	3,501	5,897	4,330	6,874
Fill	W	W	768	1,001
Miscellaneous	3,531	6,523	2,994	6,141
Paving	127	195	W	W
Other uses ³	935	1,335	902	1,118
Total ²	8,095	13,951	8,994	15,134
Total sand and gravel ²	18,504	33,915	19,668	36,162

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

¹ Includes glass, grinding and polishing, blast, engine filtration, oil (hydrofrac), ground, and other sands, and fill and fire or furnace sand in 1971.

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

³ Includes railroad ballast (1970), fill (1970), miscellaneous, and other gravel.

for nearly 41 percent of the total production of dimension stone and 76 percent of its total value.

Crushed and broken stone produced at 201 operations in 47 counties equaled 98.4 percent of the total stone production and 95.5 percent of its total value. The average value of crushed and broken stone increased to \$1.76 per short ton from \$1.73 in 1970. The number of operations producing crushed and broken stone was as follows: Limestone, 144; sandstone, 26; traprock, 13; quartzite, eight; other stone, six; dolomite, two; slate and granite, one each.

In crushed and broken form, the major use of granite, limestone, quartzite, sandstone, traprock, and other stone was for road aggregates and road base stone. The

major use of dolomite was for calcined products. Crushed and broken limestone accounted for about 82 percent of the production and 80 percent of the value of the total crushed and broken stone production. The distribution of the total crushed and broken limestone production by percent and uses follows: Road aggregates and road base stone 62.5; cement manufacture, 20.7; flux stone, 7.2; lime manufacture, 3.0; agricultural uses, 2.8; and 18 minor uses, 3.8. The types of transportation and the approximate percentages of crushed and broken limestone moved were truck, 81.5; railroads, 8.9; waterway, 0.4; and other methods, 9.2.

Four quarries prepared limestone suitable for mine dusting. The 1971 production

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

(Thousand short tons and thousand dollars)

County	1970		1971			Kind of stone produced in 1971
	Number of quarries	Quantity	Value	Number of quarries	Quantity		Value
Allegheny	1	54	W	1	W	W
Armstrong	5	249	\$562	5	249	\$525
Berks	13	3,863	5,659	11	4,018	5,475
Blair	11	1,210	2,110	9	1,318	2,223
Bucks	18	4,133	6,430	14	5,030	9,257
Butler	5	1,738	4,630	5	1,623	3,679
Centre	9	3,273	5,974	8	2,710	4,810
Chester	12	2,850	5,153	7	2,085	2,963
Clarion	W	W	W	3	206	W
Cumberland	6	1,483	2,443	6	W	3,253
Dauphin	4	950	1,465	3	W	1,311
Franklin	5	W	990	5	W	W
Huntingdon	5	W	1,042	6	673	2,347
Lancaster	15	4,317	7,635	15	4,968	9,177
Lawrence	5	2,881	3,895	4	2,387	3,465
Lebanon	4	1,039	1,801	2	W	W
Lehigh	10	2,663	3,951	7	1,756	3,149
Luzerne	4	451	W	3	1,134	1,741
McKean	1	W	W	1	39	W
Mifflin	4	286	330	3	W	W
Montgomery	16	5,277	9,377	14	5,574	10,050
Northampton	20	5,826	10,637	20	6,433	11,538
Northumberland	3	306	498	3	235	520
Potter	5	3	93	3	3	101
Schuylkill	4	1,091	1,641	3	162	W
Somerset	5	564	1,593	4	457	1,225
Susquehanna	8	W	606	7	W	553
Venango	1	W	4	--	W	W
Wayne	2	W	407	1	W	W
Westmoreland	11	1,445	2,879	8	1,692	3,378
York	11	4,025	9,312	10	3,488	7,988
Undistributed ¹	43	16,259	28,923	42	18,228	29,736
Total ²	271	66,241	120,187	233	64,467	118,469

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

¹ Includes production for Adams, Bedford, Cambria, Carbon, Columbia, Delaware, Elk, Fayette, Fulton, Jefferson, Lycoming, Mercer (1971), Monroe, Montour, Perry, Snyder, Union, and Washington Counties, and data indicated by symbol W.

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

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

Use	1970		1971	
	Quantity	Value	Quantity	Value
Dimension stone:				
Building stone.....	68	\$1,432	55	\$960
Curbing and flagging.....	25	758	24	637
Other uses ¹	29	3,688	29	3,718
Total ².....	122	5,879	108	5,314
Crushed and broken stone:				
Bituminous aggregate.....	4,276	7,709	6,048	11,019
Concrete aggregate.....	10,150	16,293	9,600	15,202
Dense graded road base stone.....	9,224	13,386	10,009	16,943
Macadam aggregate.....	1,667	2,549	1,340	2,254
Surface treatment aggregate.....	2,526	3,471	2,681	3,779
Unspecified aggregate & roadstone.....	13,481	22,102	12,689	20,985
Agricultural limestone.....	1,825	5,711	1,620	4,392
Filter stone ³	670	1,342	271	500
Flux ⁴	5,681	10,953	4,100	8,095
Railroad ballast.....	775	1,237	619	1,036
Refractory stone.....	252	1,732	199	2,498
Riprap and jetty stone.....	122	194	187	327
Other uses ⁵	15,470	27,629	14,996	26,125
Total ².....	66,119	114,308	64,359	113,155
Grand total.....	66,241	120,187	64,467	118,469

¹ Includes monumental stone, roofing slate, millstock, and uses not listed or unspecified.

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

³ Includes stone sand.

⁴ Includes stone used in dead-burned dolomite.

⁵ Includes stone used in cement and lime manufacture, chemicals, abrasives (1971), mine dusting, asphalt fill (1971), whitening, roofing aggregates, and other uses in smaller quantities.

totalled 238,955 short tons, 6.3 percent less than the 255,127-ton production in 1970.

Winners of safety honors in the eighth annual National Limestone Institute Safety Competition conducted by the U.S. Bureau of Mines were Faylor Lime & Stone Co., Dauphin County quarry, Winfield, and Mifflin County quarry, Winfield; David M. Burkholder, Inc., Ephrata quarry, Ephrata; Meckley's Limestone Products Co., Herndon mine, Herndon; and Sugar Hill Limestone Co., Sugar Hill quarry, Brockaway.

The Faylor Lime and Stone Co., near Shamokin, in April completed the installation of a stationary 250-ton-per-hour-capacity crushed stone plant, which included equipment for three crushing and two screening phases.

Special publications SR 70-3 and SR 70-4, released by the Pennsylvania State University's Experiment Station, described the results of the small industries research program on bluestone that was performed by the University and sponsored by the Pennsylvania Bluestone Association. Methods for improving the image of the Pennsylvania product were suggested, including establishment of industry-wide grades, use

of a new trade name, and rigid quality control.

Sulfur.—Four petroleum refineries operated by four companies in Delaware and Philadelphia Counties used modified or improved Claus processes to produce 22,081 long tons of elemental sulfur (100-percent basis). Shipments totaling 20,769 long-tons (100-percent basis) were 18.5 percent greater than in 1970. However, the average value of shipments was \$21.09 per long ton, compared with \$26.32 per long ton in 1970. One of the four refineries shipped more than 93 percent of the hydrogen sulfide produced by a Girdler recovery system that used monoethanolamine as the absorbent medium.

Approximately three-fourths of the total sulfuric acid produced by the New Jersey Zinc Co. in Palmerton and St. Joseph Lead Co. in Josephstown was consumed by the producers.

Talc (Sericite-Schist).—For the first time in many years, no talc was produced by Summit Industries Inc., the State's sole talc producer, in Adams County.

Tripoli (Rottenstone).—Crude tripoli, mined and processed by two companies in Lycoming County, was 16 percent less in

quantity and 20 percent greater in average value per ton than in 1970. The material was prepared for use as a filler by one plant near Muncy. The other company, near Oriole, employed drying, crushing, and roller-mill grinding to produce abrasives and fillers. Pennsylvania ranked fourth in the list of U.S. producers in both quantity and value.

Vermiculite (Exfoliated).—Hyzer and Lewellen in Bucks County and W. R. Grace & Company in Lawrence County exfoliated vermiculite produced outside Pennsylvania. Approximately 88 percent of the production was sold, principally for loose fill insulation, concrete aggregates, and horticultural uses.

METALS

Aluminum.—In late March, the Aluminum Co. of America (Alcoa) culminated operations at its New Kensington works and sold the 80-year-old plant to the Schreiber Industrial Development Co. The operations phased out included those producing impact extrusions, powder, pigments, and other specialty products.

Beryllium.—Kawecki Berylco Industries, Inc. (KBI) produced Berylco CR-1, the casting version of KBI's beryllium-nickel alloy 440. The product reportedly eliminated the corrosion of oilfield parts exposed to fluids and gases. The age-hardenable material, which was usable up to 800° F, combined high hardness and wear resistance with good ductility.

At Reading, KBI installed two new Sendzimir mills designed to reduce materials to 0.001-inch thickness. Both mills had modern gage instrumentation controls and were designed for ultimate conversion to computer control. Because of the precipitation hardening behavior of beryllium copper, the mills were designed more for accuracy than speed. New slitters, heat treating furnaces, and pickling equipment were also installed to augment the new mills.

Carbides.—Kennametal Inc., in Latrobe, following six years of development work, perfected a new isostatic process that yielded cemented sintered carbides free of all surface pits and internal flaws. The process, code-named Keziz, used helium or argon at pressures as high as 20,000 pounds per square inch and sintering tem-

peratures as high as 2,750° F. Two installations using the process on a 48-hour start-to-finish basis can produce 300,000 pounds per year of sintered carbide products.

Cobalt.—The quantity of cobalt produced was 1 percent less and its value was 18.1 percent less than in 1970. This cobalt, the only domestic source, was recovered by the flotation of separator tailings during the beneficiation of magnetic iron ore mined by the Bethlehem Steel Corp. from its Grace mine in Berks County and its Cornwall mine in Lebanon County. The ore from the Cornwall mine contained about two-thirds of the total recoverable cobalt.

The cobaltic pyrite concentrate, recovered near the two underground mines, were processed at the corporation's Sparrows Point, Md., steel plant to produce sulfuric acid. The resulting calcined iron residue was leached to recover cobalt and copper as a concentrated sulfate solution devoid of gold and silver. The concentrated solution was shipped to the Pyrites Co., Inc., Wilmington, Del., where it was processed to recover cobalt as metal, oxide, and hydrate, and copper chemicals.

Copper, Gold, and Silver.—Compared with 1970, the respective production of these metals was 32, 30, and 50 percent greater, and their respective value was 19, 49, and 27 percent greater. These metals were present in chalcopyrite concentrates produced during the flotation of iron ore from the Bethlehem Steel Corp. Cornwall mine in Lebanon County. The chalcopyrite concentrates containing 26.6 percent copper were shipped to a western smelter.

Iron Ore.—The Bethlehem Steel Corp. produced magnetic iron ores at the Grace underground mine in Berks County and at the Cornwall underground mine in Lebanon County. Explosives consumed at these mines comprised 362,600 pounds of dynamites and 1.49 million pounds of bagged and bulk ammonium nitrate mixed with fuel oil. Both mines used the block-caving mining method. All operations at the Cornwall Division will cease at the end of 1972. Two plants beneficiated the crude ore into a product that was pelletized prior to shipment to the corporation's iron and steel works. Pellet shipments were about 13 percent greater in quantity and about 18.7 percent greater in value than in 1970.

One chemical plant in Fayette County produced iron oxide clinker from pyritic roasting.

Iron Oxide Pigments.—Finished natural and manufactured iron oxide pigments were shipped from one plant in Allegheny County, from one plant in Carbon County, and from two plants in Northampton County. Compared with 1970, the shipments were 3.6 percent greater in tonnage and their value was 17.1 percent greater.

Iron and Steel.—The Armco Steel Corp., in Ambridge, contracted for a two-zone walking beam furnace capable of normalizing 30 tons per hour of pipe with outside diameter ranging from 2-3/8 inches to 14-3/8 inches. The design, engineering, and construction will be performed by Rust Furnace Co., a division of Litton Industries.

The Babcock & Wilcox Co. was expanding and modernizing cold finishing seamless tubing operations at its Beaver Falls plant. Production capacity will be increased about 20 percent. New equipment will include a 400,000-pound drawbench, five new cranes, two high-speed straighteners, one additional ultrasonic testing line, and two 150-foot furnaces. A \$12 million pollution-control project was well underway by yearend at the plant. The company in November announced plans to install a major new specialty tube mill in buildings purchased from the Armco Steel Corp., in Ambridge. Although several miles away, the Ambridge plant will be an integral part of the firm's existing pipe and tube plants in Beaver Falls and Koppel, Pa.

Construction began on a \$12 million, 16-month project to prevent air pollution at the Koppel and Wallace Run steel mills of the Tubular Products Division of the Babcock & Wilcox Co. in Beaver County. A total of five baghouses in the two mills will contain 10,300 dacron fiber bags, each 31 feet long. Dust and fume particles will be collected from a maximum of 2,360,000 cubic feet per minute of air. At the Koppel mill, a \$750,000 air-cleaning device was in operation on an automatic scarfer and a \$715,000 water-treatment facility was scheduled.

Bethlehem Steel Corp. began construction of a \$5.5 million system to control dust emissions at its Bethlehem plant. The system, to be completed in the fall of 1972,

will collect 8.5 tons per day of dust from the plant's electric furnaces. The dust will be pelletized and recycled as blast furnace feed.

The first unit of a new scrap preheater system, also the first in the industry, was placed into operation by midyear at the Steelton, Pa., plant of the Bethlehem Steel Corp. Specifications for the Steelton operation called for preheating scrap to 1,500° F. for a three-bucket charge to a 200-ton electric arc furnace.

The Bethlehem Steel Corp. rebuilt blast furnace E at its Johnstown plant. A helicopter, during 14 lifts performed in one-half day, carried away the old parts and raised the various new parts required in the work performed atop the 125-foot-high furnace. The corporation opened can-collection centers in Steelton and Bethlehem, where collections totaled 3.5 tons per week.

A strike that started October 8 kept workers idle through yearend at the Pittsburgh, Blawnox, Groveton, and Ellwood City, Pa. plants of the Blaw-Knox Co., a division of White Consolidated Industries.

The Carpenter Technology Corp., a special materials producer in Reading, began the operation of two 25-ton basic electroslag furnaces, each costing \$300,000. Each furnace was rated at 3,000 tons per year. Ingots up to 16 feet long and 40 inches in diameter can be produced in the \$2 million electroslag facilities.

The State's Justice Department and the Crucible Steel Corp. in April agreed on a proposal to begin reducing the pollutants discharged into the Ohio River by the company's Midland works. The agreement covered any pollutants from the company's coke plant, the discharge of acid rinse waters, and wastes from the cyanide treatment facilities at the company's blast furnace operation.

The Crucible Stainless Steel Division of Colt Industries announced plans to install a 100-ton argon-oxygen refining unit in its electric furnace shop in Midland. Full operation was predicted for early 1972.

In February, Jones & Laughlin Steel Corp. (J & L) awarded an \$8 million contract to install two new electrostatic precipitators and to modify existing precipitators at the Aliquippa No. 2 BOF shop. The contract specified completion and op-

eration by June 22, 1972. The corporation developed a failsafe coke oven door removal system that sharply reduced the emission of smoke and dust while pushing coke from the ovens. The system was installed at the corporation's coke plants at Aliquippa and Pittsburgh.

Chemfix, a chemically oriented fixation process that in no more than 3 days turns industrial solids, liquids and sludges into a claylike solid suitable for landfill, was used to treat 100,000 gallons per day of liquid wastes at the J & L Hennepin works. The pollution-control process was developed by Environmental Sciences, Inc., based in Pittsburgh.

J & L closed the open hearths, blast furnaces, and ingot foundry at its Pittsburgh works on September 18 for an indefinite period. The corporation reported that it intended to sharply cut the work force in its integrated works in Pittsburgh where the ironmaking and steelmaking sections currently were idle. About 1,250 jobs were to be eliminated in the southside portion of the Pittsburgh works that contained the open hearth furnaces. However on December 30, it was announced that about 2,000 workers would be recalled at the Pittsburgh works by mid-January 1972, resulting in a total work force of about 5,500 employees. In early December, the corporation announced that the P-3 blast furnace would be relined as the first step in a revitalization project in the Pittsburgh works.

The Lukens Steel Co. installed a strand-casting machine for producing cast steel slabs and an electroslag-remelting furnace for refining steel. The casting machine, which started operation in January, set a new record in strand casting by producing a 157.5-ton steel slab, 12 inches thick, 85 inches wide, and 94 feet long.

The United States Steel Corp. (U.S. Steel) announced a major steelmaking expansion to be completed in 1972 at its Fairless works. The expansion will include two 200-ton-capacity electric furnaces, vacuum degassing facilities, a dual-strand continuous caster that will produce 230 tons per hour of 10-inch or 23-inch blooms, and two 5-zone pusher-type bloom reheating furnaces fueled by natural gas with fuel oil as standby. The installation of additional electrostatic precipitator capacity during 1971 at the Fairless works reduced the emission of particulates from the open

hearth furnaces by about 40 tons per day. A company spokesman stated that it cost more than \$1.50 to control air pollution for each ton of raw steel produced.

All steelmaking at the 2.0-million-ton-per-year-capacity Edgar Thomson works of U.S. Steel was temporarily halted on June 26. This action resulted in the layoff of about 2,000 workers from a total work force of 3,000. The works had eleven 225-ton-capacity open hearth furnaces not equipped with devices for smoke and fume removal, six blast furnaces, an ingot mold foundry, slab rolling facilities, and miscellaneous other departments. In July, the 2-million-ton-per-year capacity open hearth shop was removed from service. An adjacent new BOF plant with high energy venturi scrubbers was expected to commence operation in early 1972. Part of a dust collection system for two 220-ton basic oxygen vessels was being constructed in early 1971 at the Edgar Thomson works. Completion of the system was expected before yearend. The estimated reduction in particulate emissions due to this change in steelmaking was about 16,000 tons per year. In late December, preparations began to reopen the Edgar Thomson works. It was estimated that 500 to 700 workers would return to the Braddock plant section of the works by mid-January 1972, boosting the total employment to between 1,500 and 2,100 workers, compared with nearly 3,000 workers a year earlier.

The corporation had the largest cutback in open hearths in 1971 when it closed a 3-million-ton-per-year shop at Braddock where in January 1972 it opened a basic-oxygen facility that has approximately the same capacity.

At the corporation's Duquesne 250,000-ton-per-year capacity electric furnace shop, facilities were being upgraded at a cost of \$6 million to reduce particulate emissions by about 1,000 tons per year. The facilities were financed by the sale of industrial revenue bonds sponsored by the Allegheny County Industrial Development Authority. Rent paid on the facilities by the corporation will pay off the principal and interest on the bonds.

U.S. Steel also obtained approval of the Allegheny County Bureau of Air Pollution Control for an improved and enlarged electrostatic precipitator system for cleaning the waste gas from the 11 open hearth

furnaces at the Homestead works, all of which were equipped with oxygen lances. The corporation contracted for the installation of a fifth precipitator that will be tied into the same exhaust system used by four existing smaller capacity precipitators. Two new waste water treatment plants were in operation at the Homestead works by yearend.

In the West Mifflin plant of its Irvin works, U.S. Steel installed new facilities comprising one 84-inch, 5-stand cold reduction mill; one 84-inch continuous pickling line; 30 four-stack annealing furnaces; 60 fast cool bases; one 84-inch temper mill; and one 84-inch recoil line. The new equipment doubled the plant's capacity to 115,000 tons per month of cold-rolled sheets. The facilities, which could create 300 to 350 additional jobs, were the largest industrial project in western Pennsylvania's history.

The Washington Steel Corp., at Washington, Pa., built a plant to treat and purify water from the pickling and cleaning operations of the cold metal division. The firm also invested about \$2.5 million in a new automated processing line for stainless steel sheet.

The third phase of a \$325,000 antipollution control system was completed by the Sinking Spring Foundry Division of Hofmann Industries, Inc. The system was designed to reduce smoke discharged by 95 percent, reduce odors in the immediate neighborhood, and result in only 1 percent of the water used by the foundry being discharged into the area's sanitary sewer system.

A \$500,000 baghouse was being installed in the Tullytown, Pa., plant of the Warner Co. The installation will be the first in the blast furnace slag processing industry. The company was also installing a 3-stage water-spray dust-suppression system for use with aggregate processing equipment.

Depressed demand for steel resulted in closedowns on November 20 of steelmaking at the Monessen works of the Wheeling-Pittsburgh Steel Corp., and at the corporation's hot-strip mill at Allenport. The closedowns idled 1,325 workers.

The Lehigh University established the Institute for Metal Forming for undergraduate and postgraduate research and education. The Institute will provide the teach-

ing of the principles and applications of metal forming technology and will assist the industry with its metal forming problems.

Five plants of United States Steel Corp. were among the award winners in the National Safety Council's metal section 1970 annual contest. Plants winning first place awards were the Johnstown works and the Christy Park works. In all, United States Steel received 10 first place awards in the various categories. Second place awards were won by the Homestead works, the National-Duquesne works, and the American Bridge division's Shiffler plant in Lawrenceville. American Bridge's Ambridge plant won a third place.

As of January 1, there were 90 iron and steel establishments in the State, including 14 that were classed as producers of raw iron and steel and that were operated by eight companies.

According to the American Iron and Steel Institute, raw steel production was 27,655,000 short tons compared with 30,031,000 tons in 1970. The blast furnace production of pig and silvery irons, ferromanganese, and spiegel totaled 18,786,000 tons, 9.6 percent less than in 1970. This total production was classed as 93 percent basic, 4 percent Bessemer, and 3 percent malleable and foundry. Blast furnace production of ferromanganese and spiegel accounted for 362,000 short tons of the total tonnage, compared with 395,000 tons in 1970.

Of the 20,128,825 tons of ores and concentrates consumed (excluding agglomerates), agglomerating plants processed 50.3 percent, blast furnaces consumed 46.1 percent, and steel furnaces consumed 3.6 percent.

Receipts of iron ores, including 171,047 tons of manganese ores, totaled 22,888,045 tons, of which 37.5 percent came from U.S. sources and the remainder from foreign countries. Iron ores in stock totaled 9,814,113 tons on January 1 and 10,875,790 tons at yearend.

Agglomerating plants consumed 10,128,399 tons of iron ores, 909,159 tons of limestone, 1,121,764 tons of dolomite, 118,273 tons of other fluxes, 803,615 tons of mill cinder and roll scale, 810,660 tons of raw flue dust, 249,142 tons of steel furnace slags, 610,289 tons of coke breeze, and 194,305 tons of anthracite.

Active blast furnaces numbered 33 on January 1 and 26 at yearend. Idle blast furnaces totaled 22 on January 1 and 29 at yearend. Solids charged into blast furnaces comprised 9,248,153 short tons of iron ores, 3,323,751 tons of regular sinter, 9,593,780 tons of semi- and self-fluxing sinter, 4,610,986 tons of regular iron ore pellets, 2,271,576 tons of agglomerates from foreign countries, 710,287 tons of limestone, 1,580,504 tons of dolomite, 154,719 tons of other fluxes, 399,849 tons of mill cinder and roll scale, 943,974 tons of steel furnace slags, 11,775,176 tons of breeze-free coke, 15,138 tons of coke breeze, 18,097 tons of pig iron, 844,271 tons of home and purchased scrap, 92,959 tons of slag scrap, and 245 tons of alloys and miscellaneous solids. Blast furnaces produced 143,356 tons of scrap, 5,275,213 tons of slag, and 539,789 tons of flue dust. The average consumption of blast furnace coke per ton of hot metal produced was 1,254 pounds, identical to the National average. Supplemental fuels injected into blast furnaces through tuyeres comprised 3,769 million cubic feet of natural gas, 535 million cubic feet of coke oven gas, 20,232,583 gallons of bunker C oil, 17,194,360 gallons of No. 6 oil, and 4,929,905 gallons of crude coal tar.

Open hearth, BOF, and Bessemer steel furnaces consumed 716,273 tons of iron ores, 371 tons of semi- and self-fluxing sinter, 35,141 tons of regular iron ore pellets, 114,931 tons of agglomerates from foreign countries, 485,363 tons of limestone, 674,763 tons of burnt lime, 428,566 tons of dolomite, 79,049 tons of fluorspar, 223,442 tons of other fluxes, 144,342 tons of mill cinder and roll scale, 1,298 tons of anthracite, 7,979,173 tons of pig iron and hot metal, 9,428,583 tons of home and purchased scrap, 90,863 tons of slag scrap, and 79,119 tons of other scrap.

Molybdenum.—Molybdenum concentrates originating at its mill in Questa, Colo., were processed by the Molybdenum Corp. of America in Washington, Pa.

Nuclear Fuels.—The Babcock & Wilcox Co., announced in November that it was entering the plutonium fuel business following the purchase of the Nuclear Materials and Equipment Corp. operations from the Atlantic Richfield Co. Acquired in the purchase were a plutonium plant and a special metals plant in Leechburg and a

uranium plant in Apollo. Both plants were in Armstrong County.

The Westinghouse Electric Corp. dedicated a \$10 million, 350,000-square-foot nuclear center in Monroeville in midyear. About 1,800 persons eventually will be employed in the development, design, engineering, and sale of pressurized water reactor nuclear-fueled electricity generating systems.

In June, CNA Nuclear announced an agreement with the Duquesne Light Co., the Ohio Edison Co., and the Pennsylvania Power Co. to lease fuel for the first 847-megawatt plant under construction at Shippingport. The lease initially was for a \$24.7 million core, although the actual value may change, owing to escalation and other factors, and could reach \$30 million. The lease was written for 1 year, with month-to-month renewal provisions.

Platinum.—Matthey Bishop, Inc., at West Whiteland, produced platinum sheet, wire and tubing, oxidation gauze, melting pots for laser materials, laboratory ware, fume-abatement equipment, and hydrogen purifiers.

Rare Earths.—The Molybdenum Corp. of America in its 45,000-square-foot plant at York processed raw materials obtained from its mines in Mountain Pass, Calif., and Questa, Colo., and purchased from other sources. The plant's 29 hourly workers primarily produced rare-earth chloride and nitrate, cerium oxide, chemical products of molybdenum, ammonium and sodium tungstates, and tungsten oxide.

Tantalum.—Kawecki Berylco Industries, Inc. (KBI) developed new types of tantalum capacitor powders that featured up to 8,000 microfarad volts capacitance per gram. The new powders were used in radio transmission equipment, industrial instrumentation, electric watches, and hearing aids. KBI at Boyertown produced tantalum and columbium alloys in strip, foil, and sheet forms.

Titanium.—Crucible, Inc., a division of Colt Industries, at Midland, produced titanium ingot from sponge metal and scrap.

Dynamet, Inc., obtained a \$52,000 loan from the Pennsylvania Industrial Development Authority for a new 9,600-square-foot building in Washington, Pa. The facility will produce titanium wire, and its 14 employees will have a \$100,000 annual payroll.

Zinc.—Zinc ore, principally sphalerite, was mined and concentrated near Center Valley in Lehigh County. The concentrate was shipped to a vertical-retort smelter in Palmerton, where anthracite was used in the sintering operation. The smelter's products included rolled zinc, slab zinc, zinc die-casting alloys, dry battery shells, zinc oxide, spiegeleisen, cadmium, and sulfuric acid.

The mine output of zinc was 7.2 percent less and the value of production was 2.5 percent less than in 1970.

In October, the Waelz sinter plant started operating baghouse equipment costing \$236,000 and capable of collecting up to 3 tons per hour of zinc oxide particulates, which were reprocessed. The insulated system prevented moisture condensation that normally results in clogging and rapid deterioration of bags.

A 40,000-ton-per-year plant was under

construction at Palmerton, to produce ammonia from natural gas to supplement an existing 35,000-ton-per-year facility.

Zinc concentrates from the St. Joe Mineral Corp. Balmat-Edwards mining complex in northern New York were processed at the corporation's Josephstown electrothermic smelter at Monaca. The smelter has an annual capacity of 210,000 tons of slab zinc and 35,000 tons of zinc oxide.

Pennsylvania State University geologists released a description of lead and zinc deposits occurring as small veins in an exposure of the Tuscarora quartzite near Mapleton, in Huntingdon County, which may amount to commercially minable quantities. A favorable zone with high values of lead, zinc, silver, and other metals in soils, waters, and streambeds, was outlined by three mineralized occurrences at least 12 miles long.

Table 17.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Nonmetallic: Satellite Alloy Corp.	9800 McKnight Rd. Pittsburgh, Pa. 15237	Plant.....	Allegheny.
Metallic:			
Abrasive Metals Co.....	26th & B. & O. RR Pittsburgh, Pa. 15222	...do.....	Do.
Durasteel Abrasive Co.....	2601 Smallman St. Pittsburgh, Pa. 15222	...do.....	Westmoreland.
Industeel Corp.....	37th & A. V. RR Pittsburgh, Pa. 15222	...do.....	Allegheny.
Pangborn Div., the Carborundum Co.	P.O. Box 380 Hagerstown, Md. 21740	...do.....	Butler.
Cement:			
Allentown Portland Cement Co., Div. National Gypsum Co. ¹	7th St. at Thruway Allentown, Pa. 18101	...do.....	Berks.
Allentown Portland Cement Co., Div. National Gypsum Co.	...do.....	...do.....	Montgomery.
Bessemer Cement Co., subsidiary of Louisville Cement Co.	510 Hanna Bldg. Cleveland, Ohio 44115	...do.....	Lawrence.
Coplay Cement Manufacturing Co. ¹	North 2d St. Coplay, Pa. 18037	...do.....	Lehigh.
Do.....	Easton Rd. Coplay, Pa. 18037	...do.....	Northampton.
Dragon Cement Co., Div. of Martin-Marietta Corp. ¹	5A Joyce Kilmer Ave. New Brunswick, N.J. 08903	...do.....	Do.
Green Bag Cement Co., Div. of Marquette Cement Manu- facturing Co.	20 North Wacker Dr. Chicago, Ill. 60606	...do.....	Allegheny.
Hercules Cement Co., Div. of American Cement Corp. ¹	555 City Line Ave. Bala-Cynwyd, Pa. 19004	...do.....	Northampton.
Keystone Portland Cement Co. ¹	2200 Hamilton St. Allentown, Pa. 18105	...do.....	Do.
Lone Star Cement Corp. ¹	P.O. Box 6237 West End Br. Richmond, Va. 23230	...do.....	Do.
Medusa Portland Cement Co. ² ..	P.O. Box 5668 Cleveland, Ohio 44101	...do.....	Lawrence.
Medusa Portland Cement Co. ³..	...do.....	...do.....	York.
National Portland Cement Co. ¹	1023 West St. George Ave. Linden, N.J. 07036	...do.....	Northampton.
Penn-Dixie Cement Corp. ⁵	P.O. Box 152 Nazareth, Pa. 18064	...do.....	Butler.
Penn-Dixie Cement Corp. ¹.....	...do.....	...do.....	Northampton.
Universal Atlas Cement Div., U.S. Steel Corp.	600 Grant St. U.S. Steel Bldg. Pittsburgh, Pa. 15230	...do.....	Allegheny.

See footnotes at end of table.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Cement—Continued			
Universal Atlas Cement Div., U.S. Steel Corp. ¹	600 Grant St. U.S. Steel Bldg. Pittsburgh, Pa. 15320	Plant.....	Northampton.
The Whitehall Cement Manu- facturing Co. ¹	123 South Broad St. Philadelphia, Pa. 19109	.....do.....	Lehigh.
Clay and shale:			
Fire:			
Drexel Refractories Div., Drexel Dynamics Corp.	P.O. Box 50 Kittanning, Pa. 16201	Underground....	Armstrong.
Freeport Brick Co.....	Drawer F Freeport, Pa. 16229	.....do.....	Do.
Freeport Brick Co., Kittan- ning Brick Div.	R.D. 1 Adrian, Pa. 16120	.....do.....	Do.
Hanley Co.....	28 Kennedy St. Bradford, Pa. 16701	.....do.....	Jefferson.
Harrison Walker Refractories Co.	2 Gateway Center Pittsburgh, Pa. 15222	Pits.....	Cambria, Centre, Clearfield, Fayette, Somerset.
Ralph A. Veon, Inc.....	Darlington, Pa. 16115	Pit.....	Lawrence.
Kaolin: The Philadelphia Clay Co.	236 West North St. Carlisle, Pa. 17013	Pit.....	Cumberland.
Common clay and shale:			
Alwine Brick Co., subsidiary of Glen-Gery Corp.	New Oxford, Pa. 17350	Pit.....	Adams.
Bylyte Corp.....	P.O. Box 1628 North End Station Wilkes-Barre, Pa. 18705	Pit.....	Luzerne.
Fenati Brick Co., Inc.....	New Castle, Pa. 16101	Pit.....	Lawrence.
Glen-Gery Corp.....	227 North 5th St. Reading, Pa. 19601	Pit.....	Berks, Northum- berland, Union, York.
Hanley Co.....	28 Kennedy St. Bradford, Pa. 16701	Pit.....	McKean, Jefferson.
McAvoy Vitrified Brick Co.	Phoenixville, Pa. 19460	Pit.....	Chester.
McQuiston Coal Co. ⁶	109 East Moody Ave. New Castle, Pa. 16101	Pit.....	Lawrence.
Milliken Brick Co., Inc.....	2100 Montier St. Pittsburgh, Pa. 15221	Pit.....	Allegheny.
The Robinson Clay Product Co.	65 West State St. Akron, Ohio 44309	Pit.....	Montgomery.
Coal:			
Anthracite:			
Blue Coal Corp. ⁴	101 South Main St. Ashley, Pa. 18706	Underground....	Luzerne.
Blue Coal Corp. ⁷.....	.....do.....	Culm bank.....	Do.
Blue Coal Corp. ⁸.....	.....do.....	Strip.....	Do.
Carbondale Coal Co., Inc. ⁴	78 Cottage St. Carbondale, Pa. 18407	.....do.....	Lackawanna.
Gangloff Brothers ⁶	New Ringgold, Pa. 17960	Culm bank.....	Northumberland.
Glen-Nan Coal Co., Inc.....	St. Mary's and River Road Wilkes-Barre, Pa. 18702	Underground....	Luzerne.
Greenwood Stripping Corp.	1 Venice St. Nesquehoning, Pa. 18240	Strip.....	Carbon, Schuylkill.
Jeddo-Highland Coal Co. ⁸	800 Exeter Ave. West Pittston, Pa. 18643	.....do.....	Luzerne.
Jeddo-Highland Coal Co. ⁴.....	.....do.....	Culm bank.....	Do.
Kerris & Helfrick, Inc.....	Lehigh & Popular St. Mount Carmel, Pa. 18751	Strip.....	Columbia, Northumberland, Schuylkill.
Lehigh Valley Anthracite, Inc.	800 Exeter Ave. West Pittston, Pa. 18643	Culm bank.....	Carbon, Schuylkill, Luzerne.
Do.....	.....do.....	Strip.....	Columbia, Luzerne, Schuylkill.
Pennsylvania Power & Light Co.	901 Hamilton St. Allentown, Pa. 18101	Dredge.....	Lancaster.
Ken Pollock, Inc. ⁴	Route 11 Hunlock Creek, Pa. 18621	Culm bank.....	Luzerne.
Reading Anthracite Co.....	200 Mahantongo St. Pottsville, Pa. 17901	.....do.....	Northumberland, Schuylkill.
Do.....	.....do.....	Strip.....	Do.
Bituminous:			
Barnes & Tucker Co.....	357 Lancaster Ave. Haverford, Pa. 19041	Underground....	Cambria, Indiana.
Bethlehem Mines Corp.....	701 East 3d St. Bethlehem, Pa. 18016	.....do.....	Cambria, Washington.
Buckeye Coal Co.....	P.O. Box 900 Youngstown, Ohio 44501	.....do.....	Greene.
Gateway Coal Co. for J & L Steel Corp.	Box 608 California, Pa. 15419	.....do.....	Do.

See footnotes at end of table.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Coal—Continued			
Bituminous—Continued			
Harmar Coal Co. ⁴ -----	Box 500 Library, Pa. 15129	Underground....	Allegheny.
Jones & Laughlin Steel Corp.	Box 608 California, Pa. 15419	....do.....	Greene.
Mathies Coal Co.-----	Box 500 Library, Pa. 15129	....do.....	Washington.
Pittsburgh Coal Co. ⁴-----	....do.....	....do.....	Do.
United States Steel Corp.---	525 Wm. Penn Pl. Pittsburgh, Pa. 15219	....do.....	Greene, Washington.
Graphite (synthetic):			
Airco Speer Carbon Products, div. of Air Reduction Co., Inc.	Theresia St. St. Marys, Pa. 15857	Plant.....	Elk.
Chas. Pfizer & Co., Inc., MPM Division.	235 East 42d St. New York, N.Y. 10017	....do.....	Northampton.
Stackpole Carbon Co.-----	St. Marys, Pa. 15857	....do.....	Elk.
Gypsum (calcined):			
United States Gypsum Co. ⁹ ---	101 South Wacker Dr. Chicago, Ill. 60606	....do.....	Philadelphia.
Iron ore:			
Bethlehem Mines Corp. ¹⁰ ----	701 East 3d St. Bethlehem, Pa. 18016	Underground....	Berks.
Bethlehem Mines Corp. ¹¹----	....do.....	....do.....	Lebanon.
Iron oxide pigments:			
Crude:			
Allegheny Ludlum Steel Corp.	2000 Oliver Bldg. Pittsburgh, Pa. 15222	Plant.....	Allegheny.
Lanzendorfer Minerals Co.---	Twin Rocks, Pa. 15960	Pit.....	Cambria.
Finished:			
Minerals, Pigments & Metals Div., Chas. Pfizer & Co., Inc.	640 North 13th St. Easton, Pa. 18042	Plant.....	Northampton.
The Prince Manufacturing Co.	Bowmanstown, Pa. 18080	....do.....	Carbon.
Reichard-Coulston, Inc.-----	15 East 26th St. New York, N.Y. 10010	....do.....	Northampton.
Lime:			
The J. E. Baker Co. ¹ -----	P.O. Box 1189 York, Pa. 17405	....do.....	York.
Mercer Lime & Stone Co.-----	1640 Oliver Bldg. Pittsburgh, Pa. 15222	....do.....	Butler.
National Gypsum Co. ¹ -----	325 Delaware Ave. Buffalo, N.Y. 14202	....do.....	Centre.
Standard Lime & Refrac. Co., Div. of Martin-Marietta Corp. ¹	2000 First National Bank Bldg. Baltimore, Md. 21203	....do.....	Do.
Warner Company ¹ -----	1721 Arch St. Philadelphia, Pa. 19103	....do.....	Centre, Chester.
Mica (crude):			
Micalith Mining Co., Inc.-----	P.O. Box 1671 Phoenix, Ariz. 85001	Pit.....	York.
Peat:			
Benton Peat.....	Benton, Pa. 17814	Bog.....	Columbia.
Blue Ridge Industries, Inc.---	Box 128, R.D. 2 White Haven, Pa. 18661	Bog.....	Luzerne.
D. M. Boyd Co.....	226 Francis St. New Wilmington, Pa. 16142	Bog.....	Lawrence.
Corry Peat Products Co.-----	515 West Columbus Ave. Corry, Pa. 16407	Bog.....	Erie.
International Peat, Inc.-----	R. D. 1 White Haven, Pa. 18661	Bog.....	Luzerne.
Lake Benton Peat Moss.....	1418 North Main St. Scranton, Pa. 18508	Bog.....	Lackawanna.
Pennsylvania Peat Moss, Inc.---	21st & Laurel Sts. Hazleton, Pa. 18201	Bog.....	Luzerne, Monroe.
Stillers Blue Ridge Peat Co.---	R. D. White Haven, Pa. 18661	Bog.....	Luzerne.
Wayne Peat Humus Co., Inc.---	P.O. Box 315 Gouldsboro, Pa. 18424	Bog.....	Wayne.
Welker's Greenhouse, Inc.-----	New Castle, Pa. 16101	Bog.....	Lawrence.
Perlite (expanded):			
Armstrong Cork Co.....	Lancaster, Pa. 17603	Plant.....	Lancaster.
The Celotex Corp.....	1500 North Dale Mabry Tampa, Fla. 33607	....do.....	Luzerne.
Insul-Fil Manufacturing Co.---	Box 325 Primos, Pa. 19018	....do.....	Delaware.
Pennsylvania Perlite Corp.-----	P.O. Box 2002 Lehigh Valley, Pa. 18001	....do.....	Lehigh, York.
Perlite Manufacturing Co.-----	P.O. Box 478 Carnegie, Pa. 15106	....do.....	Allegheny.

See footnotes at end of table.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Petroleum refineries:			
Atlantic Richfield Co.-----	260 South Broad St. Philadelphia, Pa. 19102	Plant.-----	Philadelphia.
BP Oil Corp.-----	600 Fifth Ave. New York, N.Y. 10001	.....do-----	Delaware.
Gulf Oil Corp.-----	P.O. Box 7408 Philadelphia, Pa. 19101	.....do-----	Erie.
Kendall Refining Co., Div. of of Witco Chemical Co.-----	Bradford, Pa. 16701-----	.....do-----	McKean.
Pennsylvania Refining Co.-----	Karns City, Pa. 16041-----	.....do-----	Butler.
Pennzoil United, Inc.-----	Oil City, Pa. 16301-----	.....do-----	Venango.
Quaker State Oil Refining Corp.-----	Farmers Valley, Pa. 16749-----	.....do-----	McKean, Venango.
Sun Oil Company-----	1608 Walnut St. Philadelphia, Pa. 19101	.....do-----	Do.
United Refining Co.-----	Warren, Pa. 16365-----	.....do-----	Warren.
Valvoline Oil Co., Div. of Ashland Oil and Refining Co.-----	Freedom, Pa. 15042-----	.....do-----	Beaver.
Wolf's Head Oil Refining Co., Inc.-----	Reno, Pa. 16343-----	.....do-----	Venango.
Sand and gravel:			
Davison Sand & Gravel Co.-----	34th Ave. & 4th St. New Kensington, Pa. 15068	Dredge-----	Westmoreland.
Erie Sand Steamship Co.-----	Erie, Pa. 16500-----	.....do-----	Erie.
Glacial Sand & Gravel Co.-----	P.O. Box 10 Kittanning, Pa. 16201	Pit-----	Armstrong.
Hunlock Sand & Gravel Co.-----	Box 275-A R.D. 1 Hunlock Creek, Pa. 18621	Pit & plant.-----	Luzerne.
Lycoming Silica Sand Co.-----	401 Broad St., Box 159 Montoursville, Pa. 17754	Pit-----	Lycoming.
Mahoning Valley Sand Co.-----	Box 1236 New Castle, Pa. 16102	Pit & plant.-----	Lawrence.
Manorville Sand Co.-----	Box 251 Manorville, Pa. 16238	Pit-----	Armstrong.
Pennsylvania Glass Sand Corp.-----	Berkeley Springs, W. Va. 25411	Pit-----	Huntingdon, Mifflin, Venango.
Penny Supply, Inc.-----	1001 Paxton St. Harrisburg, Pa. 17104	Pit-----	Perry.
Seidle Sand & Gravel, Inc.-----	R.D. 4 Mercer, Pa. 16137	Pit-----	Mercer.
State Aggregates, Inc.-----	635 Lucknow Lane Harrisburg, Pa. 17110	Pit-----	Bradford.
Warner Company-----	1721 Arch St. Philadelphia, Pa. 19103	Pit-----	Bucks.
Smelters:			
The New Jersey Zinc Co.-----	Palmerton, Pa. 18071-----	Plant-----	Carbon.
St. Joe Minerals Corp.-----	Josephstown, Pa. 15061-----	.....do-----	Beaver.
Stone:			
Limestone and dolomite— crushed:			
Appalachian Stone Div., Martin-Marietta Corp.-----	Box 120 Mercersburg, Pa. 17236	Quarry-----	Centre, Chester, Fayette, Franklin.
Bethlehem Mines Corp.-----	701 East 3d St. Bethlehem, Pa. 18016	.....do-----	Adams.
Bethlehem Mines Corp.-----	.....do-----	.....do-----	Mifflin, Montgomery, Northampton.
Bradford Hills Quarries, Inc.-----	Box 231 Easton, Pa. 18042	.....do-----	Chester, Lancaster, Perry.
G. & W. H. Corson, Inc. ¹² -----	Plymouth Meeting, Pa. 19462	.....do-----	Montgomery.
Eureka Stone Quarry, Inc.-----	Lower State & Pickertown Rds. Eureka, Pa. 18914	.....do-----	Bucks.
Eastern Industries, Inc.-----	Box 183 Wescosville, Pa. 18090	.....do-----	Berks, Lehigh.
Lycoming Silica Sand Co.-----	P.O. Box 159 Montoursville, Pa. 17754	.....do-----	Columbia, Lycom- ing, Montour.
National Gypsum Co.-----	325 Delaware Ave. Buffalo, N.Y. 14202	.....do-----	Berks, Centre, York.
New Enterprise Stone & Lime.-----	New Enterprise, Pa. 16664-----	.....do-----	Bedford, Blair, Franklin, Huntingdon.
United States Steel Corp.-----	Hillsville, Pa. 16132-----	.....do-----	Lawrence.
Miscellaneous—crushed & broken:			
Gill Quarries, Inc.-----	P.O. Box 187 Fairview Village, Pa. 19434	.....do-----	Montgomery.
M & M Stone Co.-----	Harleysville, Pa. 19438-----	.....do-----	Do.
Miscellaneous—dimension:			
F. Cantono & Sons-----	454 Germantown Pike Lafayette Hill, Pa. 19444	.....do-----	Delaware.

See footnotes at end of table.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Sandstone and quartzite—			
crushed:			
American Asphalt Paving Co.	Box 95, R.D. 5 Shavertown, Pa. 18700	Quarry-----	Luzerne.
Bear Gap Stone Inc.-----	R.D. 1 Elysburg, Pa. 17824	---do-----	Northumberland.
Coolbaugh Sand & Stone, Inc.	32 Railroad Ave. Scranton, Pa. 18505	---do-----	Luzerne.
Detwilers Industries, Inc., subsidiary of New Enterprise Stone & Lime Co., Inc.	New Enterprise, Pa. 16664	---do-----	Bedford, Somerset.
Eidemiller Enterprises, Inc.	Greensburg, Pa. 15601	---do-----	Westmoreland.
Faylor Lime & Stone Co.---	Winfield, Pa. 17889	---do-----	Dauphin, Northampton.
Keeler Supply Co., Inc.----	Box 12 Clifford, Pa. 18413	---do-----	Susquehanna.
Latrobe Construction Co.---	P.O. Box 150 Latrobe, Pa. 15650	Underground---	Westmoreland.
No. 1 Contracting Corp. of Delaware.	Box 460 Pittston, Pa. 18640	Quarry-----	Northampton, Schuylkill.
Summit Quarries, Div. of J. Robert Bazley, Inc.	P.O. Box 298 Pottsville, Pa. 17901	---do-----	Schuylkill.
Sandstone and quartzite—			
dimension:			
Cain Building Stone Corp.---	R.D. 1 Zion Grove, Pa. 17985	---do-----	Chester.
Delaware Quarries-----	Lumberville, Pa. 18938	---do-----	Bucks.
Freestone Products Co., Inc.	300 Willow Grove Ave. Glenside, Pa. 19038	---do-----	Montgomery.
Media Quarry Co.-----	131 East 2d St. Media, Pa. 19063	---do-----	Delaware.
Valley Forge Building Stone.	P.O. Box 195 Morgantown, Pa. 19543	---do-----	Chester.
Slate—crushed:			
Pennsylvania Light-weight Aggregate, Inc.	Bangor, Pa. 18013	---do-----	Northampton.
Slate—dimension:			
Capitol Slate Co., Inc.----	P.O. Box 281 East Bangor, Pa. 18040	---do-----	Do.
Anthony Dally & Sons, Inc.	Robinson Ave. Pen Argyl, Pa. 18072	---do-----	Do.
Doney Slate Co.-----	Pen Argyl, Pa. 18072	---do-----	Do.
Emerald Slate Corp.-----	Alpha Road Wind Gap, Pa. 18091	---do-----	Do.
North Bangor Slate Co.----	Bangor, Pa. 18013	---do-----	Do.
Penn Big Bed Slate Co., Inc.	446 Main St. Slatington, Pa. 18080	---do-----	Lehigh.
Stephens-Jackson Co.-----	Main St. & Schanck Ave. Pen Argyl, Pa. 18072	---do-----	Northampton.
D. Stoddard & Sons, Inc.---	Bangor, Pa. 18013	---do-----	Do.
Traprock (basalt)—crushed and broken:			
Bucks County Crushed Stone, Inc.	Ottsville, Pa. 18942	---do-----	Bucks.
V. Di Francesco & Sons----	17 Mifflin Ave. Havertown, Pa. 19083	---do-----	Chester.
Do-----	do	---do-----	Delaware.
The General Crushed Stone Co.	712 Drake Bldg. Easton, Pa. 18042	---do-----	Bucks, Delaware.
Vernon B. Horn-----	R.D. Chalfont, Pa. 18914	---do-----	Bucks.
Kibblehouse Quarries, Inc.	Perkiomenville, Pa. 18074	---do-----	Montgomery.
Montgomery Stone Co., Inc. ³	Montgomeryville, Pa. 18936	---do-----	Do.
Pottstown Trap Rock Quarries, Inc.	R.D. 1 Douglasville, Pa. 19518	---do-----	Berks, Montgomery.
Tohickon Quarry Co.-----	Quakertown, Pa. 18951	---do-----	Bucks.
Warner Company-----	1721 Arch St. Philadelphia, Pa. 19103	---do-----	Berks.
Traprock (basalt)—dimension:			
Coopersburg Granite Co.---	Coopersburg, Pa. 18036	---do-----	Bucks.
Granite—crushed:			
Mignatti Construction Co., Inc.	2310 Terwood Ave. Bethayres, Pa. 19006	---do-----	Montgomery.
Granite—dimension:			
Carl Galantino, Inc.-----	42 Hirst Ave. East Lansdowne, Pa. 19050.	---do-----	Delaware.

See footnotes at end of table.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sulfur:			
Atlantic Richfield Co.....	3144 Passyunk Ave. Philadelphia, Pa. 19145	Plant.....	Philadelphia.
Gulf Oil Corp.....	P.O. Box 7408 Philadelphia, Pa. 19101	---do-----	Do.
BP Oil Corp., subsidiary of British Petroleum Corp. Ltd.	P.O. Box 428 Marcus Hook, Pa. 19061	---do-----	Delaware.
Sun Oil Co.....	1608 Walnut St. Philadelphia, Pa. 19103	---do-----	Do.
Tripoli (rottenstone):			
Keystone Filler & Manufactur- ing Co.	Muncy, Pa. 17756.....	Pit.....	Lycoming.
Penn Paint & Filler Co.....	Antes Fort, Pa. 17720.....	Pit.....	Do.
Vermiculite (exfoliated):			
Hyzer & Lewellen.....	P.O. Box 155 Southampton, Pa. 18966	Plant.....	Bucks.
W. R. Grace & Company, Zonolite Div.	62 Whittemore Ave. Cambridge, Mass. 02140	---do-----	Lawrence.

¹ Also limestone.² Also limestone and shale.³ Also limestone and clay.⁴ 2 operations.⁵ Also limestone and sand and gravel.⁶ Also fire clay.⁷ 3 operations.⁸ 4 operations.⁹ Also expanded perlite.¹⁰ Also byproduct cobalt and pyrites.¹¹ Also byproduct gold, silver, copper, cobalt, and pyrites.¹² Also lime.¹³ Also dimension.

The Mineral Industry of Puerto Rico, the Panama Canal Zone, the Virgin Islands, Pacific Island Possessions, and Trust Territory of the Pacific Islands

The Puerto Rico section of this chapter has been prepared through cooperation among the Bureau of Mines, U.S. Department of the Interior, the Mining Commission of Puerto Rico, and the Economic Development Administration (Fomento) Commonwealth of Puerto Rico.

By Herbert R. Babitzke,¹ Sarkis G. Ampian,² and Charles D. Hoyt³

PUERTO RICO⁴

The most significant event in 1971 for the mineral-based industry of Puerto Rico was the Commonwealth Oil Refining Co. Inc.'s (CORCO) signing an \$8 billion, 25 year supply contract with the Algerian Government-owned Société Nationale pour la Recherche, la Production, la Transport, la Transformation, et la Commercialisation des Hydrocarbures (SONATRACH), to provide 380 million tons of low sulfur crude oil and petroleum products. This was the largest country-to-company contract ever

signed. Deliveries to CORCO, which owns and operates a \$350 million refinery and petrochemical complex in south-central (Peñuelas area) Puerto Rico, are to begin in 1972 and by 1975 are expected to reach 400,000 barrels per day. In 1971, CORCO had a throughput of 155,000 barrels daily.

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⁴ Prepared by Herbert R. Babitzke and Charles D. Hoyt.

Table 1.—Mineral production in Puerto Rico¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement, portland.....thousand 376-pound barrels...	9,460	\$29,515	10,642	\$38,413
Clays.....thousand short tons...	429	486	342	358
Lime.....do....	41	W	44	W
Salt.....do....	32	395	29	570
Sand and gravel.....do....	11,506	28,001	7,292	20,607
Stone.....do....	7,296	13,947	12,130	29,847
Total ²	XX	72,344	XX	89,795
Total 1967 constant dollars.....	XX	64,712	XX	78,014

^p Preliminary. W Withheld to avoid disclosing individual company confidential data. XX Not applicable.

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

² Total does not include value of items withheld.

Table 2.—Value of mineral production in Puerto Rico, by district
(Thousands)

Senatorial district	1970 ¹	1971	Minerals produced in 1971 in order of value
Aguadilla.....	\$3,303	\$2,741	Sand and gravel.
Arecibo.....	4,370	3,806	Sand and gravel, stone.
Guayama.....	2,562	1,537	Sand and gravel.
Humacao.....	1,961	1,610	Do.
Mayagüez.....	4,344	3,722	Sand and gravel, salt.
Ponce ¹	26,024	29,017	Cement, sand and gravel, stone, clays.
San Juan.....	29,779	19,398	Cement, stone, sand and gravel, clays.
Undistributed ²		27,966	
Total ³	72,344	89,795	

¹ Revised.

² Excludes value of lime, which is being withheld to avoid disclosing individual company confidential data.

³ Includes stone that cannot be assigned to a specific district.

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

No agreements were reached in 1971 between the copper companies and the Commonwealth of Puerto Rico. In February and March 1971, the Puerto Rican Government held public hearings in San Juan, Mayagüez, and Utuado on the proposed copper mining. In mid-October the Mining Commission of Puerto Rico released its official position⁵ as to its proposed requirements for the completion of an acceptable agreement for the exploitation of the copper deposits. As part of its position, the Mining Commission stated the following: "... The copper mining development of the deposits of Piedra Hueca, Cala Abajo, and Tanamá is feasible without incurring irreparable damages to the natural environment of the area and the health of the inhabitants. Being conscious of the possible environmental risks which an operation of this nature could entail, the Commission will require the necessary measures to control water, soil, and air pollution in order to comply with all the laws, regulations, and norms which from time to time are promulgated towards this end . . ."

In press coverage of the Mining Commission position,⁶ a spokesman for the commission indicated that the Puerto Rican Government is seeking approximately 50 percent of the net income and the establishment of a refinery in Puerto Rico. At yearend the companies had not officially responded to the Puerto Rican Governmental position, which rejected their December 1969 proposal, but there were indications that negotiations would resume in early 1972.

The Mining Commission of Puerto Rico reported that at the end of 1971 there were 10 exclusive exploration permits and one mining lease in effect. Details concerning the permits are shown in table 3.

In June 1970, Puerto Rico formally began an era of environmental concern with the passage of the Public Environmental Policy Act, which established the Environmental Quality Board (EQB) in the Office of the Governor. Staffing of this new agency did not begin until late 1970. Therefore, much of 1971 was devoted to hiring personnel, establishing responsibilities and priorities, and formulating plans and standards for pollution regulations and enforcement procedures.

During the year, Puerto Rico's only steel producer, Industrial Siderurgica, Inc., started an expansion program that will double its annual capacity from 50,000 tons to 100,000 tons. The existing plant produces reinforcing rods from Puerto Rican scrap. The new facility will be fully automated and will use continuous casting methods. The expansion is scheduled for completion in 1972.

Government Programs.—The Geological Laboratory of Natural Resources completed its second year of operation. The laboratory is operated jointly by the Puerto Rican Area of Natural Resources, Department of Public Works, and the U.S. Geological Survey. In a cooperative study a U.S. Geological Survey geochemist has discovered that trace amounts of gold in the soil may indicate the presence of porphyry-type copper mineralization in the underlying rocks, even where extreme tropical weathering has leached nearly all traces of copper from the soil.

Geologists with the Puerto Rican Bureau of Geology and Mineral Resources, cooper-

⁵ Copies may be obtained from the Mining Commission, Commonwealth of Puerto Rico, GPO Box 3088, San Juan, P.R. 00936.

⁶ The San Juan Star. 12th year No. 288, Oct. 15, 1971, pp. 1, 20.

Table 3.—Exclusive prospecting permits in Puerto Rico
(December 31, 1971)

Permit holder	Date	Subsidiary	Minerals
Weaver Oil & Gas Corp.....	Aug. 20, 1968.....	.....	Gas and oil.
Caribe Sun Oil Co.....	Sept. 11, 1969.....	Sun Oil Co.....	Do.
Puerto Rico Petroleum Exploration Corp.....	July 14, 1968.....	.....	Do.
Oceanic Exploration Co.....	Sept. 24, 1971.....	Eastman Dillon Union Securities & Co., Inc.....	Copper and associated minerals.
Cobre Caribe, S.A. ¹	Aug. 5, 1958.....	Kennecott Copper Corp.....	Do.
Ponce Mining Co. ¹	May 15, 1961.....	American Metal Climax, Inc.....	Do.
Anthony Rojas.....	Oct. 27, 1970.....	.....	Do.
Oceanic Exploration Co.....	Oct. 27, 1970.....	Eastman Dillon Union Securities & Co., Inc.....	Do.
Parnasse Co.....	Oct. 27, 1970.....	Parnasse Delaware Co.....	Do.
John Q. St. Clair.....	Dec. 8, 1971.....	.....	Magnesium, nickel, cobalt, chromium, and associated minerals.

¹ Application has been made for a mining lease.

ating with the Natural Resources Laboratory, have completed soil and stream float geochemical surveys in southwestern Puerto Rico. Several anomalous concentrations of copper-molybdenum and gold-silver-arsenic have been outlined by this work.

A geochemical survey was made of the island of Culebra at the request of the Governor of Puerto Rico. No indications of metallic mineral resources were discovered, but small sand resources were outlined.

Training programs for Latin American chemists, geochemists, and geologists have been conducted during the year. This cooperative program has been arranged by the U.S. Geological Survey and the Department of Public Works Natural Resources Laboratory with the U.S. Agency for International Development. Trainees from Brazil and Colombia have received on-the-job training at the San Juan laboratory in the use of the spectrograph, atomic absorption spectrophotometer, mercury and sulfur detection instruments, sample control, data storage and retrieval, as well as field methods in geochemistry.

Studies of the porphyry copper deposits have been made using isotopic dating of rocks and hydrothermal minerals. This work, done by U.S. Geological Survey geologists and a Yale University graduate student, has shown that the ore bodies are related to Eocene quartz diorite porphyries and are distinctly younger than the larger granodiorite batholiths of eastern and central Puerto Rico.

The petrology and alteration of the Puerto Rican porphyry copper deposits were studied in detail by a U.S. Geological Sur-

vey geologist. The results were presented in a paper given at geological meetings in Puerto Rico and Venezuela.⁷

In late 1971, the U.S. Geological Survey's geologic mapping program in Puerto Rico became a cooperative effort with the Puerto Rico Department of Public Works, Area of Natural Resources. Formerly, cooperation was with the Economic Development Administration. The project goals are now being broadened to include primary and derivative studies aimed at environmental and land resource aspects of Puerto Rico geology. Fieldwork continued in the preparation of a series of 7½-minute geologic quadrangle maps covering most of the island. During 1971 six geologic maps⁸ and one professional paper were published.⁹

Extensive hydrological programs were continued in 1971 by the Caribbean Dis-

⁷ Cox, Dennis P. Puerto Rican Porphyry Copper Deposits, Petrology and Alteration. Transactions of the Sixth Caribbean Geol. Conf. Porlamar, Venezuela, Biblioteca de la Escuela de Geología, Universidad Central de Venezuela, Apartado No. 50926, Caracas, Venezuela, July 6-12, 1971.

⁸ Briggs, R. P. Geologic Map of the Orocovis Quadrangle, Puerto Rico. Misc. Geol. Inv. Map No. I-615. U.S. Geol. Survey, 1971.

McIntyre, D. H. Geologic Map of the Central La Plata Quadrangle, Puerto Rico. Misc. Geol. Inv. Map No. I-660, U.S. Geol. Survey, 1971.

Monroe, Watson H. Geologic Map of the Manati Quadrangle, Puerto Rico. Misc. Geol. Inv. Map No. I-671, U.S. Geol. Survey, 1971.

Seiders, Victor M. Geologic Map of Gurabo Quadrangle, Puerto Rico. Misc. Geol. Inv. Map No. I-657, U.S. Geol. Survey, 1971.

..... Geologic Map of the El Yunque Quadrangle, Puerto Rico. Misc. Geol. Inv. Map No. I-658, U.S. Geol. Survey, 1971.

Tobisch, Othmar T., and Mort D. Turner. Geologic Map of the San Sebastián Quadrangle, Puerto Rico. Misc. Geol. Inv. Map No. I-661, U.S. Geol. Survey, 1971.

⁹ Glover, Lynn, III. Geology of the Coamo Area, Puerto Rico, and its Relation to the Volcanic Arc-Trench Association, Geol. Survey Prof. Paper 636, U.S. Geol. Survey, 1971. 102 pp.

tract of the Water Resources Division of the U.S. Geological Survey. In 1971, the Caribbean district office issued seven publications.¹⁰ This office, which opened in November 1957, has 32 employees, half of whom are professionals. In 1971, three electrical analog models of alluvial aquifers were completed. One model of the Yabuco Valley, south-east Puerto Rico, is being used for long-range planning in the development of public and industrial water supplies from an aquifer that was essentially untapped 2 years ago. Another model of the south-coast Guayama area will be used as a water management tool in an area of increasing water demand. The third model, under construction, is of the alluvial aquifers of the eastern two-thirds of the south coast.

The Caribbean district completed a study of the tertiary limestone aquifer underlying metropolitan San Juan. The use of this aquifer is limited but is a potential source of emergency water supply during drought periods.

Investigations of the north-coast Aymamon and Aguada limestones indicate that they may prove to be among the more productive aquifers in Puerto Rico. Preliminary studies show discharges of about 120 million gallons per day to the sea.

In September 1971, the Bureau of Mines established a State Liaison office in Puerto Rico as part of its nationwide State Liaison Office program which began in mid-1970. The purpose of the program is to foster closer and more productive relationships between the Federal Government and the States in solving mineral-related problems.

REVIEW BY MINERAL COMMODITIES

Nonmetals.—Cement.—The cement industry, whose prices are controlled by the Puerto Rican Government, both expanded its output and improved its financial outlook during 1971. The continuing expan-

sion of the construction industry (table 5) provided the growth in demand and two Government-allowed price increases, one in mid-1971 and the second in December 1971, served as the financial stimulus. Projections indicate that cement demand in Puerto Rico for the next few years will grow at a rate of 3 to 6 percent annually.

At yearend, producer prices were set at \$1.30 per bag to both retail and bulk customers. Retail prices were \$1.45 per 94-pound bag. The Government also granted annual future price increases of 5 cents per bag without prior approval.

A new producer, the San Juan Cement Co., completed its first full year of operation in 1971. The firm was planning to install a third kiln during 1972, which would expand its annual capacity from 2.5 to 4 million tons.

The major producer, the Puerto Rican Cement Co., Inc. with plants in Ponce and San Juan, reported earnings¹¹ of slightly over \$1 million, contrasted with a small loss in 1970. In late 1971 the company resumed production of white cement and at yearend was producing at a rate of 40,000 bags per month. Producer prices for white cement, not subject to control, are \$2.40 per bag in bulk.

¹⁰ Giusti, Ennio V. Water Resources of the Juana Diaz Area, Puerto Rico. A Preliminary Appraisal, 1966. Commonwealth of Puerto Rico, Water Res. Bull. 8, 1971, 43 pp.

Haire, William J. Floods in Patillas-Maunabo Area, Puerto Rico. Hydrol. Inv. Atlas HA-445, 1971.

— Floods in Guayama Area, Puerto Rico. Hydrol. Inv. Atlas HA-446, 1971.

— Floods in Salinas Area, Puerto Rico. Hydrol. Inv. Atlas HA-447, 1971.

— Floods in Santa Isabel Area, Puerto Rico. Hydrol. Inv. Atlas HA-448, 1971.

Jordan, Donald G. Water and Copper-Mine Tailings in Karst Terrane of Rio Tanamá Basin, Puerto Rico. Caribbean District Open-File Rep., October 1970, 24 pp.

Lopez, Miguel A., and Fred K. Fields. A Proposed Streamflow-Data Program For Puerto Rico. Caribbean District Open-File Rep., August 1970, 35 pp.

¹¹ Puerto Rican Cement Co., Inc. Annual Report, 1971, p. 2.

Table 4.—Portland cement salient statistics
(Thousand 376-pound barrels and thousand dollars)

	1970	1971
Number of active plants.....	3	3
Rated capacity, Dec. 31.....	12,000	12,000
Production.....	9,523	10,594
Shipments from mills:		
Quantity.....	9,460	10,642
Value.....	\$29,515	\$38,413
Stocks at mills, Dec. 31.....	217	140

† Revised.

A \$1.5 million expansion program at the Puerto Rican Cement Co., Inc. will increase its plant capacity by 2 million bags per year. In 1971 the company also increased its output of Mezcla-Lista (a ready-mix mortar) to a record level of 91,952 tons, up almost 80 percent over 1970 output.

Lime.—Puerto Rican Cement Co., Inc., produced lime at Ponce for mason's lime, sugar refining, and other uses. Output was 44,000 tons, an increase of 7 percent and a new annual record. The lime was consumed in Puerto Rico and the Virgin Islands. Increased demands by the chemical and construction industries compensated for reduced sales to the agricultural sector.

Construction Materials.—The Puerto Rican construction industry continued its rapid growth in 1971, as shown in table 5. In the last 5 years, construction activity has nearly doubled to reach \$1.15 billion for fiscal 1971 (ending June 30). The pace continued during the balance of 1971 with an estimated \$650 million in new construction projects. This record activity has required expanded output from sand and gravel operations and stone quarries throughout Puerto Rico. Sand and gravel output in 1971 from public lands increased 10 percent over 1971 levels, and production from private lands expanded even more, although exact statistics are not presently available.

Marble deposits are found throughout Puerto Rico. Marble quarries were being operated in south-central Puerto Rico east of Ponce; other quarries exploited were near

the towns of Caguas, Las Marias, Dorado, Barranquitas, Rosario, Cidra, Cayay, Aguas Buenas, Corozal and Naguabo. The major producer of high-quality marble for architectural finishing was Marmoles de Puerto Rico, Inc. (Cienni), which employed 40 persons in the operation of a \$2 million highly modern plant located 15 miles west of San Juan. About 150 men worked in the six quarries operated by this firm.

San Juan Marble, Inc., operated a smaller plant that has 15 employees and is located in Carolina, a San Juan suburb. Various terrazzo plants were also operating in Puerto Rico that used marble chips to produce terrazzo tiles, which were used as flooring in the majority of commercial and residential construction projects.

Mineral Fuels.—In 1971, crude and unfinished oil imports into Puerto Rico, used as feedstock for refining and the petrochemical industry, increased 16 percent over that of 1970 for an average of 270,666 barrels per day. In addition 2,955 barrels per day of residual fuel oil and finished products were imported.

Petrochemicals.—CORCO, processed nearly 57 million barrels (155,500 barrels per day) of raw materials in its refinery and seven petrochemical plants, an increase of 3 percent over that of 1970.

CORCO was the largest refining and petrochemical processor in Puerto Rico and one of the world's largest producers of aromatics with a capacity of over 115,000 barrels per day. CORCO was also the single largest importer and exporter of petroleum

Table 5.—Construction activity in Puerto Rico
(Million dollars)

Type of construction	1969 ¹	1970 ¹	1971 ¹
Dwellings:			
Private.....	281.5	276.3	306.5
Public.....	66.3	60.3	96.9
Total.....	347.8	336.6	403.4
Industrial and commercial:			
Private.....	162.4	343.9	388.0
Public.....	142.8	158.9	196.3
Total.....	305.2	502.8	584.3
Roads, schools, other public works:			
Puerto Rican Government.....	84.5	138.5	147.5
Municipalities.....	22.1	15.9	17.5
Total.....	106.6	154.4	165.0
Grand total.....	759.6	993.8	1,152.7

¹ Fiscal year—July 1 to June 30.

Source: Puerto Rico Planning Board.

Table 6.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970 ^r		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	3,325	\$8,057	2,299	\$6,006
Fill.....	1,234	1,478	650	706
Paving.....	2,372	5,343	1,134	3,018
Total.....	6,931	14,878	4,083	9,730
Gravel:				
Building.....	2,147	7,018	1,991	7,207
Fill.....	824	984	255	319
Paving.....	1,399	4,542	840	2,971
Total ¹	4,370	12,494	3,085	10,497
Government-and-contractor operations:				
Sand:				
Building.....	167	511	83	234
Paving.....	37	118	41	146
Total ¹	204	629	124	381
Total sand and gravel ¹	11,506	28,001	7,292	20,607

^r Revised.

¹ Data may not add to totals shown because of independent rounding.

Table 7.—Stone sold or used by producers
(Thousand short tons and thousand dollars)

Year	Dimension limestone		Crushed limestone	
	Quantity	Value	Quantity	Value
1967.....	101	\$293	5,578	\$8,767
1968.....	101	293	5,619	9,408
1969.....	101	292	5,238	9,380
1970.....	101	292	5,549	9,777
1971.....	142	441	9,662	15,856
	Miscellaneous stone ¹		Total	
	Quantity	Value	Quantity	Value
1967.....	1,590	\$3,735	7,269	\$12,795
1968.....	1,647	3,879	7,367	13,580
1969.....	1,646	3,878	6,985	13,550
1970.....	1,646	3,878	7,296	13,947
1971.....	2,326	13,550	12,130	29,847

¹ Includes granite, marble, and other stone.

products in Puerto Rico. The company brought in a daily average of 154,136 barrels of crude and unfinished oil, and shipped 60,019 barrels per day of petroleum products. The plant is located on a 4½-mile-long complex at Guayanilla Bay. CORCO's integrated aromatics plants have the capacity to produce 185 million gallons of benzene per year, plus large amounts of toluene and xylenes. The SACCI plant, owned by Shell and Commonwealth Chemicals, Inc., had a yearly capacity for producing 30 million gallons of cyclohexane. Hercor Chemical Corp., a joint venture of CORCO and Hercules Inc., operated a paraxylene plant that had an annual capacity

of 225 million pounds. The mixed xylenes feedstock was supplied by CORCO's aromatics plants. The Styrochem plant, which makes ethylbenzene, had a capacity of 12 million gallons per year. Oxochem Enterprise, and oxo-alcohol plant and a joint venture with a W. R. Grace & Co. subsidiary, had a plant capacity of about 245 million pounds per year. Production included 2-ethyl hexanol, n-butanol and iso-butanol. Puerto Rico Olefins Co., owned by CORCO and PPG Industries, Inc., had the capacity to turn out 1 billion pounds of ethylene, 650 million pounds of propylene and 200 million pounds of butadiene per year.

Construction of the Yabucoa Sun Oil Company refinery is scheduled for completion early in 1972. The core crude and vacuum units along with utilities and waste treatment were completed in June, 1971, and went on stream in July. The furnace oil desulfurizer and hydrogen plant were placed in operation in December. Upon completion, the refinery will produce high viscosity index lubricating oils, furnace oils, jet fuels, petrochemical feedstocks, bunker fuels, unfinished wax, gas oils, and aromatic rubber process oil. Total capacity for the above combination will be 123,000 barrels per day.

Union Carbide Caribe Inc., which has operated in Puerto Rico since 1957, completed and started up several major units in 1971, including a 1-billion-pound-per-year ethylene plant plus large satellites such as ethylene, ethylene oxide, ethylene glycol, cumene, butadiene, refined benzene, toluene, and xylene, and others. A large low-density polyethylene plant is scheduled to go on stream in January 1972. A phenol-acetone unit, a Bisphenol-A plant and a glycol ethers plant have been completed ahead of schedule. Commissioning and start-up phases will be during the summer of 1972. These new plants will complete the current phase of the \$275 million expansion of Union Carbide Caribe Inc. in Puerto Rico scheduled for 1971 and 1972.

The Chemical Division of PPG Industries began operating its olefins plant at Peñuelas during the last quarter of 1971. The plant is operated jointly with CORCO and had an ethylene capacity of 1 billion pounds per year. It provided feedstocks for PPG's wholly owned three-plant complex at Guayanilla to produce vinyl chloride monomer, ethylene glycol, chlorine, and caustic soda. The Puerto Rican operation reinforced the Chemical Division of PPG Industries' position as the leading marketer

of chlorine in the United States and the second ranking seller of caustic soda.

Phillips Puerto Rico Core Inc., (Core) a subsidiary of Phillips Petroleum Co., has operated a petrochemical plant at Guayama since February 1, 1968. Core converted 50,000 barrels per day of imported light naphtha into benzene, cyclohexane, toluene, paraxylene, orthoxylene, biphenyl, a paraffinic fraction, and motor fuel. Phillips Petroleum Co. was a major supplier of synthetic fiber raw material and in 1965, entered a joint venture with a leading industrial concern in France. Fibers International Corp. (FIC) was formed with ownership of 80 percent Phillips and 20 percent Rhône-Poulenc; the nylon plant was completed in March 1968 and had an installed capacity of 20 million pounds per year of fine-denier nylon 66 fibers. With present expansions, FIC has tripled its capacity to include production of polyester fiber and carpet yarn in addition to nylon.

Air Products & Chemicals, Inc., went on stream to produce industrial gases in 1970 at Guayanilla. The plant produced 400,000 tons of oxygen and 300,000 tons of nitrogen per year. The oxygen was used in Puerto Rico by PPG Industries for producing ethylene oxide.

Puerto Rico Chemical Co., a subsidiary of Hooker Chemical Corp., produced 90 million pounds of phthalic anhydride per year. CORCO and Phillips Puerto Rico Core, Inc., provided the feedstock for the plant.

Caribbean Gulf Refining Corp. was the first refinery in Puerto Rico. With the addition of a distillate desulfurizer (Gulfiner), a naphtha pretreater for the platformer, and a new expanded sulfur recovery unit in 1971, this company expanded the capacity to 40,000 barrels per day and became a completely integrated refinery which supplied a full range of products to the islands.

PANAMA CANAL ZONE ¹²

Mineral production ceased in the Panama Canal Zone in 1971. The Republic of Panama is now supplying the sand and gravel, basalt, and andesite used as aggregate in concrete, roadstone, railroad ballast, and

riprap. Most of the construction work, with the exception of routine maintenance by the Panama Canal Co., is being performed by local contractors.

¹² Prepared by Sarkis G. Ampian.

VIRGIN ISLANDS¹³

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 consisted chiefly of basalt, a trap rock which is crushed for use in concrete and asphalt aggregate, or roadstone. Caribbean Material Supply Co. and Springfield Crusher Division of Masonry Products, Inc., on St. Croix, and Controlled Concrete Inc. on St. Thomas, accounted for the total production. Output in 1971 increased fourfold over that produced in 1970. Construction projects, brought about largely by the increasing number of tourists and a continuing population growth, continued to lead the way. An accelerated highway construction program, due in part to eligi-

bility in 1971 for Federal Highway funds, was also underway. Many low-cost housing units built in cooperation with HUD programs were completed in 1971.

New sewage systems and treatment facilities for St. Croix and St. Thomas were started during the year. Plans were also finalized for constructing desalination plants on St. Croix and St. Thomas. Expansion of the 250,000 barrels per day Amerada Hess refinery to 450,000 barrels per day was completed. Martin Marietta Corp. also acquired the Harvey Aluminum Inc. facility on St. Croix. The Harvey Aluminum Inc. operation converted African bauxites to alumina, prior to shipment to their Portland, Oreg., reduction plant.

Suspension of offshore sand dredging permits, prompted by the possible ecological damage to the Islands' beaches, was invoked in 1971. The main islands, in 1971, had only a 6-month supply of building sand.

Table 8.—Mineral production in the Panama Canal Zone and the Virgin Islands¹
(Short tons)

Area and mineral	1970		1971	
	Quantity	Value	Quantity	Value
Canal Zone:				
Sand and gravel.....	60,000	\$97,000	-----	-----
Traprock.....	84,600	265,398	-----	-----
Total.....	XX	362,398	-----	-----
Virgin Islands: Traprock.....	513,767	2,225,988	2,236,282	W

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).

PACIFIC ISLAND POSSESSIONS¹⁴

REVIEW BY ISLANDS

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 percent of the Territory's population. Most of the Samoan mineral production is on Tutuila, mainly volcanic cinder, sand, and traprock. All production was by Government crews and was for construction and road use. The basalt quarry located in the Tau Mountain area has been idle since the airport improvements were completed in the mid-1960's.

Mineral output decreased 44 percent in 1971 compared with 1970. The 32-mile-long southern coastal highway was completed during the year by the Department of Public Works. The Department also began installing a small-scale breakwater system in Pago Pago Bay. Sand dredging for an enlarged beach area near Fagaalu is also currently in progress.

Guam.—Coral limestone was quarried and crushed in many Municipalities throughout the Territory for aggregate use. The total output for 1971 increased 15 percent over that produced in 1970. Producers were Hawaiian Bitumuls and Paving Co.

¹³ Prepared by Sarkis G. Ampian.

¹⁴ Prepared by Sarkis G. Ampian.

Ltd., and the Public Works Department of the Guam Government.

Guam's economic upswing, attributed to the rapid growth of tourism and a growing population led by construction projects, continues to set the pace. Major road construction, drainage and flood projects, harbor and airport facilities, and public and private buildings are currently underway or in the final planning stages.¹⁵

Kaiser Cement & Gypsum Corp. announced plans for enlarging its distribution facilities on Cabras Island.

Wake.—The Wake Island group is a coral atoll consisting of Wake, Wilkes, and Peale Islands. Wake is the main island; Wilkes and Peale Islands contain only air and sea navigation facilities. During 1971,

coral limestone was recovered by clamshell draglines on Wake Island by the Federal Aviation Agency (FAA). The crushed limestone aggregate was used in concrete for new housing and rehabilitation of existing structures, and in asphalt for road improvements.

The output of coral in 1971, compared with that of 1970, decreased 11 percent. This decreased production was due to the continued decline in the islands' population. The future coral demand is uncertain. The islands will be transferred from the FAA to the Department of Defense.

Other Pacific Island Possessions.—No mineral production was reported for the islands of Canton, Enderbury, Jarvis, Johnston, Midway, or Palmyra.

Table 9.—Mineral production in the Pacific Island Possessions¹

(Short tons)

Area and mineral	1970		1971	
	Quantity	Value	Quantity	Value
American Samoa:				
Volcanic cinder.....	1,784	\$6,224	10,052	\$35,182
Sand.....	26,000	25,000	32,357	24,986
Traprock.....	48,642	68,952	679	4,753
Total.....	XX	100,176	XX	64,921
Guam: Limestone.....	626,168	1,288,577	718,495	1,705,167
Wake: Limestone.....	3,550	17,750	3,165	15,825

XX Not applicable.

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

TRUST TERRITORY OF THE PACIFIC ISLANDS¹⁶

Production of bauxite, manganese ore, volcanic rock, limestone, and phosphate rock, notably from Babelthau in the Palau District, has not been reported for years. The feasibility of a localized structural products industry supplied by nearby clays

and building stone deposits is currently under study.¹⁷

¹⁵ Territory of Guam. Fiscal Year 1971 Annual Report. Territory of Guam. pp. 20-29.

¹⁶ Prepared by Sarkis G. Ampian.

¹⁷ Department of State. Trust Territory of the Pacific Islands. Dept. of State Pub. 8520, Internat. Organization and Conf. Ser. 91, May 1972, 335 pp.

The Mineral Industry of Rhode Island

By Frank B. Fulkerson ¹

The mineral production value of Rhode Island in 1971 was \$4.3 million, compared with \$4.4 million in 1970. Sand and gravel provided 71 percent of the State's mineral production value; stone accounted for vir-

tually all the remainder. Four of the five counties had mineral production, with the greatest value from Providence County. Kent County was second, followed by Washington and Newport Counties. Sand

Table 1.—Value of mineral production in Rhode Island, by county ¹
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Kent.....	\$1,628	W	Sand and gravel.
Newport.....	W	W	Sand and gravel, stone.
Providence.....	2,032	\$1,871	Do.
Washington.....	W	W	Stone, sand and gravel.
Undistributed ²	726	2,428	
Total.....	4,386	4,299	
Total 1967 constant dollars.....	3,923	p 3,735	

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

¹ Bristol County not included because no production was reported.

² Includes value of sand and gravel that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

and gravel was mined in all four mineral-producing counties and was used chiefly for building construction. Crushed granite and crushed miscellaneous stone were quarried and used principally for highway construction. A sizable tonnage of crushed limestone was sold for agricultural and other purposes. Dressed dimension granite

was sold for architectural uses. Gem stones were gathered by collectors.

A report outlining the bedrock geology of Rhode Island was published.²

¹ Industry economist, Division of Nonmetallic Minerals.

² Quinn, Alonzo W. Bedrock Geology of Rhode Island. U.S. Geol. Survey Bull. 1295, 1971, 68 pp.

Table 2.—Indicators of Rhode Island business activity

	1970	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force..... thousands..	395.0	395.9	+0.2
Unemployment..... percent of work force..	5.3	6.9	+30.2
Employment:			
Manufacturing..... thousands..	120.7	115.0	-4.7
Durables..... do.....	49.0	45.3	-7.6
Nondurables..... do.....	71.8	69.6	-3.1
Nonmanufacturing..... do.....	220.9	221.6	+0.3
Construction..... do.....	14.8	14.0	-5.4
Service (including mining)..... do.....	54.9	55.5	+1.1
Payroll-average weekly earnings:			
Manufacturing.....	\$111.72	\$117.52	+5.2
Personal income:			
Total..... millions..	\$3,711	\$3,914	+5.5
Per capita.....	\$3,902	\$4,077	+4.5
Construction activity:			
Cement shipments to Rhode Island..... thousand 376-pound barrels..	1,001	1,080	+7.9
Mineral production value..... thousands..	\$4,386	\$4,299	-2.0

^p Preliminary.

Sources: Rhode Island Department of Labor; New England Economic Indicators, Federal Reserve Bank of Boston; Employment and Earnings, U.S. Department of Labor; Rhode Island Economic Trends; Survey of Current Business; U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Sand and gravel.....	165	189	31	258	--	6	23.26	988
Stone.....	43	250	11	90	--	2	22.10	199
Total ¹	208	202	42	348	--	8	22.96	783
1971: ^p								
Sand and gravel.....	160	192	30	242	--	7	28.89	351
Stone.....	50	221	12	92	--	4	43.44	3,312
Total ¹	210	199	42	334	--	11	32.90	1,166

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

REVIEW BY MINERAL COMMODITIES

NONMETALS

Gem Stones.—Mineral specimens were gathered by collectors from quarries and other exposed rock outcrops, mostly in the northern part of the State.

Sand and Gravel.—Sand and gravel continued to be the State's principal mineral product. Sixteen producers sold 1,164,000 tons of sand and gravel for building purposes, 661,000 tons for paving use, and 427,000 tons for fill, ice control, foundry sand, and miscellaneous use. Kent was the leading county in sand and gravel production. Leading producers were Rhode Island Sand & Gravel Co., Inc., and A. Cardi Construction Co., Inc. Total sand and

Table 4.—Principal uses and value of sand and gravel

Use	Sand		Gravel	
	Percent	Value (thousands)	Percent	Value (thousands)
Building construction..	57	\$773	54	\$924
Paving.....	31	414	28	483
Other.....	12	162	18	296

gravel output decreased 6 percent, from 2,387,000 tons in 1970 to 2,252,000 tons in 1971. Value of production, however, was \$3,052,000, an increase of 5 percent over that of 1970. Average value per ton increased from \$1.22 in 1970 to \$1.36 in 1971.

Stone.—Production of stone by four firms decreased 27 percent in quantity and 15 percent in value compared with 1970 figures. Output of dressed granite for architectural work decreased 20 percent in both quantity and value. Output of crushed limestone declined 6 percent; value was unchanged. Agricultural lime

was the biggest limestone product, followed by roofing granules, terrazzo chips, and metallurgical flux. Sizable tonnages of crushed granite and miscellaneous stone (conglomerate) were produced and used for concrete and bituminous aggregate, roadstone, riprap, and stone sand. Output was down 30 percent in quantity and 20 percent in value.

MINERAL FUELS

Petroleum.—Rhode Island does not produce crude petroleum, but Mobil Oil Corp. operated a refinery in East Provi-

dence. Plant capacity in 1971 was 10,000 barrels per stream day. The plant utilizes domestic and foreign unfinished oils to produce asphalt and fuel oil.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	County
Petroleum:			
Mobil Oil Corporation.....	1001 Wampanoag Trail E. Providence, R.I. 02915	Refinery.....	Providence.
Sand and gravel:			
A. Cardi Construction Co., Inc.	451 Arnold Road Coventry, R.I. 02816	Pit.....	Kent.
Coventry Sand & Gravel Co....	Reservoir Road Coventry, R.I. 02816	Pit.....	Do.
Del Bonis Sand & Gravel Co....	950 Phenix Ave. Cranston, R.I. 02920	Pit.....	Providence.
Forte Brothers, Inc.....	14 Whipple St. Berkeley, R.I. 02900	Pit.....	Do.
Lapham Sand & Gravel Co....	R.F.D. 2, Greenville Rd. Woonsocket, R.I. 02895	Pit.....	Do.
Mack Construction Co.....	Pawtucket, R.I. 02860.....	Pit.....	Do.
Peckham Bros. Co., Inc.....	Paradise Ave. Middletown, R.I. 02840	Pit.....	Newport.
Rhode Island Sand & Gravel Co., Inc.	Kilvert St. Hills Grove, R.I. 02886	Pit.....	Kent.
J. Romanella & Sons Inc.....	Box 546, Westerly, R.I. 02891.....	Pit.....	Washington.
J. Santoro, Inc.....	11 Herbert Street Providence, R.I. 02909	Pit.....	Providence.
South County Sand & Gravel Co., Inc.	North Rd. Peace Dale, R.I. 02883	Pit.....	Washington.
Tasca Sand & Gravel Co.....	Box 113, R.F.D. 4 Esmond, R.I. 02917	Pit.....	Providence.
Town Line Sand & Gravel Inc.	Victory Highway Slatersville, R.I. 02876	Pit.....	Do.
Whitehead Bros. Co.....	60 Hanover Road Florham Park, N.J. 07932	Pit.....	Kent.
Stone:			
Granite, dimension: Providence Granite Co....	210 Kingsley Ave. Providence, R.I. 02903	Quarry.....	Washington.
Limestone, crushed: The Conklin Limestone Co., Inc.	R.F.D. 1 Lincoln, R.I. 02865	---do.....	Providence.
Other stone, crushed and broken: M.A. Gammino Con- struction Co.	875 Phenix Ave. Cranston, R.I. 02920	---do.....	
Peckham Brothers Co., Inc.	Paradise Ave. Newport, R.I. 02840	---do.....	Newport.

The Mineral Industry of South Carolina

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the South Carolina Division of Geology, State Development Board, for collecting information on all minerals except fuels.

By Robert G. Clarke¹ and
Alan J. Lehocky²

The value of mineral production in South Carolina in 1971 was \$66.9 million the highest on record. Increased production of cement, sand and gravel, stone, and peat offset a decrease in kaolin.

The production of kaolin and vermicu-

lite in South Carolina ranked second nationally; that of mica and feldspar ranked fourth.

¹ Physical scientist, Division of Nonmetallic Minerals.

² Staff geologist, Division of Geology, State Development Board, Columbia, S.C.

Table 1.—Mineral production in South Carolina¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays.....thousand short tons..	1,974	\$9,878	² 2,049	² \$10,201
Sand and gravel.....do.....	5,864	7,766	6,438	9,119
Stone.....do.....	9,710	³ 14,734	11,046	17,852
Value of items that cannot be disclosed: Cement, clay (fire) (1971), feldspar, scrap mica, peat, stone (dimension) (1970), and vermiculite.....	XX	23,987	XX	29,716
Total.....	XX	¹ 56,365	XX	66,888
Total 1967 constant dollars.....	XX	50,418	XX	¹ 58,112

¹ Preliminary. ² Revised. X Not applicable.

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

² Excludes value of fire clay; included with "Value of items that cannot be disclosed."

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

Table 2.—Value of mineral production in South Carolina, by county ¹
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Aiken.....	\$7,403	\$7,935	Clays, sand and gravel.
Anderson.....	80	W	Stone.
Berkeley.....	W	W	Stone, clays, sand and gravel.
Cherokee.....	W	1,557	Sand and gravel.
Chesterfield.....	669	717	Peat.
Colleton.....	W	W	Cement, stone, clays, sand and gravel.
Dorchester.....	W	W	Clays.
Edgefield.....	W	W	Stone, clays.
Fairfield.....	W	W	Sand and gravel.
Florence.....	W	W	Stone, clays, sand and gravel.
Greenville.....	W	1,748	Stone.
Greenwood.....	W	W	Sand and gravel, clays.
Horry.....	W	W	Sand and gravel.
Jasper.....	W	W	Sand and gravel, clays, stone.
Kershaw.....	860	818	Mica, clays, sand and gravel.
Lancaster.....	W	W	Vermiculite, stone.
Laurens.....	W	W	Stone, sand and gravel, clays.
Lexington.....	4,827	4,920	Sand and gravel, clays.
Marion.....	W	W	Do.
Marlboro.....	W	W	Clays, stone.
Newberry.....	W	W	Cement, stone, clays.
Orangeburg.....	W	W	Stone, sand and gravel.
Pickens.....	W	W	Stone, clays, sand and gravel.
Richland.....	2,629	2,843	Stone, feldspar, sand and gravel.
Spartanburg.....	W	W	Stone.
Sumter.....	W	W	Sand and gravel, clays.
York.....	W	W	Stone.
Undistributed.....	39,894	46,348	
Total ²	56,365	66,888	

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

¹ The following counties are not listed because no production was reported: Abbeville, Allendale, Bamberg, Barnwell, Beaufort, Calhoun, Charleston, Chester, Clarendon, Darlington, Dillon, Georgetown, Hampton, Lee, McCormick, Oconee, Saluda, Union, and Williamsburg.

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

Table 3.—Indicators of South Carolina business activity

	1970	1971 [¶]	Change, percent
Employment and labor force, annual average:			
Total work force.....	thousands.. 1,091.1	NA	NA
Unemployment.....	do..... 54.2	NA	NA
All employment.....	do..... 1,036.5	NA	NA
Wage and salary employment:			
Mining.....	do..... 1.7	1.6	-5.9
Contract construction.....	do..... 51.5	53.9	+4.7
Transportation, communication, and public utilities.....	do..... 37.5	38.2	+1.9
Manufacturing.....	do..... 340.0	337.4	- .8
Trade.....	do..... 141.8	147.1	+3.7
Finance, insurance, and real estate.....	do..... 29.7	31.0	+4.4
Services.....	do..... 87.4	92.2	+5.5
Government.....	do..... 149.9	157.3	+4.9
Personal income:			
Total.....	millions.. \$7,616	\$8,306	+9.1
Per capita.....	do..... \$2,934	\$3,162	+7.8
Construction activity:			
Value of nonresidential construction.....	millions.. \$73.4	\$58.8	-19.9
Number of housing units authorized.....	do..... 21,935	26,069	+18.8
Farm marketing receipts.....	millions.. \$441.5	NA	NA
Mineral production value.....	do..... \$56.4	\$66.9	+18.6

[¶] Preliminary. NA Not available.

Sources: South Carolina Employment Security Commission; U.S. Department of Commerce; U.S. Department of Agriculture; and U.S. Bureau of Mines.

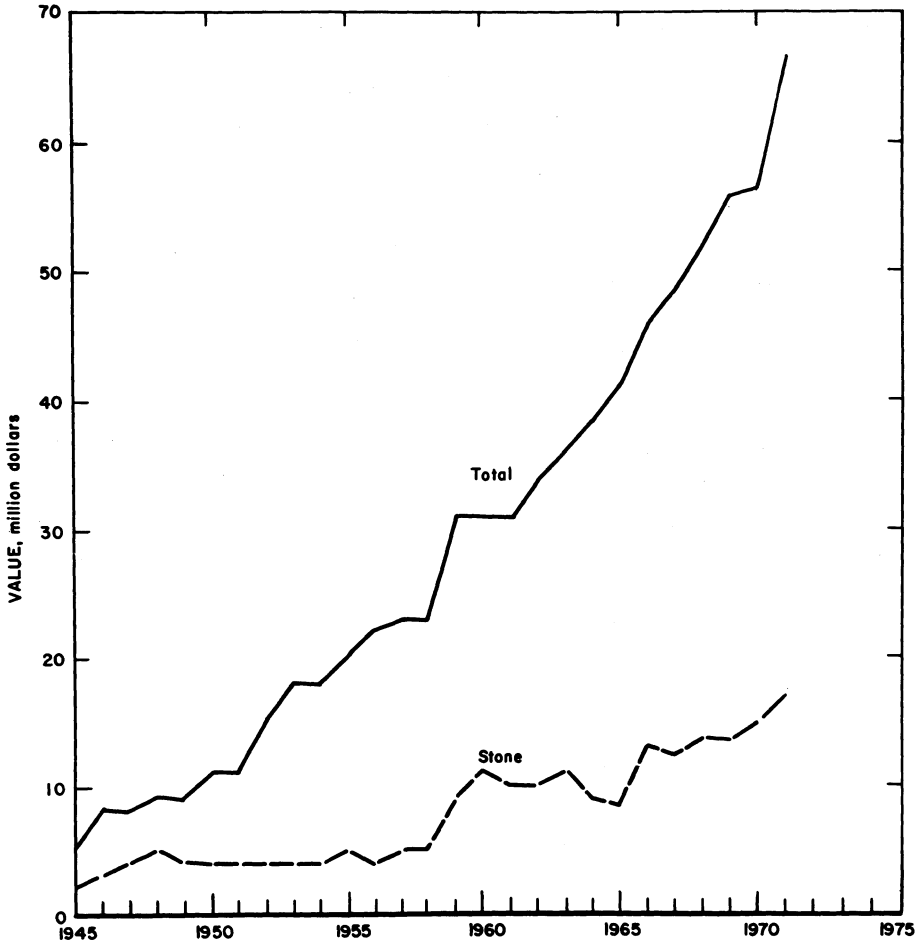


Figure 1.—Value of stone, and total value of mineral production in South Carolina.

Government Programs.—The U.S. Bureau of Mines and the State completed an agreement covering analyses of rock and clay specimens for the exploration and evaluation of nonmetallic raw materials for ceramic and other uses. The State Legisla-

ture passed Bill S-11, an act to authorize county sediment control programs to prescribe procedures therefore, and to provide penalties for violations. The act permits any county that has established a sediment control program to issue permits for com-

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Nonmetal.....	1,080	265	272	2,202	--	63	28.61	657
Sand and gravel.....	387	251	97	899	--	7	7.78	153
Stone.....	824	289	238	2,032	2	23	12.30	6,286
Total.....	2,241	271	607	5,133	2	93	18.51	2,797
1971: ^p								
Nonmetal ¹	1,005	261	263	2,126	--	78	36.68	698
Sand and gravel.....	425	242	103	989	--	6	6.07	270
Stone.....	815	281	229	1,964	2	24	13.24	8,139
Total.....	2,245	265	2 594	5,079	2	108	21.66	3,492

^p Preliminary.¹ Beginning in 1971, data concerning peat operations are included in the nonmetals industry on a continuing basis.² Data may not add to total shown because of independent rounding.

mercial mining only after erosion and siltation control plans are approved. The State Legislature conducted hearings on

legislation pertinent to the environment, the interstate mining compact, and rehabilitation of surface-mined lands.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Portland and masonry cements were produced by Giant Portland Cement Co. in Dorchester County, and Santee Portland Cement Co. in Orangeburg County. Shipments of portland cement increased 14 percent, and shipments of masonry cement increased 17 percent. Ninety-eight percent of the portland cement shipped was Type I and II for general use; the remainder was Type III, high early strength. Portland and masonry cements consumed in South Carolina totaled 4.7 million 376-pound barrels and 1.1 million 280-pound barrels, respectively. Most of the shipments were for ready-mixed concrete products and building materials usage; a small percentage went into highway construction. The raw materials used consisted mostly of limestone or marl, clay, and additives such as gypsum, iron-bearing materials, air-entraining compounds, and grinding aids. Natural gas and fuel oil were used as fuels, depending on seasonal rates. Both plants announced expansion programs; a third producer, Gifford-Hill Portland Cement, with headquarters at Midlothian, Tex., announced its intent to build a plant in South Carolina.

Clays.—Overall clay production, excluding a small amount of fireclay, accounted for 15 percent of South Carolina's mineral production value. Output increased 4 percent, and value increased 3 percent.

Kaolin production decreased 13 percent in quantity to 450,000 tons, and value decreased 1 percent to \$7,954,000. Production of kaolin in South Carolina was still second highest in the Nation. The principal uses for kaolin were in rubber, insecticides and fungicides, paint, and ceramics. Kaolin was produced by six companies at 14 mines in two counties. Aiken County was the leader in kaolin production. Leading producers were J. M. Huber Corp. and Dixie Clay Co.

Common clay production, at 1.6 million tons valued at \$2.2 million, increased 10 percent in quantity and 20 percent in value. Thirty mines were operated by 17 companies in 15 counties. Leading counties, in decreasing order of tonnage, were Dorchester, Richland, and Greenwood. Leading producers were Southern Brick Co. in Greenwood and Newberry Counties, Giant Portland Cement Co., in Dorchester County and Richtex Corp. in Fairfield, Lexington and Richland Counties.

Table 5.—Kaolin sold or used by producers, by use
(Thousand short tons)

Use	1970	1971
Rubber.....	262	226
Firebrick and block.....	19	W
Insecticide and fungicide.....	20	8
Paint.....	5	7
Exports.....	NA	49
Other uses ¹	213	160
Total.....	519	450

NA Not available. W Withheld to avoid disclosing individual company confidential data included in "Other uses."

¹ Includes building brick (1970), fertilizers, paper, floor and wall tile, pottery and whiteware, drilling mud (1971), chemicals (1971), Fiberglas (1971), animal feed (1971), vitrified sewer pipe (1970), drain tile (1970), other uses, and uses indicated by symbol W.

Feldspar.—Production of feldspar increased 6 percent in quantity and 9 percent in value to a new record. The State continued to rank fourth nationally in feldspar production. The one producer, Spartan Minerals Co., Spartanburg County, recovered feldspar as a byproduct feldspar-silica mixture from purchased crushed granite fines. The recovered mixture was used primarily in the manufacture of pottery, glass, and rubber.

Lime.—South Carolina was not a producer of lime in 1971; however, apparent consumption, as measured by shipments of lime into the State, was 47,000 tons.

Mica.—Flake and scrap mica was produced from sericite schist at the operation of The Mineral Mining Corp. in Lancaster County. Production increased 10 percent in quantity and 20 percent in value. Production from South Carolina was fourth in rank nationally in both quantity and value. The finished mica, after grinding, was used mainly in paint, joint cement, and electronics.

Sand and Gravel.—Sand and gravel was produced in 17 counties at 29 locations, and ranked fourth in value of mineral commodities produced in South Carolina. The quantity of sand and gravel increased 10 percent, and the value increased 17 percent. The average value per ton increased \$1.32 to \$1.42. All sand and gravel was commercial production.

The leading counties ranking in descending order by quantity were Marlboro, Sumter, Chesterfield, and Lexington; and in descending order by value, Marlboro, Lexington, Sumter, and Chesterfield.

Table 6.—Sand and gravel sold or used by producers by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Blasting sand.....	20	\$108	W	W
Building sand.....	3,310	2,012	2,948	\$1,889
Paving sand.....	W	W	1,002	460
Other sand and gravel ¹	2,534	5,651	2,488	6,769
Total.....	5,864	7,766	6,438	9,119

W Withheld to avoid disclosing individual company confidential data; included with "Other sand and gravel."

¹ Includes glass (unground), molding, fire-furnace, engine (1970), filtration, abrasives, chemical, fill, glass (ground), pottery, railroad ballast, and other sands; and building, paving, fill, and other gravel.

² Data may not add to total shown because of independent rounding.

Table 7.—Sand and gravel sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Aiken.....	1	83	\$91	1	114	W
Anderson.....	1	54	80	-	-	-
Chesterfield.....	4	1,020	669	3	1,041	\$717
Lexington.....	6	1,027	2,003	4	979	1,952
Undistributed ¹	17	3,681	4,924	18	4,304	6,450
Total ²	29	5,864	7,766	26	6,438	9,119

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

¹ Includes Cherokee, Dorchester, Florence, Greenville, Horry, Jasper, Kershaw, Lancaster, Marion, Marlboro, Pickens (1971), Richland, Spartanburg, and Sumter Counties.

² Data may not add to total shown because of independent rounding.

Stone.—The quantity of stone production increased 14 percent; value also increased. Of the State's total mineral production value, the stone value accounted for 27 percent.

Crushed granite was produced in nine counties from 11 quarries by three companies: Lone Star Industries, Inc., Martin-Marietta Corp., and Vulcan Materials Co. Pickens, Lexington, Spartanburg, and Richland Counties, in that order, led the State in output of crushed granite. Crushed granite was used for concrete aggregate, macadam aggregate, bituminous aggregate, roadbase stone, railroad ballast, riprap, jetty stone, and miscellaneous fine aggregate. Eighty-seven percent of the crushed granite was transported by truck; and 13 percent, by rail.

Dimension granite was produced by Winnsboro Granite Corp. from a quarry in Fairfield County, by Comolli Granite Co. from a quarry in Kershaw County, and by Kershaw Granite Co. from two quarries in Kershaw County and one quarry in Newberry County.

Crushed limestone was produced by Vulcan Materials Co. from a quarry in Cherokee County, and by Martin-Marietta Corp. from a quarry in Berkeley County. The principal uses for crushed limestone were bituminous and macadam aggregate, concrete aggregate, agricultural limestone, and cement. Giant Portland Cement Co. produced crushed marl from a quarry in Dorchester County, and Santee Portland Cement Co. produced crushed marl from a quarry in Orangeburg County. Both companies used the crushed marl in the production of cement.

Vermiculite.—Crude vermiculite production increased 2 percent in quantity and 8 percent in value. Concrete Products Div. (formerly Zonolite Div.), W. R. Grace & Co., produced crude vermiculite from its mines in Laurens County, and exfoliated vermiculite in Greenville County. Patterson Vermiculite Co. produced crude and exfoliated vermiculite in Laurens County. The use pattern of the exfoliated vermiculite was 56 percent for soil additives, 27 percent for lightweight aggregates (concrete, plaster, and roofing), and 17 percent for loose insulation and block insulation.

The production of crude vermiculite in South Carolina was less than in Montana, the only other vermiculite producing State.

METALS

Ferroalloys.—Pittsburgh Metallurgical Co., Charleston, produced ferrosilicon, ferrochromium, and ferrochromium silicon.

Zirconium.—M & T Chemicals, Inc., operated a grinding plant near Andrews, Georgetown County, for the production of milled zircon for foundry, refractory, ceramic, and glass uses. The zircon mineral was obtained from out-of-State sources.

MINERAL FUELS

Peat.—United States Peat Corp. (formerly Ti Ti Peat Humus Co., Inc.) produced peat from a bog near Green Pond, Colleton County. About two-thirds of the peat was sold in bulk form, and the remainder was packaged. All of the peat was used for general soil improvement. An increase of production moved South Carolina into 13th place in peat production in the United States.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Giant Portland Cement Co.-----	150 Strafford Ave. Wayne, Pa. 19087	Plant-----	Dorchester.
Santee Portland Cement Co.-----	Box 698 Holly Hill, S.C. 29059	---do-----	Orangeburg.
Clays:			
Kaolin:			
Cyprus Mines Corp.-----	Box 1201 Trenton, N.J. 08606	Mine-----	Aiken.
Dixie Clay Co.-----	230 Park Ave. New York, N.Y. 10017	2 mines-----	Do.
J. M. Huber Corp.-----	630 Third Ave. New York, N.Y. 10017	4 mines-----	Do.
National Kaolin Products Co.	Box 431 Aiken, S.C. 29801	Mine-----	Do.
Southeastern Clay Co.-----	Box 1022 Aiken, S.C. 29801	6 mines-----	Do.

Table 8.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clays—Continued			
Common clay and shale:			
Ashe Brick Co.....	Van Wyck, S.C. 29744	Mine.....	Lancaster.
Broad River Brick Co.....	Box 550 Gaffney, S.C. 29340	do.....	Cherokee.
Giant Portland Cement Co..	150 Strafford Ave. Wayne, Pa. 19087	do.....	Dorchester.
Guignard Brick Co.....	Box 568 Cayce, S.C. 29033	3 mines.....	Lexington.
Palmetto Brick Co.....	Box 430 Cheraw, S.C. 29520	Mine.....	Marlboro.
Richtex Corp.....	Box 3307 Columbia, S.C. 29203	6 mines.....	Fairfield, Lexington, Richland.
Santee Portland Cement Co..	Box 698 Holly Hill, S.C. 29059	Mine.....	Orangeburg.
Southern Brick Co.....	Box 208 Ninety Six, S.C. 29666	2 mines.....	Greenwood and Newberry.
Feldspar, crude:			
Spartan Minerals Co.....	Route 1, Box 14A Pacolet, S.C. 29372	Plant.....	Spartanburg.
Mica, flake and scrap:			
The Mineral Mining Corp.....	Kershaw, S.C. 29067	Mine.....	Lancaster.
Peat:			
United States Peat Corp.....	Box 568 Walterboro, S.C. 29488	Bog.....	Colleton.
Sand and gravel:			
Becker Sand & Gravel Co.....	Box 848 Cheraw, S.C. 29520	5 mines.....	Chesterfield, Dorchester, Marlboro, Sumter.
Columbia Silica Sand Co.....	Box 1519 Columbia, S.C. 29202	2 mines.....	Lexington.
Palmetto Quarries Co.....	Drawer 5185 Columbia, S.C. 29205	Mine.....	Richland.
Pennsylvania Glass Sand Corp...	Gen. Operations Dept. Berkeley Springs, W. Va. 25411	do.....	Lexington.
Wilson Bros. Sand Co., Inc.....	Box 945 Greenwood, S.C. 29646	do.....	Do.
Stone:			
Granite, crushed:			
Martin-Marietta Corp.....	Box 2568 Raleigh, N.C. 27602	4 quarries.....	Fairfield, Lexington, Richland, York.
Lone Star Industries, Inc....	Drawer 5185 Columbia, S.C. 29205	3 quarries.....	Fairfield, Greenwood, Richland.
Vulcan Materials Co.....	Drawer 8834 Greenville, S.C. 29604	4 quarries.....	Greenville, Laurens, Pickens, Spartanburg.
Granite, dimension:			
Comolli Granite Co.....	Box 898 Elberton, Ga. 30635	Quarry.....	Kershaw.
Kershaw Granite Co., Inc....	Box 250 Elberton, Ga. 30635	3 quarries.....	Kershaw and Newberry.
Winnboro Granite Co.....	Rion, S.C. 29132	Quarry.....	Fairfield.
Limestone, crushed:			
Martin-Marietta Corp.....	Box 2568 Raleigh, N.C. 27602	do.....	Berkeley.
Vulcan Materials Co.....	Drawer 8834 Greenville, S.C. 29604	do.....	Cherokee.
Marl, crushed:			
Giant Portland Cement Co..	150 Strafford Ave. Wayne, Pa. 19087	do.....	Dorchester.
Santee Portland Cement Co..	Box 698 Holly Hill, S.C. 29059	do.....	Orangeburg.
Vermiculite:			
Crude:			
W. R. Grace & Co.....	62 Whittemore Ave. Cambridge, Mass. 02140	Several mines..	Laurens.
Patterson Vermiculite Co....	Route 1 Enoree, S.C. 29335	Mine.....	Do.
Exfoliated:			
W. R. Grace & Co.....	62 Whittemore Ave. Cambridge, Mass. 02140	2 plants.....	Greenville and Laurens.
Patterson Vermiculite Co....	Route 1 Enoree, S.C. 29335	Plant.....	Laurens.

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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 J. M. West ¹

The value of mineral production in South Dakota reached an alltime high of \$63 million in 1971, 2 percent more than in 1970. Metals, principally gold, accounted for over one-third of the value and nonmetals for most of the balance. Petroleum accounted for about 1 percent of the total. The value for metals was \$23 million, about the same as in 1970, despite an increase in the value of gold to \$41.25 per ounce (average free market price). The value for nonmetals was \$39.4 million, up 3 percent, principally because of higher values for sand and gravel and cement. Fuels, consisting solely of petroleum, were

valued at \$0.6 million, 61 percent higher than in 1970.

Gold accounted for 34 percent of South Dakota's total mineral output. The State remained first in the Nation in gold production, with the Homestake mine at Lead reporting a production of 513,494 ounces of gold valued at over \$21 million.² Although value held about the same level as in 1970 owing to price increases, the quantity of gold produced in the State fell 11 percent.

¹ Physical scientist, Division of Nonferrous Metals.

² Homestake Mining Co. 1971 Annual Report. P. 4.

Table 1.—Mineral production in South Dakota ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays.....thousand short tons..	165	\$946	² 150	² \$128
Feldspar.....long tons..	17,211	114	22,000	539
Gem stones.....	NA	35	NA	40
Gold (recoverable content of ores, etc.)...troy ounces..	578,716	21,059	513,427	21,179
Gypsum.....thousand short tons..	15	61	21	83
Lead (recoverable content of ores, etc.)...short tons..	3	1		
Mica (scrap and flake).....do.....	(³)	34	W	W
Petroleum (crude).....thousand 42-gallon barrels..	160	374	233	604
Sand and gravel.....thousand short tons..	16,556	16,656	16,727	18,392
Silver (recoverable content of ores, etc.)...thousand troy ounces..	120	212	107	165
Stone.....thousand short tons..	1,979	13,375	2,199	8,874
Zinc.....short tons..	1	(³)	--	--
Value of items that cannot be disclosed: Beryllium concentrate, cement (masonry and portland), clay (bentonite, 1971), lime, uranium, vanadium (1970), and items indicated by symbol W.....	XX	8,709	XX	12,984
Total.....	XX	61,576	XX	62,988
Total 1967 constant dollars.....	XX	55,080	XX	P 54,724

¹ 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.

² Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

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

⁴ Less than 1/2 unit.

Table 2.—Value of mineral production in South Dakota, by county ¹
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Aurora.....	W	W	Sand and gravel.
Beadle.....	\$317	W	Do.
Bon Homme.....	85	\$42	Do.
Brookings.....	321	779	Sand and gravel, stone.
Brown.....	302	181	Sand and gravel.
Brule.....	105	W	Do.
Buffalo.....	W	W	Do.
Butte.....	W	W	Clays, sand and gravel.
Campbell.....	188	303	Sand and gravel, stone.
Charles Mix.....	125	140	Sand and gravel.
Clark.....	W	155	Do.
Clay.....	W	W	Do.
Codington.....	681	840	Do.
Corson.....	W	W	Do.
Custer.....	200	685	Feldspar, sand and gravel, lime, stone.
Davison.....	130	W	Sand and gravel.
Day.....	223	W	Do.
Deuel.....	123	W	Do.
Dewey.....	W	W	Sand and gravel, petroleum.
Douglas.....	95	W	Sand and gravel.
Edmunds.....	W	318	Do.
Fall River.....	W	W	Uranium, sand and gravel, petroleum.
Faulk.....	W	140	Sand and gravel.
Grant.....	W	W	Stone, sand and gravel.
Gregory.....	W	154	Sand and gravel.
Hamlin.....	107	260	Do.
Hand.....	385	524	Do.
Hanson.....	W	W	Stone, sand and gravel.
Harding.....	W	605	Petroleum, sand and gravel.
Hughes.....	94	W	Sand and gravel.
Hutchinson.....	W	W	Do.
Hyde.....	W	(²)	Do.
Jerauld.....	29	48	Do.
Jones.....	W	--	Do.
Kingsbury.....	108	22	Do.
Lake.....	120	W	Do.
Lawrence.....	21,499	21,558	Gold, sand and gravel, silver, stone.
Lincoln.....	237	W	Sand and gravel.
Lyman.....	W	W	Do.
McCook.....	W	W	Do.
McPherson.....	234	W	Do.
Marshall.....	189	433	Do.
Meade.....	W	363	Sand and gravel, gypsum.
Mellette.....	154	W	Sand and gravel.
Miner.....	W	7	Do.
Minnehaha.....	W	W	Sand and gravel, stone.
Moody.....	166	157	Sand and gravel.
Pennington.....	8,503	12,313	Cement, stone, sand and gravel, lime, clays, mica (scrap), beryllium concentrate, feldspar.
Perkins.....	155	294	Sand and gravel.
Potter.....	W	W	Do.
Roberts.....	91	257	Do.
Sanborn.....	4	4	Do.
Shannon.....	34	35	Do.
Spink.....	W	W	Do.
Stanley.....	W	W	Do.
Sully.....	60	W	Do.
Todd.....	14	69	Do.
Tripp.....	W	138	Sand and gravel, stone.
Turner.....	W	W	Sand and gravel.
Union.....	W	134	Do.
Walworth.....	145	W	Do.
Washabaugh.....	W	W	Do.
Yankton.....	176	W	Do.
Ziebach.....	--	55	Do.
Undistributed ³	26,173	21,982	
Total ⁴	61,576	62,988	

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

¹ Haakon, Bennett, and Jackson Counties not listed because no production was reported.

² Less than ½ unit.

³ Includes sand and gravel, and stone that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

⁴ Data may not add to totals shown because of independent rounding.

Early in the year the South Dakota Open Pit Mining Law was passed by the State Legislature to regulate surface mining. The State Health Department conducted a brief testing program to determine the location and extent of mercury contamination due to industrial discharges, and also to determine the location and sig-

nificance of naturally occurring mercury. An Environmental Enforcement Conference was held in Rapid City in October, at which the topics of discussion included pollution of Whitewood Creek and plans for pollution control by the Lead-Deadwood Sanitary District; mill wastes in Whitewood Creek and in the Belle

Table 3.—Indicators of South Dakota business activity

	1970 ^a	1971 ^b	Change, percent
Employment and labor force, annual average:			
Total labor force.....	276.2	278.6	+0.9
Employment.....	267.1	268.7	+0.6
Unemployment.....	9.1	9.9	+8.8
Nonagricultural employment.....	176.9	179.2	+1.3
Mining.....	2.8	2.8	--
Construction.....	7.2	7.4	+2.8
Manufacturing.....	15.8	16.1	+1.9
Government.....	55.5	56.4	+1.6
Other nonagricultural employment.....	96.1	97.0	+ .9
Personal income:			
Total.....	\$2,108	\$2,309	+9.5
Per capita.....	\$3,165	\$3,446	+8.9
Construction activity:			
Highway construction contracts awarded.....	\$54,201	\$50,471	-6.9
Cement shipments to and within the State thousand 376-pound barrels.....	1,289	1,710	+32.7
Number of authorized residential units.....	2,440	2,585	+5.9
Value of nonresidential construction.....	\$26.3	\$12.4	-52.9
Mineral production value.....	\$61,576	\$62,988	+2.3

^a Preliminary. ^b Revised.

Sources: Employment and Earnings, v. 18, No. 11, May 1972; Survey of Current Business, v. 52, No. 4, April 1972; Roads and Streets, April 1972.

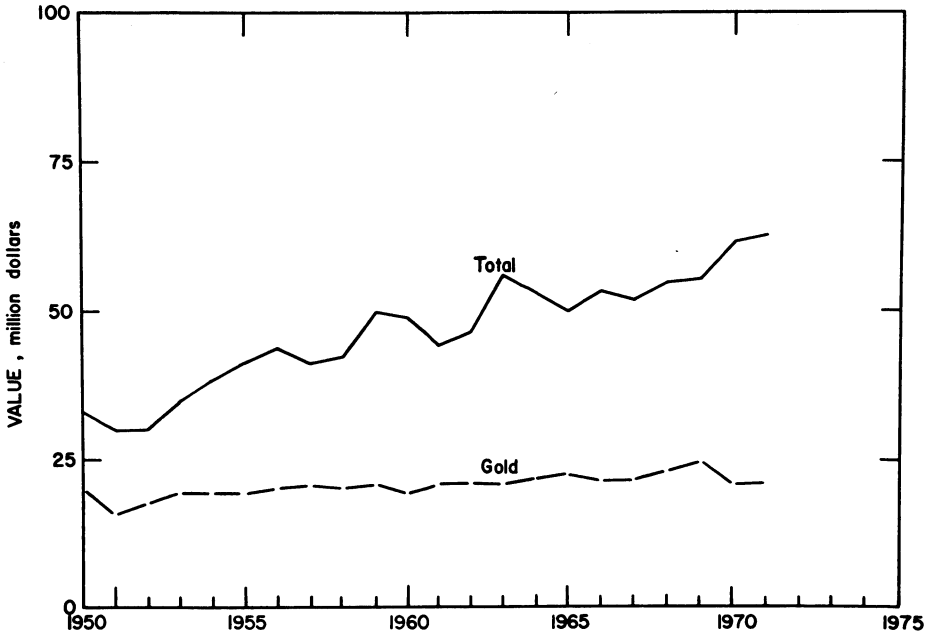


Figure 1.—Value of mine production of gold, and total value of mineral production in South Dakota.

Fourche and Cheyenne Rivers; arsenic concentrations in wells within the Cheyenne Basin; mercury hazards in fish; uranium and vanadium in liquid mill wastes at Edgemont; and stabilization of sand tailings at Edgemont. The Federal Environmental Protection Agency approved South Dakota's 1971 plan for water pollution control. Improvement and treatment of Lead and Deadwood mill and sanitary wastes was planned in nearby Centennial Valley, pending cost and environmental impact studies.

The 325,000-gallon-per-day experimental desalination plant at Webster was closed. The plant was among five original demonstration units built by the Office of Saline Water as authorized by Congress in 1958 and went into operation in 1962.

Coal-grinding tests were performed at the Consolidation Coal Co. lignite gasification pilot plant in Rapid City prior to startup, which was rescheduled for early 1972. Expenditures on the plant, chiefly financed by a grant from the Office of

Coal Research, U.S. Department of the Interior, reached \$13.2 million by yearend.

The Department of the Interior and the National Aeronautics and Space Administration signed a contract to build a \$4.8 million Earth Resources Observation Systems (EROS) information center at Sioux Falls, S. Dak. The center will receive sensor data from aircraft and spacecraft for resource and environmental purposes. The first EROS satellite was scheduled for launching in 1972 and, in preparation, the U.S. Geological Survey and the South Dakota State Geological Survey were completing topographic maps of unmapped portions of the State.

Among U.S. Geological Survey publications dealing with South Dakota in 1971 were a map³ and a bulletin describing uranium and other mineral deposits along with geology of a portion of Fall River County.⁴

Employment and Injuries.—The extent of employment and injuries in the mineral industry, exclusive of the petroleum industry, is shown in table 4.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Metal.....	1,621	312	506	4,058	3	98	24.89	5,805
Nonmetal.....	194	219	42	340	--	14	41.19	1,539
Sand and gravel..	825	184	151	1,366	--	29	21.22	763
Stone.....	524	240	126	1,071	1	31	29.87	6,138
Total ¹	3,164	261	826	6,836	4	172	25.75	4,637
1971:^p								
Metal.....	1,680	310	520	4,167	1	91	22.08	2,712
Nonmetal.....	155	170	26	215	1	11	55.71	28,362
Sand and gravel..	820	166	137	1,340	1	34	26.12	5,058
Stone.....	540	260	140	1,160	--	32	27.58	804
Total ¹	3,200	258	824	6,883	3	168	24.85	3,650

^p Preliminary.

¹ Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Production and shipments of cement exceeded those of 1970 by about 40 percent. Output was reported at 2.19 million barrels (376-pound) of portland cement valued at \$8.56 million and 45,000 barrels (280-pound) of masonry cement valued at \$178,000.⁵ All production was from the State-owned plant operated by the South Dakota Cement Commission at

Rapid City, Pennington County. The Commission also maintained distribution terminals in Chamberlain and Aberdeen, South

³ King, R. V., and W. H. Raymond. Geologic Map of the Scenic Area, Pennington, Shannon, and Custer Counties, S. Dak. U.S. Geol. Survey Map I-662, 1971.

⁴ Bell, Henry, and E. V. Post. Geology of the Flint Hill Quadrangle, Fall River County, S. Dak. U.S. Geol. Survey Bull., 1063-M, 1971, pp. 505-586.

⁵ Rock Products. South Dakota Cement. V. 75, No. 3, March 1972, p. 100.

Dakota, and Bismarck, North Dakota. Construction of a 20,000-barrel-per-day capacity distribution terminal at Sioux Falls was planned in 1972. About three-fourths of the cement was used in the building industry and most of the remainder in highway construction. Nearly 80 percent of the total shipments were within the State, and most of the balance went to North Dakota and Wyoming. Raw materials consumed in cement production were as follows, in thousand tons: Limestone, 419; shale, 101; sand, 28; gypsum, 15; and iron ore, 6.

Clays.—Production of clays rose sharply in 1971. A sizable portion consisted of bentonite for oil well drilling; other types of clays were used for cement, lightweight aggregate, and bricks. The American Colloid Co. continued to operate the State's only bentonite-processing plant, using crude materials from South Dakota and Wyoming.

Feldspar.—Feldspar production increased 28 percent over that of 1970. Nearly all of the 22,000 tons produced came from Custer County. The bulk was sold to and processed by International Minerals and Chemical Corp. which operated a grinding plant at Custer. Products were shipped nationwide. Twenty mines were active in Custer County and two mines in Pennington County. A newly organized firm, Keystone Products Corp., began producing quartz

and feldspar products at Custer. Quartz planned an addition to its feldspar grinding plant at the Peerless property near Keystone.

Gypsum.—The South Dakota Cement Commission operated a small surface mine in Meade County, supplying its needs for gypsum as a cement ingredient. Production totaled 20,736 tons valued at \$83,000.

Lime.—The production of lime by two operators, Pete Lien & Sons, Rapid City, and the Black Hills Lime Co., Pringle, increased slightly in 1971 to a new record. The bulk of the output was hydrated lime, but some was quicklime. Consumption in South Dakota was 36,805 tons. Lime was also shipped to Colorado, North Dakota, and other States.

Mica.—A small tonnage of scrap and flake mica was produced by one mine in Pennington County.

Sand and Gravel.—Sand and gravel was produced in nearly every county. Of the total output of 16.7 million tons, 8.6 million (52 percent) was produced for governmental agencies. A total of 144 firms operated commercially. Production included 1.7 million tons of sand and 15 million tons of gravel. Counties leading in output were Minnehaha, Pennington, Codington, Brookings, and Hand, supplying 4.7 million tons, which was 28 percent of the total.

Table 5.—Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Beadle.....	5	337	\$317	2	W	W
Bennett.....	1	15	W	--	--	--
Bon Homme.....	3	W	85	1	149	\$42
Brookings.....	9	385	313	5	552	773
Brown.....	8	343	302	3	163	181
Brule.....	3	118	105	1	W	W
Butte.....	4	122	96	1	W	W
Campbell.....	4	118	138	4	263	249
Charles Mix.....	9	143	125	2	121	140
Clark.....	1	W	W	1	108	155
Codington.....	12	723	681	8	753	840
Davison.....	8	161	130	2	W	W
Day.....	5	328	223	3	W	W
Deuel.....	5	181	123	1	W	W
Douglas.....	4	104	95	6	120	W
Edmunds.....	2	W	W	--	W	318
Fall River.....	2	W	W	2	136	W
Faulk.....	3	W	W	--	97	140
Gregory.....	6	W	W	3	192	154
Hamlin.....	5	174	107	4	270	260
Hand.....	14	446	385	6	524	524
Harding.....	3	W	W	1	60	26

See footnotes at end of table.

Table 5.—Sand and gravel sold or used by producers, by county—Continued
(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Hughes.....	4	120	\$94	4	W	W
Hyde.....	2	W	W	1	41	(1)
Jerauld.....	2	80	29	1	40	\$48
Jones.....	2	75	W	—	—	—
Kingsbury.....	7	112	108	5	180	22
Lake.....	7	177	120	2	W	W
Lawrence.....	4	271	194	4	W	W
Lincoln.....	4	279	237	3	W	W
McPherson.....	4	291	234	3	W	W
Marshall.....	7	162	189	3	367	433
Meade.....	1	65	79	1	186	280
Mellette.....	4	178	154	—	—	—
Miner.....	1	W	W	1	67	7
Minnehaha.....	14	892	303	15	1,741	1,734
Moody.....	6	215	166	4	238	157
Fennington.....	8	389	437	10	1,124	1,333
Perkins.....	8	116	155	4	231	294
Roberts.....	3	75	91	3	249	257
Sanborn.....	1	28	4	1	37	4
Shannon.....	2	45	34	2	47	35
Sully.....	3	W	60	3	W	W
Todd.....	1	25	14	1	61	69
Tripp.....	1	15	W	—	54	86
Union.....	1	W	W	1	102	134
Walworth.....	5	223	145	2	W	W
Yankton.....	5	272	176	4	W	W
Ziebach.....	—	—	—	—	31	55
Various.....	36	—	—	15	1,520	1,510
Undistributed ²	49	8,754	9,905	35	6,903	8,075
Total ³	312	16,556	16,656	185	16,727	18,392

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

¹ Less than 1/2 unit.

² Includes Aurora, Buffalo, Clay, Corson, Custer, Dewey, Grant, Hanson, Hutchinson, Lyman, McCook, Potter, Spink, Stanley, Turner and Washabaugh Counties.

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

Table 6.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	496	\$567	793	\$983
Fill.....	110	60	140	65
Paving.....	254	287	564	807
Other uses ¹	56	69	9	2
Total ²	917	983	1,506	1,856
Gravel:				
Building.....	152	245	329	461
Fill.....	117	91	459	252
Paving.....	4,762	4,062	5,031	5,102
Miscellaneous.....	889	691	W	W
Other uses ³	179	165	793	546
Total ²	6,098	5,254	6,611	6,362
Government-and-contractor operations:				
Sand:				
Fill.....	1	1	1	(4)
Paving.....	248	205	178	185
Other uses.....	25	13	—	—
Total ²	274	218	179	185

See footnotes at end of table.

Table 6.—Sand and gravel sold or used by producers, by class of operation and use—Continued

(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Government-and-contractor operations—Continued				
Gravel:				
Building	2	\$2	26	\$24
Fill	2	2	62	8
Paving	9,144	10,079	8,220	9,834
Other uses	118	118	122	122
Total ²	9,266	10,201	8,430	9,989
Total sand and gravel ²	16,556	16,656	16,727	18,392

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

¹ Includes unground sands (1970).² Data may not add to totals shown because of independent rounding.³ Includes railroad ballast, miscellaneous, and other gravel.⁴ Less than ½ unit.**Table 7.—Stone sold or used by producers, by kind**

(Thousand short tons and thousand dollars)

Kind of stone	1970		1971	
	Quantity	Value	Quantity	Value
Dimension:				
Limestone	W	W	--	--
Granite	63	\$10,409	36	\$5,654
Quartz	(1)	2	--	--
Crushed and broken:				
Limestone	1,043	1,052	1,426	1,621
Quartz	W	40	W	65
Quartzite	833	1,764	701	1,476
Traprock	3	8	3	6
Other stone	36	100	34	54
Total ²	1,979	13,375	2,199	8,874

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

¹ Less than ½ unit; included with "Other stone."² Data may not add to totals shown because of independent rounding.**Table 8.—Stone sold or used by producers, by use**

Use	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension stone:				
Rough construction and rubble	W	W	W	W
Dressed architectural	1,557	W	225	W
Rough monumental	118	\$2,818	112	\$2,874
Dressed monumental	W	W	--	--
Flagging				
Total (approximate thousand short tons)	68	10,462	36	5,654
Crushed and broken stone:				
Concentrate aggregates	453	847	506	856
Other road aggregates	777	1,276	899	1,527
Cement	310	218	419	273
Railroad ballast	207	(2)	173	(2)
Riprap and jetty stone	37	54	42	70
Other ³	125	518	125	494
Total ⁴	1,911	2,913	2,164	3,220
Grand total ⁴	1,979	13,375	2,199	8,874

W Withheld to avoid disclosing individual company confidential data; included in "Total."

¹ Includes a small amount of stone used for structural and sanitary purposes.² Withheld to avoid disclosing individual company confidential data; included with "Other."³ Includes stone used for agricultural lime, lime manufacture, other fillers; also roofing aggregates, stone sand, terrazzo, and refractories (1970 only), and small amounts of crushed and broken stone not listed or unspecified.⁴ Data may not add to totals shown because of independent rounding.

Stone.—Production of stone was higher in tonnage but lower in value in 1971. Granite, quartzite, limestone, quartz, traprock, and miscellaneous stone were mined or quarried. Granite, mostly prepared for monumental or architectural stone, was valued at \$5.7 million, which was 64 percent of the total value of stone produced. The granite all came from Grant County, in the northeast corner of the State, and was supplied by five companies. Limestone and quartzite were valued at a total of \$3.1 million.

METALS

Gold and Silver.—The Homestake gold mine in Lead processed 1.8 million tons of ore from which over 513,400 ounces of gold and about 107,000 ounces of silver were recovered. The Homestake mine accounted for virtually all of the State's production of gold and silver. Output was lower than in 1970 because of a shortage of skilled miners and reassignment of available personnel to an ongoing deep level development program. Work prog-

ressed during the year with sinking of the No. 6 winze (Ross extension) from the 6800 level to the 7189 level and the excavation of a hoist room on the 4550 level. The program was begun in 1970 to develop ore lying between the 4850-foot and 6800-foot levels in the "Nineteen" and "Twenty-one" Ledges of the mine. Total ore reserves at yearend in the Homestake mine were estimated at 11 million tons averaging 0.336 ounces of gold per ton. Metallurgical recovery was down to 93 percent compared with 95 percent in 1970 owing to discontinuance of an amalgam process using mercury which was identified as a hazardous pollutant. After much testing of other processes, a Bureau of Mines carbon-in-pulp process was found promising and installation of an \$850,000 plant was authorized by the Homestake management. Plans were made to complete the new installation by early 1973, after which the slime treatment plant at Deadwood would serve no further purpose, owing to the substitution of the new process, and could be abandoned.

Table 9.—Mine production (recoverable) of gold and silver

	1969	1970	1971
Mines producing:			
Lode.....	2	2	1
Placer.....	1	--	--
Material sold or treated:			
Ore: Gold..... thousand short tons..	1,935	1,954	1,800
Production (recoverable):			
Quantity:			
Gold..... troy ounces.....	593,146	578,716	513,427
Silver..... do.....	124,497	119,766	106,785
Value:			
Gold..... thousands.....	\$24,621	\$21,059	\$21,179
Silver..... do.....	223	212	165
Total..... do.....	24,844	21,271	21,344

¹ Excludes placer gravel.

Table 10.—Homestake mine ore milled and receipts for bullion

Year	Ore milled (thousand short tons)	Receipts for bullion products	
		Total (thousands)	Per ton
1967.....	1,896	\$21,200	\$11.18
1968.....	1,922	22,064	11.48
1969.....	1,935	24,570	12.70
1970.....	1,954	21,059	10.78
1971.....	1,800	21,179	11.77

Source: Homestake Mining Co. Annual Reports.

Three miles below Deadwood on White-wood Creek, the New Era Mining Co. floated a steel boat on which thirty-six 8-foot Humphrey spiral classifiers were mounted and experimented on the recovery of placer gold and mercury from old mill wastes.

Iron Ore.—The Black Hills Conservancy Subdistrict went on record as opposed to development or patenting of iron-bearing claims in the Black Hills unless there were adequate safeguards to prevent serious degradation of land and water. Applications

had been filed for patents to claims held by several companies covering about 1,000 acres containing low-grade taconites.

Uranium.—Uranium production rose in 1971 and sales reached a record high. Susquehanna Corp., owner of Mines Development, Inc., which operated a mill at Edgemont, announced receipt of orders from three electric utility companies for delivery of an additional 3 million pounds of uranium oxide in 1971-75. As a result, stripping was started for another large pit north of Edgemont, and several additional pits were planned for development. Known reserves were estimated to be adequate for 3 years of operation at existing rates of extraction—about 650 tons of ore per day.

MINERAL FUELS

Coal (Lignite).—South Dakota's only coal mine, owned by Firesteel Coal Co. at Timber Lake, was closed. Consolidation Coal Co., subsidiary of Continental Oil Corp., continued construction of a pilot plant for experimental commercial-scale lignite gasification at Rapid City. Startup operations were scheduled for late 1971 or early 1972, utilizing char and lignite from North Dakota. Capacity of the pilot plant was set for 35 tons per day, and it was expected that successful tests might lead to future utilization of Harding County coal in northwestern South Dakota.

Petroleum.—Output of petroleum rose nearly 46 percent, largely as the result of a highly productive well brought in by Depco, Inc. in the new Red River Field

near Ludlow, Harding County. Production from 24 wells in the Buffalo field, northwest of Buffalo, Harding County, was 142,618 barrels in 1971, compared with 159,059 barrels in 1970, and included about 9 million cubic feet of natural gas used for repressuring. Four wells in the Barker Dome field of Fall River County, north of Edgemont, produced 6,388 barrels of oil in 1971. Investors Drilling Ventures began shipping a small quantity of oil from its group of wells in the Lantry area of Dewey County. A total of 4,596 barrels of oil had been produced, and about 1,000 barrels sold, since discovery in May 1970.

Exploration drilling declined in 1971, with less than half the holes and footage that were drilled in 1970. Only two of 35 holes drilled for oil were successful, one each in Dewey and Harding Counties (table 11). Texaco Oil Co. was reported planning to drill four test wells in Harding and Perkins Counties. In December, the State issued permits to Depco, Inc. for a deep test well planned for 9,050 feet in Harding County, and to Webb Resources, Inc., for two shallow test wells northeast of Ardmore and northwest of Edgemont, in Fall River County.

In November, the State reported an additional 42,159 acres leased on competitive bids for oil exploration in eight counties. The highest bid, \$11.32 per acre, was offered for a 640-acre track in Harding County by Wood Petroleum Corp. of Oklahoma City.

Table 11.—Oil and gas well drilling completions, by county

County	Proved field wells ¹			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Butte.....	--	--	--	--	--	2	2	6,550
Corson.....	--	--	--	--	--	1	1	3,147
Custer.....	--	--	--	--	--	1	1	2,625
Dewey.....	--	--	--	1	--	--	1	5,066
Fall River.....	--	--	--	--	--	15	15	37,359
Harding.....	--	--	--	1	--	12	13	62,340
Perkins.....	--	--	--	--	--	2	2	8,850
Total.....	--	--	--	2	--	33	35	125,937

¹ Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Beryllium:			
Jack Pendleton.....	Custer, S. Dak. 57730.....	Open pit.....	Pennington.
John Carter.....	608 St. Cloud Rapid City, S. Dak. 57701	do.....	Do.
L. W. Judson.....	Hermosa, S. Dak. 57744.....	See Mica.....	Do.
Merle Chase.....	do.....	Open pit.....	Do.
Cement:			
South Dakota Cement Commission.	Drawer 351 Rapid City, S. Dak. 57701	Wet-process, 3-rotary-kiln plant.	Do.
Clays:			
American Colloid Co.....	5100 Suffield Ct. Skokie, Ill. 60076	Open pit mine and plant..	Butte.
Light Aggregates, Inc.....	Box 1922 Rapid City, S. Dak. 57701	do.....	Pennington.
South Dakota Cement Commission.	Drawer 351 Rapid City, S. Dak. 57701	Open pit mine.....	Do.
Feldspar:			
George Bland.....	Custer, S. Dak. 57730.....	2 open pit mines.....	Custer.
International Minerals & Chemical Corp., Indus- trial Minerals Division.	Administration Center Old Orchard Rd. Skokie, Ill. 60079	4 open pit mines and dry- grinding plant.	Do.
Gold:			
Homestake Mining Co....	Lead, S. Dak. 57754.....	Underground mine, cyanidation mill, and refinery.	Lawrence.
Gypsum:			
South Dakota Cement Commission.	Drawer 351 Rapid City, S. Dak. 57701	Open pit mine.....	Meade.
Lime:			
Pete Lien & Sons.....	Box 3124, P.O. Annex Rapid City, S. Dak. 57703	1-rotary-kiln, 1-vertical- kiln, continuous-hydrator plant.	Pennington.
Mica (scrap):			
L. W. Judson.....	Hermosa, S. Dak. 57744.....	Open pit mine.....	Do.
Northwest Beryllium Corp.	218-219 American National Bank Bldg. Rapid City, S. Dak. 57701	Stockpile.....	Do.
Petroleum:			
The Ozark Corp.....	Box 2491 Casper, Wyo. 82601	Crude oil wells.....	Custer (Barker Dome field).
Penzoil United, Inc.....	900 Southwest Tower Houston, Tex. 77002	do.....	Harding (Buffalo field).
Phillips Petroleum Co....	Frank Phillips Bldg. Bartlesville, Okla. 74003	do.....	Do.
Sand and gravel (commercial):			
Aggregates, Inc.....	Selby, S. Dak. 57472.....	Pit and plant.....	Lawrence.
Concrete Materials Co....	3000 West Madison St. Sioux Falls, S. Dak. 57104	Pit and 2 plants.....	Minnehaha.
F. J. McLaughlin Co.....	Watertown, S. Dak. 57201..	do.....	Codington.
Floyd Oberg & Sons Construction Co.	Colton, S. Dak. 57018.....	Pit.....	Minnehaha.
Hallett Construction Co...	Crosby, Minn. 56441.....	Pit.....	Spink.
L. G. Everist, Inc.....	302 Paulton Bldg. Sioux Falls, S. Dak. 57102	2 pits and plants.....	Codington.
Pikus Construction Co....	Box 1414 Aberdeen, S. Dak. 57401	Pit and plant.....	Brookings.
Tom Luke Construction...	Kimball, S. Dak. 57335.....	do.....	Pennington.
		3 pits.....	Brown.
		3 pits.....	Brule.
		3 pits and plant.....	Davison.
		2 pits.....	Douglas.
		3 pits.....	Lyman.
Silver:			
Homestake Mining Co....	Lead, S. Dak. 57754.....	See Gold.....	Lawrence.
Stone:			
Cold Spring Granite Co...	Cold Spring, Minn. 56320..	2 quarries.....	Grant.
Concrete Materials Co....	3000 West Madison Street Sioux Falls, S. Dak. 57104	Quarry and plant.....	Minnehaha.
Dakota Granite Co.....	Box 269 Milbank, S. Dak. 57252	2 quarries.....	Grant.
Delano Granite Works, Inc.	Delano, Minn. 55328.....	Quarry.....	Do.
Hills Materials Co.....	Box 1392 Rapid City, S. Dak. 57701	Quarry and plant.....	Pennington.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
L. G. Everist, Inc.-----	302 Paulton Bldg. Sioux Falls, S. Dak. 57102	Quarry and plant.-----	Minnehaha.
Pete Lien & Sons.-----	Box 3124, P.O. Annex Rapid City, S. Dak. 57703	-----do.-----	Pennington. Do.
Robert Hunter Granite Co., Inc.	Milbank, S. Dak. 57252..	Quarry-----	Grant.
South Dakota Cement Commission.	Drawer 351 Rapid City, S. Dak. 57701	Quarry and plant.-----	Pennington.
Spencer Quarries, Inc.-----	Spencer, S. Dak. 57374.----	Quarry-----	Hanson.
Steiner-Rausch Granite Co., Inc.	Ortonville, Minn. 56278.----	-----do.-----	Grant.
Uranium:			
Susquehanna-Western, Inc.	Edgemont, S. Dak. 57735. .	Underground mine.-----	Fall River.
Mines Development, Inc. .-	-----do.-----	Acid-leach mill.-----	Do.

The Mineral Industry of Tennessee

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

By Herbert R. Babitzke,¹ William D. Hardeman² and Robert E. Hershey³

The 1971 production of the mining and petroleum industries was valued at \$240 million, an increase of 9 percent over that of 1970. Tennessee was the leading producing State for ball clay, pyrite, and zinc.

Development and exploration of the large zinc ore body in middle Tennessee, increased drilling activity in the Oneida West oilfield, and growth in coal production to become the major mineral commodity produced, were the most important aspects of Tennessee's mineral industry in 1971.

Modernization and expansion of the Cities Service Co., Copperhill Operations complex, will increase copper output by 40 percent and permit offgas recovery to satisfy Environmental Protection Agency and State requirements for the prevention of air pollution when completed in 1972.

Improvements have been made in reclaiming strip-mined land.

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³ State geologist, Department of Conservation, Division of Geology, Nashville, Tenn.

Table 1.—Mineral production in Tennessee¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite.....thousand short tons..	19	\$286	21	\$342
Cement:				
Portland.....thousand 376-pound barrels..	8,878	29,832	9,110	33,733
Masonry.....thousand 280-pound barrels..	969	2,749	1,135	3,649
Clays ².....thousand short tons..	1,401	7,123	1,537	6,595
Coal (bituminous).....do....	8,237	40,372	9,271	59,368
Copper (recoverable content of ores, etc.).....short tons..	15,535	17,928	13,916	14,473
Gold (recoverable content of ores, etc.).....troy ounces..	124	5	192	8
Natural gas.....million cubic feet..	64	13	89	20
Petroleum (crude).....thousand 42-gallon barrels..	309	W	398	W
Phosphate rock.....thousand short tons..	3,073	15,005	2,571	12,151
Sand and gravel.....do....	6,715	10,639	8,018	11,845
Silver (recoverable content of ores, etc.) thousand troy ounces..	95	168	131	203
Stone.....thousand short tons..	35,374	50,013	32,369	48,665
Zinc (recoverable content of ores, etc.).....short tons..	118,260	36,233	119,295	38,413
Value of items that cannot be disclosed: Clays (fuller's earth), lime, pyrites and values indicated by symbol W.....	XX	10,099	XX	10,197
Total.....	XX	220,465	XX	239,662
Total 1967 constant dollars.....	XX	197,206	XX	208,218

¹ Preliminary. W Withheld to avoid disclosing individual company confidential data, included with "Value of items that cannot be disclosed." XX Not applicable.

² Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

³ Excludes fuller's earth; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Tennessee, by county ¹
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Anderson	W	W	Coal, stone.
Bedford	W	\$420	Stone.
Benton	W	W	Sand and gravel, stone.
Bledsoe	W	246	Coal.
Blount	W	W	Stone.
Bradley	\$1,697	W	Do.
Campbell	8,981	15,437	Coal, stone, sand and gravel.
Cannon	W	W	Stone.
Carter	W	W	Do.
Claiborne	W	12,826	Coal, stone, petroleum.
Clay	W	W	Stone, petroleum.
Cocke	W	--	
Coffee	W	W	Stone.
Cumberland	1,716	1,942	Stone, sand and gravel, coal.
Davidson	9,580	11,195	Cement, stone, clay.
Decatur	W	W	Stone, sand and gravel.
De Kalb	135	224	Stone.
Dickson	451	W	Do.
Fayette	55	W	Stone, sand and gravel.
Fentress	418	1,032	Coal, stone, petroleum.
Franklin	4,720	4,466	Cement, stone, sand and gravel, clay.
Gibson	W	W	Sand and gravel.
Giles	1,519	1,224	Phosphate rock, stone, sand and gravel.
Grainger	146	143	Stone.
Greene	W	W	Stone, sand and gravel.
Grundy	W	W	Coal, sand and gravel, stone.
Hamblen	W	W	Stone.
Hamilton	13,745	16,087	Cement, stone, sand and gravel, coal, clay.
Hancock	W	W	Zinc, stone.
Hardeman	W	W	Sand and gravel.
Hardin	W	W	Sand and gravel, stone.
Hawkins	W	W	Stone.
Haywood	--	7	Sand and gravel.
Henderson	W	W	Do.
Henry	3,564	W	Clay.
Hickman	W	W	Phosphate rock.
Humphreys	W	W	Stone, sand and gravel.
Jefferson	25,040	26,911	Zinc, stone.
Johnson	W	W	Stone.
Knox	23,966	20,132	Cement, zinc, stone, lime, sand and gravel, clay.
Lauderdale	W	74	Sand and gravel.
Lincoln	W	W	Stone.
Loudon	421	408	Barite, clay, stone, sand and gravel.
McMinn	726	444	Sand and gravel, stone, barite.
McNairy	W	W	Sand and gravel.
Macon	W	W	Stone.
Marion	W	W	Coal, cement, stone.
Marshall	W	W	Stone.
Maury	6,679	W	Phosphate rock, stone.
Meigs	W	W	Stone.
Monroe	W	W	Stone, barite, sand and gravel.
Montgomery	W	W	Stone.
Moore	W	W	Do.
Morgan	2,312	2,820	Coal, petroleum, natural gas.
Obion	W	W	Sand and gravel.
Overton	73	W	Stone, petroleum.
Perry	W	W	Sand and gravel.
Pickett	24	71	Stone, petroleum.
Polk	W	23,782	Copper, pyrites, zinc, silver, sand and gravel, gold.
Putnam	1,720	2,097	Stone, coal, sand and gravel.
Rhea	W	W	Stone, clay.
Roane	W	W	Stone, coal.
Robertson	W	W	Stone, petroleum.
Rutherford	1,097	940	Stone.
Scott	3,473	4,510	Coal, petroleum, natural gas.
Sequatchie	W	W	Coal, stone.
Sevier	606	W	Stone, sand and gravel.
Shelby	810	2,173	Sand and gravel.
Smith	W	81	Stone.
Stewart	W	W	Do.
Sullivan	W	W	Cement, stone, clay.
Sumner	W	W	Stone.
Tipton	W	W	Sand and gravel.
Tipton	W	W	Sand and gravel, stone.
Union	135	1,140	Stone.
Van Buren	1,853	1,095	Coal.
Warren	W	W	Stone, natural gas.
Washington	W	W	Stone, sand and gravel, clay.

See footnotes at end of table.

Table 2.—Value of mineral production in Tennessee, by county ¹—Continued

(Thousands)			
County	1970	1971	Minerals produced in 1971 in order of value
Wayne.....	W	W	Sand and gravel, stone.
Weakley.....	W	W	Clay.
White.....	W	W	Stone, coal.
Williamson.....	W	W	Stone, phosphate rock.
Wilson.....	W	W	Stone.
Undistributed.....	\$104,793	\$87,723	
Total ²	220,465	³ 239,662	

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

¹ The following counties are not listed because no production was reported: Carroll, Cheatham, Chester, Crockett, Dyer, Houston, Jackson, Lake, Lawrence, Lewis, Madison, and Trousdale.

² Includes values indicated by symbol W.

³ Data does not add to total shown because of independent rounding.

Table 3.—Indicators of Tennessee business activity

	1970 ^r	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total work force.....	thousands.. 1,706.8	1,738.9	+ 1.9
Unemployment.....	do... 75.5	79.3	+ 5.0
Total nonagricultural employment.....	do... 1,327.6	1,353.8	+ 2.0
Mining.....	do... 7.0	7.0	--
Manufacturing.....	do... 464.6	459.3	- 1.1
Construction.....	do... 63.1	68.7	+ 8.9
Transportation and public utilities.....	do... 66.1	67.3	+ 1.8
Wholesale and retail trade.....	do... 258.6	268.2	+ 3.7
Finance, insurance, and real estate.....	do... 57.2	59.8	+ 4.5
Services.....	do... 185.1	192.2	+ 3.8
Government.....	do... 225.9	231.3	+ 2.4
Personal income:			
Total.....	millions.. \$12,128	\$13,266	+ 9.4
Per capita.....	\$3,084	\$3,325	+ 7.8
Construction activity:			
Number of new housing units authorized.....	24,769	36,375	+46.9
Valuation of nonresidential construction.....	millions.. \$253.7	\$270.4	+ 6.6
Cement shipments to and within Tennessee			
thousand 376-pound barrels..	7,320	8,247	+12.7
millions..	\$220.5	\$239.7	+ 8.7

^p Preliminary. ^r Revised.

Sources: Employment and Earnings, Area Trends in Employment and Unemployment, Construction Review, Survey of Current Business, and the U.S. Bureau of Mines.

Government Programs.—The Tennessee Division of Geology continued its program of quadrangle mapping of geology and mineral resources, and 13 new maps and reports were published for the following quadrangles: Big Sandy, Buchanan, Buena Vista, Dry Valley, Hollow Springs, Huntingdon, Mulberry, Norma, Normandy, Olivehill, Ovoca, Shop Springs, and Thurman. The mapping program is a cooperative project with the Tennessee Valley Authority (TVA), and about 250 maps have been published since the program began in 1962. In addition, two technical publications ⁴ and two special maps ⁵ were published.

The Bureau of Mines Liaison Office completed its first year of operation. The office was involved in a wide variety of informal cooperative mineral-related activities with various State agencies, especially with the Departments of Labor, Conserva-

tion, and Public Health. A close working relationship was also maintained with several branches of TVA and with the U.S. Geological Survey.

TVA continued construction on three major powerplants—the Sequoyah nuclear plant and the Raccoon Mountain pumped storage project, which are both near Chattanooga, and the Cumberland coal-fired steamplant in northwest Tennessee. The Sequoyah and Raccoon Mountain projects are scheduled for completion in 1974, and

⁴ Carpenter, R. H., G. D. Robinson, and J. M. Fagan. Stream Sediment Geochemical Studies in northwest Tennessee and east Tennessee. Tennessee Div. of Geol., RI 32, 1971, 31 pp.

Wilcox, J. T. Preliminary Investigations of Heavy Minerals in the McNairy Sand of West Tennessee. Tennessee Div. of Geol., RI 31, 1971, 11 pp.

⁵ Tennessee Division of Geology. Well Location Index Map of Cumberland County, Tennessee. 1971.

———. Well Location Index Map of Pickett County, Tennessee. 1971.

the Cumberland plant is scheduled for completion by mid-1972.

TVA began preliminary construction on the Normandy dam site on Duck River. The dam will be earth-filled with a concrete spillway section rising to a maximum height of approximately 110 feet. The Geologic Branch of TVA investigated potential thermal powersites throughout the State as well as pumped storage sites. The Mineral Resources Section of the Geologic Branch completed magnetic ground surveys of 19 quadrangles. A proton-procession airborne magnetometer was purchased and will be used in a continuing program of magnetic surveying in cooperation with the Tennessee Division of Geology. The TVA Office of Tributary Area Development is engaged in a continuing cooperative program with local governments for junked car removal and disposal.

The U.S. Geological Survey made detailed geologic studies of the Knox dolomite and the zinc resources of east Tennes-

see. The Survey is also conducting cooperative programs of water resources investigations and geologic mapping with the Tennessee Divisions of Water Resources and Geology.

An important step was made toward the improvement of reclamation of surface-mined land in the State. The Department of Conservation commissioned the Tennessee Environmental Council to investigate and make recommendations. The investigation was made for the Council by Dr. Edward Thaxton, Department of Environmental and Water Resources Engineering, Vanderbilt University, to serve as background information for the development of a new and improved surface mining law to be proposed to the 1972 Tennessee General Assembly.

Taxes.—Tennessee has a privilege tax on oil of 4.2 cents per barrel and 5 percent gross value on gas. No severance taxes are levied on minerals.

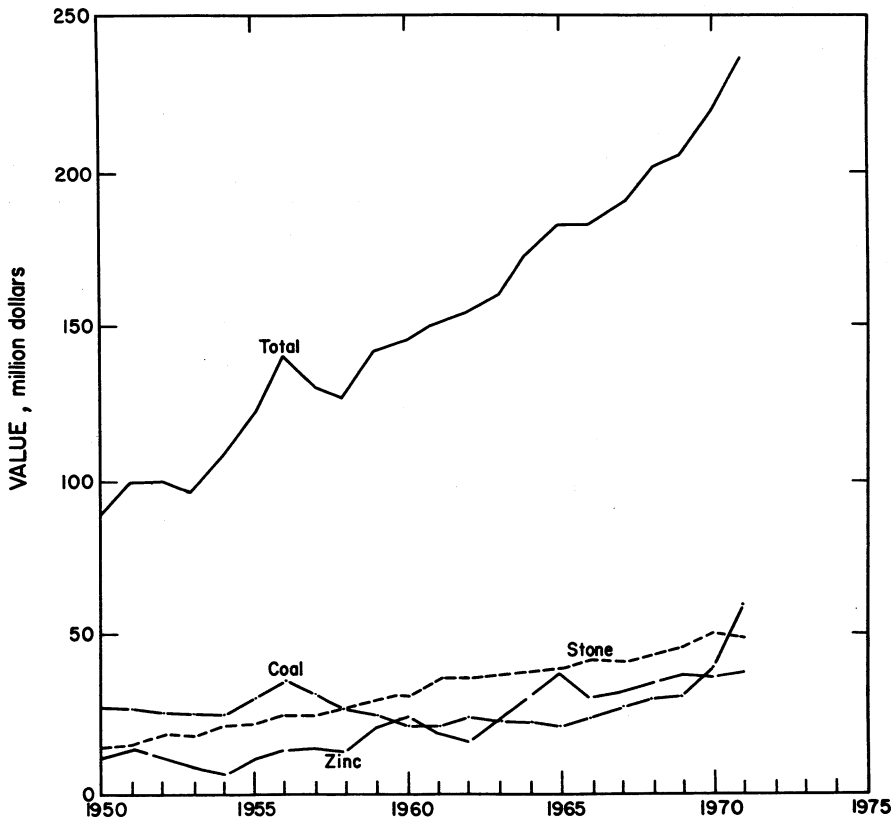


Figure 1.—Value of stone, coal, zinc, and total value of mineral production in Tennessee.

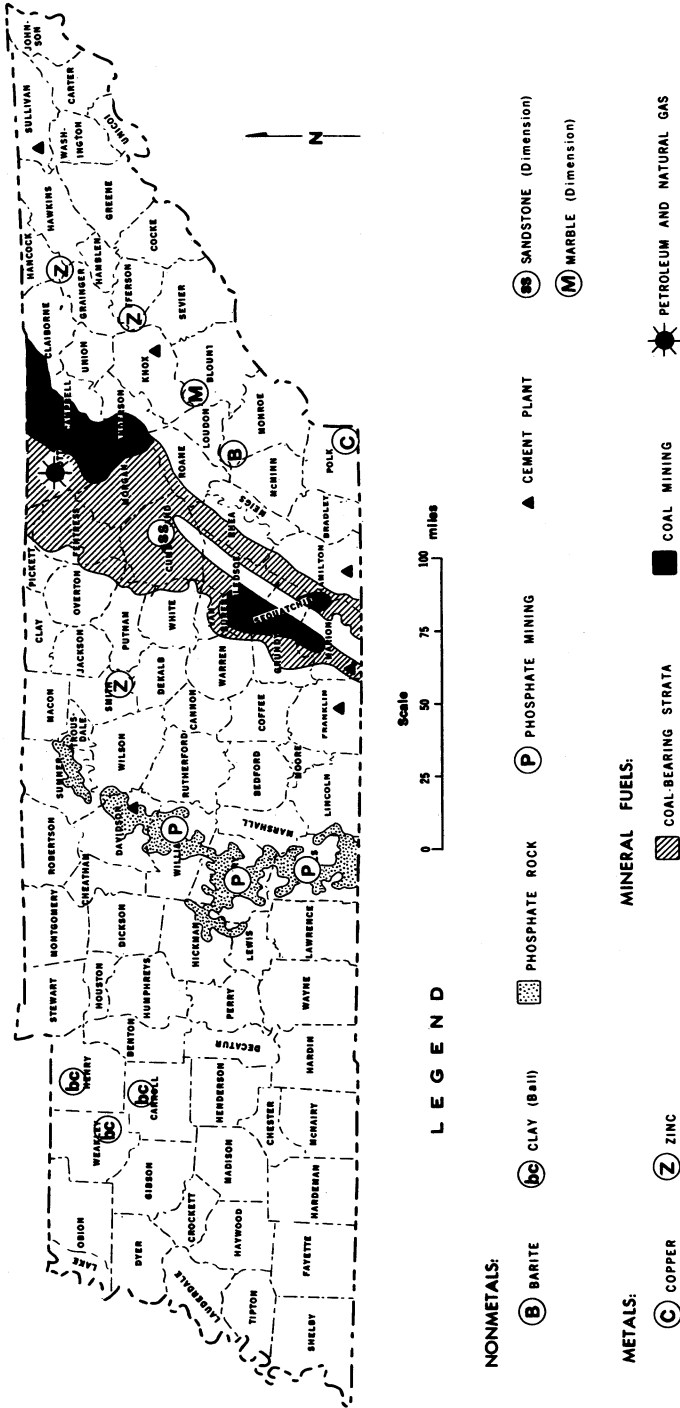


Figure 2.—Generalized map of selected mining areas and industries in Tennessee.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Coal.....	1,910	192	367	3,015	1	93	31.18	3,508
Metal.....	1,721	272	467	3,740	2	103	28.08	6,019
Nonmetal.....	661	258	171	1,435	--	39	27.18	761
Sand and gravel.....	550	261	144	1,249	1	33	27.22	5,918
Stone.....	2,681	256	686	5,885	4	135	23.62	6,181
Total ¹	7,523	244	1,835	15,323	8	403	26.32	5,087
1971:^p								
Coal.....	1,870	180	336	2,799	8	120	45.74	19,252
Metal.....	1,740	259	451	3,610	5	97	23.26	12,085
Nonmetal.....	815	254	206	1,697	--	33	19.45	668
Sand and gravel.....	615	251	154	1,361	--	36	26.45	918
Stone.....	2,755	264	726	6,151	3	123	20.49	3,787
Total ¹	7,790	241	1,874	15,617	16	409	27.21	7,888

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

REVIEW BY MINERAL COMMODITIES

NONMETALS

Nonmetals accounted for 53 percent of the total value of mineral production with an increase of 1 percent over that of 1970. The three principal nonmetallic commodities, in order of value, were stone, cement, and phosphate rock.

Barite.—Three companies operated open pit mines and plants in the Sweet-water District of eastern Tennessee. Permits were issued allowing 7 acres of land to be disturbed in 1971. Production and value both increased over last year. N L Industries, Inc., Baroid Division, shipped all its crushed ore to New Orleans to be ground for use as drilling mud; Godsey Mines, Inc., shipped all its ore out of State for processing; and B. C. Wood shipped its ore out of State for manufacture of barium chemicals.

Cement.—Portland cement was produced by four companies at six plants, and masonry cement was produced at four plants. Total value of portland cement production rose to \$34 million in 1971, a 13-percent increase over that of 1970. Masonry cement production amounted to \$3.6 million, a 33-percent increase over that of 1970.

Raw materials used were limestone, cement rock, clay, shale, sand, gypsum and iron-bearing materials. Most of the portland cement was consumed for ready-mix concrete (65 percent). The remainder was used for concrete products (18 percent),

building materials (6 percent), contractors (7 percent) and miscellaneous (4 percent). Nearly all of the portland cement shipped was of the general-use and moderate-heat type. The rest was high-early-strength, white, and expansive type. Fuel and energy used to produce the cement was 3.4 billion cubic feet of natural gas, 384,000 tons of bituminous coal, and 233 million kilowatt hours of electric energy.

Three plants in the State reported air pollution control improvements. Penn-Dixie Cement Corp. was scheduled to initiate an air pollution control program at its Richard City plant in 1972. Ideal Cement Co., Div. of Ideal Basic Industries, Inc., installed three electrostatic precipitators at its Knoxville plant. General Portland Cement Co.'s new precipitator under construction at the Chattanooga plant is scheduled for operation late in 1972.

Clays.—Tennessee ranked first in the Nation in the production of ball clay by producing 63 percent of the U.S. total. The clay industry also produced fire clay, fuller's earth and miscellaneous clays. Permits were issued allowing 236 acres of land to be disturbed for clay removal in 1971.

Ball clay production was 377,421 short tons valued at \$5.5 million. This clay was mined at open pits in Henry and Weakley Counties for use in pottery, whiteware, brick, fillers, floor and wall tile, insecticides, and catalysts.

Fuller's earth production and value were down from that of 1970 while the price remained constant. This clay was mined in Henry County by open pit methods for use as absorbent material.

Miscellaneous clay production was up from 1970, but the total value was down. Major uses for this clay were for building brick, lightweight aggregate, and cement.

Graphite.—Artificial graphite was produced from petroleum coke by Union Carbide Corp. at its plant near Columbia, Tenn. All the graphite was used for the manufacture of electrodes.

Table 5.—Ball clay sold or used by producers, by use

(Short tons)

Use	1970	1971
Whiteware, etc.....	242,342	259,321
Floor and wall tile.....	64,600	78,600
Other uses ¹	103,136	39,500
Total.....	410,078	377,421

¹ Includes firebrick and block, kiln furniture, insecticides and fungicides and other uses. Heavy clay products and other refractories (1970), and other filler 1971.

Lime.—Foote Mineral Co. and Williams Lime Mfg. Co. produced lime in Knox County for paper and pulp, water purification, metallurgy, and other uses. Output increased 9 percent over that of 1970 but was 6 percent below the 1967 record. The lime was consumed in North Carolina, Tennessee, South Carolina, and other States. Total consumption of lime in Tennessee was 146,856 tons.

Perlite.—Chemrock Corp. continued expanding crude perlite at its Nashville plant for use as filter aids and concrete aggregate. Production and value both decreased from 1970. All the raw material came from New Mexico.

Phosphate Rock.—Tennessee ranked third in the Nation in phosphate rock production. The industry is in a four-county area in central Tennessee.

Marketable production was 2,571,075 short tons, a 16-percent decrease in production from that of 1970; value decreased 19 percent. Ninety-nine percent of the rock mined was used as a furnace charge in the manufacture of elemental phosphorous, and the remainder was used as fertilizer filler.

Production was by three companies and TVA. The rock was mined by open pit methods and was shipped to plants near the mines. Permits were issued by the State allowing 703 acres of land to be disturbed in 1971 for phosphate rock mining.

Pyrite.—Tennessee led the Nation in pyrite output. The only producer was Cities Service Co., Copperhill Operations. No significant change in production volume was reported from previous years. Pyrite concentrate recovered by flotation from sulfide ore mined in Polk County was used to produce sulfuric acid, sulfur dioxide, ferric sulfate, and iron sinter. Cities Service Co. produced about 1 million tons of sulfuric acid during the year thus making acid the most valuable product at the Copperhill Operations. The iron sinter was shipped to Alabama for processing.

Sand and Gravel.—Sand and gravel production increased 19 percent over that of 1970. Total value increased 11 percent, but the unit value of both sand and gravel was 7 percent less than last year.

Shelby County led the State in production in 1971 followed by Benton County. Most of the sand and gravel produced was construction grade. Commercial sand and gravel production was 90 percent of the total; the remaining 10 percent, which was noncommercial production by State and county governments, was used for paving. Production came from 39 stationary plants, nine portable plants, and 14 dredges which were operated in 32 counties by 49 companies and Government operators. Permits were issued by the State allowing 260 acres of land to be disturbed for mining sand and gravel in 1971.

Benton County led the State in the production of industrial unground sand used for glass and molding, almost all of which was produced by Hardy Sand Co. Most of the glass sand was used at the Ford Motor Co. glass plant in Nashville.

Stone.—For 14 consecutive years stone was the major mineral commodity produced in Tennessee, but the 1971 production value slipped to second place, being displaced by coal. The production was 32,369,220 short tons valued at \$48.7 million, an 8-percent decrease in tonnage and a 3-percent decrease in value from that in 1970. Davidson County was the leading producing county in quantity and value.

Table 6.—Sand and gravel sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Benton.....	8	1,078	\$1,811	8	1,082	\$1,828
Fayette.....	2	61	55	4	139	143
Giles.....	1	W	W	1	208	208
Haywood.....	--	--	--	2	74	7
Lauderdale.....	1	W	W	1	122	74
Polk.....	1	28	62	1	24	70
Shelby.....	4	688	810	8	1,914	2,178
Various.....	1	186	157	--	--	--
Undistributed ¹	32	4,728	7,745	40	4,456	7,337
Total ²	50	6,715	10,639	65	8,018	11,845

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
¹ Includes Campbell (1971), Cumberland, Decatur, Franklin, Gibson, Greene (1971), Grundy, Hamilton, Hardeman, Hardin, Henderson, Humphreys, Knox, Loudon, McMinn, McNairy, Monroe, Obion, Perry, Putnam, Sevier, Stewart (1970), Tipton, Unicoi, Washington, Wayne, and some sand and gravel that cannot be assigned to specific counties (1970).

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

Table 7.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	1,822	\$2,660	2,420	\$3,755
Paving.....	935	1,678	876	1,658
Other uses ¹	790	2,537	732	1,922
Total ²	3,547	6,876	4,029	7,335
Gravel:				
Building.....	872	1,137	1,498	2,175
Fill.....	W	W	50	58
Paving.....	1,198	1,470	1,444	1,457
Miscellaneous.....	W	W	111	113
Other uses ³	314	462	110	218
Total ²	2,884	3,069	3,213	4,022
Government and contractor operations:				
Sand:				
Paving.....	2	2	7	8
Total.....	2	2	7	8
Gravel:				
Fill.....	40	40	42	42
Paving.....	744	653	727	438
Total.....	784	693	769	480
Total sand and gravel ²	6,715	10,639	8,018	11,845

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
¹ Includes abrasives (1970), blast, chemical (1970), engine, fire or furnace, fill, glass, molding, railroad ballast (1971), and other sands.

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

³ Includes railroad ballast and other gravel.

Limestone was produced by 33 companies from 122 quarries; dolomite by two companies from two quarries; quartzite by three companies from three quarries; sandstone by three companies from three quarries; and marble by three companies from seven quarries. The stone was quarried at 137 sites in 64 counties. Limestone contin-

ues to be of greatest importance in terms of tonnage of all the stone produced in Tennessee. End uses for crushed limestone were road base stone (40 percent), concrete aggregate (16 percent), bituminous aggregate (10 percent), cement (7 percent), and numerous miscellaneous uses (27 percent).

Table 8.—Crushed limestone ¹ sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Bedford.....	1	W	W	1	W	\$420
Bradley.....	2	1,150	\$1,697	2	W	W
Campbell.....	3	691	W	4	700	W
Davidson.....	7	4,296	5,289	11	4,460	5,491
De Kalb.....	1	103	135	1	175	224
Dickson.....	1	301	451	1	W	W
Fentress.....	1	149	199	1	146	201
Franklin.....	4	965	W	4	1,070	W
Grainger.....	1	80	108	1	80	108
Greene.....	4	283	393	5	W	W
Jefferson.....	5	1,738	2,223	3	673	702
Knox.....	9	4,444	6,211	7	1,815	3,046
McMinn.....	2	W	W	1	W	139
Marion.....	4	1,266	1,800	4	W	W
Overton.....	1	53	78	1	W	W
Pickett.....	1	15	24	1	W	71
Rutherford.....	3	836	1,097	4	815	940
Smith.....	1	W	W	1	52	81
Union.....	1	101	135	1	760	1,140
Undistributed ²	65	18,706	28,671	70	21,406	34,389
Total	117	35,177	48,512	124	32,152	46,952

¹ Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

² Data for 1971 includes dolomite.

³ Includes Anderson, Benton, Blount, Cannon, Carter, Claiborne, Clay, Cocke (1970), Coffee, Cumberland, Decatur, Fayette, Giles, Grundy, Hamblen, Hamilton, Hancock, Hardin, Hawkins, Humphreys, Johnson, Lincoln, Loudon, Macon, Marshall, Maury, Meigs, Monroe, Montgomery, Moore, Putnam, Rhea, Roane, Robertson, Sequatchie, Sevier, Stewart, Sullivan, Sumner, Unicoi, Warren, Washington, Wayne, White, Williamson, and Wilson Counties.

⁴ Data does not add to total shown because of independent rounding.

Table 9.—Crushed limestone ¹ sold or used by producers, by use
(Thousand short tons and thousand dollars)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Bituminous aggregate.....	4,206	\$6,230	3,132	\$4,908
Concrete aggregate.....	5,157	7,024	5,131	7,712
Dense graded road base stone.....	10,412	13,864	12,695	17,372
Macadam aggregate.....	572	796	1,875	2,769
Surface treatment aggregate.....	1,531	1,972	1,413	2,042
Unspecified aggregate and roadstone.....	2,831	3,784	2,331	3,485
Agricultural limestone ²	2,716	3,805	1,391	1,907
Asphalt filler.....	6	27	W	W
Cement ³	2,462	3,231	2,437	3,645
Riprap and jetty stone.....	88	107	123	206
Stone sand.....	453	722	112	198
Other uses ⁴	4,743	6,952	1,512	2,709
Total ⁵	35,177	48,512	32,152	46,952

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

¹ Data for 1971 includes dolomite.

² Data includes poultry grit and other soil conditioners.

³ Data includes lime.

⁴ Includes fluxing stone, railroad ballast, drain fields, roofing aggregate, and other unspecified uses; also, filter stone, glass, and mine dusting (1970) and chemical stone (1971).

⁵ Data may not add to totals shown because of independent rounding.

Dimension marble production was 5,812 short tons, up from 5,132 tons in 1970. Most of the dimension marble was used for rough blocks, and all the crushed marble was used in terrazzo.

Seventy-five percent of the dolomite produced was used for agricultural lime. The major use for dimension sandstone was

house stone veneer and rough stone; crushed and broken sandstone was used for asphalt fill and production of glass and ferrosilicon. Major uses for quartzite were to produce house stone veneer and irregular-shaped stone.

Vermiculite.—Construction Products Division of W. R. Grace & Co. at Nashville

continued expanding crude vermiculite from South Carolina. Vermiculite was used for concrete and plaster aggregates, fire-proof loose-fill insulation, agriculture, and fire-proof base for fire beds.

METALS

Metals accounted for 22 percent of the total value of mineral production in 1971. Zinc production accounted for 72 percent of metal value, and copper accounted for most of the remainder. Total metal production was down 2 percent from 1970.

Aluminum.—Tennessee ranked third in the Nation in quantity and value of aluminum produced in 1971. The Aluminum Co. of America (Alcoa) in Blount County and Consolidated Aluminum Corp. (Conalco) in Madison County produced aluminum metal from alumina imported from outside the State.

Alcoa suspended operation of a second potline on July 3, 1971, with an annual capacity of 25,000 tons and deferred the production schedule of its new 100,000-ton line. The shutdown and delay was necessary to help keep the primary aluminum supply in balance with market demand. Aluminum production decreased 14 percent from that of 1970.

Copper.—Cities Service Co., Copperhill Operations, in Polk County, was the only producer of copper in the State. The company recovered copper concentrate from sulfide ore mined in its five underground

mines in Polk County. Mining operations were at capacity throughout the year. Copper metal production in 1971 was 13,916 short tons valued at \$14.5 million, a decline of 10 percent in quantity and 19 percent in value from the previous year. Part of the output was used to make copper sulfate, and the remainder was shipped to refineries outside the State as blister copper. The blister copper was solidified in two ways, either as 1-ton cakes which were shipped to refineries, or as pellets which were used as raw material in the copper sulfate plant. The copper sulfate production used two of Cities Service Co.'s products as basic material—copper pellets and sulfuric acid. The copper sulfate was used in fertilizer mixtures, chemical processing, plating, flotation metallurgy, inks, animal feeds, and for algae control in water purification. The crystals were produced in several sizes to meet customer requirements. The major byproduct, however, was sulfuric acid.

Modernization and expansion of the complex at Copperhill progressed on schedule. When the project is completed in 1972, the output will increase approximately 40 percent. The expansion program will not only increase the copper production but also the byproduct yield. The program includes replacement of the Copperhill reverberatory furnace with an electric furnace which will permit offgas recovery of most of the smelter's sulfur throughput.

Table 10.—Mine production (recoverable) of gold, silver, copper, and zinc

	1969	1970	1971
Mines producing: Lode	13	13	13
Material sold or treated:			
Ore			
Copper-zinc	5,863	5,837	¹ 5,948
Zinc	1,574	1,680	1,704
Production (recoverable):	4,239	4,157	4,245
Quantity:			
Gold	126	124	192
Silver	78,614	94,770	131,349
Copper	15,353	15,535	13,916
Zinc	124,532	118,260	119,295
Value:			
Gold	\$5	\$5	\$8
Silver	141	168	203
Copper	14,596	17,928	14,473
Zinc	36,363	36,233	38,413
Total	51,105	54,333	¹ 53,097

¹ Data may not add to totals shown because of independent rounding.

Ferroalloys.—Five companies produced ferroalloys in Maury, Roane, and Shelby Counties. The plants in Maury County produced ferrophosphorus as a byproduct in making phosphorus; the plants in Roane and Shelby Counties produced ferromanganese, ferrosilicon, and silicomanganese. The Shelby County plant also produced ferrochromium and ferrochromium-silicon.

Shipments of ferroalloys in 1971 were 204,354 short tons valued at \$37.7 million.

Gold.—Gold recovered at out-of-state refineries was a byproduct of refining copper from Cities Service Co., Copperhill Operations. Although copper production decreased from 1970, the yield and value of gold recovered increased to 192 troy ounces valued at \$7,920.

Manganese.—For economic reasons Foote Mineral Co. transferred all its Knoxville, Tenn., manganese activities to its new and expanded facilities at New Johnsonville when electrolytic manganese metal production was stopped at their old plant in downtown Knoxville late in 1970. The plant in Knoxville began laying off employees early in 1971 and by December 31, the entire plant was closed.

Silver.—Silver recovered at out-of-state refineries was a byproduct of refining copper from Cities Service Co., Copperhill Operations. Production of silver increased 38 percent from 1970 to 131,000 troy ounces valued at \$203,000.

Titanium.—E. I. duPont de Nemours and Co., Inc., produced titanium dioxide pigments from concentrates imported from Florida and Georgia. The plant at New Johnsonville had a capacity of 95,000 tons per year. The proposed expansion scheduled for completion in 1971 did not occur, but is expected to go onstream early in 1972 with a capacity of 140,000 tons per year.

Zinc.—Tennessee has led the Nation in zinc production since 1957. In 1971, the State produced 24 percent of the zinc in the United States. Production, which was more than last year, amounted to 119,295 tons valued at \$38.4 million, thus ranking third in value of all commodities produced in the State.

Four companies mined zinc ore from eight mines in eastern Tennessee (Hancock, Jefferson, and Knox Counties). Zinc metal was also recovered from zinc concen-

trates produced by Cities Service Co., Copperhill Operations, in Polk County.

American Zinc Co. of St. Louis, which had extensive holdings in East Tennessee, sold all its mines, plants, mineral properties, and other real estate interests to American Smelting and Refining Company (Asarco). The sale was consummated on November 29, 1971.

The New Jersey Zinc Co. (a subsidiary of Gulf & Western Industries, Inc.) continued exploration and development of the Elmwood discovery site near Carthage in Smith County. A 1,325-foot prospecting shaft was completed and evaluation of the ore's commercial quality began. At the time of the discovery, New Jersey Zinc Co. announced one ore body between 13 and 50 million tons assaying from 5.0 to 10.0 percent zinc. At Jefferson City, the discovery of a small additional body of ore has extended the commercial life of the mine, and studies are being made to determine how long it can be operated profitably.

Occidental Minerals Corp. acquired additional acreage near Carthage, 2 miles from the area of its previous zinc discovery. This new acquisition gave the company control of approximately 10,000 acres, and more land was being optioned. Wide-spaced drilling was initiated late in 1971 to evaluate this new area for the possible existence of additional zinc deposits similar to those found previously. Other major companies that were active in the area included Humble Oil & Refining Co., Cominco American, Inc., and St. Joe Minerals Corp. J. Fred Landers and Assoc. also held mining leases covering about 200,000 acres.

MINERAL FUELS

Mineral fuels accounted for 25 percent of the total value of mineral production in 1971. Increased coal production was responsible for this sharp jump compared to 1970 output, when mineral fuels accounted for 19 percent of the total production value.

Coal (Bituminous).—Coal was the major mineral commodity produced in Tennessee in 1971. The quantity produced and value both increased compared with 1970 figures. Value was \$59 million for 9.3 million short tons, an increase of 1 million short tons. Production was from 186 mines in 16 counties in the Cumberland Plateau region of east-central Tennessee. Strip mining ac-

counted for 58 percent of the total production, underground mining for 38 percent, and auger mining for the remaining 4 percent.

The nine northern counties (Coal District #8) produced 83 percent of the total coal at 141 mines. The seven southern counties (Coal District #13) produced 17 percent at 45 mines.

Most of the coal produced in Tennessee was used for heating and power produc-

tion. Coal-fired steam plants supplied about 75 percent of the total electrical output in 1971. TVA was the major consumer. However, the entire output of more than 1 million tons from Consolidation Coal Co.'s Mathews Mine (the State's largest) went by unitrain operation to the Georgia Power Co. at Eatonton, Ga. Tennessee Consolidated Coal Co. began shipping coking coal to Japan under a long-term contract.

Table 11.—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	
Anderson.....	22	15	4	41	1,111	1,037	116	2,264	\$15,498
Bledsoe.....	--	1	--	1	--	44	--	44	246
Campbell.....	9	25	3	37	110	1,718	157	1,985	14,114
Claiborne.....	2	8	--	10	1,156	962	--	2,118	12,596
Cumberland.....	1	1	--	2	3	5	--	8	53
Fentress.....	3	2	--	5	34	103	--	137	829
Grundy.....	1	2	--	3	39	96	--	135	877
Hamilton.....	1	2	1	4	11	37	6	54	364
Marion.....	19	--	--	19	636	--	--	636	4,068
Morgan.....	7	13	--	20	102	346	--	448	2,811
Putnam.....	1	--	--	1	97	--	--	97	580
Roane.....	1	--	--	1	18	--	--	18	125
Scott.....	2	20	2	24	16	587	18	621	3,338
Sequatchie.....	8	2	1	11	211	186	18	415	2,362
Van Buren.....	1	3	--	4	2	223	--	225	1,095
White.....	--	3	--	3	--	66	--	66	412
Total.....	78	97	11	186	3,546	5,410	315	9,271	59,368

Permits were issued by the State of Tennessee allowing 4,712 acres of land to be disturbed for coal strip mining in 1971.

Coke.—Chattanooga Coke and Chemicals, Woodward Co., Div. The Mead Corp. produced all the State's coke and breeze in its plant at Alton Park, Tenn. Additional commodities produced were ammonium sulfate, crude coal tar, crude light oil, benzene, toluene, xylene and naphthalene. The coal used for production of coke and byproducts was imported from Pennsylvania, Virginia, and West Virginia.

Natural Gas.—Standard Explorations Co. and Pemberton Oil and Lumber Co., Inc., both of Oneida, Tenn., and Harris and Walton of Midland, Tex., were the leading producers of natural gas in 1971. Production was 89 million cubic feet, a 39-percent increase compared with the 64 million cubic feet produced in 1970. Production was from three wells in Scott County, 16 wells in Morgan County, and one well in Warren County.

Petroleum.—Crude oil production for Tennessee in 1971 was 398,424 barrels, up 29 percent over that of 1970.

The Oneida West field produced 369,500 barrels from a total of 45 wells in 1971, and cumulative production totaled 702,000 barrels since mid-1969. Although 20 successful completions were made during the year, the production rate declined appreciably because of excessive flaring of gas in 1970 and 1971. In August the State Oil and Gas Board shut in a number of wells with excessive gas-oil ratios, and by year-end the field was producing about 550 barrels of oil per day.

A total of 171 oil and gas tests reflected an increase in drilling activity, up from 74 wells in 1970. Total footage increased from 96,988 feet in 1970 to 245,844 feet in 1971, of which 169,986 feet was exploratory. No significant discoveries were made during 1971, but there were several small finds made in Scott, Morgan, and Overton Counties. These and other discoveries reported during the year were small and had not been tested sufficiently to be evaluated by the end of 1971. No deep tests were completed in 1971. One well in the Oneida West field, Scott County, was deepened to the Copper Ridge (lower Knox) forma-

tion. Several interesting dry holes were drilled in a relatively unexplored area along the western edge of the structurally deformed Valley and Ridge province. Two Silurian tests drilled on a faulted anticline in Rhea County encountered a massive sec-

tion of Mississippian carbonates and slight shows at several horizons. A 3,125-foot test in southeastern Morgan County was drilled below the Chattanooga Shale in a complexly faulted area.

Table 12.—Oil and gas well drilling completions, by county

	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Foot-age
Cannon.....	--	--	3	1	--	1	5	1,025
Clay.....	--	--	1	2	--	4	7	6,875
Cumberland.....	--	--	--	--	--	2	2	3,657
Fentress.....	--	--	1	--	--	3	4	3,759
Humphreys.....	--	--	--	--	--	1	1	625
Jackson.....	--	--	--	--	--	2	2	1,781
Lewis.....	--	--	--	--	--	1	1	842
Lincoln.....	--	--	--	--	--	1	1	1,315
Macon.....	--	--	--	--	--	1	1	1,429
Morgan.....	1	--	--	--	2	10	13	23,830
Overton.....	6	--	6	3	1	6	22	19,704
Perry.....	--	--	--	--	--	1	1	1,603
Putnam.....	--	--	--	--	--	8	8	8,892
Rhea.....	--	--	--	--	--	2	2	4,245
Scott ¹	28	7	5	9	8	37	94	161,622
Smith.....	--	--	--	--	--	1	1	320
Warren.....	--	1	--	--	1	--	2	296
White.....	--	--	--	--	--	3	3	3,724
Wilson.....	--	--	--	--	--	1	1	350
Total.....	35	8	16	15	12	85	171	245,844
API totals ²	41	9	17	16	14	98	195	273,745

¹ Total of 4,457 feet of exploratory footage drilled in two deeper-pool tests completed as development wells. These wells were classed as development wells, but deeper-drilled footage is added to exploratory total.

² Discrepancy between American Petroleum Institute (API) and Tennessee Division of Geology data are because 24 wells were treated as 1970 completions by Tennessee Division of Geology but as 1971 completions by API.

Source: Tennessee Division of Geology.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum smelters:			
Consolidated Aluminum Corp. New Johnsonville.	1102 Richmond St. Jackson, Tenn. 38301	Plant.....	Humphreys.
Aluminum Co. of America.	P.O. Box 158 Alcoa, Tenn. 37701	.....do.....	Blount.
Barite:			
Godsey Mines, Inc.....	Box 227 Sweetwater, Tenn. 37874	Open pit mine and plant.	McMinn.
N L Industries, Inc., Baroid Division	Box 187 Sweetwater, Tenn. 37874	.....do.....	Monroe.
B. C. Wood.....	Box 284 Sweetwater, Tenn. 37874	.....do.....	Loudon.
Cement:			
General Portland Cement Co., Signal Mountain Division.	1300 American National Bank Bldg. Chattanooga, Tenn. 37402	Plant.....	Hamilton.
Ideal Cement Co.....	P.O. Box 6238 Knoxville, Tenn. 37914	.....do.....	Knox.
Marquette Cement Mfg. Co.	P.O. Box 1242 Nashville, Tenn. 37202	.....do.....	Davidson.
Penn-Dixie Cement Corp..	P.O. Box 157 Cowan, Tenn. 37318	Open pit mine and plant.	Franklin.
	Richard City, Tenn. 37371	Plant.....	Marion.
	Kingsport, Tenn. 37662	.....do.....	Sullivan.
Clay:			
Ball:			
Bell Clay Co.....	Gleason, Tenn. 38229	4 open pit mines and plant.	Weakley.
United Sierra, Div. Cyprus Mines Corp.	.....do.....	8 open pit mines and plant.	Do.
Kentucky-Tennessee Clay Co.	Box 449 Mayfield, Ky. 42066	5 open pit mines and plant.	Henry.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clay—Continued			
Ball—Continued			
Laird Brick Co., Inc.	P.O. Box 98 Furyear, Tenn. 38251	Open pit mine and plant.	Henry.
H. C. Spinks Clay Co., Inc.	Box 829 Paris, Tenn. 38242	7 open pit mines and plants.	Henry and Weakley.
Fuller's earth:			
Southern Clay, Inc. (Subsidiary of Lowe's, Inc.)	Box 819 Paris, Tenn. 38242	Open pit mine and plant.	Henry.
Miscellaneous:			
General Portland Cement Co.	1300 American National Bank Bldg. Chattanooga, Tenn. 37402	-----do-----	Hamilton.
General Shale Pro- ducts Corp.	Box 3547 Johnson City, Tenn. 37601	4 open pit mines and plants.	Hamilton, Knox, Sullivan, and Washington.
Shalite Corp.	Box 441 Knoxville, Tenn. 37901	Open pit mine and plant.	Knox.
Tennlite, Inc.	Box 340 Greenbrier, Tenn. 37073	-----do-----	Davidson.
Coal:			
Consolidation Coal Co.	Box 460 Middlesboro, Ky. 40965	1 underground mine and plant.	Claiborne.
Howard Ensley Coal Co., Inc.	Rt. 1, Box 49B Newcomb, Tenn. 37819	1 strip mine	Campbell.
Farrell Mining Co.	414 Cotton Exchange Bldg. Memphis, Tenn. 38103	1 auger and 1 strip mine.	Do.
Grundy Mining Co.	Box 873 Jasper, Tenn. 37347	2 underground mines.	Marion.
Oliver Springs Mining Co., Inc.	Box 350 Oliver Springs, Tenn. 37840	3 underground mines.	Anderson.
Volunteer Coal Co.	Cody, Ky. 41808	Underground mine	Do.
Coke:			
Chattanooga Coke and Chemicals, Woodward Co., Div. The Mead Corp.	4800 Central Ave. Chattanooga, Tenn. 37410	Plant	Hamilton.
Copper:			
Cities Service Co., Copper- hill Operations.	Copperhill, Tenn. 37317	5 underground mines, mill, smelter, chemical plant.	Polk.
Ferroalloys:			
Chromium Mining and Smelting Co.	P.O. Box 28538 Memphis, Tenn. 38128	Plant	Shelby.
Hooker Chemical Corp.	P.O. Box 591 Columbia, Tenn. 38401	-----do-----	Maury.
Monsanto Co.	Columbia, Tenn. 38401	-----do-----	Do.
Roane Electric Furnace, Woodward Co., Div. The Mead Corp.	Box 298 Rockwood, Tenn. 37854	-----do-----	Roane.
Stauffer Chemical Co.	P.O. Box 472 (Furnace Plant) Mt. Pleasant, Tenn. 38474	-----do-----	Maury.
Gold:			
Cities Service Co., Copper- hill Operations.	Copperhill, Tenn. 37317	See Copper	Polk.
Graphite, artificial:			
Union Carbide Corp.	P.O. Box 513 Columbia, Tenn. 38401	Plant	Maury.
Lime, primary:			
Foote Mineral Co.	Rt. 8, Asbury Rd. Knoxville, Tenn. 37914	Limekiln	Knox.
Williams Lime Mfg. Co.	Box 2286 Knoxville, Tenn. 37901	-----do-----	Do.
Natural gas:			
Harris and Walton	P.O. Box 187 Midland, Texas 79701	2 wells	Warren.
Standard Explorations Co.	P.O. Box 420 Oneida, Tenn. 37841	-----do-----	Scott.
Pemberton Oil and Lumber Co., Inc.	P.O. Box P Oneida, Tenn. 37841	9 wells	Morgan.
Perlite, expanded:			
Chemrock Corp.	Osage St. Nashville, Tenn. 37208	Plant	Davidson.
Petroleum:			
E. J. Clowes & William Ray.	P.O. Box 199 Oneida, Tenn. 37841	2 wells	Scott.
C. G. Collins	P.O. Box 370 Greensburg, Ky. 42743	3 wells	Do.
Green River Gas Co.	P.O. Box 420 Oneida, Tenn. 37841	4 wells	Do.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Petroleum—Continued			
Tenexco Co.....	P.O. Box 290 Oneida, Tenn. 37841	3 wells.....	Scott.
Irvin Vawter.....	Box 223 Albany, Ky. 42602	5 wells.....	Do.
Petroleum refinery:			
Delta Refinery Co.....	543 W. Mallory Ave. Memphis, Tenn. 38106	Refinery.....	Shelby.
Phosphate rock:			
Hooker Chemical Corp....	Box 588 Columbia, Tenn. 38401	Open pit mines and plant.....	Hickman and Maury.
Monsanto Co.....	Columbia, Tenn. 38401	.....do.....	Davidson, Giles, Hickman, Maury, and Williamson.
Stauffer Chemical Co.....	P.O. Box 472 (Furnace Plant) Mt. Pleasant, Tenn. 38474	.....do.....	Maury.
Tennessee Valley Authority.	Muscle Shoals Ala. 35660	.....do.....	Maury and Williamson.
Pyrite:			
Cities Service Co., Copper- hill Operations.	Copperhill, Tenn. 37317	See Copper.....	Polk.
Sand and gravel:			
Camden Gravel Co.....	Camden, Tenn. 38320	Open pit mine.....	Benton.
Dixie Sand & Gravel Co....	515 River St. Chattanooga, Tenn. 37402	Open pit and dredge.....	Hamilton.
Hardy Sand Co.....	P.O. Box 507 Camden, Tenn. 38320	2 open pit mines	Benton.
Memphis Sand & Gravel Co.	Box 6247 Memphis, Tenn. 38106	.....do.....	Benton and Shelby.
T. L. Herbert & Sons.....	1136—2nd Ave., North Nashville, Tenn. 37208	Open pit mine.....	Stewart.
W. S. Jordan Gravel Co....	Box 16142 Memphis, Tenn. 38116	.....do.....	Shelby.
Silver:			
Cities Service Co., Copper- hill Operations.	Copperhill, Tenn. 37317	See Copper.....	Polk
Stone:			
Dolomite:			
Agricultural Lime Co., Inc.	R.F.D. 9 Greeneville, Tenn. 37743	Open quarry.....	Greene.
New Jersey Zinc Co. (Gulf Western Industries, Inc.)	Jefferson City, Tenn. 37760	Underground mine..	Jefferson.
Limestone, crushed:			
Hoover Co.....	Box 7201 Nashville, Tenn. 37210	5 quarries.....	Davidson.
Ralph Rogers & Co....	720 Argyle Ave. Nashville, Tenn. 37203	2 open quarries and 1 underground mine.....	Anderson, Coffee, and Sumner.
The Stone Man, Inc....	3908 B Tennessee Ave. Chattanooga, Tenn. 37409	5 open quarries.....	Bedford, Hamilton, Moore, Ruther- ford, and Warren.
Vulcan Materials Co....	Box 7 Knoxville, Tenn. 37901	20 open quarries....	Anderson, Benton, Blount, Claiborne, Davidson, Decatur, Hamilton, Hardin, Hawkins, Hum- phreys, Knox, Loudon, Marion, Roane, Robertson, Sevier, Sullivan, Wayne, and Williamson.
Watauga Stone Co....	Mascot, Tenn. 37806	Open quarry.....	Carter.
Marble, crushed:			
John J. Craig Co.....	P.O. Box 9300 Knoxville, Tenn. 37920	3 open quarries.....	Blount and Loudon.
Marble, dimension:			
John J. Craig Co.....	.....do.....	4 open quarries.....	Do.
Georgia Marble Co....	Box 1550 Knoxville, Tenn. 37901	2 open quarries.....	Fayette and Union.
Imperial Black Marble Co.	801 Bluff Dr. Knoxville, Tenn. 37919	Open quarry.....	Grainger.
Quartzite, dimension:			
Ross L. Brown Cut Stone Co., Inc.	Crab Orchard, Tenn. 37723	.....do.....	Cumberland.
Crab Orchard Stone Co., Inc.	P.O. Drawer J. Crossville, Tenn. 38555	.....do.....	Do.
Crossville Stone Co....	Box 426 Crossville, Tenn. 38555	.....do.....	Fentress.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Sandstone, crushed:			
Hunt's Gap Sand and Clay Corp.	Box 929 Kingsport, Tenn. 37600	Open quarry-----	Hawkins.
Turner Bros. Stone Co., Inc.	P.O. Box 297 Crossville, Tenn. 38555	-----do-----	Cumberland.
White Silica Sand Co., Inc.	Rt. 2 Caryville, Tenn. 37714	-----do-----	Campbell.
Sandstone, dimension:			
Turner Bros. Stone Co., Inc.	P.O. Box 297 Crossville, Tenn. 38555	-----do-----	Cumberland.
Vermiculite, exfoliated:			
W. R. Grace & Co., Construction Products Div.	4061 Powell Ave. Nashville, Tenn. 37204	Plant-----	Davidson.
Zinc:			
American Zinc Co-----	Mascot, Tenn. 37806-----	4 underground mines and mill.	Jefferson and Knox.
Cities Service Co., Copperhill Operations.	Copperhill, Tenn. 37317-----	See Copper-----	Polk
New Jersey Zinc Co., (Gulf & Western Industries, Inc.)	Jefferson City, Tenn. 37760.	2 underground mines and mill.	Hancock and Jefferson.
New Market Zinc Co-----	Box 66 New Market, Tenn. 37820	Underground mine and mill.	Jefferson.
United States Steel Corp--	Box 599 Fairfield, Ala. 35064	-----do-----	Do.

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 S. O. Wood, Jr.¹ and Roselle Girard²

Mineral output value attained a record high of \$6.8 billion and led the Nation for the 37th consecutive year. Texas ranked first in the production of petroleum, natural gas, natural gas liquids, natural graphite, magnesium metal, and recovered sulfur. Important quantities of helium, Frasch sulfur, lime, gypsum, clays, sand and gravel, salt, metallic sodium, and uranium

were also produced. Mineral production was obtained from 237 of the State's 254 counties. Petroleum was produced in 204 counties, natural gas in 208, nonmetallic minerals in 147, and metallic mineral ores in seven.

¹ Petroleum engineer, Division of Fossil Fuels.
² Geologist, Bureau of Economic Geology, The University of Texas at Austin, Austin, Tex.

Table 1.—Mineral production in Texas¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland..... thousand 376-pound barrels	33,967	\$122,960	38,287	\$140,206
Masonry..... thousand 280-pound barrels	1,007	3,769	1,209	4,514
Clays..... thousand short tons	4,148	9,587	4,615	10,432
Gem stones.....	NA	150	NA	155
Gypsum..... thousand short tons	1,220	4,252	1,303	4,806
Helium:				
High-purity..... million cubic feet	82	2,862	50	1,750
Crude..... do	1,157	13,262	1,208	14,496
Lime..... thousand short tons	1,673	24,427	1,612	24,583
Natural gas (marketed)..... million cubic feet	8,357,716	1,203,511	8,550,705	1,376,664
Natural gas liquids:				
Natural gasoline and cycle products				
LP gases..... thousand 42-gallon barrels	97,511	234,871	96,286	299,981
Salt..... do	204,177	334,850	210,435	380,887
Petroleum (crude)..... do	1,249,697	4,104,005	1,222,926	4,261,775
Pumicite..... thousand short tons	W	W	4	4
Salt..... do	10,184	45,000	9,217	40,838
Sand and gravel..... do	31,438	46,362	32,788	51,814
Stone..... do	45,557	64,422	41,168	62,144
Sulfur (Frasch process)..... thousand long tons	2,801	62,290	3,075	W
Talc..... short tons	171,420	878	193,830	1,024
Value of items that cannot be disclosed: Asphalt (native), coal (lignite), fluorspar, graphite, iron ore (usable), magnesium chloride (for metal), magnesium compounds (except for metal), mercury, pumicite (1970), sodium sulfate, stone (dimension), uranium (recoverable content U ₃ O ₈) and values indicated by symbol W	XX	74,541	XX	131,882
Total.....	XX	6,401,999	XX	6,807,955
Total 1967 constant dollars.....	XX	5,726,588	XX	5,914,751

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

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

² Excludes value of dimension stone; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Texas, by county 1
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Anderson	\$44,998	\$41,959	Petroleum, natural gas, natural gas liquids.
Andrews	260,084	257,666	Do.
Angelina	201	W	Clays, natural gas, petroleum.
Aransas	13,340	15,083	Natural gas, petroleum, natural gas liquids.
Archer	17,545	17,955	Petroleum, natural gas, sand and gravel, stone.
Armstrong	W	761	Sand and gravel.
Atascosa	22,973	23,305	Petroleum, natural gas, natural gas liquids.
Austin	8,868	9,430	Petroleum, natural gas, sand and gravel, natural gas liquids.
Bastrop	895	884	Petroleum, clays, natural gas.
Baylor	3,700	3,270	Petroleum, sand and gravel, natural gas.
Bee	17,378	17,940	Natural gas, petroleum, natural gas liquids, stone.
Bell	W	W	Sand and gravel.
Bexar	30,794	32,157	Cement, stone, petroleum, natural gas liquids, sand and gravel, lime, clays, natural gas.
Blanco	1	W	Sand and gravel.
Borden	31,398	31,034	Petroleum, natural gas, sand and gravel.
Bosque	W	727	Lime, stone, sand and gravel.
Bowie	339	377	Sand and gravel, petroleum, natural gas.
Brazoria	254,356	244,189	Petroleum, natural gas, magnesium chloride, natural gas liquids, salt, magnesium compounds, lime, sand and gravel.
Brazos	1,189	W	Sand and gravel, petroleum, natural gas.
Brewster	W	W	Mercury, clays, fluorspar.
Briscoe	--	144	Sand and gravel.
Brooks	58,944	62,960	Natural gas, petroleum, natural gas liquids.
Brown	3,090	W	Stone, petroleum, natural gas, clays.
Burleson	485	267	Petroleum, natural gas.
Burnet	4,365	5,418	Stone, graphite, sand and gravel.
Caldwell	10,807	9,918	Petroleum, stone, natural gas, sand and gravel.
Calhoun	29,641	26,175	Natural gas, petroleum, natural gas liquids, stone, lime, sand and gravel.
Callahan	5,242	4,888	Petroleum, natural gas, stone, natural gas liquids.
Cameron	2,911	3,008	Natural gas, petroleum.
Camp	3,115	3,254	Petroleum, natural gas.
Carson	31,334	35,334	Natural gas, natural gas liquids, petroleum.
Cass	15,203	20,822	Natural gas liquids, petroleum, natural gas, iron ore.
Chambers	113,420	117,835	Petroleum, natural gas, natural gas liquids, salt, clays.
Cherokee	4,182	11,144	Petroleum, natural gas liquids, natural gas, clays.
Childress	658	773	Sand and gravel, petroleum, natural gas.
Clay	11,893	12,174	Petroleum, stone, natural gas, sand and gravel.
Cochran	39,100	37,182	Petroleum, natural gas, natural gas liquids.
Coke	26,247	25,123	Petroleum, natural gas liquids, natural gas, sand and gravel.
Coleman	3,485	3,712	Petroleum, natural gas, stone, clays.
Collin	W	W	Stone, lime, sand and gravel.
Collingsworth	1,027	1,565	Natural gas, petroleum.
Colorado	45,538	53,002	Natural gas, natural gas liquids, sand and gravel, petroleum.
Comal	W	W	Stone, lime, sand and gravel.
Comanche	147	178	Natural gas, stone, clays, petroleum.
Concho	1,592	1,648	Petroleum, natural gas, natural gas liquids.
Cooke	29,986	33,427	Petroleum, natural gas liquids, natural gas, sand and gravel.
Coryell	W	W	Sand and gravel, stone.
Cottle	81	71	Petroleum, natural gas, sand and gravel.
Crane	187,436	206,119	Petroleum, natural gas, natural gas liquids.
Crockett	48,603	53,411	Do.
Crosby	1,107	1,053	Sand and gravel, petroleum, natural gas.
Culberson	W	W	Sulfur, petroleum, natural gas, stone, talc.
Dallam	27	29	Natural gas.
Dallas	13,927	15,261	Sand and gravel, cement, stone, clays.
Dawson	34,550	37,602	Petroleum, natural gas, natural gas liquids, stone.
Denton	1,781	1,992	Sand and gravel, clays, petroleum, stone, natural gas.
DeWitt	13,248	13,298	Natural gas, petroleum, natural gas liquids, sand and gravel.
Dickens	1,339	1,058	Petroleum, sand and gravel, natural gas.
Dimmit	3,232	21,853	Petroleum, natural gas, natural gas liquids.
Donley	W	51	Sand and gravel, natural gas.
Duval	36,758	38,819	Petroleum, natural gas, natural gas liquids, salt, sand and gravel.
Eastland	2,447	3,507	Petroleum, stone, natural gas, clays, natural gas liquids.
Ector	305,842	335,673	Petroleum, natural gas liquids, natural gas, cement, stone.
Edwards	68	39	Petroleum, natural gas, stone.

See footnotes at end of table.

Table 2.—Value of mineral production in Texas, by county 1—Continued

(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Ellis	W	W	Cement, stone, clays, petroleum, natural gas.
El Paso	\$6,300	W	Cement, stone, sand and gravel.
Erath	1,063	\$989	Natural gas, natural gas liquids, petroleum.
Falls	32	98	Natural gas, petroleum, sand and gravel.
Fayette	1,833	1,631	Petroleum, clays, natural gas, sand and gravel.
Fisher	24,863	27,754	Petroleum, natural gas liquids, natural gas, gypsum, clays.
Floyd	10	7	Petroleum, natural gas.
Foard	1,311	1,172	Petroleum, natural gas, sand and gravel.
Fort Bend	65,152	69,291	Petroleum, sulfur, natural gas, salt, natural gas liquids, clays, sand and gravel.
Franklin	17,647	19,344	Petroleum, natural gas liquids, natural gas.
Freestone	3,753	7,946	Stone, natural gas, coal, petroleum, clays.
Frio	4,416	4,569	Petroleum, natural gas, natural gas liquids.
Gaines	153,501	165,797	Petroleum, natural gas, sodium sulfate, natural gas liquids, stone.
Galveston	48,449	45,928	Petroleum, natural gas, natural gas liquids, sulfur, clays, sand and gravel.
Garza	14,941	15,248	Petroleum, natural gas.
Gillespie	W	W	Gypsum, stone, sand and gravel.
Glasscock	7,472	9,200	Petroleum, natural gas.
Goliad	10,448	10,026	Do.
Gonzales	1,795	1,624	Natural gas, petroleum, clays, sand and gravel.
Gray	39,952	40,203	Petroleum, natural gas, natural gas liquids.
Grayson	34,816	35,231	Petroleum, natural gas, natural gas liquids, sand and gravel, stone.
Gregg	174,552	185,641	Petroleum, natural gas liquids, natural gas.
Grimes	141	92	Petroleum, natural gas, stone.
Guadalupe	9,603	9,627	Petroleum, sand and gravel, clays, natural gas.
Hale	15,020	17,788	Petroleum, natural gas, natural gas liquids.
Hall	W	15	Sand and gravel.
Hamilton	118	78	Natural gas, petroleum.
Hansford	21,161	21,883	Natural gas, helium, petroleum.
Hardeman	5,337	5,211	Petroleum, gypsum, natural gas liquids, natural gas, sand and gravel.
Hardin	29,835	28,579	Petroleum, natural gas, natural gas liquids, sand and gravel.
Harris	155,071	171,777	Petroleum, cement, natural gas liquids, natural gas, lime, salt, sand and gravel, clays, stone.
Harrison	21,244	18,936	Petroleum, natural gas, natural gas liquids, coal, clays.
Hartley	2,232	2,254	Natural gas, petroleum.
Haskell	11,577	10,243	Petroleum, natural gas, stone.
Hays	W	--	
Hemphill	16,455	26,748	Natural gas, petroleum.
Henderson	40,507	44,908	Petroleum, natural gas, natural gas liquids, clays, sand and gravel.
Hidalgo	33,662	36,293	Natural gas, natural gas liquids, petroleum, sand and gravel, clays.
Hill	W	W	Lime.
Hockley	124,143	149,416	Petroleum, natural gas liquids, natural gas.
Hood	569	25	Natural gas.
Hopkins	9,071	11,731	Petroleum, natural gas liquids, natural gas.
Houston	9,826	8,059	Petroleum, natural gas, natural gas liquids.
Howard	60,956	61,457	Petroleum, natural gas liquids, natural gas, sand and gravel.
Hudspeth	1,154	1,892	Talc, petroleum, stone, gypsum, natural gas.
Hunt	194	182	Natural gas, petroleum.
Hutchinson	64,535	74,275	Natural gas liquids, petroleum, natural gas, salt, stone.
Irion	5,059	5,567	Petroleum, natural gas liquids, natural gas.
Jack	16,246	15,916	Petroleum, natural gas, stone, natural gas liquids, sand and gravel.
Jackson	107,459	104,894	Petroleum, natural gas, natural gas liquids, sand and gravel.
Jasper	1,898	2,327	Petroleum, natural gas, stone, lime.
Jefferson	69,835	71,242	Petroleum, natural gas, sulfur, natural gas liquids, salt, sand and gravel.
Jim Hogg	14,533	12,681	Natural gas, petroleum, natural gas liquids.
Jim Wells	84,904	85,850	Do.
Johnson	W	W	Lime, stone, sand and gravel.
Jones	9,379	9,020	Petroleum, natural gas liquids, natural gas, sand and gravel, stone.
Karnes	24,223	25,257	Petroleum, uranium, natural gas, natural gas liquids.
Kaufman	2,946	2,828	Petroleum, stone, natural gas.
Kenedy	22,430	27,507	Natural gas, petroleum, natural gas liquids.
Kent	83,271	56,689	Petroleum, natural gas.
Kerr	W	W	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Texas, by county 1—Continued
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Kimble.....	\$118	\$134	Natural gas.
King.....	3,909	6,032	Petroleum, natural gas.
Kinney.....	--	3	Sand and gravel.
Kleberg.....	171,302	198,456	Natural gas, petroleum, natural gas liquids.
Knox.....	5,452	4,463	Petroleum, natural gas.
Lamb.....	998	1,035	Do.
Lampasas.....	W	3	Sand and gravel.
La Salle.....	2,298	2,582	Petroleum, natural gas.
Lavaca.....	7,818	8,202	Natural gas, natural gas liquids, petroleum.
Lee.....	28	188	Sand and gravel, petroleum, natural gas.
Leon.....	3,149	3,248	Petroleum, natural gas, natural gas liquids.
Liberty.....	39,815	38,167	Petroleum, sulfur, natural gas, natural gas liquids, sand and gravel.
Limestone.....	4,689	5,092	Natural gas, sand and gravel, clays, petroleum.
Lipscomb.....	15,146	13,610	Natural gas, petroleum.
Live Oak.....	20,982	22,217	Natural gas, petroleum, uranium, natural gas liquids.
Llano.....	W	W	Stone, sand and gravel.
Loving.....	5,358	6,070	Petroleum, natural gas, sand and gravel.
Lubbock.....	1,699	2,759	Petroleum, natural gas.
Lynn.....	1,235	1,124	Do.
McCulloch.....	W	W	Sand and gravel, natural gas, stone.
McLennan.....	8,502	9,253	Cement, sand and gravel, natural gas liquids, stone, clays, petroleum, natural gas.
McMullen.....	11,123	11,276	Natural gas, petroleum, sand and gravel.
Madison.....	3,035	2,986	Natural gas, petroleum.
Marion.....	7,138	7,170	Petroleum, natural gas, natural gas liquids, clays.
Martin.....	27,630	39,655	Petroleum, natural gas.
Mason.....	W	2	Sand and gravel.
Matagorda.....	62,100	64,293	Natural gas, petroleum, natural gas liquids, stone, salt, sulfur.
Maverick.....	4,126	4,371	Petroleum, natural gas liquids, natural gas.
Medina.....	880	718	Petroleum, clays, natural gas.
Menard.....	1,015	960	Petroleum, natural gas.
Midland.....	56,024	66,609	Petroleum, natural gas, natural gas liquids, sand and gravel.
Milam.....	W	W	Coal, petroleum, stone, natural gas.
Mills.....	W	10	Stone.
Mitchell.....	14,957	16,673	Petroleum, natural gas, sand and gravel.
Montague.....	18,374	15,277	Petroleum, natural gas, natural gas liquids, sand and gravel.
Montgomery.....	53,354	59,892	Petroleum, natural gas liquids, natural gas, sand and gravel.
Moore.....	62,485	70,581	Natural gas, natural gas liquids, helium, petroleum.
Morris.....	W	W	Iron ore.
Motley.....	1,425	1,921	Petroleum, sand and gravel, natural gas.
Nacogdoches.....	5,764	5,029	Natural gas, iron ore, petroleum, clays.
Navarro.....	4,522	7,231	Petroleum, natural gas, clays, stone, sand and gravel.
Newton.....	4,952	4,856	Petroleum, natural gas, natural gas liquids.
Nolan.....	32,021	34,383	Petroleum, cement, natural gas liquids, natural gas, gypsum, stone, sand and gravel.
Nueces.....	94,717	95,609	Natural gas, petroleum, natural gas liquids, cement, lime, stone, sand and gravel.
Ochiltree.....	33,238	36,908	Petroleum, natural gas, natural gas liquids.
Oldham.....	1,803	1,495	Petroleum, natural gas.
Orange.....	10,282	11,409	Cement, petroleum, natural gas, clays.
Palo Pinto.....	12,279	5,533	Natural gas liquids, natural gas, petroleum, clays, sand and gravel.
Panola.....	26,750	29,616	Natural gas, natural gas liquids, petroleum.
Parker.....	5,183	5,472	Natural gas liquids, natural gas, stone, sand and gravel, clays, petroleum.
Pecos.....	176,663	207,464	Natural gas, petroleum, natural gas liquids, sulfur, sand and gravel.
Polk.....	5,958	6,344	Petroleum, natural gas.
Potter.....	18,448	20,628	Natural gas, natural gas liquids, cement, stone, petroleum.
Presidio.....	W	W	Mercury.
Rains.....	1,304	1,013	Natural gas, petroleum.
Randall.....	1,069	472	Stone.
Reagan.....	41,817	42,558	Petroleum, natural gas liquids, natural gas.
Red River.....	80	73	Petroleum, natural gas.
Reeves.....	32,267	41,908	Natural gas, petroleum, natural gas liquids, sand and gravel, stone.
Refugio.....	137,470	144,378	Petroleum natural gas, natural gas liquids.
Roberts.....	10,335	10,425	Natural gas, petroleum.
Robertson.....	49	51	Natural gas, stone, petroleum.
Runnels.....	6,556	7,292	Petroleum, natural gas, natural gas liquids.
Rusk.....	86,358	87,189	Petroleum, natural gas liquids, natural gas, clays.

See footnotes at end of table.

Table 2.—Value of mineral production in Texas, by county 1—Continued

(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
San Jacinto	\$1,490	\$1,280	Petroleum, natural gas.
San Patricio	45,692	39,644	Petroleum, natural gas, natural gas liquids, stone, sand and gravel, clays.
San Saba	W	6	Stone.
Schleicher	11,921	12,349	Petroleum, natural gas, natural gas liquids.
Scurry	219,447	294,373	Petroleum, natural gas liquids, natural gas, magnesium chloride.
Shackelford	13,232	14,323	Petroleum, natural gas, natural gas liquids, stone.
Shelby	856	1,049	Natural gas, petroleum.
Sherman	11,343	12,424	Do.
Smith	16,303	17,468	Petroleum, natural gas, natural gas liquids, clays.
Somervell	W	W	Sand and gravel.
Starr	44,746	49,682	Petroleum, natural gas, natural gas liquids, stone, pumice, clays.
Stephens	7,172	9,667	Petroleum, natural gas, natural gas liquids.
Sterling	7,323	6,774	Petroleum, natural gas.
Stonewall	22,368	23,061	Petroleum, natural gas liquids, natural gas.
Sutton	2,604	2,544	Natural gas, petroleum, sand and gravel.
Tarrant	9,414	13,692	Cement, sand and gravel, stone, natural gas.
Taylor	12,754	12,869	Petroleum, natural gas, stone, natural gas liquids, clays.
Terrell	4,783	5,457	Natural gas, petroleum.
Terry	34,656	38,835	Petroleum, sodium sulfate, natural gas liquids, natural gas.
Throckmorton	6,567	6,748	Petroleum, natural gas.
Titus	9,135	9,556	Do.
Tom Green	7,566	7,746	Petroleum, natural gas, natural gas liquids.
Travis	5,802	5,317	Lime, stone, sand and gravel, petroleum, natural gas.
Trinity	---	17	Petroleum, natural gas.
Tyler	4,774	4,466	Do.
Upshur	11,214	11,545	Petroleum, natural gas, sand and gravel.
Upton	73,254	61,970	Petroleum, natural gas, natural gas liquids, sand and gravel.
Uvalde	W	7,251	Stone, native asphalt, sand and gravel, natural gas.
Val Verde	510	513	Natural gas, petroleum, sand and gravel.
Van Zandt	52,918	60,752	Petroleum, natural gas liquids, salt, natural gas, stone, clays.
Victoria	23,849	23,734	Petroleum, natural gas, sand and gravel, natural gas liquids.
Walker	282	382	Stone, clays, natural gas, petroleum, sand and gravel.
Waller	66,144	83,002	Natural gas, natural gas liquids, petroleum.
Ward	75,285	93,525	Petroleum, natural gas, natural gas liquids, sand and gravel, salt.
Washington	758	855	Petroleum, stone, sand and gravel, natural gas.
Webb	11,445	11,249	Natural gas, petroleum, natural gas liquids, sand and gravel, clays.
Wharton	64,000	53,881	Petroleum, natural gas, sulfur, natural gas liquids, clays, sand and gravel.
Wheeler	8,882	8,958	Petroleum, natural gas, natural gas liquids, sand and gravel.
Wichita	28,719	28,302	Petroleum, natural gas liquids, sand and gravel, natural gas, stone.
Wilbarger	12,785	14,957	Petroleum, natural gas liquids, natural gas, sand and gravel, stone.
Willacy	14,869	14,715	Petroleum, natural gas.
Williamson	W	W	Stone, lime, petroleum, sand and gravel, natural gas.
Wilson	2,642	2,633	Petroleum, clays, natural gas.
Winkler	105,169	110,767	Petroleum, natural gas, natural gas liquids.
Wise	43,052	46,818	Natural gas liquids, natural gas, stone, petroleum, clays, sand and gravel.
Wood	127,800	137,859	Petroleum, natural gas liquids, natural gas, sand and gravel, clays.
Yoakum	161,230	180,762	Petroleum, natural gas liquids, natural gas, salt.
Young	13,163	12,558	Petroleum, natural gas, natural gas liquids, sand and gravel.
Zapata	4,177	3,858	Natural gas, petroleum, stone.
Zavala	2,062	4,490	Petroleum, natural gas.
Undistributed ²	144,082	91,430	
Total ³	6,401,999	6,807,955	

¹ Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

² The following counties were not listed because no production was reported: Bailey, Bandera, Castro, Deaf Smith, Delta, Fannin, Jeff Davis, Kendall, Lamar, Parmer, Real, Rockwall, Sabine, San Augustine, and Swisher.

³ Includes some sand and gravel and stone that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

⁴ Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Texas business activity

	1970 ^a	1971 ^b	Change, percent
Annual average labor force and employment:			
Total labor force.....	thousands... 4,690.0	4,752.3	+1.3
Unemployment.....	do... 167.8	198.8	+18.5
Employment:			
Construction.....	do... 225.0	226.8	+0.8
Mining.....	do... 103.8	101.7	-2.0
Manufacturing.....	do... 740.9	712.7	-3.8
Transportation and public utilities.....	do... 254.4	254.5	(¹)
Wholesale and retail trade.....	do... 871.7	895.9	+2.8
Finance, insurance, and real estate.....	do... 192.1	200.7	+4.5
Services.....	do... 586.2	598.5	+2.1
Government.....	do... 662.2	680.2	+2.7
Personal income:			
Total.....	millions... \$39,671.0	\$42,193.0	+6.4
Per capita.....	do... \$3,525.0	\$3,682.0	+4.5
Construction activity:			
Value of authorized nonresidential construction.....	millions... \$900.3	\$968.3	+7.6
Number of new building permits issued.....	do... 94,266	127,224	+35.0
Highway construction contracts awarded.....	millions... \$371.8	\$412.2	+10.9
Cement shipments to and within Texas.....	thousand 376-pound barrels... 28,792	32,758	+13.8
Mineral production value.....	millions... \$6,401.9	\$6,807.9	+6.3

^a Preliminary. ^r Revised.
¹ Less than ½ of one percent.

Sources: Survey of Current Business; Area Trends in Employment and Unemployment; Employment and Earnings and Annual Report on the Labor Force; Construction Review; Roads and Streets Magazine; and U.S. Bureau of Mines.

The varied metals-extractive industry in Texas consisted of smelters, refineries, and reduction plant facilities that produced aluminum, antimony, cadmium, copper, iron, lead, magnesium, manganese, sodium, tin-tungsten, and zinc. Precious metals were also recovered in special units associated with existing smelting facilities. Secondary metal recovery plants processed various types of scrap and other secondary materials to recover aluminum, lead, iron and steel, tin, zinc, and precious metals.

The value of mineral output in each of 17 counties was more than \$100 million. In six of these counties, mineral output value exceeded \$200 million. Petroleum continued to be the largest contributor to the State's mineral value by accounting for 62.6 percent of the total. Natural gas and natural gas liquids contributed 20.2 and 10.0 percent, respectively, of the State total.

Mineral industry developments during the year included the following:

Texas Industries, Inc., started construction to increase capacity of its Midlothian cement manufacturing plant from 4.8 million to 6.4 million barrels annually. Gifford-Hill Portland Cement Co. scheduled the addition of a third kiln at its Midlothian plant to increase capacity to 4.5 million barrels annually and increase storage capacity to 325,000 barrels by constructing four additional silos.

United States Steel Corp. completed its first completely new plant in more than 20 years near Houston. The plant can produce more than 1 million tons of high strength alloy and carbon plate steel annually.

Amoco Production Co. shutdown all sulfur mining operations at its High Island plant in June. The shutdown was one of a series of sulfur facility closings attributed to the depressed unit value for sulfur.

Operations were initiated by D & F Minerals to produce fluorspar at a new mine in Brewster County.

The Texas Air Control Board and The Texas Water Quality Board cited many mineral operations for pollution violations. Many citations resulted in fines, and some were instrumental in the shutdown of mineral activities. Among operations shutdown either from citations or because of pollution control costs were The American Zinc Co. smelter at Dumas; the American Magnesium Co. plant that produced magnesium and chlorine at Snyder; and the Sid W. Richardson Carbon & Gasoline Co. plant at Odessa that produced carbon black.

Armco Steel Corp. was ordered to close its Houston coke plant as a result of a suit charging Armco with discharging 1,000 pounds per day of toxic substances into the Houston Ship Channel, filed by the Justice Department at the urging of the

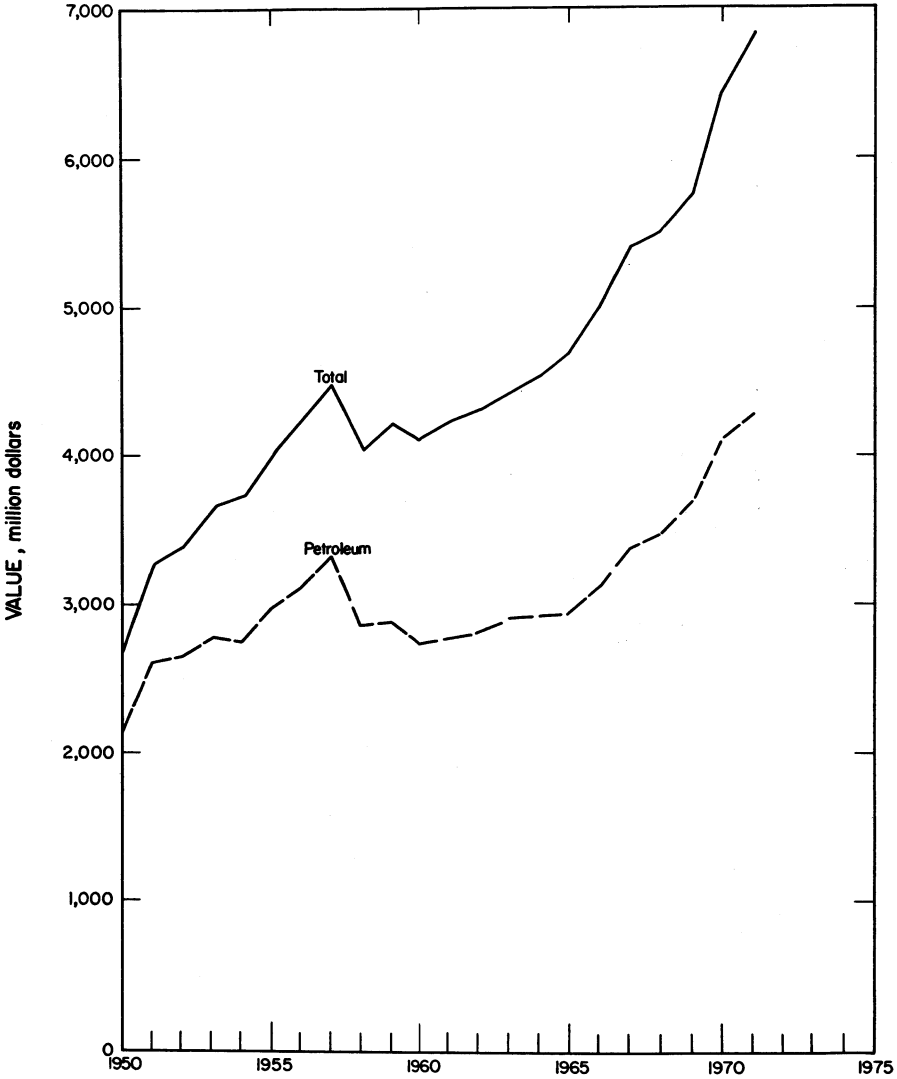


Figure 1.—Value of petroleum and total value of mineral production in Texas.

Environmental Protection Agency. The order to close down was a landmark decision in that the type of effluent pollutants were in solution rather than suspension and were therefore no obstruction to navigation. A consent order, having stringent conditions, was subsequently issued that allowed Armco to resume operating the plant.

Trends and Developments.—Value of

mineral fuels production established a record high. Production and value of natural gas and natural gas liquids continued their long-term trend increases. Although the number of natural gas processing plants decreased, throughput capacity increased. Estimated proved reserves of natural gas, natural gas liquids, and petroleum decreased.

Footage drilled for oil and gas continued

an uninterrupted decline that began in 1962 in spite of increases in average unit value for these commodities. Production of petroleum decreased for the first time since 1960. There were, however, significantly different reasons. The 1960 decrease was attributed to the severe allowable restrictions that reflected a decrease in demand for petroleum produced in Texas. In 1971, allowables were higher than in 1970, and the decrease in production was attributed to a decline in productive capability. The output of coal (lignite) was somewhat higher in 1971 than in 1970. Asphalt, carbon black, and high-purity helium output decreased. One channel process carbon black plant was shutdown.

The trends of nonmetallic minerals was mixed. Output of cement, clays, sand and gravel, gypsum, magnesium compounds, sodium sulfate, and talc increased. Decreased production was reported for graphite, lime, stone, and salt. Sulfur production by the Frasch process decreased, but shipments increased. Sulfur prices, however, continued at depressed levels. The U.S. Treasury Department conducted an antidumping investigation of Mexican sulfur imports following a decision by the Customs Bureau that there were grounds for a full-scale investigation. A provisional finding that Mexican sulfur was being sold at prices which constituted dumping was announced by the Treasury Department in November.³

Contrary to the national trend, output of aluminum in Texas increased slightly.

However, during the last half of the year Aluminum Company of America shutdown one of the eight potlines at its Rockdale plant. Output of iron ore was less than in 1970. Output of uranium and mercury increased significantly. However, declining prices and decreases in demand contributed toward two mercury ore mines becoming inactive during the year.

Legislation and Government Programs.

—A new permit system for industrial air pollution control in Texas became effective on August 30, 1971. The system requires operators in any industry who are planning new construction or modification of a process which emits air contaminants to obtain a permit from the Texas Air Control Board before starting the work.

The U.S. Bureau of Mines contracted with The University of Texas to investigate establishing an early warning system for underground incipient rock failures. In the contracted study, seismic wave characteristics will be noted as the waves pass through rocks that are under stress or in the process of breaking.

Texas and Louisiana attorneys presented information to a U.S. Supreme Court-appointed Special Master to resolve the location of the common boundary along the Sabine River. Louisiana claims the boundary should be the west bank of the river, and Texas claims that the boundary

³ Gittinger, L. B., Jr. Sulfur. Engineering and Mining Journal, v. 173, No. 4, March 1972, pp. 160-163.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Coal.....	120	302	36	290	--	5	17.24	228
Metal.....	1,732	324	561	4,507	2	50	11.54	3,700
Nonmetal.....	2,954	290	856	6,914	5	147	21.99	5,286
Sand and gravel.....	1,914	258	494	4,575	--	126	27.54	1,724
Stone.....	4,266	303	1,291	11,074	2	247	22.48	2,198
Total ¹	10,986	295	3,239	27,360	9	575	21.35	3,126
1971:^p								
Coal.....	130	285	37	296	--	5	16.90	220
Metal.....	1,635	277	453	3,646	--	40	10.97	452
Nonmetal.....	1,980	267	530	4,358	--	139	31.90	681
Sand and gravel.....	1,930	259	500	4,736	--	120	25.34	758
Stone.....	4,310	300	1,294	11,104	2	233	21.16	2,314
Total ¹	9,990	282	2,813	24,140	2	537	22.33	1,407

^p Preliminary.

¹ Data may not add to totals shown because of independent rounding.

should be the middle of the river. A decision is expected in 1972.

Employment and Injuries.—Employment

and injury statistics for the mineral industry as compiled by the Federal Bureau of Mines are shown in table 4.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The value of mineral fuels increased 6.6 percent to \$6,346 million and accounted for 93.2 percent of the State mineral production value. Petroleum continued to rank as the leading mineral commodity and contributed 67.1 percent of the mineral fuels value. Natural gas and natural gas liquids furnished 21.7 and 10.7 percent, respectively, of mineral fuel value. Asphalt, coal (lignite), and helium accounted for the remainder.

Oil production was regulated by the Texas Railroad Commission. During 1971 the market demand factor (MDF) was in the range of 63.0 to 83.1 percent of the base allowable. For the year the average MDF was 72.6 percent as compared with 71.6 percent in 1970. Although the MDF was higher in 1971, petroleum production decreased thereby confirming the decline in producing capability in the State.

An unusual secondary recovery project was started by Standard Oil Co. of Texas, operator for the Scurry Area Canyon Reef Operators Committee (SACROC) unit, in the Kelly-Snyder field. The project is a large-scale miscible-drive application using carbon dioxide (CO₂). A pipeline, about 220 miles in length including laterals, was built to transport CO₂ produced in the Puckett, Brown-Bassett, and Grey Ranch fields to the Kelly-Snyder project site. The operator anticipated that 156 million barrels of additional oil will be recovered from the secondary recovery operations.

According to the American Petroleum Institute (API), a total of 7,271 exploratory and development wells were drilled in Texas (including offshore) in 1971. This was 453 fewer wells than was drilled in 1970, a decline of 5.9 percent. Exploratory drilling accounted for 1,818 wells of which 19.7 percent were completed to produce oil and/or gas. There were 186 successful oil and 172 successful gas exploratory wells. Footage drilled in exploratory operations was oil wells, 1,148,220; gas wells, 1,356,194; and dry holes, 8,746,718 feet. Developmental drilling totaled 5,453 wells of

which 3,694 were oil productive; 638 produced gas, and 1,121 were dry. Success ratio of developmental drilling was 79.4 percent. Footage drilled in developmental operations was oil wells, 16,462,567; gas wells 5,074,832; and dry holes accounted for 4,835,894 feet.

In addition to the above drilling, other wells drilled in association with oil and gas operations (such as service wells, water source wells, disposal wells, etc.) totaled 457. Total footage drilled was 1,412,464 feet.

A world depth drilling record was established on November 6, 1971, when the Ralph Lowe Estate 1-17 University test in west-central Pecos County passed the previous depth record of 25,600 feet. At year-end drilling operations were in progress below 27,700 feet, and projected total depth was 28,500 feet.

A new world depth record for a producing well was established with completion of Texaco, Inc., No. 1 S.E. Riggs Gas Unit to produce 20 MMcf of gas from a perforated interval at 21,837 to 23,040 feet. The well is about 6 miles northwest of Fort Stockton, Pecos County, in the Gomez (Ellenburger) gasfield.

Pipelines.—Products and natural gas pipelines accounted for most of the pipeline construction projects completed in 1971. One of the largest projects was the Explorer pipeline. This products common carrier extends from the Gulf Coast to Chicago and is jointly owned by Gulf Oil Corp.; Shell Oil Co.; Texaco, Inc.; Sun Oil Co.; Continental Oil Co.; Cities Service Oil Co.; Phillips Petroleum Co.; and Apco Oil Corp. The 28-inch line was completed from the Gulf Coast to Tulsa, Okla., and was operational at yearend. Six products—jet fuel, three grades of gasoline, and two grades of distillate fuel oil were transported by this pipeline. Eventual line capacity is expected to be 800,000 barrels per day. Mobil Pipeline Co. installed 175 miles of 12 3/4-inch line from Corsicana to Hull, 40 miles of 12 3/4-inch line from Hull to Beaumont and 30 miles of 8 5/8-inch line

Table 5.—Production and value of petroleum, natural gas and natural gas liquids

Year	Crude petroleum		Natural gas ¹		
	Thousand 42-gallon barrels	Value (thousands)	Million cubic feet	Value (thousands)	
1967	1,119,962	\$3,375,565	7,188,900	\$948,935	
1968	1,133,380	3,450,707	7,495,414	1,011,881	
1969	1,151,775	3,696,328	7,853,199	1,075,888	
1970	1,249,697	4,104,005	8,357,716	1,203,511	
1971	1,222,926	4,261,775	8,550,705	1,376,664	

	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)
1967	95,991	\$277,105	177,367	\$320,326	273,358	\$597,431
1968	97,075	269,132	189,162	278,063	286,237	547,250
1969	96,628	289,042	194,599	237,411	291,227	526,453
1970	97,511	284,871	204,177	334,850	301,688	619,721
1971	96,286	299,981	210,435	330,887	306,721	630,368

¹ Marketed production, gas either sold or consumed by producers including losses in transmission, amounts added to storage, and increases in gas pipelines.

Table 6.—Production trends of crude oil, natural gas, and natural gas liquids

(Million barrels of crude oil equivalent)

	Production ¹				Percentage of—							
					Annual total			Change from previous year				
	Oil	Gas	Liquids	Total	Oil	Gas	Liquids	Oil	Gas	Liquids	Total	
1967	1,120	1,284	199	2,603	43.0	49.3	7.7	5.9	3.4	11.2	5.0	
1968	1,133	1,338	203	2,679	42.3	49.9	7.8	1.2	4.2	4.5	2.9	
1969	1,152	1,402	211	2,765	41.7	50.7	7.6	1.7	4.8	1.4	3.2	
1970	1,250	1,492	219	2,961	42.2	50.4	7.4	8.5	6.4	3.8	7.1	
1971	1,223	1,527	224	2,974	41.1	51.4	7.5	-2.2	2.4	2.3	.4	

¹ One barrel of crude oil equivalent to 5,600 cubic feet of natural gas or 57.6 gallons of natural gas liquids.

Table 7.—Comparison of crude oil, natural gas, and natural gas liquids production in Texas and the United States

(Million barrels of crude oil equivalent)

Fuel	Production as oil equivalent ¹				Change from 1970 (percent)		Distribution percentage				Texas percent of United States	
	Texas		United States		Texas	United States	Texas		United States		1970	1971
	1970	1971	1970	1971			1970	1971	1970	1971		
	1970	1971	1970	1971								
Crude oil	1,250	1,223	3,517	3,454	-2.2	-1.8	42.2	41.1	44.7	43.6	35.5	35.4
Natural gas	1,492	1,527	3,914	4,017	+2.3	+2.6	50.4	51.4	49.7	50.7	38.1	38.0
Natural gas liquids	219	224	440	450	+2.3	+2.3	7.4	7.5	5.6	5.7	49.8	49.8
Total equivalent	2,961	2,974	7,871	7,921	+.4	+.6	100.0	100.0	100.0	100.0	37.6	37.5

¹ One barrel of crude oil equivalent to 5,600 cubic feet of natural gas or 57.6 gallons of natural gas liquids.

Table 8.—Crude oil, natural gas, and natural gas liquids reserves to production ratio in Texas and the United States

(Million barrels of crude oil equivalent)

Fuel	Percent											
	Reserves ¹				Texas of		Change from 1970		Reserve ratio			
	Texas		United States		United States				Texas		United States	
	1970	1971	1970	1971	1970	1971	Texas	United States	1970	1971	1970	1971
Crude oil.....	13,195	13,024	99,001	98,063	33.8	34.2	-1.3	-2.4	10.6	10.6	11.1	11.0
Natural gas.....	18,992	18,120	51,919	49,787	36.6	36.4	-4.6	-4.1	12.7	11.9	13.3	12.4
Natural gas liquids..	2,428	2,261	5,617	5,326	43.2	42.5	-6.9	-5.2	11.1	10.1	12.8	11.8
Total oil equivalent.	34,615	33,405	96,537	93,176	35.9	35.9	-3.5	-3.5	11.7	11.2	12.3	11.8

¹ Estimated proved reserves from American Petroleum Institute. One barrel crude oil equivalent to 5,600 cubic feet of natural gas or 57.6 gallons of natural gas liquids.

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

Railroad commission district	Proved reserves Dec. 31, 1970	Extensions and revisions	New fields and new pools	Proved reserves Dec. 31, 1971	Change from Dec. 31, 1970
NATURAL GAS (MILLION CUBIC FEET)					
1.....	1,954,567	-19,705	39,113	1,843,711	-110,856
2.....	10,060,030	+164,147	174,599	9,811,922	-248,108
3.....	22,813,727	+570,708	345,483	22,115,227	-698,500
4.....	29,237,231	-960,195	401,345	27,073,438	-2,213,793
5.....	1,393,484	-39,583	20,263	1,260,652	-132,832
6.....	5,830,740	+195,768	83,162	5,736,503	-94,237
7B.....	752,131	-42,445	5,813	627,582	-124,549
7C.....	3,602,966	-304,451	13,787	3,074,154	-528,812
8.....	16,104,203	+1,487,279	41,529	15,887,502	-216,701
8A.....	2,596,621	+171,786	1,073	2,533,463	-63,158
9.....	1,864,447	-4,644	1,864	1,683,171	-181,276
10.....	10,092,846	+872,408	68,313	9,824,783	-268,063
Total.....	106,352,993	+2,091,073	1,196,344	101,472,103	-4,880,885
NATURAL GAS LIQUIDS (THOUSAND BARRELS)					
1.....	28,980	-2,587	1,412	24,832	-4,148
2.....	132,961	+8,890	2,018	130,974	-1,987
3.....	635,846	+545	2,863	623,599	-57,247
4.....	597,633	-14,411	8,499	526,108	-71,575
5.....	83,915	-329	252	78,093	-5,822
6.....	423,879	+4,945	947	402,660	-21,219
7B.....	58,790	-5,635	452	45,692	-13,098
7C.....	173,494	+1,060	303	158,082	-15,412
8.....	499,965	+40,865	23	476,654	-23,311
8A.....	272,197	+14,845	0	261,322	-10,875
9.....	68,304	+8,760	81	67,422	-882
10.....	304,145	+30,142	2,061	300,179	-3,966
Total.....	3,330,159	+87,090	18,911	3,100,617	-229,542
CRUDE OIL (THOUSAND BARRELS)					
1.....	153,325	+21,452	3,225	157,078	+3,753
2.....	844,961	+11,544	2,525	785,638	-59,323
3.....	1,686,995	+102,625	4,215	1,638,611	-48,384
4.....	523,403	-55,266	10,386	415,664	-112,739
5.....	128,102	+6,775	195	118,305	-9,797
6.....	2,497,771	+9,782	602	2,359,624	-138,147
7B.....	238,803	+4,014	3,047	209,473	-29,330
7C.....	298,519	-14,270	2,623	251,304	-47,215
8.....	3,106,879	+703,594	3,753	3,528,991	+422,112
8A.....	3,130,328	+136,102	2,778	3,002,588	-127,740
9.....	363,453	+39,131	4,897	356,007	-7,451
10.....	217,932	+7,097	--	200,246	-17,686
Total.....	13,195,476	+972,580	38,246	13,023,529	-171,947

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

from Hull to Mont Belview. The system was designed to transport liquefied petroleum gases. Santa Fe Pipeline Co. installed 27 miles of 4-inch line to connect the Hamlin plant, Fisher County, with the Chaparral pipeline. Coastal States Gas Producing Co. through its subsidiary Lo Vaca Gathering Co. began gas deliveries from its 395-mile 36-inch North Texas intrastate system that is jointly owned with Texas Utilities Co. The system was connected to Coastal's West Texas system in Pecos County.

Cities Service Gas Co. completed 187 miles of 26-inch line from the Texas Panhandle to Blackwell, Okla. The line was an extension to supply the company's five-State 7,500-mile distribution system. Transcontinental Gas Pipeline Corp. completed an 88.5 mile gas pipeline project, 54.5 miles of 30-inch line and 34.0 miles of 20-inch line, to connect the company's field gathering lateral at North Markham with offshore production in the Brazos area off Matagorda County.

Tesoro Petroleum Corp. installed 20 miles of 6-inch, 8 miles of 4-inch, and 2 miles of 3-inch crude pipelines to connect the Big Wells field in Dimmit County with the Humble Pipe Line Co. 8-inch line at Pearsall.

Asphalt (Native).—Native asphalt was produced in Uvalde County. Although output was down from the 1970 level, increases in unit value resulted in a small increase in total value. Principal use for this commodity was for highway maintenance.

Carbon Black.—Production was 1,326 million pounds, a decrease of 70 million pounds or 5 percent less than 1970 production. The rubber industry continued as the largest market for carbon black. Texas was the leading producer of carbon black and accounted for 44 percent of the Nation's output. During the year, 11 furnace, three channel, and one combination furnace and channel type plants operated in 13 counties. Furnace production was 1,280 million pounds, 96.5 percent of total output. Statewide, the yield from 32 billion cubic feet of natural gas feed averaged 1.34 pounds per thousand cubic feet (Mcf), and average yield from 250 million gallons of liquid hydrocarbon feed was 5.13 pounds per gallon.

Sid Richardson Carbon & Gasoline Co.

started construction of an additional unit at its Big Spring plant. Yearly capacity will be increased from 85 million to 120 million pounds. This plant produces reinforcement-type carbon black used in the manufacture of tires and other segments of the rubber industry. The Sid W. Richardson Carbon & Gasoline Co. shutdown its Odessa plant on July 1, 1971. This channel process plant had been cited by the Texas Air Pollution Control Board due to pollution emitted during production operations.

Coal (Lignite).—Freestone became the third active lignite producing county in 1971. Atlas Chemical Industries, Inc., continued to mine lignite in Harrison County for use in making activated carbon, and Industrial Generating Co. mined lignite in Milam County to fuel an electric generating plant. Production from Freestone County was used to fuel the Big Brown electric generating plant, about 10 miles northeast of Fairfield, that is owned jointly by Texas Power and Light Co., Dallas Power and Light Co., and Texas Electric Service Co. The first unit of the plant was scheduled to become fully operational in 1972, and lignite fuel requirement was expected to increase to 5.4 million tons annually in 1973 with the start up of a second unit.

Coastal Gas Co. drilled test holes on a 1-mile grid pattern to evaluate lignite deposits in a 100-square mile area in McMullen County, about 70 miles south of San Antonio. The company also conducted exploratory drilling operations in Lee and Bastrop Counties, about 30 miles east of Austin.

Helium.—About one-fourth of the total U.S. production was in Texas. Three extraction plants recovered helium. The Federal Bureau of Mines operated one plant at Excell. Phillips Petroleum Co. operated two plants, one each in Moore and Hansford Counties. Helium production in Texas totaled 1,258 MMcf, virtually unchanged from the previous year. The entire high-purity helium output of 50.3 MMcf was from the Bureau of Mines plant and was valued at \$1.8 million. Output of 239.1 MMcf of crude helium from the Bureau plant was stored underground in the Cliffside field in Potter County for conservation purposes.

Production from the two Phillips Petroleum Co. plants totaled 973.4 MMcf of

crude helium, a decrease of 2.2 percent from the 1970 output of 995.4 MMcf. The Bureau of Mines purchased 956.5 MMcf from Phillips Petroleum Co. for \$11.5 million for storage as part of the helium conservation program.

An extensive modernization of the Bureau of Mines plant was underway and scheduled for completion in mid-1972.

Natural Gas.—Texas continued as the Nation's leader in output and volume of natural gas. Production of 9.5 trillion cubic feet, 7.3 trillion from gas wells and 2.2 trillion from oil wells, was 39.5 percent of U.S. output. Natural gas was obtained from 211 of the 254 counties in the State. According to the Texas Railroad Commission, 18 counties had outputs greater than 100 billion cubic feet, and in nine counties output was more than 200 billion cubic feet. The four leading counties accounted for 22 percent of natural gas production. Principal counties and production in billion cubic feet were: Pecos, 842; Kleberg, 592; Waller, 392; and Nueces 300.

Principal companies ranked according to 1971 production were Humble Oil & Refining Co., Gulf Oil Corp., Mobil Oil Corp., Phillips Petroleum Co., and Amoco Production Co.

At yearend there were 23,280 producing gas wells. Average production was 862 Mcfd per well, 2 percent higher than in 1970. Natural gas produced from oil wells (172,696 wells at yearend 1971) averaged 34.8 Mcfd, a 4-percent increase from 1970 average output.

According to the American Gas Association (AGA), proved natural gas reserves in Texas at yearend 1971 were 101.5 trillion cubic feet, a decrease of 4.9 trillion cubic feet during the year. This State had 36 percent of domestic proved reserves of natural gas at yearend 1971.

AGA estimates indicated additions of 3,287 billion cubic feet of proved natural gas reserves from extensions, new field discoveries, and new reservoir discoveries in old fields. Ninety percent of the additions was nonassociated gas, and the remaining 10 percent was associated-dissolved gas. The AGA defined associated-dissolved gas as the combined volume of natural gas which occurs in crude oil reservoirs either as free gas (associated) or as gas in solution with crude oil (dissolved).

The largest reserve addition was in Rail-

road Commission (RRC) district 8, wherein extensions amounted to 1,487 billion cubic feet. Largest reserve additions from new reservoir discoveries in old fields were in RRC districts 2, 3, and 4. These districts accounted for 85 percent of the 878 billion cubic feet reserve addition for new reservoir discoveries in old fields. Reserve addition from new field discoveries totaled 318 billion cubic feet, and each RRC district was credited with a portion of the addition.

Although marketed gas increased 2.3 percent to a record 8,551 billion cubic feet, the growth was less than half the annual average increase of 4.7 percent experienced from 1965 through 1970. The slowdown in growth rate was considered to be an indicator that production was at near capacity.

Operations for underground storage of gas were conducted in 17 reservoirs—six dry gas, five oil and gas, and six oil. At yearend underground storage capacity was 110 billion cubic feet, and gas in storage totaled 64.5 billion cubic feet.

Drilling activity resulted in completion of 810 gas wells, 172 exploratory and 638 developmental. Exploratory gas well completions were in 70 counties and the offshore area. Wharton County had 10 completions, and the offshore area had eight. Other leading counties and number of successful exploratory gas well completions were Pecos and Sutton, seven; Jackson, Lavaca, and Montgomery, six; and Colorado, Goliad, and Palo Pinto, five.

Developmental gas wells were completed in 102 counties and the offshore area. Leading counties and number of developmental gas well completions were Pecos, 39; Crockett, 35; Sutton, 34; Wharton, 33; and Nueces, 25.

Natural Gas Liquids.—Texas continued as the principal producer of natural gas liquids in 1971, supplying 49.6 percent of the Nation's output. Production increased 1.7 percent to 306.7 million barrels, and value increased 9.9 percent to \$680.9 million. According to the annual Oil and Gas Journal Survey,⁴ there were 374 gas processing plants at yearend 1971 compared with 386 at yearend 1970. Installed capacity was 29.0 MMMcfd, a 1.4-percent decrease from the 1970 yearend capacity of 29.4

⁴ Cantrell, Aileen. 1972 Survey of Gas-Processing Plants. Oil and Gas J., v. 70, No. 28, July 10, 1972, p. 71.

MMMcf. As reported by the American Petroleum Institute (API), proved natural gas liquids reserves at yearend 1971 in Texas were 3.10 billion barrels, a decrease of 6.9 percent during the year. The State had 42.4 percent of the Nation's natural gas liquids reserves.

Among the numerous expansions to existing plants and new plant construction underway or completed were the following. Amoco Production Co. started construction to increase gas-treating capacity by 60 MMcf at its Edgewood plant. Chevron Oil Co. expanded capacity of its North Snyder plant by 130 MMcf. The plant processes gas from the Kelly-Snyder field. Cities Service Oil Co. completed construction of facilities to increase processing capacity of its Seminole gasoline plant by 23 MMcf. Coastal States Gas Producing Co. installed a 60-MMcf natural gas-treating unit at Ft. Stockton. Continental Oil Co. completed construction of a 20-MMcf gas-processing plant near Hamlin. The plant, jointly owned with General Crude Oil Co. and Texas Pacific Oil Co., Inc., processes gas from the Round Top field. Gulf Energy and Development Corp. constructed a gas-treating plant at Corsicana. Gulf Refining Co. increased capacity of its Mont Belview fractionator from 135,000 to 165,000 barrels per day.

Mapco Inc. started construction to expand capacity of their Westpan plant in Hutchinson County by 60 MMcf. Marathon Oil Co. increased gas-processing capacity of its Yates plant to 25 MMcf. Northern Gas Products Co. constructed a 10-MMcf gas-processing plant in Martin County. The plant was designed to recover 113,500 gallons per day of a mixed liquid product. Shell Oil Co. started construction to increase propane recovery capacity of its Bryans Mill plant by 20,000 gallons per day. Shell Oil Co. completed a 15-MMcf expansion in gas-processing capacity of its Tippett plant. Anticipated increase in recovery is 100,000 gallons of ethane and 30,000 gallons of propane per day. Sun Oil Co. started operations to increase throughput capacity of its Snyder plant from 90 MMcf to 160 MMcf. The plant was designed to recover about 70 percent of the ethane and nearly 100 percent of the heavier components of processed gas. Texaco, Inc., doubled capacity of its Knight gas-treating plant near Pecos to 120 MMcf.

The plant processes gas from the Greasewood field. Union Oil Co. of California increased refrigeration absorption capacity of its Van plant by 7.0 MMcf.

Petroleum.—Production declined slightly to 1,223 million barrels, a decrease of 27 million barrels from 1970 output. Although the average market demand factor, 72.6 percent of base allowable, was 1.0 percent higher than in 1970, petroleum output declined. Correlation of output and market demand factors indicated a substantial reduction in productive capacity. The decline in productive capacity was anticipated, however, because of the uninterrupted annual decline in footage drilled since 1962 and the decline of proved crude oil reserves to the lowest level in more than 20 years.

The value of petroleum production attained a record high of \$4,262 million. Although production was 27 million barrels less than in 1970, the average unit value increase from \$3.28 to \$3.48 per barrel was sufficient to establish the record high value. Texas continued to lead the Nation in petroleum output and value. The State accounted for 35.4 percent of the national output and 36.4 percent of the national value for this mineral commodity.

Petroleum producers by rank of 1971 output were Humble Oil & Refining Co., Amoco Production Co., Gulf Oil Corp., Texaco, Inc., Chevron Oil Co., Mobil Oil Corp., Atlantic-Richfield Co., Shell Oil Co., Sun Oil Co., and Union Oil Co. of California.

Petroleum production was obtained from 204 counties. The six leading counties and their production in million barrels were Scurry, 73.0; Andrews, 67.2; Gregg, 48.0; Crane, 45.7; Gaines, 43.8; and Yoakum, 43.8. Combined production from these six leading counties was 321.5 million barrels or 26.3 percent of total State output. Crude oil production in each of 30 counties was more than 10 million barrels. There were 172,696 producing oil wells at yearend 1971, a decrease of 4,525 wells during the year. Average production per well per day during the year was 19.4 barrels, an increase from 19.0 barrels in 1970.

Drilling operations were conducted in 208 counties and the offshore area. Exploratory wells were completed in 195 of these counties and offshore. In each of 17 counties and offshore there were more

than 20 exploratory wells drilled. Leading with 40 exploratory well completions each were Dimmit and Pecos Counties. The offshore area ranked third with 38 completions. There were 186 successful oil exploratory wells completed in 73 counties. In three counties—Pecos, Shackelford, and Throckmorton—10 successful exploratory oil wells were completed. Seven successful exploratory oil wells were reported for Howard, Taylor, and Young Counties. Other leaders in number of successful exploratory oil well completions were Irion with six and Dimmit with five wells.

Developmental drilling was conducted in 178 counties and offshore. More than 100 developmental wells were drilled in 10 counties. The leading counties and number of developmental wells drilled were Martin, 321; Wichita, 226; Dimmit, 177; Ector, 165; Crane, 163; Shackelford and Yoakum, 152; Hockley, 142; Archer, 118; and Caldwell, 107. Successful developmental oil well completions were made in 153 counties. In eight counties there were more than 100 successful oil well completions. These counties and the number of developmental oil well completions were Martin, 321; Wichita, 199; Dimmit, 172; Yoakum, 151; Crane, 149; Ector, 143; Hockley, 138; and Caldwell, 105. These eight counties combined accounted for 37 percent of the successful developmental oil well completions.

Crude oil stocks above ground in Texas at yearend totaled 81.6 million barrels, a decrease of 13.9 percent from the end of 1970. Refinery product stocks were 115.7 million barrels, 16.8 percent of the U.S. total. Stocks at tank farms and in pipelines totaled 62.7 million barrels, and lease tank stocks were 4.9 million barrels. Compared with 1970 end of the year stocks, refinery product stocks were up 5.9 percent, tank farm and pipeline crude petroleum stocks were down 12.9 percent, and lease stocks were down 8.4 percent. The 1971 crude oil refinery receipts in Texas amounted to 1,067 million barrels, 26.1 percent of U.S. total. Intrastate production accounted for 74.8 percent of the Texas refinery receipts. Refinery receipts from interstate sources were 23.5 percent, and foreign receipts were 1.7 percent.

The 40 active refineries in Texas had a calendar day throughput capacity of 3.47 million barrels, virtually unchanged from the previous year, according to the Oil and

Gas Journal annual survey.⁵ The State had 26.5 percent of total domestic refining capacity. There were three fewer refineries in Texas than in 1970; however, refinery capacity was virtually unchanged due to additions and expansion at existing refineries. Among construction activities completed or started in 1971 were the following: American Oil Co. added gasoline splitter facilities (43,000 barrels per day) and increased ultraformer capacity from 90,000 to 135,000 barrels per day at its Texas City refinery. Total capacity of the refinery was increased to 335,000 barrels per day. Atlantic Richfield Co. began construction to add 40,000 barrels per day of catalytic reforming capacity to its Houston refinery. BP Oil Corp. started installation of a light naphtha treating unit at their Port Arthur refinery. Champlin Petroleum Co. increased total capacity of its Corpus Christi refinery to 61,200 barrels per day. The company also began construction to increase platforming capacity to 26,200 barrels per day and catalytic hydrotreating capacity to 26,500 barrels per day. Chevron Oil Co. added a 25,000-barrel-per-day rheniforming unit to its El Paso refinery. Diamond Shamrock Oil and Gas Co. increased throughput capacity of its Sunray refinery to 47,500 barrels per day. Vacuum capacity was also increased to 14,000 barrels per day. Humble Oil & Refining Co. added a two-train Hydrofiner (total capacity 60,000 barrels per day) to its Baytown refinery. Mobil Oil Corp. increased lube-oil capacity of their Beaumont refinery to 8,800 barrels per day and was also adding 55,000 barrels per day of fluid catalytic-cracking capability.

Phillips Petroleum Co. completed a 26,000-barrel-per-day catalytic reformer feed addition to its Sweeny refinery. The company also started construction to increase catalytic reformer feed and hydrotreating capacities at its Borger refinery. Shell Oil Co. completed additions of 25,000 barrels per day of catalytic hydrocracking facilities, 36,000 barrels per day of catalytic reformer equipment, and a 75-MMcfd hydrogen-synthesis unit at its Deer Park refinery. Texaco, Inc., completed the expansion of its Port Arthur refinery to 400,000 barrels per day throughput capacity. This refinery

⁵ Oil and Gas Journal. Survey of Operating Refineries in the U.S. V. 70, No. 13, Mar. 27, 1972, p. 136.

Table 10.—Oil and gas well drilling completions, by county

County	Proved field wells ¹			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Anderson	62	3	16	--	1	10	92	219,293
Andrews	54	--	4	1	--	3	62	477,299
Angelina	--	--	--	--	--	3	3	18,178
Aransas	1	7	5	--	1	5	19	208,453
Archer	78	--	40	3	--	18	139	375,061
Atascosa	6	--	6	1	--	9	22	127,105
Austin	9	--	1	--	--	2	12	15,465
Bandera	--	--	--	--	--	2	2	14,803
Bastrop	8	--	--	--	--	2	10	23,838
Baylor	--	--	5	1	--	4	10	38,796
Bee	2	6	6	1	4	15	34	189,550
Bexar	18	--	2	--	--	1	21	20,375
Borden	7	--	3	2	--	9	21	158,950
Bowie	--	1	--	--	--	2	3	28,271
Brazoria	31	1	16	3	1	10	62	395,842
Brazos	2	6	3	--	--	1	12	51,818
Brewster	--	--	--	--	--	1	1	7,201
Briscoe	--	--	--	--	--	1	1	8,888
Brooks	9	4	3	--	1	6	23	172,239
Brown	30	2	9	--	--	7	48	90,292
Burleson	18	--	4	--	--	1	23	75,529
Caldwell	105	--	2	--	--	2	109	253,280
Calhoun	2	8	3	2	1	17	33	266,321
Callahan	35	4	40	1	--	18	98	124,578
Cameron	1	2	1	--	--	6	10	64,730
Camp	--	--	--	--	--	1	1	14,110
Carson	13	1	--	--	--	--	14	45,782
Cass	1	--	1	--	1	4	7	61,410
Chambers	14	2	6	2	2	4	30	234,851
Cherokee	4	1	4	--	--	10	19	94,121
Childress	--	--	--	--	--	1	1	4,800
Clay	26	--	10	1	--	20	57	234,466
Cochran	39	--	1	--	--	1	41	182,241
Coke	3	--	4	2	--	9	18	101,685
Coleman	3	2	6	1	--	7	20	29,780
Colorado	1	9	4	3	5	25	47	344,579
Comanche	--	--	1	--	--	--	1	407
Concho	--	--	--	--	--	9	9	20,922
Cooke	31	--	11	1	--	14	57	171,554
Coryell	--	--	--	--	--	1	1	7,481
Cottle	--	--	1	--	--	4	5	23,333
Crane	149	4	10	4	--	6	173	748,123
Crockett	19	35	9	4	2	11	80	471,744
Crosby	--	--	--	--	--	2	2	14,000
Culberson	--	--	2	--	--	6	8	15,615
Dawson	33	--	4	--	--	5	42	263,322
DeWitt	2	3	--	2	--	6	13	98,144
Dickens	1	--	2	--	--	5	8	43,560
Dimmit	172	1	4	5	--	35	217	1,212,613
Duval	20	10	23	--	2	18	73	249,756
Eastland	8	--	1	--	--	9	9	24,860
Ector	143	1	21	1	--	--	167	1,033,139
Ellis	--	--	--	--	--	2	2	3,636
Erath	2	2	--	--	2	6	12	29,020
Falls	--	--	10	--	3	1	16	38,077
Fannin	2	--	--	--	--	1	1	16,200
Fayette	--	2	--	--	5	7	28,550	
Fisher	18	--	3	--	--	15	36	165,244
Floyd	--	--	--	--	--	1	1	4,670
Foard	--	--	--	--	--	1	1	3,593
Fort Bend	41	3	8	--	1	6	59	266,075
Franklin	5	--	2	--	--	1	8	56,621
Freestone	--	1	3	--	2	2	8	57,550
Frio	--	--	--	--	--	17	17	88,985
Gaines	14	--	6	1	--	16	37	319,236
Galveston	5	1	2	--	4	5	17	162,105
Garza	16	--	2	3	--	10	31	165,762
Glasscock	11	--	--	2	--	5	18	114,866
Goliad	1	8	4	1	5	9	28	164,181
Gonzales	1	--	2	--	--	8	11	38,803
Gray	23	1	6	--	--	--	30	98,222
Gregg	4	--	--	--	--	2	6	22,261
Grimes	--	4	2	--	--	4	10	42,103
Guadalupe	60	--	1	--	--	1	62	159,961
Hale	10	--	1	--	--	--	11	69,019
Hamilton	--	--	--	--	--	2	2	5,609
Hansford	--	4	8	--	--	1	13	84,830
Hardin	43	4	18	--	4	9	78	379,392

See footnotes at end of table.

Table 10.—Oil and gas well drilling completions, by county—Continued

County	Proved field wells ¹			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Harris	51	3	6	--	2	6	68	393,560
Harrison	5	3	5	--	--	5	18	120,900
Hartley	--	1	--	--	--	4	5	29,399
Haskell	2	--	6	--	--	19	27	111,224
Hemphill	1	18	5	--	4	1	29	457,018
Henderson	--	1	1	--	--	2	4	46,674
Hidalgo	--	18	4	--	2	6	30	282,790
Hockley	138	--	4	4	--	4	150	669,905
Hood	--	--	--	--	--	1	1	1,699
Hopkins	1	1	4	--	--	5	11	81,521
Houston	4	6	3	1	3	5	22	205,835
Howard	69	--	6	7	--	11	93	443,041
Hunt	--	--	--	--	--	4	4	21,754
Hutchinson	3	4	1	--	1	1	10	40,235
Irion	11	1	9	6	1	3	31	196,195
Jack	24	8	23	2	--	13	70	231,750
Jackson	23	7	5	3	6	24	68	469,838
Jasper	3	3	3	2	--	5	16	144,042
Jeff Davis	--	--	--	--	--	1	1	8,901
Jefferson	23	2	4	1	1	10	41	250,145
Jim Hogg	5	1	10	--	1	11	28	122,847
Jim Wells	12	8	9	--	1	1	31	186,809
Jones	18	--	16	2	--	11	47	116,965
Karnes	1	2	--	--	2	8	13	101,621
Kaufman	--	1	--	--	--	5	6	36,727
Kenedy	2	7	1	--	1	9	20	197,676
Kent	16	--	2	1	--	11	30	171,886
Kimble	--	--	--	--	--	2	2	7,913
King	12	--	7	2	--	7	28	135,464
Kleberg	38	8	17	--	3	7	73	571,086
Knox	7	--	2	--	--	5	14	39,638
Lamb	--	--	--	--	--	1	1	8,666
La Salle	9	5	3	2	1	15	35	180,347
Lavaca	3	7	2	2	6	15	35	292,029
Lee	--	--	--	1	--	--	1	8,245
Leon	1	4	--	--	1	2	8	53,398
Liberty	27	2	13	--	1	10	53	304,275
Limestone	3	1	6	--	--	9	19	141,061
Lipscomb	3	5	4	--	--	1	13	102,552
Live Oak	4	4	5	1	4	22	40	204,624
Loving	1	--	1	--	--	--	2	8,443
Lubbock	11	--	2	--	--	6	19	134,870
Lynn	--	--	--	--	--	4	4	27,191
McCulloch	--	--	17	--	--	4	21	28,539
McMullen	2	4	2	--	3	11	22	142,057
Madison	--	2	1	--	--	1	4	39,749
Marion	57	--	4	1	--	5	67	207,435
Martin	321	--	--	3	--	--	324	2,971,675
Matagorda	1	6	6	1	3	16	33	265,062
Maverick	10	--	2	2	--	11	25	65,441
Medina	1	--	1	--	--	--	2	1,929
Menard	2	--	3	2	--	12	19	48,566
Midland	44	3	3	--	--	--	50	367,398
Milam	14	--	3	--	--	8	25	78,013
Mitchell	4	--	--	--	--	--	4	6,908
Montague	10	--	6	3	--	15	34	183,068
Montgomery	2	2	3	1	6	8	22	157,060
Moore	8	4	--	--	--	--	12	30,497
Motley	2	--	1	--	--	1	4	17,348
Nacogdoches	3	--	--	--	1	4	8	50,636
Navarro	11	5	5	--	--	18	39	183,223
Newton	4	3	4	4	3	11	29	255,454
Nolan	46	--	6	4	2	12	70	408,383
Nueces	15	25	19	--	2	11	72	569,187
Ochiltree	15	5	4	--	--	1	25	211,956
Oldham	--	--	1	--	--	1	2	14,678
Orange	5	--	1	--	--	6	12	84,466
Palo Pinto	5	8	9	1	5	7	35	119,484
Panola	10	1	2	1	1	--	15	82,448
Parker	--	4	3	--	1	1	9	29,496
Parmer	--	--	--	--	--	1	1	4,250
Pecos	43	39	20	10	7	23	142	1,186,472
Polk	--	--	4	--	--	1	5	29,776
Potter	4	17	3	--	--	--	24	57,363
Rains	--	1	--	--	--	--	1	12,810
Reagan	94	--	1	1	--	--	96	295,576
Real	--	--	--	--	--	1	1	9,489
Red River	1	--	--	--	--	1	2	9,817

See footnotes at end of table.

Table 10.—Oil and gas well drilling completions, by county—Continued

County	Proved field wells ¹			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Reeves	10	8	2	--	--	7	27	320,463
Refugio	13	19	2	2	1	13	50	298,580
Roberts	1	--	1	--	1	3	6	54,784
Runnels	13	--	7	5	--	14	39	129,832
Rusk	10	--	2	--	1	3	16	78,292
Sabine	--	--	--	--	--	1	1	9,290
San Jacinto	--	1	1	--	--	3	5	45,600
San Patricio	17	12	15	1	--	11	56	416,261
Schleicher	13	5	7	1	1	13	40	197,421
Scurry	34	--	6	2	--	7	49	271,763
Shackelford	95	3	54	10	4	20	186	428,954
Shelby	--	2	--	--	--	6	8	49,339
Sherman	1	1	--	--	--	--	2	8,625
Smith	2	1	2	1	1	13	20	135,581
Starr	19	18	18	1	1	24	81	394,638
Stephens	15	5	7	1	3	7	38	139,756
Sterling	4	--	2	--	--	3	9	61,667
Stonewall	12	--	8	4	--	25	49	231,167
Sutton	--	34	10	--	7	9	60	366,023
Tarrant	--	--	--	--	--	1	1	6,000
Taylor	47	2	28	7	2	24	110	875,209
Terrell	--	--	--	--	--	1	1	5,186
Terry	8	2	3	2	--	7	22	129,829
Throckmorton	40	--	33	10	--	25	108	315,903
Titus	6	--	--	1	--	--	7	30,623
Tom Green	--	--	3	2	--	7	12	59,175
Trinity	--	--	--	--	--	1	1	19,490
Tyler	1	--	--	--	--	8	9	66,853
Upshur	2	7	--	--	1	4	14	139,024
Upton	24	4	3	--	--	3	34	155,502
Val Verde	--	--	--	--	--	1	1	12,600
Van Zandt	9	2	6	--	--	6	23	176,004
Victoria	5	5	6	2	2	13	33	198,661
Walker	--	--	--	--	--	4	4	31,691
Waller	--	3	--	--	--	--	3	22,661
Ward	64	16	13	1	2	6	102	691,391
Washington	--	--	1	--	--	2	3	15,550
Webb	16	18	8	--	1	27	70	355,610
Wharton	10	33	35	--	10	24	112	517,239
Wheeler	4	--	1	--	1	3	9	91,820
Wichita	199	--	27	--	--	3	229	362,030
Willbarger	47	--	45	--	--	10	102	294,097
Willacy	1	7	3	--	--	4	15	99,817
Williamson	--	--	--	--	--	5	5	5,667
Wilson	9	--	3	--	--	17	29	93,659
Winkler	12	4	7	3	1	5	32	320,916
Wise	6	13	2	1	--	1	23	137,591
Wood	16	--	3	4	1	7	31	174,860
Yoakum	151	--	1	1	--	6	159	681,440
Young	56	4	36	7	1	27	131	338,204
Zapata	14	5	5	--	--	11	35	166,713
Zavala	5	1	6	--	1	13	26	110,205
Offshore area	--	2	4	--	8	30	44	446,522
Total	3,694	638	1,121	186	172	1,460	7,271	37,624,425

¹ Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

ranks second in the nation in throughput capacity.

Amerada Hess Corp. shutdown its Corpus Christi 55,000-barrel-per-day refinery in April. The refinery had been operating on a limited basis since some of its processing units were damaged by Hurricane Celia in August 1970.

Wing Corp. closed its 3,000-barrel-per-day refinery at San Antonio in November. The refinery had been in operation for about 40 years.

P.P.G. Industries, Inc., closed its 5,000-barrel-per-day refinery at Corpus Christi.

Petrochemicals.—The petrochemical industry continued to make a major contribution to the manufacturing economy of the State. Most of the industry was concentrated along the Gulf Coast from Corpus Christi to the Louisiana border. Additional contributions to the State's economy resulted from the building of new petrochemical plants and expansions to existing facilities. Among construction operations

Table 11.—Crude petroleum production, indicated demand, and stocks in 1971, by month

(Thousand 42-gallon barrels)

Month	Production	Indicated demand	End of month stocks originating within Texas
January	109,596	108,452	111,520
February	99,143	103,251	107,412
March	109,798	111,411	105,799
April	105,633	105,096	106,336
May	107,152	107,366	106,122
June	101,984	101,736	106,370
July	101,842	104,494	103,718
August	100,229	99,959	103,988
September	95,885	97,866	102,007
October	98,489	102,492	98,004
November	95,085	94,511	98,578
December	98,090	103,364	93,304
Total:			
1971	1,222,926	1,239,998	XX
1970	1,249,697	1,237,824	XX

XX Not applicable.

Table 12.—Runs to stills and output of refineries in 1971, by month

(Thousand 42-gallon barrels)

Month	Runs					Output				
	Crude	Products	Lube oil	Gasoline	Kerosine	Fuel Oil		Jet fuel	Petrochemical feedstocks	Miscellaneous
						Dis-tillate	Residual			
January	90,257	13,494	1,841	50,251	3,597	21,988	5,309	6,853	4,464	9,448
February	84,444	11,786	1,994	46,265	3,045	20,464	5,066	6,556	4,461	8,379
March	89,555	12,540	2,329	49,860	3,032	23,364	3,931	7,314	4,537	7,728
April	87,426	11,902	2,340	44,462	3,096	21,742	2,010	6,191	5,369	14,118
May	91,874	12,290	2,407	48,965	2,339	22,555	2,263	7,209	5,480	12,946
June	90,592	12,233	2,315	48,322	3,195	21,756	3,028	6,132	5,270	12,807
July	88,972	11,990	2,516	50,864	2,933	20,462	3,182	5,814	4,713	10,478
August	91,365	12,251	2,416	54,500	2,399	21,821	3,096	5,854	5,019	8,511
September	84,337	11,785	2,192	51,934	1,816	17,951	2,660	6,022	5,654	7,893
October	90,496	12,442	2,304	51,219	2,941	20,436	3,509	6,777	5,854	9,898
November	86,624	11,901	2,070	49,768	2,909	18,439	3,052	6,771	5,301	10,215
December	91,485	13,121	2,011	52,005	3,643	19,573	3,408	6,805	6,557	10,604
Total	1,067,427	147,735	26,735	598,415	34,945	250,551	40,514	78,298	62,679	123,025

Table 13.—Stocks of refined products held by refining and pipeline companies in 1971, by month

(Thousand 42-gallon barrels)

Month	Naphthas	Gasoline	Kerosine	Fuel oil		Jet fuel	Miscellaneous products	Total refined products
				Distillate	Residual			
January	2,455	40,858	3,989	16,781	5,099	5,046	37,873	112,101
February	2,421	45,476	2,630	11,613	4,300	4,610	37,584	108,634
March	2,245	44,905	2,671	11,776	3,492	4,577	35,571	105,237
April	2,254	39,815	2,882	13,437	3,348	4,038	37,596	103,370
May	1,939	37,611	3,337	14,172	3,514	4,931	38,517	104,021
June	2,002	34,311	3,933	16,051	3,935	5,295	40,243	105,770
July	1,894	32,560	4,384	19,501	4,098	5,534	39,037	107,008
August	2,021	32,640	4,784	24,011	5,206	5,063	38,030	111,755
September	1,909	33,871	4,111	26,749	5,629	4,456	36,920	113,645
October	2,072	35,890	4,086	29,204	6,103	4,632	36,921	118,908
November	1,963	39,640	3,732	28,132	5,703	5,041	36,183	120,394
December	1,994	40,162	2,628	24,068	5,124	4,710	36,981	115,667

Table 14.—Stocks of crude petroleum at refineries, tank farms, and gathering systems in 1971, as of the last day of each month

(Thousand 42-gallon barrels)

Month	Refineries	Tank farms and pipelines	Lease tanks	Total
January.....	17,531	71,175	5,326	94,032
February.....	16,427	68,312	5,341	90,080
March.....	16,948	67,346	5,162	89,456
April.....	16,644	68,920	5,134	90,698
May.....	17,214	69,408	5,253	91,875
June.....	17,087	71,636	5,266	93,989
July.....	18,100	67,790	5,095	90,985
August.....	16,423	67,902	5,126	89,451
September.....	15,735	66,841	5,075	87,651
October.....	17,042	63,459	5,218	85,719
November.....	15,082	64,158	4,987	84,227
December.....	14,098	62,657	4,866	81,621

during the year were the following. Arco Chemical Co. increased butadiene capability of its Channelview plant. Celanese Chemical Co. installed a 200-million-gallon-per-year methanol unit at its Clear Lake plant. The company expects to increase high-density polyethylene production to 200 million pounds per year by 1972. Dow Chemical Co. added a 500-ton-per-day phenol plant to the Oyster Creek operations at Freeport. Goodyear Tire and Rubber Co. increased polybutadiene capacity of its Beaumont facility to 220 million pounds per year. Goodyear stated that they were the world's biggest polybutadiene producer. B. F. Goodrich Chemical Co. completed a plant at Orange that produces ethylene-propylene-diene monomer rubber. Gulf Oil Corp. increased capacity of its ethylene plant at Port Arthur to 2.5 million pounds per day. Hill Chemicals Inc. completed a plant at Borger designed to produce 150 tons per day of urea. Jefferson Chemical Co., started construction of polymeric isocyanates plant at Port Neches. Monsanto Co. completed several additions to its Texas City operations including a 130-million-pound-per-year phthalic anhydride unit, a 150-million-pound-per-year oxo-alcohol unit, and a 300-million-pound-per-year styrene monomer unit. National Petro Chemical Co. increased polyethane capacity of its Houston plant to 240 million pounds per year. Oxirane Chemical Co. installed equipment to produce 340 million pounds per year of propylene oxide and other products at its Bayport plant. Petro Gas Producing Co. installed equipment to produce 60,000 gallons per day of propylene from refinery gas at its Groves plant. Petro-Tex Chemical Corp.

started construction to increase maleic anhydride and butadiene at their Houston plant. Phillips Petroleum Co. started construction of a 6-million-ton-per-year plant at Borger to produce polyphenylene sulfide plastic resins. Rexene Polymers Co. increased polypropylene capacity of its Odessa plant to 130 million pounds per year. Rohm and Haas Co. completed a 150-million-pound-per-year acrylate monomer plant at Deer Park. Shell Chemical Co. completed construction of facilities at its Houston plant to produce vinyl chloride monomer (1,000 tons per day) and to increase bisphenol production to 100 million pounds per year. Shell Oil Co. placed its new ethylene facility at Deer Park into operation. The facility is one of the world's largest olefin producing units. Design capacity is 1.2 billion pounds of ethylene annually, about 10 percent of total United States capacity. Signal Chemical Co. increased hydroquinone production at its Baytown plant to full capacity rate of 6 million pounds per year. Southern Petrochemicals Corp. expanded polystyrene capacity at their Houston plant to 100 million pounds per year. Texaco, Inc., was modernizing and expanding their aromatics plant at Port Arthur to increase benzene and toluene manufacturing capacity. Union Carbide Corp. increased ethylene oxide capacity of its Seadrift plant to 450 million pounds per year.

U.S. Industrial Chemicals Co. completed the world's largest (300 million pounds per year) vinyl acetate monomer plant at La Porte. The plant utilizes an ethylene base vapor phase process for the manufacture of vinyl acetate monomer.

NONMETALS

The value of nonmetals produced in Texas during 1971 totaled \$402 million, an increase of 1.6 percent. The nonmetals accounted for 5.9 percent of the State's total mineral production value. The three principal nonmetals in order of value were cement, stone, and sand and gravel.

Increases were reported in the output of cement, common clay, fuller's earth, gem stones, gypsum, magnesium compounds, natural sodium sulfate, sand and gravel, and talc. Declines were noted in the production of ball clay, bentonite, fire clay, graphite, kaolin, lime, stone, salt, and sulfur produced by the Frasch process. Texas became a producer of fluorspar with commencement of mining operations by D & F Minerals in Brewster County. Although not mined in Texas barite, mica, perlite, and vermiculite were processed at plants in the State.

Barite.—No barite mines operated in Texas during 1971, but three grinding plants, located in Brownsville, Corpus Christi, and Houston, processed crude barite that was shipped into the State. The ground material was used chiefly as a drilling-mud additive and as a filler or extender.

Cement.—The portland cement industry of Texas, making a strong recovery from the decline of the previous year, set new records in amount and value of shipments. The increased output reflected a rise in construction activity in the State. Shipments of portland cement were up 13 percent, while value was 14 percent higher than the 1970 total. Average mill price per barrel of Texas shipments was \$3.66 compared with \$3.62 in 1970. Texas plants accounted for 9 percent of the Nation's total shipments of portland cement in 1971.

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. Leading in output were Harris, Ellis, and Bexar Counties. Most of the plants used limestone as the chief raw material; however, several plants along the Gulf Coast utilized shell that was dredged from shallow bays. Sixty-five percent of the portland cement was consumed for ready-mix concrete, 10 percent for concrete products, 6 percent for building materials, 12 per-

cent by contractors, and the remainder by miscellaneous customer.

In addition to portland cement, 12 of the plants also produced masonry cement. Shipment and total value of masonry cement were 20 percent greater than during the previous year. Texas cement plants used almost 46.9 billion cubic feet of natural gas and 801.6 million kilowatt hours of electrical energy in 1971.

Two of the Texas cement producers announced plans for major expansion of their respective plants in Ellis County. Both facilities are near Midlothian in the Dallas-Fort Worth trade area. Gifford-Hill Portland Cement Co., scheduled construction of a third kiln and four new storage silos—annual plant capacity will increase from 3 million to 4.5 million barrels. Texas Industries, Inc., Cement Div., started installing a fourth 12- by 450-foot kiln and new grinding mill. Production capacity will be increased from 4.8 million to 6.4 million barrels annually and the plant will be one of the largest in the Nation.

Several cement producers installed air pollution control equipment. Trinity Portland Cement, Div. of General Portland Cement Co., added a new electrostatic precipitator and modernized existing precipitators at its Fort Worth plant. The company also began construction of a masonry electrical-precipitator building at its Houston plant. Lone Star Industries, Inc., installed an electrostatic precipitator at its Houston plant and a glass bag dust collector at its Maryneal plant. Air pollution control equipment also was added to the Waco plant of Universal Atlas Cement, Division of United States Steel Corp.

Clays.—Production of clays and shale was reported by 51 companies from 109 operations located in 45 Texas counties during 1971. Total output was up over 11 percent, and total value increased almost 9

Table 15.—Portland cement salient statistics¹

(Thousand 376-pound barrels and thousand dollars)

	1970	1971
Number of active plants.....	18	18
Rated clinker capacity, Dec. 31.....	43,424	44,314
Production.....	34,584	37,968
Shipments from mills:		
Quantity.....	33,967	38,287
Value.....	\$122,960	\$140,206
Stocks at mills, Dec. 31.....	2,827	2,486

¹ Includes white cement.

percent. The gain in total production was due to greater output of common clay and shale (up 23 percent) and fuller's earth. Declines were registered in the production of ball clay, bentonite, fire clay, and kaolin during the year.

Common clay and shale constituted almost 95 percent of the total clay mined in Texas during 1971. Output was reported from 92 pits in 38 counties, Bexar, Eastland, Harris, Fort Bend, and Chambers Counties led in production. Forty-three percent of the 1971 output was used to make building brick and other heavy clay products. Common clay and shale also were used extensively in the manufacture of cement and lightweight aggregates.

Bentonite production dropped 13 percent in 1971. Four producers reported output from pits in Angelina, Fayette, Gonzales, and Walker Counties. The bentonite was used as a drilling mud additive, a filtering and decolorizing agent, and for other purposes.

Fire clay output declined sharply during the year. Three companies reported production from operations in Bastrop, Cherokee, and Wood Counties. Uses included the manufacture of refractory firebrick and mortar.

Three producers obtained fuller's earth from pits in Angelina, Brewster, and Fayette Counties. The output was used chiefly as an absorbent filler.

Kaolin, mined by one company in Limestone County, was used principally as a filler in fertilizer. Other uses included the manufacture of pottery whiteware, fiberglass, and animal feed; oil refinery catalyst; and for other purposes. One company reported production of ball clay in Cherokee County.

During 1971, one of the Texas clay producers, Featherlite Corp., became a wholly owned subsidiary of Kingstip, Inc., a hold-

ing company. Featherlite, with headquarters in Austin, mined clay and shale in Bexar, Eastland, and Palo Pinto Counties during the year for use in preparing lightweight aggregate. Another producer, Texas Clay Industries, Inc., of Malakoff, merged with TemTex Industries, Inc., of Dallas.

Fluorspar.—A recently organized company, D. & F. Minerals, began the development and production from a new fluorspar mine, La Mina Pisano, in the Christmas Mountains northwest of Big Bend National Park, Brewster County. Exploration for fluorspar deposits continued in west Texas. Much of the interest focused on the Eagle Mountains of Hudspeth County, an area in which fluorspar formerly was mined. Fluorspar, mined in Mexico, was processed at plants in Brownsville, Eagle Pass, and Marathon.

Gem Stones.—Value of gem stones and specimens of rocks and minerals found in the State during the year was estimated at \$155,000. No gem stone mines were in operation, but dealers and hobbyists collected specimens that included agate, calcite, celestite, jasper, cinnabar, feldspar, fluorite, fossiliferous limestone, opal, petrified wood, tektites, quartz, and topaz.

Graphite.—The Nation's only production of natural graphite came from the open pit mine of Southwestern Graphite Co., subsidiary of The Joseph Dixon Crucible Co. Output from the mine, which is located in western Burnet County in Central Texas, was down slightly from that of the previous year. Total value, however, showed an increase. Natural crystalline flake graphite is used chiefly in crucibles, foundry facings, and pencils.

Gypsum.—Gypsum production increased 7 percent in 1971, and total value was up 13 percent. Although registering a gain for the year, the output was about 3 percent less than the record high achieved in 1959.

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

Year	Bentonite		Fire clay		Common clay and shale		Total ¹	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1967.....	97	\$660	748	\$1,862	3,598	\$4,882	4,497	\$8,081
1968.....	92	611	766	1,988	3,756	5,388	4,687	8,860
1969.....	100	655	635	1,669	3,593	5,402	4,407	8,664
1970.....	74	839	351	1,334	3,550	4,945	4,148	9,587
1971.....	W	W	W	W	4,374	7,098	4,615	10,432

W Withheld to avoid disclosing individual company confidential data; included in "Total."

¹ Includes ball, kaolin, fuller's earth, and data indicated by symbol W.

Average price was \$3.69 per short ton in 1971 as compared with \$3.53 in 1959.

Seven companies reported production of the crude gypsum from seven surface mines in Fisher, Gillespie, Hardeman, Hudspeth, and Nolan Counties. The open pit gypsum mine of Elcor Chemical Corp. in Culberson County, which was in operation the previous year, was inactive in 1971. The company had planned to extract sulfur from gypsum at a facility near the mine.

Seventy-nine percent of the crude gypsum mined in Texas during the year was calcined before use. Seven calcining plants operated in Fisher, Dallas, Nolan, Hardeman, and Harris Counties. Some of the plants processed gypsum that was mined outside of the State. The calcined material was utilized in the manufacture of gypsum board, building plasters, lath sheathing, formboard, and other products. Chief use of uncalcined gypsum was as a retarder in portland cement.

Lime.—Twelve companies prepared lime at 14 plants in 12 Texas counties during 1971. Nueces, Brazoria, and Johnson Counties led in production. The total output of hydrated and quicklime in Texas was down 4 percent from the record high of the previous year; total value increased less than 1 percent. Quicklime accounted for 52 percent of the total lime production. Raw materials used to prepare lime were dolomite, limestone, and shell. The lime was used chiefly to stabilize soils in the construction of roads, bridges, parking lots, buildings, and airport landing strips. Some additional uses were in water purification, paper manufacture, petrochemical feedstock, and the treatment of sewage and industrial wastes.

The new lime plant of Texas Lime Co. began production in Central Texas during 1971. The plant near Clifton in Bosque County, has a 250-ton-per-day rotary kiln and also hydrating facilities.

Magnesium Compounds.—In addition to magnesium chloride used to produce magnesium metal (see "Metals" section), three companies in Brazoria County extracted magnesium compounds. The Dow Chemical Co. produced magnesium hydroxide and caustic calcined magnesia from Gulf of Mexico sea water at its Freeport plants. The company also supplied magnesium hydroxide to A. P. Green Refractories Co. and E. J. Lavino & Co. for feedstock used to produce magnesium oxide (refractory magnesia). Magnesium compounds were consumed by the chemical, sugar, paper, rayon, fertilizer, rubber, ceramic, and petroleum industries. They also were used in refractories and in the preparation of oxychloride and oxysulfate cements. The use of caustic calcined or light-burned magnesia in air-pollution-control applications continued to grow.

Mica.—Mica was not mined in Texas during 1971, but Western Mica Co., Division of United States Gypsum Co., processed out-of-State mica at a grinding plant in Fort Worth. The ground mica was used in the manufacture of joint cement and paint.

Natural Sodium Sulfate.—One producer, Ozark-Mahoning Co., obtained sodium sulfate-bearing brines through shallow wells drilled into alkali-lake beds in Gaines and Terry Counties in western Texas. The brines were processed into salt cake at company plants located near Brownfield and Seagraves. Output was up in 1971, but total value declined slightly. Salt cake is

Table 17.—Lime sold or used by producers, by use
(Short tons)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Construction.....	546,376	\$6,815,703	470,238	\$6,134,023
Water purification.....	113,677	1,392,018	141,814	1,917,763
Paper and pulp.....	92,205	1,678,248	89,832	1,692,031
Steel, open-hearth.....	59,975	659,264	W	W
Oil well drilling.....	W	W	9,849	158,620
Other uses ¹	861,085	13,882,068	900,482	14,680,221
Total.....	1,673,318	24,427,301	1,612,215	24,582,658

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

¹ Includes alkalis, other chemicals, aluminum, electric steel furnaces, petrochemicals, chrome (1971), petroleum refining, magnesium metal, sewage, sand-lime brick (1970), insecticides, food (1971), magnesia from sea water, agriculture (1971), and uses indicated by symbol W.

used chiefly in the preparation of kraft paper. It also is used in the manufacture of glass, ceramic glazes, chemicals, dyes, and other products.

Perlite.—Several truckloads of perlite were hauled from the inactive open pit mine at Shely Ranch in Presidio County by the ranch owner. The mine formerly was operated by Lanmont, Inc., subsidiary of General Energy Corp.

Perlite mined outside of Texas was expanded at six plants in Dallas, LaPorte, Tomball, Midland, and Sweetwater. The expanding plant of Sil-Flo Corp. that formerly operated in Fort Worth was abandoned in 1970, and the plant of Texas Lightweight Products Co. at Irving was inactive during 1971. Chief use of the perlite was as an aggregate in concrete. The expanded material also was used as filter aid, horticultural aggregate, plaster aggregate, low-temperature insulation, masonry and cavity-fill insulation, and filler. Total output and value dropped sharply during 1971.

Pumicite (Volcanic Ash).—One producer, Nordmeyer, Inc., mined pumicite from an open pit near Rio Grande City in Starr County. Chief uses of the material were as a concrete admixture and as an insecticide carrier. Output and total value declined slightly during 1971.

Salt.—Salt production in Texas failed to match the record high output of the previous year as tonnage decreased 9.5 percent. Nevertheless, Texas accounted for 21 percent of the Nation's total salt production and was the second leading salt-producing State.

Nine companies obtained salt at 12 operations in 11 counties. Production consisted of salt brine, rock salt, and evaporated salt. Seven of the companies produced salt brine, which constituted most of the salt produced in the State. The brine was obtained through wells drilled into salt domes in Brazoria, Chambers, Duval, Harris, Jefferson, and Matagorda Counties and into Permian salt beds in Hutchinson, Ward, and Yoakum Counties.

Two of the companies mined rock salt—one at Grand Saline salt dome in Van Zandt County and the other at Hockley salt dome in Harris County. The two companies also prepared evaporated salt at operations in Van Zandt and Fort Bend Counties.

Texas salt output was used in the preparation of chlorine, caustic soda, and other chemicals; as table salt; for water softening; and for numerous other purposes.

Sand and Gravel.—Output of sand and gravel increased 4.3 percent, and average value increased 7.2 percent to \$1.58 per ton. Commercial operations accounted for 90.3 percent of total production, and Government-and-contractor operations accounted for 9.7 percent. Output of sand increased 13.5 percent, while gravel output decreased 3.4 percent. Average value of sand increased 11.2 percent to \$1.59 per ton, and average value of gravel increased 4.0 percent to \$1.57 per ton.

A total of 176 commercial and 124 Government-and-contractor operations were active during 1971. Production was reported in 99 counties. Ranked according to output, the leading counties were Colorado, Dallas, Tarrant, Victoria, Young, and McLennan. These six leading counties produced 58.3 percent of the State total output.

Early in the year, one of the commercial producers of sand and gravel in Texas, Capitol Aggregates, Inc., of San Antonio, purchased D. R. Concrete Products, of Del Rio. In May, R. H. Chandler Construction Co. requested permission from the Texas Parks and Wildlife Department to remove sand and gravel from the Llano River about 4 miles northwest of Kingsland in Llano County.

Stone.—Crushed stone was produced at 194 quarries, and dimension stone came from six quarries. More than 68 counties were indicated to have stone production. Total stone sold or used by producers was down 9.6 percent from the 1970 level, but average unit value increased 10 percent to \$1.51 per ton. Leading counties in order of output were Wise, Williamson, Matagorda, Bexar, Ellis, and Comal. Production from these counties accounted for 55.5 percent of the State total. Leading producers in rank of output were Texas State Highway Department, Parker Bros. & Co., Inc., Texas Crushed Stone Co., Lone Star Industries, and Gifford-Hill & Co., Inc.

Limestone production accounted for 74.5 percent of total stone output. Other stone production included basalt, dolomite, granite, marble, quartzite, sandstone, and shell. Principal uses for limestone were for the manufacture of cement and as concrete ag-

**Table 18.—Sand and gravel sold or used by producers,
by class of operation and use**

(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	8,886	\$10,894	9,017	\$13,959
Fill.....	314	234	760	563
Paving.....	2,080	2,426	4,157	5,198
Other uses ¹	2,409	6,269	1,733	5,471
Total ²	13,689	19,824	15,668	25,192
Gravel:				
Building.....	8,840	15,391	8,207	14,396
Fill.....	252	180	231	87
Paving.....	3,196	4,507	4,937	8,146
Other uses ²	1,489	2,350	565	1,012
Total ²	13,776	22,428	13,940	23,641
Government-and-contractor operations:				
Sand:				
Building.....	20	2	159	42
Fill.....	3	(⁴)	1	(⁴)
Paving.....	605	704	417	539
Total ²	628	707	578	581
Gravel:				
Building.....	52	42	63	82
Fill.....	--	--	130	106
Paving.....	3,294	3,361	2,379	2,200
Other.....	--	--	31	14
Total ²	3,346	3,403	2,604	2,402
Total sand and gravel ²	31,438	46,362	32,788	51,814

¹ Includes abrasives (1970), blast, enamel, engine (1971), filtration, fill, foundry, glass, oil (hydrafrac), molding, pottery, and other sands.

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

³ Includes miscellaneous and other gravel.

⁴ Less than ½ unit.

Table 19.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel ¹	
	Quantity	Value	Quantity	Value	Quantity	Value
1967.....	25,397	\$33,630	6,001	\$5,539	31,398	\$39,170
1968.....	27,919	38,183	3,924	3,363	31,843	41,546
1969.....	24,226	33,123	5,746	6,633	29,972	39,756
1970.....	27,464	42,252	3,973	4,110	31,438	46,362
1971.....	29,607	48,831	3,181	2,983	32,788	51,814

¹ Data may not add to totals shown because of independent rounding.

gregate and road base stone. Other uses included bitumin and macadam aggregate, agricultural purposes, railroad ballast, riprap, filter stone, and for other purposes.

Changes in ownership affecting several Texas stone producers occurred during 1971. One of the producers, Crushers, Inc., with quarries in Grayson and Wise Counties, was purchased by Vulcan Materials, Inc., of Birmingham, Ala. Vulcan also acquired Olmos Rock Products Corp., a pro-

ducer of crushed limestone in the San Antonio area. Both acquisitions became a part of Vulcan's Southeast Division.

In order to reduce dust emission at its crushed-limestone plant at Marble Falls, Pure Stone Co. installed new pollution control equipment and a new washing system.

Sulfur.—Production of native sulfur in Texas declined about 1 percent in 1971, while sales increased almost 10 percent.

Table 20.—Stone sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Kind of stone	1970		1971	
	Quantity	Value	Quantity	Value
Dimension stone—total	29	\$1,850	22	W
Crushed and broken:				
Limestone and dolomite ¹	35,229	49,673	31,725	\$46,314
Sandstone and quartz	2,166	3,583	2,405	5,510
Shell	W	W	5,985	8,482
Other stone ²	8,133	9,316	1,030	1,838
Total crushed	45,528	62,572	³ 41,146	62,144
Grand total	45,557	64,442	41,168	62,144

W Withheld to avoid disclosing individual company confidential data.

¹ Data for 1970 includes limestone only.² Includes dolomite (1970), granite, marble, marl, trap rock, and shell (1970).³ Data does not add to total shown because of independent rounding.

Total value and price per ton, however, dropped sharply, continuing the downward trend of the past several years. Ninety percent of the 1971 output was sold; producer inventories were up 11 percent at yearend.

Five companies produced the sulfur at eight Frasch operations in seven Texas counties. Two of the operations were in Culberson and Pecos Counties in western Texas, where the sulfur was produced through wells drilled into sulfur deposits in subsurface Permian strata. Six of the sulfur 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, High Island in Galveston County, Fannett and Spindletop in Jefferson County, Moss Bluff in Liberty County, and Boling in Wharton County. In addition, one company reported sales of sulfur from stocks remaining after Frasch operations ceased in 1970 at the Gulf salt dome in Matagorda County. Another producer, Amoco Production Co., shutdown its high Island sulfur facility on June 1.

Recovered sulfur was produced also in Texas during the year. It was extracted from sour natural gas and oil at 46 plants in 25 counties. Output totaled 778,591 long tons, an increase of 3 percent for the year. Sales, reported from 48 plants in 26 counties (including stockpile sales from two inactive plants), totaled 770,432 long tons, an increase of less than 1 percent for the year. Total value of the sales was \$10,335,991, a decrease of 24 percent. Average price was \$13.42 per long ton compared with a price of \$17.71 in 1970. (Sta-

istics of recovered sulfur are not included in table 1.)

Information about sulfur—its history, uses, properties, mining, recovery, conservation, and geology of Texas deposits—is contained in a publication, "Sulfur in Texas," by Samuel P. Ellison, Jr., dated January 1971, and issued as Handbook No. 2 of the Bureau of Economic Geology of The University of Texas at Austin.

Table 21.—Sulfur produced and shipped from Frasch mines

(Thousand long tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value ¹
1967	2,956	3,448	\$111,931
1968	3,203	2,571	105,482
1969	3,289	2,552	68,360
1970	3,446	2,801	62,290
1971	3,408	3,075	W

W Withheld to avoid disclosing individual company confidential data.

¹ F.O.B. mine plant.

Talc and Soapstone.—Five operators obtained production from seven mines—six in Hudspeth County and one in Culberson County. Output was 13 percent higher in 1971 than in 1970. Average value of crude mined material was \$5.28 per ton, and average value after grinding was \$19.71 per ton. Talc and soapstone were used in the manufacture of ceramic wall tile, roofing material, insecticides, paint, rubber, and plastics.

The Continental Minerals talc mine and grinding mill in the Van Horn area of Culberson County were acquired by Milwhite Co., Inc., of Houston, a producer of

bentonite in Texas. Milwhite began the calcining and milling of talc products during 1971.

Vermiculite.—No mine production of vermiculite was reported in Texas during 1971. The only vermiculite mine (Llano County) remained closed. Three exfoliating plants in Dallas, Houston, and San Antonio processed vermiculite that was brought into the State. The expanded material was used as concrete aggregate, plaster aggregate, loose-fill insulation, fireproofing material, and for horticulture and other purposes.

METALS

The metals sector contributed \$60 million, less than 1 percent, to the State's total mineral value. Metals mining was limited to iron ore, magnesium, mercury, and uranium. However, other metallic metals—aluminum, antimony, cadmium, copper, lead, manganese, tin, and zinc—were recovered at smelters, refineries, and reduction plants.

A noteworthy addition to the metal industry in Texas was United States Steel Corp.'s new works at Cedar Point, about 35 miles from Houston, that began operation in April. This complex, the first completely new plant that the company has built in nearly 20 years, can produce more than 1 million tons of high-strength alloy and carbon plate steel annually. The complex has a 160-inch plate mill fed by a continuous slab caster that receives its steel from two 200-ton electric furnaces.

Duval Corp., Louisiana Land and Exploration Earth Resources, and other individuals or companies conducted exploratory operations in the Trans-Pecos area. In addition to lead, zinc, copper, silver, gold, and mercury ores deposits of fluor spar are known to exist in this mountainous area.

Aluminum.—Output and value increased slightly, and Texas continued to rank second in aluminum production. Alumina was produced from bauxite shipped into Texas from other States and foreign countries at the Point Comfort plant of Aluminum Company of America (Alcoa) in Calhoun County and at the Sherwin Works by Reynolds Metals Co. in San Patricio County.

Alcoa completed an expansion of its Point Comfort plant that increased capacity to about 6.5 million pounds of alumina

per day. In August the company was ordered to refrain from dumping mercury into Lavaca Bay because oysters were found to contain mercury at levels above limits considered safe for human consumption. Alcoa shutdown one of eight potlines at its Rockdale plant in Milam County during the last half of 1971 because of a decrease in the demand for aluminum.

Antimony.—Primary antimony metal was produced at the Laredo smelter of National Lead Co., principally from ores imported from Mexico. Output was down 15 percent from the 1970 level. Principal use for antimony was as an alloying constituent with lead to manufacture storage batteries.

Cadmium.—This metal was recovered as a byproduct of processing zinc-bearing ores. The American Smelting and Refining Co. (Asarco) produced cadmium at its Corpus Christi facility. Output in 1971 was significantly higher than in 1970.

Copper.—Ores and concentrates from other States and foreign countries and scrap copper were processed by Asarco and Phelps Dodge Refining Corp. at their El Paso operations. Although deposits of copper minerals are known to exist in the Trans-Pecos region, in the Permian "red beds" of north-central Texas, and in the Central Mineral region (Llano uplift); no production has been reported in recent years.

Asarco and Phelps Dodge Corp. completed construction of a 20-ton-per-day pilot plant at El Paso to evaluate a new process of converting sulfur dioxide in copper smelter gases into elemental sulfur. Asarco also awarded a contract for construction of facilities to utilize the Bayer/Lurgi double catalysis process for production of sulfuric acid from smoke-stack emissions of sulfur dioxide gas at its El Paso metallurgical complex.

The Federal Bureau of Mines reported improved methods to recover copper from junked automobile starters, generators, and alternators.⁶ By accelerating the leaching rate, the techniques allow processors to use smaller and less expensive equipment to yield a high-grade sulfide product.

S. E. C. Corp. applied a solvent extraction-electrowinning sequence to nickel-cop-

⁶ Staker, W. L., C. U. Chindgren, and K. C. Dean. Improved Cupric Ammonium Carbonate Leaching of Copper Scrap. BuMines Rept. of Inv. 7554, 1971, 9 pp.

per ores at a new plant in El Paso. The corporation plans to license the method which may be helpful to small copper companies.

Iron Ore.—Large deposits of iron ore in the form of siderite and limonite are present in northeast Texas, and small deposits in the form of magnetite occur in Precambrian rocks of the Central Mineral region. Iron ore production was reported for Cass, Morris, and Nacogdoches Counties. Output and value were less than in 1970. Principal uses for iron ore mined in Texas was for the manufacture of iron and steel, in the manufacture of cement, and as a mineral supplement in livestock feeds.

Lead.—Lead ores are known to exist in Hudspeth, Presidio, and Brewster Counties, and in the Central Mineral region. However, no production has been reported in recent years. Lead was produced from ores and concentrates, imported principally from Mexico, at the Asarco smelter at El Paso. Secondary recovery of lead was widespread as can be noted in the listing of secondary metal recovery plants.

Magnesium.—Magnesium chloride (for metal) output increased about 11 percent. The metal was recovered from Gulf of Mexico waters using a chemical and electrolytic process by The Dow Chemical Co., the world's largest producer. The American Magnesium Co. processed subsurface brines from Borden, and Scurry Counties at its Snyder plant by an electrolytic process to recover magnesium and chlorine. Texas Air Control Board actions and a fire resulted in a suspension of operations in July.

Manganese.—Silicomanganese and ferromanganese were produced by the Tenn-Tex Alloy Chemical Corp. at its Harris County plant. Feedstock ores were foreign imports. Manganese was used principally in the production of cast iron and steel.

Mercury.—Texas ranked third nationwide in the output of mercury. Production was obtained from Brewster and Presidio Counties and was significantly higher than in 1970. The Study Butte mine, operated by Mineral Industries, Inc., in Brewster County, became inactive on June 1, 1971. The White-Roy mine, operated by The Anchor Co. in Presidio County, was idle after August 1971.

Nationwide there was a continued de-

crease in mercury demand—about 15 percent below the 1970 demand, and 33 percent below the 1969 total. Average unit value declined from \$408 in 1970 to \$292 per 76-pound flask in 1971.

Sodium.—Metallic sodium was produced by an electrolysis processing of brine feedstock by Ethyl Corp. at its plant near Houston. The output was used chiefly to produce tetraethyl and tetramethyl lead, two compounds added to hydrocarbon fuels to increase antiknock ratings.

Tin.—The Texas City smelter, built by the Federal Government in 1942, was operated by Gulf Chemical & Metallurgical Corp. Tin and tin alloys were recovered by smelting and refining imported ores and concentrates. Imports were principally from Bolivia; however, a small quantity was received from Mexico.

Uranium.—Output of uranium (U_3O_8) increased significantly in 1971. Texas ranked fourth among the eight producing States. According to the U.S. Atomic Energy Commission, uranium ore reserves in 39 known deposits in Texas at yearend 1971 totaled 10.23 billion tons. At an average ore content of 0.142 percent, U_3O_8 reserves were 14.56 million tons, third highest in the Nation. There was a sharp decline in uranium drilling both nationwide and in Texas. The decline was attributed to a softening in demand and in prices for this mineral. In Texas drilling activity decreased from 6.08 million feet in 1970 to 3.87 million feet in 1971. About 85 percent of the drilling was in exploratory efforts. Acreage held for mining and exploratory operations decreased from 1.1 million acres at yearend 1970 to 0.9 million acres at yearend 1971.

Continental Oil Co. and Pioneer Natural Gas Co. were jointly constructing a 1,750-ton-per-day processing mill near Falls City, about 50 miles southeast of San Antonio. The mill was designed to produce 1.5 million pounds of uranium concentrate per year. Upon completion in early 1972, the mill will become the third operation in south Texas. Susquehanna-Western, Inc., operated a 1,000-ton-per-day mill in Karnes County and its 1,000-ton-per-day Ray Point mill in Live Oak County.

Zinc.—Zinc ore was not mined in Texas, but this metal was recovered from the processing of concentrates and ores from foreign countries and other States. The

American Zinc Co. smelter at Dumas, that was built in 1940, ceased operations in August. Company officials stated that the plant closing resulted from pollution control problems, small profit margins, and competition from Canadian produced zinc.

Table 22.—Smelters, refineries, and reduction plants in 1971

Product, company, and plant	Location (county)	Material treated
Aluminum:		
Aluminum Company of America:		
Point Comfort (alumina).....	Calhoun.....	Bauxite.
Point Comfort (reduction).....	do.....	Alumina.
Rockdale (reduction).....	Milam.....	Do.
Reynolds Metals Co.:		
Sherwin Works (alumina).....	San Patricio.....	Bauxite.
San Patricio (reduction).....	do.....	Alumina.
Antimony:		
National Lead Co.:		
Laredo smelter.....	Webb.....	Ore.
Cadmium:		
American Smelting & Refining Co.:		
Electrolytic.....	Nueces.....	Flue dust.
Copper:		
American Smelting & Refining Co.:		
El Paso smelter.....	El Paso.....	Ore and concentrates.
Phelps Dodge Refining Corp.:		
Nichols refinery.....	do.....	Blister and anode.
Iron:		
Lone Star Steel Co.:		
Daingerfield plant.....	Morris.....	Ore and scrap.
Armco Steel Corp.:		
Houston plant.....	Harris.....	Do.
Lead:		
American Smelting & Refining Co.:		
El Paso smelter.....	El Paso.....	Ore and concentrates.
Magnesium:		
American Magnesium Co.:		
Snyder plant, Electrolytic.....	Scurry.....	Brine.
The Dow Chemical Co.:		
Freeport plants, Electrolytic.....	Brazoria.....	Sea water.
Manganese: Tenn-Tex Alloy Corp.....	Harris.....	Ore.
Sodium: Ethyl Corp.....	do.....	Brine.
Tin-Tungsten:		
Gulf Chemical & Metallurgical Corp.:		
Texas City smelter.....	Galveston.....	Ore.
Zinc:		
American Smelting & Refining Co.:		
Amarillo retort smelter.....	Potter.....	Ore and concentrates.
Corpus Christi electrolytic.....	Nueces.....	Do.
El Paso fuming plant.....	El Paso.....	Dusts and residues.
American Zinc Co.: Dumas retort smelter.....	Moore.....	Concentrates and fumes.

Table 23.—Secondary metal recovery plants

County and company	Material	Products
Dallas:		
ABASCO, Inc.....	Aluminum scrap.....	Aluminum ingots, dioxidizing bars and shot.
American Smelting & Refining Co.....	Lead and zinc scrap.....	Lead and zinc ingots, pigs, alloys.
Dixie Lead Co.....	Lead scrap.....	Lead pigs, alloys, chemicals.
National Lead Co., Southwestern Branch.....	Battery plates.....	Lead products.
Southern Lead Co.....	do.....	Lead pigs, alloys.
El Paso: Border Steel Mills, Inc.....	Steel scrap.....	Steel shapes, reinforcing bars.
Gregg: R. G. LeTourneau, Inc.....	do.....	Heavy mobile equipment.
Guadalupe: Structural Metals, Inc.....	do.....	Structural steel reinforcing bars.
Harris:		
A & B Metal & Smelting Co.....	Aluminum, lead scrap.....	Lead pigs, ingots, aluminum ingots, alloys.
Federated Metals.....	Various metals.....	Lead products, alloys of copper, lead, zinc, magnesium, tin.
Gulf Reduction Corp.....	Aluminum, zinc scrap.....	Aluminum and zinc ingots, alloys.
Houston Lead Co.....	Lead scrap.....	Lead pigs, ingots, alloys.
Houston Fishing Tackle Co.....	Soft lead scrap.....	Lead products.
Lead Products, Inc.....	Lead scrap.....	Lead pigs, ingots, alloys.
Magnus Metal.....	Various metal scrap.....	Lead, brass, bronze bearing metal.
Southwest Saw Corp.....	Steel scrap.....	Steel alloys.
Sterling Type, Rule, & Metals Co.....	Type metal.....	Type metal.
Vulcan Detinning Co.....	Tinned scrap.....	Refined tin, baled detinned steel.
Tarrant:		
National Metal & Smelting Co.....	Battery lead and aluminum scrap.....	Lead pigs, ingots, battery metal, aluminum ingots.
Texas Steel Co.....	Steel scrap.....	Carbon and alloy steel bars and shapes, reinforcing bars.

Table 24.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt (native):			
Uvalde Rock Asphalt Co.....	P.O. Box 531 San Antonio, Tex. 78206	Mine.....	Uvalde.
White's Uvalde Mines, Inc.....	P.O. Box 499 San Antonio, Tex. 78206	---do.....	Do.
Barite:			
Dresser Minerals.....	P.O. Box 6504 Houston, Tex. 77005	Grinding plant...	Cameron.
The Milwhite Co., Inc.....	P.O. Box 15038 Houston, Tex. 77020	---do.....	Harris.
National Lead Co.....	P.O. Box 1675 Houston, Tex. 77001	---do.....	Nueces.
Carbon black:			
Ashland Chemical Co.....	P.O. Box 1503 Houston, Tex. 77005	Furnace.....	Aransas and Wheeler.
Cabot Corp.....	125 High St. Boston, Mass. 02110	Channel.....	Carson.
Do.....	---do.....	Furnace.....	Gray and Howard.
Columbian Carbon Co.....	380 Madison Ave. New York, N.Y. 10017	---do.....	Montgomery and Terry.
Do.....	---do.....	Channel.....	Gaines.
Continental Carbon Co.....	P.O. Box 22085 Houston, Tex. 77027	Furnace.....	Moore.
J. M. Huber Corp.....	P.O. Box 831 Borger, Tex. 79006	---do.....	Harris and Hutchinson.
Phillips Petroleum Co.....	Bartlesville, Okla. 74003	---do.....	Hutchinson and Orange.
Sid Richardson Carbon & Gasoline Co.....	1200 Ft. Worth National Bank Bldg. Ft. Worth, Tex. 76102	Channel.....	Ector.
Do.....	---do.....	Furnace.....	Howard.
Cement:			
Alpha Portland Cement Co.....	15 South Third St. Easton, Pa. 18042	Quarry and plant.	Orange.
Capitol Aggregates, Inc.....	Route 13, Box 412 San Antonio, Tex. 78209	Plant.....	Bexar.
Centex Cement Corp.....	P.O. Box 9294 Corpus Christi, Tex. 78408	Quarry and plant.	Nueces.
General Portland Cement Co.....	2800 Republic Bank Tower Dallas, Tex. 75201	---do.....	Dallas, Harris, Tarrant.
Gifford-Hill Portland Cement Co...	P.O. Box 520 Midlothian, Tex. 76065	---do.....	Ellis.
Gulf Coast Portland Cement Co., Div. of McDonough Co.	P.O. Box 262 Houston, Tex. 77001	---do.....	Harris.
Ideal Cement Co., Div. Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	---do.....	Do.
Kaiser Cement & Gypsum Corp....	Permanente Rd. Permanente, Calif. 95014	Plant.....	Bexar.
Lone Star Industries, Inc.....	P.O. Box 47327 Dallas, Tex. 75247	Quarry and plant.	Harris and Nolan.
San Antonio Portland Cement Co...	P.O. Box 6925 San Antonio, Tex. 78209	---do.....	Bexar.
Southwestern Portland Cement Co..	P.O. Box 392 El Paso, Tex. 79943	---do.....	Ector and El Paso.
Texas Industries, Inc.....	P.O. 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.
Clays and shale:			
Acme Brick Co.....	P.O. Box 425 Ft. Worth, Tex. 76101	Mine and plant...	Denton, Guadalupe, Henderson, Nacogdoches, Parker, Wise.
Alpha Portland Cement Co.....	15 South Third St. Easton, Pa. 18042	---do.....	Orange.
Dresser Minerals.....	P.O. Box 6504 Houston, Tex. 77005	---do.....	Angelina and Limestone.
Elgin Butler Brick Co.....	4000 East Ave. Austin, Tex. 78767	---do.....	Bastrop.
Featherlite Corp.....	P.O. Box 141 Ranger, Tex. 76470	---do.....	Bexar and Eastland.
General Portland Cement Co.....	P.O. Box 2698 Dallas, Tex. 75201	---do.....	Dallas, Harris, Limestone.
General Refractories Co.....	1520 Locust St. Philadelphia, Pa. 19102	---do.....	Cherokee.
Gulf Coast Portland Cement Co., Div. of McDonough Co.	P.O. Box 262 Houston, Tex. 77001	---do.....	Chambers.
Henderson Clay Products Co.....	P.O. Box 1251 Henderson, Tex. 75652	---do.....	Rusk.

Table 24.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clays and shale—Continued			
Ideal Cement Co., Div. Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	Mine and plant..	Galveston.
Lone Star Industries, Inc.	P.O. Box 47327 Dallas, Tex. 75247	...do.....	Fisher and Harris.
The Milwhite Co., Inc.	P.O. Box 15038 Houston, Tex. 77020	Mine.....	Fayette and Walker.
Reliance Clay Products Co.	P.O. Box 20237 Dallas, Tex. 75221	Mine and plant..	Ellis, Palo Pinto, Smith.
Southern Clay Products, Inc.	P.O. Box 44 Gonzales, Tex. 78629	...do.....	Cherokee and Gonzales.
Texas Clay Products, Inc.	P.O. Box T Malakoff, Tex. 75148	...do.....	Henderson.
Texas Industries, Inc.	8100 Carpenter Freeway Dallas, Tex. 75247	...do.....	Dallas, Eastland, Comanche, Ellis, Fort Bend, Henderson, Van Zandt.
Coal (lignite):			
Atlas Chemical Indust., Inc.	P.O. Box 790 Marshall, Tex. 75670	Strip mine.....	Harrison.
Industrial Generating Co.	P.O. Box 1111 Rockdale, Tex. 76567	...do.....	Freestone and Milam.
Fluorspar:			
D & F Minerals	P.O. Box 75 Terlingua, Tex. 79852	Mine.....	Brewster.
Graphite: Southwestern Graphite Co.	Burnet, Tex. 78611	...do.....	Burnet.
Gypsum:			
The Celotex Corp.	1500 North Dale Mabry Tampa, Fla. 33607	Open pit mine and calcining plant.	Fisher.
The Flintkote Co.	480 Central Ave. East Rutherford, N.J. 07073	...do.....	Nolan.
Georgia-Pacific Corp.	P.O. Box 311 Portland, Ore. 97207	...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.	P.O. Box 12226 Dallas, Tex. 75225	Open pit.....	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.	P.O. Box 1367 Houston, Tex. 77001	...do.....	Harris.
Austin White Lime Co.	General Delivery McNeil, Tex. 78651	...do.....	Travis.
Champion Papers, Inc.	P.O. Box 872 Pasadena, Tex. 77501	...do.....	Harris.
The Dow Chemical Co.	2020 Dow Center Midland, Mich. 48640	...do.....	Brazoria.
Eastex, Inc.	P.O. Box 816 Silsbee, Tex. 77656	...do.....	Jasper.
McDonough Bros., Inc.	Fredericksburg Rd. Route 8, Box 222 San Antonio, Tex. 78228	...do.....	Bezar.
PPG Industries, Inc.	P.O. Box 4026 Corpus Christi, Tex. 78408	...do.....	Nueces.
Round Rock Lime Co.	P.O. Box 218 Round Rock, Tex. 78764	...do.....	Hill and Williamson.
Texas Lime Co.	P.O. Box 851 Cleburne, Tex. 76031	...do.....	Johnson.
United States Gypsum Co.	101 South Wacker Dr. Chicago, Ill. 60606	...do.....	Comal and Harris.
Magnesium compounds:			
The Dow Chemical Co.	Midland, Mich. 48640	...do.....	Brazoria.
A. P. Green Refractories Co.	Freeport, Tex. 77541	...do.....	Do.
E. J. Lavino & Co.	Three Penn Center Plaza Philadelphia, Pa. 19102	...do.....	Do.
Mercury:			
Anchor Co.	309 North 3rd St. Alpine, Tex. 79830	Mine.....	Presidio.
Butte Mining Corp.	P.O. Box 3 Terlingua, Tex. 79852	...do.....	Brewster and Presidio.
Mineral Industries, Inc.	P.O. Box 62 Terlingua, Tex. 79852	...do.....	Brewster.

Table 24.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Mica:			
Western Mica Company, Div. United States Gypsum Co.	101 South Wacker Dr. Chicago, Ill. 60606	Plant.....	Tarrant.
Perlite:			
Filter Media, Inc.....	P.O. Box 19156 Houston, Tex. 77024	Expanding plant.	Harris.
Perlite of Houston, Inc.....	P.O. Box 8386 Houston, Tex. 77004	---do.....	Do.
Perlite Industries, Inc.....	P.O. Box 6216 Midland, Tex. 79701	---do.....	Midland.
Perlite Products Co.....	2651 Manila Dallas, Tex. 75212	---do.....	Dallas.
Sil-Flo Corp.....	3405 North Sylvania Ave. P.O. Box 7086 Ft. Worth, Tex. 76111	---do.....	Tarrant.
Texas Lightweight Products Co.....	117 North Britain Rd. Irving, Tex. 75060	---do.....	Dallas.
United States Gypsum Co.....	101 South Wacker Dr. Chicago, Ill. 60606	---do.....	Nolan.
Roofing granules: H. B. Reed & Co., Inc	8149 Kennedy Ave. Highland, Ind. 46322	Plant.....	Milam.
Salt:			
Diamond Shamrock Chemical Co....	300 Union Commerce Bldg. Cleveland, Ohio 44115	Brine wells.....	Chambers.
The Dow Chemical Co.....	Midland, Mich. 48640	---do.....	Brazoria.
Montex Chemical Co.....	104 East Third Monahans, Tex. 79756	---do.....	Ward.
Morton Salt Co.....	110 North Wacker Dr. Chicago, Ill. 60606	Underground mine and brine wells.	Van Zandt.
PPG Industries, Inc.....	P.O. Box 4026 Corpus Christi, Tex. 77704	Brine wells.....	Duval.
Phillips Petroleum Co.....	Bartlesville, Okla. 74003	---do.....	Hutchinson.
Texas Brine Corp.....	4614 Montrose Blvd. Houston, Tex. 77006	---do.....	Harris, Jefferson, Matagorda.
United Salt Corp.....	---do.....	Underground mine and brine wells.	Fort Bend and Harris.
Vulcan Materials Co.....	P.O. Box 1060 Denver City, Tex. 79323	Brine wells.....	Yoakum.
Sand and gravel:			
Barrett Industries.....	2718 SW Military Dr. San Antonio, Tex. 78221	Stationary.....	Bexar.
Capitol Aggregates, Inc.....	Route 13, Box 412 San Antonio, Tex. 78209	---do.....	Guadalupe and Travis.
Dresser Minerals.....	Kosse, Tex. 76653	---do.....	Limestone.
The Fordyce Co.....	P.O. Box 1981 San Antonio, Tex. 78206	---do.....	Hidalgo and San Patricio.
Ft. Worth Sand & Gravel Co.....	P.O. Box 400 Arlington, Tex. 76010	---do.....	Dallas, Denton, Tarrant.
Gifford-Hill & Co., Inc.....	P.O. Box 47127 Dallas, Tex. 75247	---do.....	Brazos, Dallas, McLennan, Tarrant, Wharton, Wichita.
H & H Materials, Inc.....	3200 Edgar Park El Paso, Tex. 79901	---do.....	El Paso.
Heldenfels Bros.....	Box 4957 Corpus Christi, Tex. 78408	---do.....	Nueces and Victoria.
Horton & Horton.....	P.O. Box 1669 Houston, Tex. 77001	Portable and dredge.	Colorado, Harris, Victoria.
Janes-Prentice, Inc.....	P.O. Box 2155 Austin, Tex. 78767	Stationary.....	Crosby.
Mineral Wells Sand & Gravel, Inc..	Box 788 Mineral Wells, Tex. 76067	---do.....	Palo Pinto.
Neelley Sand & Gravel, Inc.....	Box 1313 Waco, Tex. 76703	Stationary and dredge.	McLennan.
Panhandle Gravel West, Inc.....	P.O. Box 807 Amarillo, Tex. 79105	Stationary.....	Armstrong.
Parker Bros. & Co., Inc.....	P.O. Box 107 Houston, Tex. 77001	Stationary and dredge.	Colorado and Harris.
Texas Construction Materials Co...	P.O. Box 86 Houston, Tex. 77001	Stationary, portable, dredge.	Colorado and Liberty.
Thorstenberg Materials Co.....	1435 Bank of the Southwest Bldg. Houston, Tex. 75247	---do.....	Colorado, Fayette, San Jacinto.
Trinity Concrete Products Co.....	P.O. Box 47524 Dallas, Tex. 75247	Stationary.....	Dallas and Johnson.
Wesco-Wamix, Inc.....	105 Empire Center 8383 Stemmons Freeway Dallas, Tex. 75247	---do.....	Dallas, Denton, Tarrant.

Table 24.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Shell:			
General Dredging Corp.....	P.O. Box 9294 Corpus Christi, Tex. 78408	Dredge.....	Nueces.
Lone Star Industries, Inc.....	P.O. Box 86 Houston, Tex. 77001	...do.....	Calhoun.
Parker Bros. & Co., Inc.....	5303 Navigation Bldg. P.O. Box 107 Houston, Tex. 77001	...do.....	Do.
Sodium (metallic): Ethyl Corp.....	P.O. 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.
General Portland Cement Co.....	2800 Republic Bank Tower Dallas, Tex. 75201	...do.....	Dallas and Tarrant.
Gifford-Hill & Co., Inc.....	P.O. Box 47127 Dallas, Tex. 75247	...do.....	Wise.
Lone Star Industries, Inc.....	P.O. Box 47327 Dallas, Tex. 75247	...do.....	Burnet, Cal- houn, Ellis, Hudspeth, Nolan, Wise.
Parker Bros. & Co., Inc.....	P.O. Box 107 Houston, Tex. 77001	...do.....	Comal and Matagorda.
Texas Crushed Stone Co.....	P.O. Box 9345 Austin, Tex. 78717	...do.....	Llano and Williamson.
Texas Industries, Inc.....	P.O. Box 146 Midlothian, Tex. 76065	...do.....	Ellis and Wise.
Trinity Concrete Products Co.....	P.O. Box 47524 Dallas, Tex. 75247	...do.....	Johnson and Wise.
White's Mines, Inc.....	P.O. Box 500 Brownwood, Tex. 76801	...do.....	Brown, Taylor, Uvalde.
Sulfur (native):			
Atlantic Richfield Co.....	P.O. Box 2319 Dallas, Tex. 75221	Frasch process...	Pecos.
Duval Corp.....	1906 First City National Bank Bldg. Houston, Tex. 77002	...do.....	Fort Bend, Culberson, Pecos.
Jefferson Lake Sulphur Co.....	P.O. Box 1185 Houston, Tex. 77001	...do.....	Fort Bend.
Amoco Production Co.....	P.O. Box 591 Tulsa, Okla. 74102	...do.....	Galveston.
Texas Gulf Sulphur Co.....	200 Park Ave. New York, N.Y. 10017	...do.....	Jefferson, Liberty, Matagorda, Wharton.
Sulfur (byproduct):			
Cities Service Oil Co.....	P.O. Box 300 Tulsa, Okla. 74102	Secondary recovery.	Cochran and Van Zandt.
Elcor Chemical Corp.....	Wilco Bldg. Midland, Tex. 79701	...do.....	Atascosa, Cass, Crane.
Getty Oil Co.....	P.O. Box 8 Scroggins, Tex. 75480	...do.....	Franklin and Freestone.
Gulf Oil Corp.....	P.O. Box 701 Port Arthur, Tex. 77640	...do.....	Jefferson.
Amoco Production Co.....	P.O. Box 591 Tulsa, Okla. 74102	...do.....	Andrews, Ector, Hockley, Van Zandt, Wood.
Phillips Petroleum Co.....	Bartlesville, Okla. 74003	...do.....	Brazoria, Crane, Ector, Hutchinson.
Shell Oil Co.....	P.O. Box 2099 Houston, Tex. 77001	...do.....	Cass, Karnes, Harris.
Warren Petroleum Corp.....	P.O. Box 1589 Tulsa, Okla. 74101	...do.....	Crane, Hop- kins, Karnes.
Talc and soapstone:			
Texas Talc Co.....	Allamoore, Tex. 79829	Mine and plant...	Hudspeth.
Pioneer Talc Co.....	Chatsworth, Ga. 30705	...do.....	Do.
Southern Clay Products, Inc.....	Box 44 Gonzales, Tex. 78629	...do.....	Do.
The United Sierra Div., Cyprus Mines Corp.	P.O. Box 1201 Trenton, N.J. 08606	Mine.....	Gillespie and Hudspeth.
Do.....	...do.....	Mine and plant...	Llano.
Westex Talc Co.....	P.O. Box 15038 Houston, Tex. 77020	...do.....	Hudspeth.
Uranium: Susquehanna-Western, Inc...	P.O. Box 217 Falls City, Tex. 78113	Mine and mill....	Live Oak and Karnes.

Table 24.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Vermiculite:			
Texas Vermiculite Co.....	2651 Manila Rd. Dallas, Tex. 75200	Exfoliating plant.	Bexar and Dallas.
Vermiculite Products, Inc.....	P.O. Box 7327 Houston, Tex. 77008	-----do-----	Harris.
Volcanic ash (pumicite): Nordmeyer, Inc.	P.O. Box 949 Mission, Tex. 78572	Mine and plant...	Starr.

The Mineral Industry of Utah

This chapter has been prepared under a cooperative agreement for collecting mineral data, except mineral fuels, between the Bureau of Mines, U.S. Department of the Interior, and the Utah Geological and Mineralogical Survey.

By Francis C. Mitko ¹

The value of mineral production in Utah in 1971 fell 13 percent, to a total value of \$525.7 million. The total value of metal commodities was \$355.0 million, down 20 percent from 1970, mainly because of decreases in production of copper, molybdenum, and lead. In 1971, production of mineral fuels increased 5 percent in total value, and accounted for 23 percent of total production in 1971. The pro-

duction value of crude petroleum, natural gas, and natural gas liquids rose. Nonmetals accounted for 9 percent of total production and increased 12 percent in 1971. Output of potassium, sodium salts and portland cement increased substantially, but output value of clay and fluorspar declined.

¹ Economist, Division of Nonferrous Metals.

Table 1.—Mineral production in Utah ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Carbon dioxide (natural).....thousand cubic feet..	60,754	\$4	55,178	\$4
Clays.....thousand short tons..	189	1,237	198	1,064
Coal (bituminous).....do.....	4,733	34,472	4,626	34,082
Copper (recoverable content of ores, etc.)				
short tons.....	295,738	341,282	263,451	273,989
do.....	19,214	595	10,947	341
Gem stones.....	NA	85	NA	90
Gold (recoverable content of ores, etc.) troy ounces	408,029	14,848	368,996	15,221
Iron ore (usable) thousand long tons, gross weight..	1,990	13,837	1,681	11,886
Lead (recoverable content of ores, etc.) short tons..	45,377	14,175	38,270	10,562
Lime.....thousand short tons..	186	3,756	172	3,569
Manganiferous ore (5 to 35 percent Mn) short tons..	700	W	112	W
Natural gas (marketed).....million cubic feet..	42,781	6,460	42,418	7,084
Petroleum (crude).....thousand 42-gallon barrels..	23,370	65,603	23,630	71,886
Pumice.....thousand short tons..	W	18	6	10
Salt.....do.....	r 450	r 4,192	614	5,213
Sand and gravel.....do.....	12,010	10,439	10,505	10,190
Silver (recoverable content of ores, etc.)				
thousand troy ounces..	6,030	10,678	5,294	8,185
thousand short tons..	1,650	4,320	2,556	5,335
Uranium (recoverable content U ₃ O ₈)				
thousand pounds..	1,635	10,023	1,445	8,959
short tons.....	257	W	226	W
Zinc (recoverable content of ores, etc.).....do.....	34,688	10,628	25,701	8,276
Values of items that cannot be disclosed: Asphalt and related bitumens, beryllium concentrate, cement, gypsum, magnesium compounds, molybdenum, natural gas liquids, perlite (1970), phosphate rock, potassium salts, sodium sulfate, tungsten concentrates, and values indicated by symbol W.....	XX	55,899	XX	49,754
Total.....	XX	r 602,551	XX	525,700
Total 1967 constant dollars.....	XX	538,982	XX	p 456,728

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

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

Table 2.—Value of mineral production in Utah, by county
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Beaver.....	\$883	\$1,928	Copper, sand and gravel, perlite, pumice.
Box Elder.....	W	W	Stone, sand and gravel, lime, salt.
Cache.....	W	W	Sand and gravel, stone, lime.
Carbon.....	W	W	Coal, sand and gravel, carbon dioxide.
Daggett.....	441	W	Petroleum, stone.
Davis.....	911	875	Sand and gravel.
Duchesne.....	W	W	Petroleum, natural gas, sand and gravel.
Emery.....	W	6,150	Coal, sand and gravel, natural gas, uranium, petroleum, vanadium.
Garfield.....	4,618	6,045	Petroleum, sand and gravel, uranium, vanadium.
Grand.....	4,365	2,710	Natural gas, uranium, petroleum, vanadium, sand and gravel, copper, silver.
Iron.....	14,040	12,049	Iron ore, sand and gravel, stone, pumice.
Juab.....	1,328	884	Clays, fluorspar, sand and gravel, stone, silver, copper, lead, zinc.
Kane.....	W	140	Coal, sand and gravel, pumice.
Millard.....	38	W	Pumice, beryllium concentrate.
Morgan.....	W	W	Cement, stone, sand and gravel.
Piute.....	1,043	715	Zinc, lead, silver, sand and gravel, gold, clays.
Rich.....	W	W	Phosphate rock, sand and gravel.
Salt Lake.....	402,459	318,919	Copper, molybdenum, gold, silver, lead, cement, zinc, sand and gravel, salt, lime, stone.
San Juan.....	52,039	54,562	Petroleum, uranium, natural gas liquids, copper, vanadium, natural gas, silver.
Sanpete.....	183	186	Sand and gravel, salt, clays.
Sevier.....	1,751	2,324	Coal, gypsum, sand and gravel, clays, salt.
Summit.....	7,082	5,747	Petroleum, sand and gravel, clays, zinc, lead, natural gas, stone, silver, coal, copper, gold.
Tooele.....	9,263	8,911	Lime, salt, potassium salts, stone, lead, zinc, silver, copper, sand and gravel, gold, tungsten.
Utah.....	27,915	29,228	Petroleum, asphalt and related bitumens, natural gas, phosphate rock, sand and gravel, natural gas liquids.
Utah.....	12,567	10,661	Lead, zinc, stone, silver, sand and gravel, clays, lime, gold, manganese ore.
Wasatch.....	W	W	Gold, copper, lead, zinc, sand and gravel, stone, petroleum.
Washington.....	84	W	Stone, sand and gravel, pumice.
Wayne.....	W	23	Sand and gravel.
Weber.....	790	5,286	Potassium salts, sand and gravel, sodium sulfate, salt, magnesium compounds, clays.
Undistributed ¹	60,191	58,346	
Total ²	601,997	525,700	

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

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

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

Table 3.—Indicators of Utah business activity

	1970	1971	Change, percent	
Employment and labor force, annual average:				
Total labor force.....	thousands ..	449.5	457.9	+1.9
Employment.....	do ..	421.2	429.7	+2.0
Unemployment.....	do ..	28.3	28.2	-.4
Nonagricultural employment.....	do ..	358.6	358.7	+(¹)
Mining.....	do ..	12.7	11.9	-6.3
Construction.....	do ..	14.6	17.0	+16.4
Manufacturing.....	do ..	55.1	55.4	+ .5
Government.....	do ..	100.1	100.9	+ .8
Other nonagricultural employment ²	do ..	176.2	182.5	+3.6
Personal income:				
Total.....	millions ..	\$3,416	\$3,731	+9.2
Per capita.....	do ..	\$3,195	\$3,395	+6.3
Construction activity:				
Total construction valuation.....	millions ..	\$333.8	\$416.7	+24.8
Residential.....	do ..	\$124.7	\$181.9	+45.9
Nonresidential.....	do ..	\$104.9	\$129.0	+23.0
Nonbuilding.....	do ..	\$104.2	\$105.9	+1.6
Highway construction contracts awarded.....	do ..	\$60.0	\$64.0	+6.6
Cement shipments to and within the State.....	thousand 376-pound barrels ..	2,228.0	2,632.0	+18.1
Mineral production value.....	millions ..	\$602.6	\$525.7	-12.8
Production of electrical energy utilized.....	million kilowatt hours ..	7,436.5	8,202.4	+10.3

¹ Less than one-tenth of 1 percent.

² Includes transportation and public utilities; wholesale and retail trade; finance, insurance, and real estate; and services.

Sources: University of Utah; Bureau of Economic and Business Research; Bureau of Labor Statistics, Employment and Earnings; U.S. Department of Commerce, Construction Review; Survey of Current Business; and U.S. Bureau of Mines.

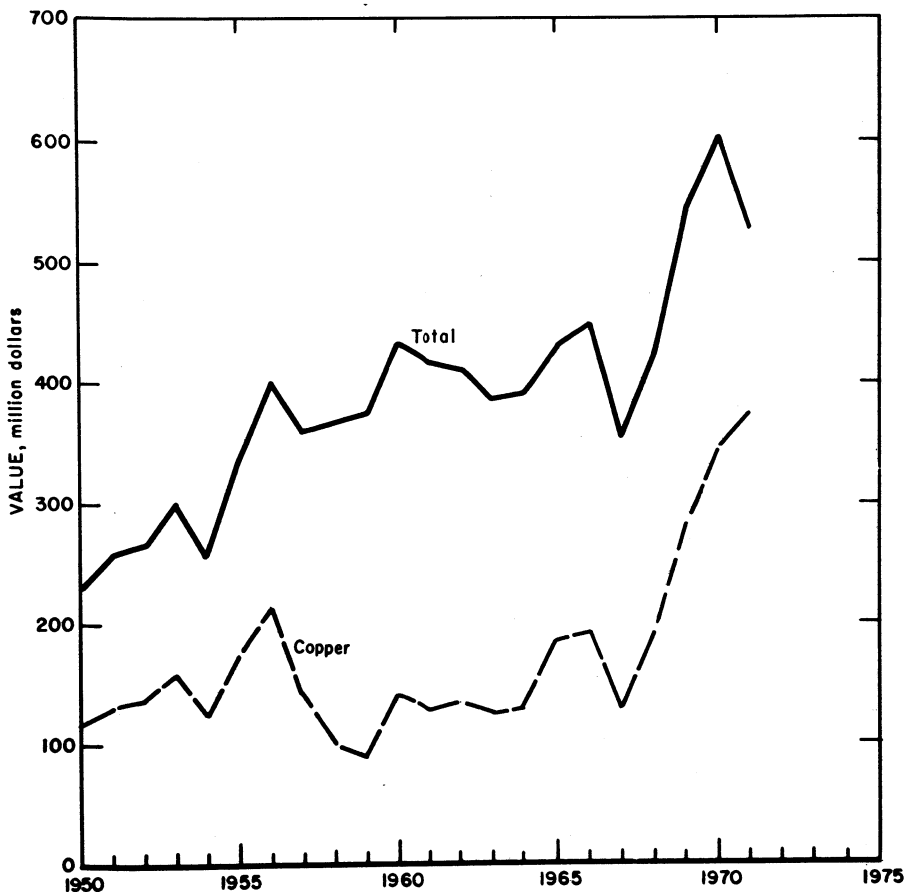


Figure 1.—Value of mine production of copper, and total value of mineral production in Utah.

Employment and Injuries.—Final employment and injury data, compiled by the Bureau of Mines for 1970, with preliminary data for 1971, are shown in table 4. Information presented excludes all mineral fuels, except the coal and asphalt-gilsonite industries.

Legislation and Government Programs.—The Office of Minerals Exploration granted a loan on one property in Utah during the year. Joe Desloge, Jr., was awarded a contract totaling \$71,600 to explore uranium occurrences in San Juan County.

President Nixon signed a bill making Arches National Monument in Grand

County, Utah, a national park. The bill permits expansion of the land area and limits land costs to \$25,000 and development to \$1,031,000. President Nixon also signed a measure adding approximately 80,000 acres of land to Canyonlands National Park in San Juan and Wayne Counties.

Metallurgists at the Salt Lake City Metallurgy Research Center have two new developments in the citrate process for removal of SO_2 from stack gases. It has been found that two-thirds of the SO_2 can be stripped from loaded citrate solution with relatively small amounts of low-pressure steam. This procedure greatly increases the

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours		
					Fatal	Non-fatal	Frequency	Severity	
1970:									
Coal.....	1,440	224	323	2,531	5	186	75.45	15,999	
Metal.....	5,210	316	1,645	13,159	3	241	13.54	2,336	
Nonmetal.....	1,042	257	267	2,133	1	77	36.57	4,320	
Sand and gravel.....	505	205	103	834	1	14	17.99	7,560	
Stone.....	388	261	101	810	--	11	13.57	590	
Total.....	8,585	284	2,440	19,467	10	529	27.69	4,536	
1971: ^P									
Coal.....	1,585	212	336	2,644	2	222	84.72	9,806	
Metal.....	5,155	307	1,581	12,645	4	210	16.92	2,473	
Nonmetal.....	585	229	133	1,068	1	34	32.76	6,544	
Sand and gravel.....	385	198	76	667	1	18	23.50	18,967	
Stone.....	345	268	93	743	--	11	14.80	351	
Total.....	8,055	275	2,219	17,768	8	495	23.31	4,264	

^P Preliminary.¹ Data does not add to total shown because of independent rounding.

versatility of the citrate process as it permits production of elemental sulfur or an essentially 100 percent SO₂ gas for conversion to sulfuric acid. The second development is a dry process for removing precipitated sulfur from citrate solution. The addition of a small amount of a light hydrocarbon causes the sulfur in the slurry to rise to the top as a free-flowing powder which can easily be collected from the surface of the citrate solution. The solution

may then be recycled without any additional treatment.

Bureau of Mines personnel at Salt Lake City, in cooperation with the staff of Homestake Mining Co., Lead, S. Dak., conducted successful pilot-scale tests of the Bureau's version of the carbon-in-pulp process to extract gold from cyanide-leached ore slimes. The company has started erection of a plant at the Homestake Mill to utilize this process.

REVIEW BY MINERAL COMMODITIES

METALS

Beryllium.—Brush Wellman Inc. (formerly The Brush Beryllium Co.) mined bertrandite ore from the Roadside open pit mine at Spor Mountain, Juab County, and trucked it to its plant 10 miles north of Delta, Millard County, for beneficiation. The company opened a new deposit, the Blue Chalk, east of the Roadside pit and northwest of Delta, Utah. The ores from both deposits will be blended prior to beneficiation when necessary.

Copper.—The quantity of copper produced fell 11 percent and the value of production declined 20 percent in 1971. A copper strike involving 6,500 employees of Kennecott Copper Corp. at its Utah Copper Division lasted from July 1 to July 29, 1971. The open pit mine of Kennecott Copper Corp. at Bingham was the largest copper producing mine in the United

States. Other leading producers included the Big Indian and GTO mines operated by Keystone-Wallace Resources Co., the Milford mines of Shield Development Co. and Essex International Inc., the Mayflower mine of Hecla Mining Co., and the U.S. and Lark mine of United States Smelting, Refining and Mining Co. (USSR&M).

Kennecott Copper Corp. added two grinding and flotation units at the Magna and Arthur plants for treatment of the coarse tailings fractions from the two primary flotation concentrators. Copper recovery was expected to increase from slightly less than 90 percent to just over 90 percent. Retreatment of the tailings, formerly discharged into a vast tailings pond, was expected to yield an additional 9.5 tons of copper per day, about 20 ounces of gold, and a small quantity of molybdenite from each plant.

Table 7.—Mine production of gold, silver, copper, lead, and zinc in 1971, by type of material processed and method of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode:					
Acid leaching (heap): Ore-----			5,673		
Smelting of concentrates from: Ore ¹ -----	367,691	5,087,338	209,883	36,243	25,288
Direct smelting of:					
Ore and cleanup-----	1,305	207,139	635	2,027	413
Precipitates-----	--	--	47,260	--	--
Total -----	1,305	207,139	47,895	2,027	413
Grand total -----	368,996	5,294,477	263,451	38,270	25,701

¹ Includes concentrate from uranium ore.

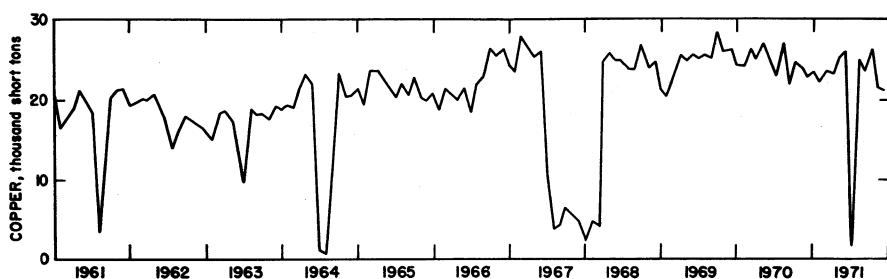


Figure 2.—Mine production of copper in Utah, by month in terms of recoverable metals.

remained the principal gold producer. The Mayflower mine, operated by Hecla Mining Co. of Wallace, Idaho, was second in gold production in the State.

Iron Ore.—Iron ore was produced at four open pit mines, all in Iron County; the Desert Mound mine of United States Steel Corp. (USS); the Iron Springs and McCahill-Thompson alluvial mines of Utah International Inc. (formerly Utah Construction & Mining Co.); and the Comstock mine operated by Utah International for CF&I Steel Corp. Total production declined 16 percent in quantity and 14 percent in value.

Ores and concentrates shipped during the year contained an average of 53.0 percent iron. The iron and steel industry utilized 99 percent of the total ore and concentrate shipments, and the remainder was used in making cement and paint.

Lead.—Total lead production fell 16 percent; the value of production fell 25 percent. The leading producers in order of output were the U.S. and Lark mine of USSR&M Co.; Burgin mine, Tintic Divi-

sion, Kennecott Copper Corp.; Mayflower mine of Hecla Mining Co.; Ophir Hill mine of USSR&M Co., operated by McFarland & Hullinger; and United Park City Mines, United Park City Mines Co.

On November 5, a subsidiary of The Anaconda Company, announced that the lead smelter at Tooele would be closed at yearend. The Tooele plant began operations as a copper smelter in 1910. Facilities for smelting lead ore and concentrate were started in 1912. Copper smelting ended in 1946. Several of the lead operations dependent on the Tooele smelter were also forced to close. On November 11, USSR&M Co. announced plans to close the lead-zinc mine at Lark and the flotation plant at Midvale; production ceased in December at the Ophir Hill mine at Ophir, owned by USSR&M Co. and operated by McFarland and Hullinger, a leasing partnership.

Manganiferous Ore.—Production of manganiferous ore (ore containing 5 percent or more manganese, natural) was all from the Burgin mine, Tintic Division, Kennecott Copper Corp. in Utah County.

Production dropped to 112 long tons containing 33.6 percent manganese, all of which was shipped to concentrators.

Molybdenum.—All molybdenum produced in Utah was recovered as a byproduct from concentration of copper ores mined by Kennecott Copper Corp. at Bingham. Production decreased 23 percent and total value of production decreased 37 percent.

Selenium.—Kennecott Copper Corp. recovered selenium as a byproduct of electrolytic refining of blister copper at the Garfield plant. Output of selenium decreased 45 percent.

Silver.—Production of silver in Utah declined 12 percent in quantity and 23 percent in value. The principal silver source was the Kennecott Copper Corp. mine at Bingham followed by the company's Burgin mine in Utah County. Twelve mines in eight counties reported silver production all of which was a byproduct of copper or lead-zinc ores.

Tungsten.—Small quantities of high grade tungsten ore and concentrate were produced at the Star Dust mine of Star Dust Mines, Inc., Clifton district, Tooele County, and trucked to Fallon, Nev. for processing by the Nevada Division of Kennametal, Inc.

Uranium.—The number of uranium mines operating in the State continued to decline; 59 operations were reported in 1971 compared with 66 operations in 1970. Production fell 12 percent and value 11 percent. Value was calculated on a basis of \$5.78 per pound recoverable content (U_3O_8) marketed through the U.S. Atomic Energy Commission and \$6.20 per pound for commercial sales. The average grade of the ores mined was 0.19 percent U_3O_8 , compared with the 1970 average of 0.22 percent U_3O_8 . Work continued on the Rio Algom Corp. Humeca uranium property in San Juan County. Initial production at the mine and mill is scheduled for the spring of 1972. The Atlas Minerals Division, Atlas Corp., announced plans to spend approximately \$1 million in surface and underground uranium exploration in fiscal year 1972.

Vanadium.—Mines in four counties yielded vanadium-bearing ores that were processed at mills in Colorado. Vanadium output recovered from Utah ores declined 12 percent in 1971.

Zinc.—Zinc production reported from nine mines in seven counties declined 26 percent in quantity and 22 percent in value. The Burgin mine of Kennecott Copper Corp. was the principal zinc producer in the State, followed by the U.S. and Lark mine of USSR&M Co., the Mayflower mine of Hecla Mining Co., the Ophir Hill mine of USSR&M Co., and the Deer Trail mine operated by Deer Trail Mines and Arundel Mining Co.

MINERAL FUELS

Asphalt and Related Bitumens.—Total output from the three gilsonite-producing companies fell 23 percent in tonnage and 19 percent in value in 1971.

Carbon Dioxide.—Production of carbon dioxide declined 9 percent; the entire output continued to come from the one-well Farnham Dome field, Carbon County.

Coal (Bituminous).—Coal output from 22 properties in five counties decreased 2 percent in quantity and 1 percent in total value. As in past years, the combined output from Carbon and Emery Counties was predominant, accounting for 96 percent of the State's total tonnage.

Exploration of the coalbeds on the Kaiparowits Plateau, Kane County, continued in 1971. The coal is to supply the proposed Kaiparowits powerplant at Nipple Bench. Resources Co., Peabody Coal Co., and El Paso Natural Gas Co., were drilling in separate parts of the Plateau. Construction of the Huntington Canyon coal-burning powerplant of Utah Power and Light Co. was begun on March 8. The plant site is 7 miles northwest of Huntington, Emery County. The first unit of the plant is to have a capacity of 430 megawatts and will be completed in 1974. Coal will be mined in the plant area by Peabody Coal Co.

Woods Petroleum Co. announced the discovery of a large coal deposit 10 miles west of Escalante, Garfield County, and drilling continued to determine the extent of the reserves. Utah Power and Light Co. arranged a 90-day purchase option on the Church coal mine near Orangeville, Emery County. The mine is owned by the Church of Jesus Christ of Latter-Day Saints. The power company explored the property by drilling. If the purchase option is completed, it is likely that Utah Power and Light Co. will mine approximately 800,000

Table 8.—Coal (bituminous) sold or used,¹ by county

County	1970		1971	
	Number of mines operating (all underground)	Thousand short tons	Number of mines operating (all underground)	Thousand short tons
Carbon.....	10	3,849	² 12	3,608
Emery.....	8	1,292	7	836
Kane.....	--	--	1	12
Sevier.....	1	79	1	158
Summit.....	1	13	1	12
Total.....	20	4,733	22	4,626

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

² Includes one strip mine producing 7,000 short tons.

tons of coal annually for powerplants in Salt Lake City and Castlegite.

Natural Gas.—Marketed natural gas decreased 1 percent, to 42,418 million cubic feet, but the value of marketed production rose 10 percent, to \$7,084,000 as the average wellhead price rose from 15.1 cents per thousand cubic feet to 16.7 cents. The State Division of Oil and Gas Conservation² reported production of 74.0 billion cubic feet. Of this output, 28.5 billion cubic feet was injected into reservoirs for storage. Uintah County was the largest producer of marketed gas, with 17.6 billion cubic feet sold. Grand County ranked second with 9.8 billion cubic feet and San Juan County ranked third with 7.6 billion cubic feet marketed.

Natural gas reserves estimated by the American Petroleum Institute (API) and the American Gas Association (AGA) totaled 982 billion cubic feet. Reserves declined 83.0 billion cubic feet; new fields and new pools added 8.2 billion cubic feet, but revisions and extensions subtracted 48.8 billion cubic feet.³

Only two development gas wells were completed in 1971, compared with six in 1970; both new wells were in Grand County. Three exploratory wells were completed in Uintah County and one in Duchesne County.

Officials of nine oil companies discussed the possibility of construction of a joint venture gas gathering and processing plant to serve producing areas in the northern part of Uinta Basin, Duchesne and Uintah Counties. Shell Oil Co. initiated the meetings and was designing a 20-million cubic feet per day processing plant, which could be onstream by November 1972, if plans prove feasible. Other companies involved included Humble Oil & Refining Co.,

Coastal State Gas Producing Co., Chevron Oil Co., Mountain Fuel Supply Co., Texaco Inc., Gulf Oil Corp., Flying Diamond Land and Minerals Co., and Warren Petroleum Corp.

Natural Gas Liquids.—Production of natural gas liquids increased 2 percent in quantity and 18 percent in total value in 1971. According to estimates by API and AGA, reserves of gas liquids decreased 2.4 million barrels to 33.9 million barrels at yearend.⁴

Petroleum.—Although output of crude petroleum increased only 1 percent—by 260,000 barrels—the value of production increased 10 percent due to the increase in wellhead prices. San Juan and Uintah Counties continued to rank first and second in the State supplying 49 and 26 percent, respectively, of the total output.

Exploratory interest in Utah's newest Tertiary trend continued at high levels, with eight companies sinking 12 wildcat wells and making two additional locations. The area extends from the Bluebell and Roosevelt fields on the northeast to the Cedar Rim-Sink Draw area on the southwest. Chevron Oil Co. announced a \$10 million expansion at its Salt Lake City refinery which will include a delayed coker plant and extensive efforts toward environmental conservation. About \$1.5 million will be spent specifically for environmental control. The first application to conduct informational core drilling on Federal oil shale lands in Utah was filed by Gulf

² Utah Department of Natural Resources, Division of Oil and Gas Conservation. Monthly Oil and Gas Production Reports, 1971.

³ American Gas Association, Inc., American Petroleum Institute, and Canadian Petroleum Association. Reserves of crude oil, natural gas liquids, and natural gas in the United States and Canada as of Dec. 31, 1971. V. 26, May 1972.

⁴ Reference cited in footnote 3.

Table 9.—Crude oil production by county
(Thousand 42-gallon barrels and thousand dollars)

County	1970	1971	Principal fields in 1971, in order of production
Daggett.....	3	6	Clay Basin.
Duchesne.....	1,902	2,984	Bluebell, Altamont, Cedar Rim.
Emery.....	4	5	Grassy Trail, Ferron.
Garfield.....	1,601	1,948	Upper Valley.
Grand.....	158	116	Salt Wash, Long Canyon, Agate, San Arroyo.
San Juan.....	12,436	11,485	Greater Aneth Area, Lisbon, Boundary Butte, Ismay Flodine.
Summit.....	1,001	841	Bridger Lake.
Uintah.....	6,265	6,244	Red Wash Area, Ashley Valley, Coyote Basin, Roosevelt.
Wasatch.....	--	1	Undesignated.
Washington.....	(¹)	--	
Total.....	23,370	23,630	
Value.....	\$65,603	\$71,886	

¹ Less than 1/2 unit.

Source: Utah Oil & Gas Conservation Commission.

Table 10.—Oil and gas well drilling completions in 1971, by county

County	Proved field wells ¹			Exploratory			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Carbon.....	--	--	--	--	--	1	1	9,165
Duchesne.....	11	--	1	7	1	6	26	254,072
Garfield.....	4	--	1	--	--	6	11	68,292
Grand.....	1	2	2	--	--	5	10	37,413
Iron.....	--	--	--	--	--	1	1	6,762
Kane.....	--	--	--	--	--	2	2	14,244
San Juan.....	2	--	1	1	--	11	15	83,987
Sevier.....	--	--	--	--	--	1	1	8,297
Summit.....	--	--	--	--	--	1	1	15,500
Uintah.....	4	--	3	--	3	6	16	95,755
Wasatch.....	--	--	--	--	--	1	1	12,264
Washington.....	--	--	--	--	--	1	1	7,060
Wayne.....	--	--	--	--	--	1	1	6,129
Total.....	22	2	8	8	4	43	87	618,940

¹ Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

Mineral Resources Co. of Denver on October 19, which planned to core-drill three sites southwest of the White River between Bonanza and Watson.

NONMETALS

Barite.—Crude barite was not produced in Utah in 1971. However, barite mined in California and Nevada, was processed for well drilling mud by Custom Milling & Supply Co. at Salt Lake City.

Cement.—Shipments of portland cement increased 11 percent. Masonry cement shipments increased 20 percent. Portland cement was produced at two plants, one of which also produced masonry cement. Portland cement shipped was type I and II (general use and moderate heat); type III (high-early-strength) and type V (high-sulfate-resistance). Portland and masonry

cement consumed in the State totaled 2,632,000 376-pound barrels and 5,000 280-pound barrels, respectively. Portland cement was consumed for ready-mix concrete, concrete products, and building materials by contractors and other customers. Raw materials used in making portland cement included limestone and cement rock, sand, gypsum and iron-bearing materials. The plants used natural gas, bituminous coal, and fuel oil in their kilns.

Producing companies were Ideal Cement Co., Utah Division of Ideal Basic Industries, Inc., and Portland Cement Co. of Utah. Ideal Cement planned to install additional dust control equipment at its Devil's Slide, Utah plant, with completion scheduled in 1973. Pozzolan Portland Cement Co., subsidiary of Friar Oil Co., was starting operation of its new 150-ton-per-day mill near Bacchus, Utah. This com-

pany does not make pozzolan portland cement but grinds pozzolanic material that can be used to make pozzolan cement.

Clays.—Production of materials classified as clays rose 5 percent, but value fell 14 percent. Fifteen operations in seven counties contributed to total production. The major producing companies were Utelite Corp., Mountain Fuel Supply Co., Interpace Corp., and Filtrol Corp. The materials listed as clays included shale, common clay, kaolin, fire clay, bentonite, and fuller's earth. Most of the clays were used as expanded material in making lightweight aggregate, in manufacturing building brick, and as support for catalysts in oil refining.

Fluorspar.—All fluorspar produced in the State was mined in the Spor Mountain area, Juab County. Nearly all ores, produced from three mines, were sold to steel companies for use as flux. Output was down 43 percent in both quantity and value.

Gem Stones.—Total value of gem stones recovered in the State during 1971 was estimated at \$90,000, slightly more than in 1970.

Gypsum.—Gypsum was produced from open pit mines near Sigurd, Sevier County, by Georgia-Pacific Corp., Gypsum Division,

and United States Gypsum Co. The crude tonnage produced rose 14 percent; the value of the crude gypsum increased 16 percent. Most of the output was calcined and sold for building purposes such as plaster or gypsum board; small quantities were sold for use as a portland cement retarder and for agricultural requirements.

Lime.—Six companies produced lime at six plants in five counties. Leading counties were Tooele and Salt Lake. Leading producers were The Flintkote Co.; Utah-Marblehead Lime Co.; and Kennecott Copper Corp. Output decreased 8 percent and was 14 percent below the 1966 record. The lime was used for refractories, copper ore concentration, sugar refining, and other uses. The lime was consumed in Utah, Idaho, California, and other States. Total consumption of lime in Utah was 120,898 tons.

Magnesium Chloride.—Magnesium chloride was produced by Kaiser Aluminum & Chemical Corp. at its Bonneville plant near Wendover and by Great Salt Lake Minerals & Chemicals Corp. in Weber County. Total value of output expanded greatly in 1971.

Natural Sodium Compounds (Sulfate).—Great Salt Lake Minerals & Chemical

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

(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Box Elder.....	5	547	\$343	4	635	\$445
Cache.....	9	366	317	11	647	620
Davis.....	10	919	911	6	1,198	875
Duchesne.....	3	840	491	2	W	W
Emery.....	8	616	817	2	W	W
Grand.....	5	618	571	2	W	W
Iron.....	4	207	187	2	W	W
Juab.....	1	45	30	1	W	31
Kane.....	3	W	W	1	W	31
Millard.....	2	49	38	--	--	--
Morgan.....	--	--	--	1	21	36
Plute.....	3	6	3	--	51	29
Rich.....	3	210	130	1	W	W
Salt Lake.....	28	3,979	3,677	25	3,286	3,014
San Juan.....	2	20	49	--	--	--
Sevier.....	4	508	343	1	W	W
Tooele.....	8	1,062	807	4	W	W
Utah.....	5	265	152	8	813	644
Wasatch.....	8	83	166	3	W	W
Washington.....	5	83	81	6	36	72
Wayne.....	3	219	220	1	103	28
Weber.....	13	468	397	9	611	657
Undistributed ¹	22	902	707	19	3,063	3,707
Total ²	154	12,010	10,439	109	10,505	10,190

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

¹ Includes Beaver, Carbon, Daggett (1970), Garfield, Sanpete, Summit, and Uintah Counties and some sand and gravel that cannot be assigned to specific counties.

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

Table 12.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,117	\$1,252	1,553	\$1,514
Fill	245	70	177	89
Paving	569	479	581	591
Other uses ¹	298	412	22	59
Total ²	2,230	2,213	2,334	2,254
Gravel:				
Building	1,400	1,573	1,729	1,471
Fill	184	88	255	119
Paving	4,973	4,475	4,069	4,928
Railroad ballast	114	14	W	W
Miscellaneous	10	7	W	W
Other uses ³	83	96	64	51
Total ²	6,763	6,253	6,117	6,569
Government-and-contractor operations:				
Sand:				
Building	8	12	3	7
Fill	80	2	1	1
Paving	420	262	103	112
Other uses	11	8	36	1
Total ²	520	283	143	121
Gravel:				
Building	7	16	50	35
Fill	858	346	787	269
Paving	1,625	1,311	1,033	904
Other uses	7	16	41	38
Total ²	2,497	1,690	1,911	1,246
Total sand and gravel	12,010	10,439	10,505	10,190

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

¹ Includes blast, engine, fill (ground; 1971), foundry, and other sands.

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

³ Includes miscellaneous, other gravel, and railroad ballast.

Corp. processed sodium sulfate from evaporation ponds on the Great Salt Lake in Weber County. Designed capacity is 150,000 tons per year, but was not obtained in 1971.

Perlite.—Two plants, Acme Lite Wate Products, Inc., Salt Lake City, and Georgia-Pacific Corp., Gypsum Division, at Sigurd, expanded perlite from out-of-State sources for use as a plaster aggregate and in building. No crude perlite was produced in Utah during 1971.

Phosphate Rock.—The Stauffer Chemical Co., the only company producing phosphate rock, operated mines in Rich and Uintah Counties. Phosphate rock from the Cherokee mine was processed in the company plant at Leefe, Wyo. Production increased about 6 percent in quantity and 8 percent in value.

Potash.—Two operations reported production of potash salts in 1971: Kaiser Aluminum & Chemical Corp., Bonneville

Ltd. Division, Tooele County, and the Great Salt Lake Minerals & Chemicals Corp., Weber County. In addition, Texas Gulf Sulphur Co. sold potash salts from its stockpile pending completion of its solution mining facilities. The company formerly used underground mining methods to obtain potash from its Cane Creek mine, Grand County. The quantities produced and sold declined, as did the value of sales, but the value of production increased substantially.

Pumice.—Five mines in different counties of Utah produced pumice, pumicite, or volcanic cinders, most of which was used in road construction. Total tonnage and value decreased.

Salt.—Production increased 36 percent to 614,000 short tons and total value of production increased 24 percent to \$5.2 million. Evaporated salt was produced by six companies with ponds in four counties. Two mines in Sanpete County and one in

Sevier County accounted for all rock salt production. The salt was sold for use in many industries, principally chemical and animal feed processing industries, but the bulk of production was sold to Government agencies for road salt.

Sand and Gravel.—Output of sand and gravel, from 154 operations in 28 counties, fell 13 percent in 1971, although the value of production declined only 2 percent. Salt

Lake County, with 28 operations, again produced the greatest amount of sand and gravel, followed by Davis County (10 operations) and Utah County (five operations). Commercial operations accounted for 80 percent of the sand and gravel output, with Government and contractor operations making up the remainder. The largest category of use was gravel sold for paving by commercial operations. Sand and

Table 13.—Stone sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	1970			1971			Kind of stone produced in 1971
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value	
Box Elder-----	6	W	\$311	5	W	W	Quartzite, slate, other stone.
Cache-----	3	W	W	3	289	\$417	Limestone, quartzite, other stone.
Daggett-----	1	W	W	1	W	W	Sandstone.
Duchesne-----	2	W	W	—	—	—	—
Iron-----	1	W	W	3	W	W	Limestone, other stone.
Juab-----	1	W	W	1	W	W	Quartzite.
Morgan-----	1	W	W	1	W	W	Limestone, sandstone.
Salt Lake-----	5	242	393	4	W	W	Limestone, quartzite, other stone.
Summit-----	5	113	518	2	W	W	Sandstone, other stone.
Tooele-----	3	W	825	3	W	970	Limestone, dolomite, marble.
Utah-----	4	W	W	5	W	W	Limestone, dolomite, marble, other stone.
Wasatch-----	2	W	W	1	W	W	Sandstone.
Washington-----	—	—	—	3	W	W	Sandstone, other stone.
Weber-----	1	W	W	—	—	—	—
Undistributed..	—	1,295	2,273	—	2,266	3,947	—
Total ¹ ..	35	1,650	4,320	32	2,556	5,335	

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

¹ Data may not add to totals shown because of independent rounding.

Table 14.—Stone sold or used by producers, by use
(Thousand short tons and thousand dollars unless otherwise specified)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough blocks-----	W	\$20	(¹)	\$8
Rough flagging-----	W	6	W	W
Sawn stone-----	—	—	W	W
House stone veneer-----	18	W	W	W
Cut stone-----	—	—	4	35
Other uses-----	—	—	W	W
Total	3	119	4	208
Crushed and broken stone:				
Riprap and jetty stone-----	207	633	(²)	(²)
Roofing aggregates-----	(²)	(²)	(²)	(²)
Dense graded road base stone-----	180	468	210	246
Surface treatment aggregates-----	(²)	(²)	(²)	(²)
Lime-----	(²)	(²)	(²)	(²)
Other uses ³ -----	1,260	3,050	2,343	4,881
Total ⁴	1,646	4,201	2,552	5,127
Grand total ⁴	1,650	4,320	2,556	5,335

W Withheld to avoid disclosing individual company confidential data; included in "Total."

¹ Less than ½ unit.

² Included in "Other uses."

³ Includes stone used in agricultural lime, poultry grit, concrete aggregate (1971), bituminous aggregate (1971), terrazzo, cement, ferrosilicon, flux stone, refractory stone, mine dusting, drain fields (1971), whitening (1970), rubble (1970), flagging (1970), and uses not specified.

⁴ Data may not add to totals shown because of independent rounding.

gravel continued to lead the nonmetallic group in total value of production.

Stone.—Although the number of quarries operating in the State dropped from 35 in 1970 to 32 in 1971, the quantity of stone increased 55 percent and the value of stone sold or used by producers increased 23 percent. The average value per ton dropped from \$2.62 to \$2.09. Principal producing companies in order of output were United States Steel Corp., Southern Pacific Railroad Co., and Ideal Basic In-

dustries. Limestone accounted for 44 percent of total stone sold or used by producers in 1971.

Vermiculite.—No vermiculite production was reported in 1971, but out-of-State material was exfoliated by Vermiculite-Intermountain Inc. in Salt Lake City. The product was sold and used principally as plaster aggregate and as block and loose-fill insulation. Other uses included concrete aggregate, pipe covering, and soil conditioning.

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

(Thousand short tons and thousand dollars)

Kind of stone	1970		1971	
	Quantity	Value	Quantity	Value
Dimension stone total ¹	3	\$119	4	\$208
Crushed and broken:				
Limestone.....	1,164	2,361	1,112	2,239
Dolomite.....	W	W	W	W
Marble.....	W	W	W	W
Sandstone.....	W	W	W	W
Quartz.....	(²)	W	W	W
Quartzite.....	6	W	W	121
Other stone.....	180	439	706	863
Undistributed.....	296	1,401	735	1,903
Crushed total ³	1,646	4,201	2,552	5,127
Grand total ³	1,650	4,320	2,556	5,335

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

¹ Includes sandstone, quartzite, slate (1971); 1970 data also includes limestone and marble.

² Less than ½ unit.

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

Table 16.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt and related bitumens:			
American Gilsonite Co.....	Suite 1150, Kennecott Bldg. Salt Lake City, Utah 84110	Underground mine..... Refinery.....	Uintah. Mesa.
Beryllium: Brush Wellman, Inc.	67 W. 2950 S. Salt Lake City, Utah 84115	Open pit mine..... Chemical processing plant..	Juab. Millard.
Carbon dioxide (natural):			
Equity Oil Co.....	806 American Oil Bldg. Salt Lake City, Utah 84101	Well and plant, Farnham Dome field.	Carbon.
Cement:			
Ideal Cement Co., Div. of Ideal Basic Industries, Inc. ¹	420 Ideal Cement Bldg. Denver, Colo. 80202	Wet process, 2-rotary-kiln plant.	Morgan.
Portland Cement Co. of Utah.	Box 1469 Salt Lake City, Utah 84110	Wet process.....	Salt Lake.
Clays:			
Filtrol Corp.....	3250 E. Washington Blvd. Los Angeles, Calif. 90023	Open pit-underground mine.	Juab.
Interstate Brick Co.....	Box 6239 Salt Lake City, Utah 84106	Open pit mines.....	Sevier, Summit, Tooele, Utah.
Utelite Corp.....	R.F.D. Coalville, Utah 84017	Open pit mine and expand- ing plant.	Summit.
Western Clay & Metals Co.	1200 S. Atlantic Blvd. Alhambra, Calif. 91803	2 open pit mines.....	Sevier.
Coal (bituminous):			
Kaiser Steel Corp.....	Sunnyside Coal Mines Sunnyside, Utah 84539	3 underground mines and cleaning plant.	Carbon.
The North American Coal Corp.	12800 Shaker Blvd. Cleveland, Ohio 44120	Underground mine and cleaning, thermal drying, and oil treatment plant.	Do.
United States Fuel Co.....	1910 University Club Bldg. Salt Lake City, Utah 84111	Underground mine..... Cleaning, crushing and oil treatment plant.	Carbon, Emery. Carbon.
United States Steel Corp., Western District.	Box 807 Dragerton, Utah 84520	Underground mine..... Cleaning, thermal drying, and crushing plant.	Carbon, Emery. Carbon.

See footnote at end of table.

Table 16.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Copper:			
Hecla Mining Co.-----	Box 320 Wallace, Idaho 83873	See Gold-----	Wasatch.
Kennecott Copper Corp., Utah Copper Division.	Box 11299 Salt Lake City, Utah 84111	Open pit mine, crusher, 2 flotation mills, precipita- tion plant, smelter, and electrolytic refinery.	Salt Lake.
United States Smelting Refining and Mining Co.	136 E. South Temple St. Salt Lake City, Utah 84111	See Lead-----	Do.
Fluorspar:			
Centennial Development Co.	Eureka, Utah 84628-----	Open pit and underground mines.	Juab.
Chesley & Black, Inc.-----	Delta, Utah 84624-----	Open pit mine-----	Do.
Spor Bros.-----	Box 276 Delta, Utah 84624	Open pit and underground mines.	Do.
Willden Fluorspar Co.-----	Box 536 Delta, Utah 84624	Underground mine-----	Do.
Gold:			
Hecla Mining Co.-----	Box 320 Wallace, Idaho 83873	Underground mine and flotation mill.	Wasatch.
Kennecott Copper Corp., Utah Copper Division.	Box 11299 Salt Lake City, Utah 84111	See Copper-----	Salt Lake.
United Park City Mines Co.	Star Route 1, Box 40 Heber City, Utah 84032	See Zinc-----	Summit.
United States Smelting Refining and Mining Co.	136 E. South Temple St. Salt Lake City, Utah 84111	See Lead-----	Salt Lake.
Gypsum:			
Georgia Pacific Corp., Gypsum Division.	P.O. Box 311 Portland, Oreg. 97207	Open pit mine and calcining plant.	Sevier.
United States Gypsum Co.	101 S. Wacker Drive Chicago, Ill. 60606	-----do-----	Do.
Iron ore:			
CF&I Steel Corp.-----	Box 1920 Pueblo, Colo. 80201	3 open pit mines-----	Iron.
United States Steel Corp., Western Ore Operations.	Lander, Wyo. 82520-----	Open pit mine-----	Do.
Utah Construction & Mining Co.	Box 649 Cedar City, Utah 84720	2 open pit mines, mobile crushing and screening plant, and beneficiation plant.	Do.
Lead:			
Deer Trail Mines & Arundel Mining Co.	1834 S. Woodside Dr. Salt Lake City, Utah 84172	See Zinc-----	Piute.
Hecla Mining Co.-----	Box 320 Wallace, Idaho 83873	See Gold-----	Wasatch.
Kennecott Copper Corp., Tintic Division.	Box 250 Eureka, Utah 84628	See Zinc-----	Utah.
United Park City Mines Co.	Star Route 1, Box 40 Heber City, Utah 84032	-----do-----	Summit.
United States Smelting Refining and Mining Co.	136 E South Temple St. Salt Lake City, Utah 84111	Underground mine and custom flotation mill.	Salt Lake.
United States Smelting Refining and Mining Co. (McFarland & Hullinger, lessee).	-----do-----	Underground mine-----	Tooele.
Lime:			
The Flintkote Co., U.S. Lime Division. ¹	2244 Beverly Blvd. Los Angeles, Calif. 90057	2-shaft-kiln plant-----	Do.
Kennecott Copper Corp.---	Box 11299 Salt Lake City, Utah 84111	Lime kiln-----	Salt Lake.
Utah Marblehead Lime Co. ¹	300 W. Washington St. Chicago, Ill. 60606	Rotary-kiln plant-----	Do.
Magnesium chloride: Kaiser Aluminum & Chemical Corp., Bonneville, Ltd., Division.	300 Lakeside Drive Oakland, Calif. 94612	Solar evaporation-----	Do.
Molybdenum: Kennecott Copper Corp., Utah Copper Division.	Box 11299 Salt Lake City, Utah 84111	See Copper-----	Do.
Natural gas and petroleum:			
American Oil Co.-----	Box 898 Salt Lake City, Utah 84110	Refinery-----	Do.
Atlantic Richfield Co.-----	717 Fifth Ave. New York, N.Y. 10022	Crude oil wells, Boundary Butte field.	San Juan.
		Natural gas wells, San Arroyo field.	Grand.
Belco Petroleum Corp.----	630 Third Ave. New York, N.Y. 10017	Crude oil wells, White River field.	Uintah.
		Natural gas wells, Chapita Wells field.	Do.

See footnote at end of table.

Table 16.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Natural gas and petroleum— Continued			
Chevron Oil Co., Western Division.	Box 599, 1700 Broadway Denver, Colo. 80201	Crude oil wells and gas processing plant, Red Wash field.	Uintah.
		Crude oil wells, Bluebell field.	Duchesne.
		Natural gas wells, Powder Springs and Horseshoe Bend fields.	Uintah.
Continental Oil Co.-----	Box 2197 Houston, Tex. 77001	Refinery-----	Salt Lake.
El Paso Natural Gas Co., Northwest Division.	Box 1526 Salt Lake City, Utah 84110	Crude oil wells, White Mesa and Bluff fields.	San Juan.
Gulf Oil Corp.-----	Gulf Bldg. Pittsburgh, Pa. 15230	Gas processing plant, Aneth field.	Do.
		Crude oil wells, Wonsits Valley field.	Uintah.
Humble Oil & Refining Co., Central Division.	2000 Classen Center North Oklahoma City, Okla. 73106	Indian Ridge field.-----	Duchesne.
Husky Oil Co.-----	Box 380 Cody, Wyo. 82414	Crude oil and natural gas wells, Walker Hollow field.	Uintah.
Monsanto Polymers & Petrochemicals Co., Hydrocarbons Division.	800 N. Lindbergh Blvd. St. Louis, Mo. 63166	Refinery-----	Salt Lake.
Phillips Petroleum Co.-----	431 S. 3d East Salt Lake City, Utah 84111	Crude oil wells, McElmo Mesa field.	San Juan.
		Crude oil wells, Ratherford field.	Do.
The Superior Oil Co.-----	Box 1521 Houston, Tex. 77001	Bridger Lake field.-----	Summit.
Tenneco Oil Co.-----	Box 251 Houston, Tex. 77001	Refinery-----	Salt Lake.
		Crude oil wells, McElmo Creek field.	San Juan.
		Crude oil wells, Upper Valley field.	Garfield.
Texaco Inc.-----	Box 2100 Denver, Colo. 80201	Natural gas wells, Clear Creek field.	Carbon.
		Crude oil wells, Aneth, Ismay and Flodine Park fields.	San Juan.
		Natural gas wells, Fence Canyon field.	Uintah.
Union Oil Company of California, Western Region.	Box 7600 Los Angeles, Calif. 90054	Crude oil wells and gas processing plant, Lisbon field.	San Juan.
Warren Petroleum Corp.---	Box 1589 Tulsa, Okla. 74101	Gas processing plant.-----	Uintah.
Phosphate rock:			
Stauffer Chemical Co.-----	636 California St. San Francisco, Calif. 94119	Open pit-underground mine.	Rich.
		Open pit mine and bene- ficiation plant.	Uintah.
Potassium salts:			
Great Salt Lake Minerals & Chemicals Corp.	Box 1190 Ogden, Utah	Brine processing plant.-----	Weber.
Kaiser Aluminum & Chemical Corp.	300 Lakeside Drive Oakland Calif. 94604	-----do-----	Tooele.
Texas Gulf Sulphur Co.---	200 Park Ave. New York, N.Y. 10017	Underground mine and flotation refinery.	Grand.
Pumice: Thompson Block Co.---	620 N. 400 W. Cedar City, Utah 84720	Open pit mine and crushing and screening plant.	Beaver.
		-----do-----	Iron.
Salt:			
Great Salt Lake Minerals & Chemicals Corp.	Box 1190 Ogden, Utah	Solar evaporation.-----	Weber.
Hardy Salt Co.-----	P.O. Drawer 449 St. Louis, Mo. 63166	-----do-----	Salt Lake.
Morton Salt Co. a division of Morton International, Inc.	110 N. Wacker Drive Chicago, Ill. 60606	Lake brine processing plant.	Do.
Solar Salt Co.-----	270 Crossroad Square Salt Lake City, Utah 84115	-----do-----	Tooele.
Sand and gravel:			
Breitling Bros. Construc- tion, Inc.	3645 S. 500 W. Salt Lake City, Utah 84104	Pit and plant.-----	Salt Lake.
Construction Materials Corp., Savage Bros., Inc., Division.	R.F.D. 4, Box 611 American Fork, Utah 84003	-----do-----	Davis.
Dan R. Fogle Sand & Gravel Products.	350 Hartwell Ave. Salt Lake City, Utah 84115	Pit and 3 plants.-----	Salt Lake.
Gibbons & Reed Co., Con- crete Products Co. Division.	41 W. Central Ave. Murray, Utah 84107	Pit and plant.-----	Davis.
		-----do-----	Salt Lake.
		-----do-----	Weber.

See footnote at end of table.

Table 16.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
Pioneer Sand & Gravel	3200 W. 5400 S. Granger Dr. Salt Lake City, Utah 84118	Pit and plant	Salt Lake.
Sorensen Sand & Gravel	Box 18545 Kerns, Utah 84118	do	Do.
Utah Sand & Gravel Products Corp.	Box 537 Salt Lake City, Utah 84110	3 pits and plants	Do.
Selenium: Kennecott Copper Corp., Utah Copper Division.	Box 11299 Salt Lake City, Utah 84111	See Copper	Do.
Silver:			
Deer Trail Mines & Arundel Mining Co.	1834 S. Woodside Dr. Salt Lake City, Utah 84172	See Zinc	Piute.
Hecla Mining Co.	Box 320 Wallace, Idaho 83873	See Gold	Wasatch.
Kennecott Copper Corp., Tintic Division.	Box 250 Eureka, Utah 84628	See Zinc	Utah.
Kennecott Copper Corp., Utah Copper Division.	Box 11299 Salt Lake City, Utah 84111	See Copper	Salt Lake.
Kennecott Copper Corp. (Ben Dixon & Christie, lessee.)	do	Underground mine	Do.
United Park City Mines Co.	Star Route 1, Box 40 Heber City, Utah 84032	See Zinc	Summit.
United States Smelting Re- fining and Mining Co.	136 E. South Temple St. Salt Lake City, Utah 84111	See Lead	Salt Lake.
United States Smelting Re- fining and Mining Co. (McFarland & Hullinger, lessee).	do	do	Tooele.
Stone:			
Le Grand Johnson Corp.	Box 248 Logan, Utah 84321	Quarry and plant	Cache.
Portland Cement Company of Utah.	Box 1469 Salt Lake City, Utah 84110	do	Salt Lake.
Southern Pacific Railroad Co.	65 Market St. San Francisco, Calif. 94105	Quarry	Box Elder.
United States Steel Corp., Western Ore Operations.	Lander, Wyo. 82520	Quarry and plant	Utah.
Utah Marblehead Lime Co.	300 W. Washington St. Chicago, Ill. 60606	do	Tooele.
Uranium:			
Atlas Corp., Atlas Minerals Division.	Box 1207 Moab, Utah 84532	Underground mine	Emery.
Homestake Mining Co.	Box 563 Moab, Utah 84532	Moab custom mill	Grand.
Lake Washburn Mining Co.	720-26 Road Grand Junction, Colo. 81501	14 underground mines	San Juan.
		Underground mine	Do.
		2 underground mines	Do.
Vanadium: See Uranium			
Zinc:			
Deer Trail Mines & Arundel Mining Co.	1834 S. Woodside Dr. Salt Lake City, Utah 84172	Underground mine	Piute.
Hecla Mining Co.	Box 320 Wallace, Idaho 83873	See Gold	Wasatch.
Kennecott Copper Corp., Tintic Division.	Box 250 Eureka, Utah 84628	2 underground mines	Utah.
United Park City Mines Co.	Star Route 1, Box 40 Heber City, Utah 84032	do	Summit.
United States Smelting Refining and Mining Co.	136 E. South Temple St. Salt Lake City, Utah 84111	See Lead	Salt Lake.
United States Smelting Re- fining and Mining Co. (McFarland & Hullinger, lessee).	do	do	Tooele.

¹ Also stone.

The Mineral Industry of Vermont

By Frank B. Fulkerson ¹

Mineral production in Vermont was valued at \$36.3 million, 30 percent more than that of 1970. Stone continued as the most valuable mineral commodity and accounted for over three-fourths of the total. During the year, stone was the only mineral product to increase in value. Sand and gravel declined in value of output. Values for asbestos and talc were virtually the same as in 1970. Rutland was the principal mineral-producing county, followed by Washington and Orleans.

Construction of the Vermont Yankee Nuclear Power Co. atomic powerplant on the Connecticut River at Vernon in the southeastern corner of the State was virtually complete at yearend. Built at a cost of \$150 million, the plant has a capacity of 540,000 kilowatts. The Atomic Energy Commission (AEC) held hearings on licensing terms for the operation of Vermont's first atomic powerplant.

¹ Industry economist, Division of Nonmetallic Minerals.

Table 1.—Mineral production in Vermont ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Peat..... thousand short tons ..	(²)	\$6	W	W
Sand and gravel..... do ..	4,046	4,122	3,761	\$3,518
Stone..... do ..	1,514	19,088	2,498	28,135
Value of items that cannot be disclosed: Asbestos, clays (1970), gem stones, talc and value indicated by symbol W ..	XX	4,627	XX	4,631
Total.....	XX	27,843	XX	36,284
Total 1967 constant dollars.....	XX	24,906	XX	² 31,524

^p Preliminary. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

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

² Less than ½ unit.

Table 2.—Value of mineral production in Vermont, by county ¹

(Thousands)

County	1970	1971	Minerals produced in 1971, in order of value
Addison.....	\$128	W	Sand and gravel.
Bennington.....	610	W	Do.
Caledonia.....	W	W	Do.
Chittenden.....	938	\$1,476	Stone, sand and gravel.
Essex.....	W	W	Sand and gravel.
Franklin.....	W	W	Stone, sand and gravel.
Lamoille.....	W	W	Talc, sand and gravel.
Orange.....	W	W	Stone, sand and gravel.
Orleans.....	W	W	Asbestos, sand and gravel, stone.
Rutland.....	W	W	Stone, sand and gravel.
Washington.....	W	W	Do.
Windham.....	W	W	Sand and gravel, talc.
Windsor.....	W	2,224	Stone, talc, sand and gravel, peat.
Undistributed.....	26,167	32,585	
Total.....	27,843	² 36,284	

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

¹ Grand Isle County is not listed because no production was reported.

² Data may not add to total shown because of independent rounding.

Table 3.—Indicators of Vermont business activity

	1970	1971 ^p	Change, percent
Employment and labor force, annual average: ¹			
Total labor force.....thousands..	190.6	193.7	+1.6
Unemployment (percent of work force).....	4.8	6.7	+39.6
Employment:			
Manufacturing.....thousands..	40.5	37.8	-6.7
Durable goods.....do.....	27.1	24.9	-8.1
Nondurable goods.....do.....	13.4	13.0	-3.0
Nonmanufacturing.....do.....	107.6	110.4	+2.6
Mining and quarrying.....do.....	1,000	NA	--
Payroll-average weekly earnings: ²			
Manufacturing.....	\$120.13	\$128.54	+7.0
Personal income: ³			
Total.....millions..	\$1,545	\$1,654	+7.1
Per capita.....	\$3,457	\$3,610	+4.4
Construction activity: ⁴			
Number of housing units authorized.....	1,732	1,764	+1.8
Valuation of nonresidential building construction.....millions..	\$16.3	\$9.6	-41.1
Portland cement shipments to and within Vermont thousand 376-pound barrels..	575	568	-1.2
Mineral production value.....thousands..	\$27,843	\$36,284	+30.3

^p Preliminary. NA Not available.

¹ New England Economic Indicators, Federal Reserve Bank of Boston.

² Employment and Earnings, U.S. Department of Labor, V. 18, No. 11, May 1972.

³ Survey of Current Business, V. 52, No. 4, April 1972.

⁴ Construction Review, Department of Commerce, March 1972.

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

Year and industry	Average men working daily	Days active	Man- days worked (thou- sands)	Man- hours worked (thou- sands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non- fatal	Fre- quency	Severity
1970:								
Nonmetal and peat.....	333	277	92	743	--	22	29.63	815
Sand and gravel.....	230	155	36	331	--	8	24.19	203
Stone.....	1,291	250	323	2,681	--	79	29.46	1,043
Total.....	1,854	243	451	3,755	--	109	29.03	924
1971 ^p								
Nonmetal ¹	335	273	92	743	--	24	32.32	8,694
Sand and gravel.....	290	165	48	457	--	7	15.32	260
Stone.....	1,265	245	309	2,502	1	60	24.38	3,173
Total ²	1,890	237	449	3,701	1	91	24.85	3,925

^p Preliminary.

¹ Beginning, in 1971, data concerning peat operations are included in the nonmetals industry on a continuing basis.

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

REVIEW BY MINERAL COMMODITIES

NONMETALS

Asbestos.—Output of chrysotile asbestos by GAF Corp., Building & Industrial Floor Products Div., from its Lowell mine, Orleans County, declined 5 percent compared with that of 1970; value of production was unchanged. The asbestos was shipped to out-of-State company plants for the manufacture of heat-resisting products.

Clays.—No clay was produced in Vermont in 1971, as Densmore Brick Co., Inc., suspended brick manufacturing at Essex Junction, Chittenden County.

Gem Stones.—Hobbyists and gem-collecting societies obtained gem materials and mineral specimens at various locations throughout the State.

Mica, Reconstituted.—The Samica Corp. at Rutland continued to process delaminated mica scrap for the manufacture of reconstituted sheet mica. The product was used principally in electrical insulation.

Sand and Gravel.—Production of sand and gravel, both commercial and Government-and-contractor, totaled 3.8 million tons valued at \$3.5 million. Output decreased 7 percent and value decreased 15

percent, owing to the greater proportion of low-value fill material. Four counties, Bennington, Chittenden, Essex, and Windsor, accounted for 56 percent of the tonnage and 59 percent of the value. About 3 million tons or 80 percent of the output was by commercial operators at an average price of \$1.09 per ton. Leading commercial producers were Caledonia Sand & Gravel Co., Inc., William E. Dailey, Inc., and Lawrence Sangravco, Inc. Government-and-contractor operations produced 768,000 tons with an average value of \$0.35 per ton. The principal uses for sand and

gravel were for paving, building, fill, and road sanding.

Construction by the Vermont Highway Department in 1971 included 41 miles of new interstate highway plus another 21 miles on the primary and secondary systems for an estimated total cost of nearly \$37 million. The Highway Department purchased sand and gravel from commercial producers or contracted for the production as part of the work project. The Department produced sand for ice control and gravel for paving, using its own crews.

Table 5.—Sand and gravel production by Government-and-contractor operations, by county
(Thousand short tons)

County	1970	1971
Addison.....	7	15
Bennington.....	50	23
Caledonia.....	3	342
Chittenden.....	5	17
Essex.....	22	9
Franklin.....	37	61
Lamoille.....	--	8
Orange.....	262	23
Orleans.....	236	181
Rutland.....	242	32
Washington.....	189	22
Windham.....	--	3
Windsor.....	9	32
Total.....	¹ 1,061	768

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

Stone.—Value of stone production increased 47 percent to \$28.1 million, resulting from greater production of dimension stone and crushed and broken stone. In terms of quantity, stone output increased 65 percent, owing mainly to greater production of crushed and broken stone for highway construction and maintenance. By kinds of stone, marble, and granite led in value, followed by limestone, slate, quartzite, and traprock. In terms of value, leading counties were Rutland, Washington, and Orange. Leading producers were Vermont Marble Co.; Rock of Ages Corp.; Wells-Lamson Quarry Co., Inc.; and the State Highway Department.

Dimension granite was produced mainly in Washington County, with significant output also coming from Orange County. Rock of Ages Corp. operated the Rock of Ages, Wetmore & Morse, and E. L. Smith quarries in Washington County and Pirie quarry in Orange County. Wells-Lamson Quarry Co., Inc., produced from its quarry

at Barre, Washington County. Almost 80 percent of the dimension granite production was rough monumental stone. The rest of the output was sold as dressed stone and rough blocks for architectural work and as rubble for construction purposes.

A new six-wire granite saw was installed at the Rock of Ages saw plant in Upper Graniteville. The machinery is capable of sawing granite blocks up to 20 feet long. The saw is believed to be one of the largest capacity multiple-wire and indoor housed granite saws in the United States.

Crushed and broken granite was produced in Washington and Windsor Counties for use as concrete and bituminous aggregate.

Activities and history of Vermont Marble Co. were featured in a trade journal article.² The company claims to be the world's largest marble producer. An under-

² Rock Products. Vermont Marble Company: 100 years of Marble Products. V. 74, No. 6, June 1971, pp 49-59.

ground mine, the Imperial quarry at Danby, Rutland County, supplied the dimension marble which is the company's principal product. Stone is worked at two levels several hundred feet underground. The stone is cut into blocks weighing between 20 to 40 tons and loaded by derrick onto a rail car which is hauled by cable to the mine entrance. At the entrance, the marble block is loaded by derrick on a truck for transport to the West Rutland sawmill. The slabs of marble are taken from West Rutland to the finishing plant at Proctor. Total haulage distance from the Imperial quarry to the Proctor finishing plant is 30 miles. The company products are mainly dressed architectural stone, dressed monumental stone, and flagging.

Vermont Marble Co. operated an automated ground products plant at Florence to process 200,000 tons of white marble per year. The plant features a central control console and two electronically controlled optical sorting machines to separate white marble from darker pieces. Specialty products included landscaping and terrazzo chips, marble sands and fillers, and agricultural limestone. The white marble was secured from the Loveland quarry in Rutland County adjacent to the plant site. A dolomitic limestone quarry next to the white marble quarry supplied aggregate for roadstone. White Pigments Corp., an affiliate of Vermont Marble Co., processed various calcium carbonate raw materials at two plants, one at New Haven and one at Florence. Products were pigment extenders and industrial fillers. Crushed high-calcium limestone was trucked 4 miles to the New Haven plant from the company quarry in East Middlebury, Addison County. Crushed

white marble for the Florence plant was hauled a distance of 26 miles from the South Wallingford quarry, Rutland County.

Swanton Lime Works, Inc., crushed limestone in Franklin County for use as construction aggregate, agricultural lime, calcium carbonate, papermill stone, and terrazzo. The Vermont Highway Department contracted for crushed traprock in Windsor County.

Contractors for the Vermont Highway Department quarried and crushed 780,000 tons of quartzite in Orange County for highway construction and maintenance.

Dimension slate was produced by 11 companies in Rutland County. Output was flagging slate, standard roofing slate, and mill stock for structural and sanitary applications.

Talc.—In 1971 Vermont ranked third in the Nation in talc production. Windsor County was the principal area for production of talc in Vermont, followed by Lamoille and Windham Counties. Output and value were approximately the same as in 1970. Windsor Minerals, Inc.; Eastern Magnesia Talc Co.; and Vermont Talc Co. operated a total of four mines for the production of crude talc. Ground talc was used in the manufacture of roofing, paper, paint, insecticides, plastics, rubber, and miscellaneous other products.

MINERAL FUELS

Peat.—Kirks Green Mountain Peat produced reed-sedge peat from a bog in Windsor County. The material was sold both in bulk and in packaged form for general soil improvement.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos:			
GAF Corporation, Bldg. & Industrial Floor Products Division. ¹	140 West 51st St. New York, N.Y. 10020	Pit.....	Orleans.
Peat:			
Kirks Green Mountain Peat.....	P.O. Box 456 Woodstock, Vt. 05091	Bog.....	Windsor.
Sand and gravel:			
Brattleboro Sand & Gravel, Inc..	P.O. Box 358 Brattleboro, Vt. 05301	Pit.....	Windham.
Caledonia Sand & Gravel Co. Inc.	Box 428 St. Johnsbury, Vt. 05819	Pit.....	Washington.
Calkins Construction, Inc.....	Danville, Vt. 05828.....	Pit.....	Orleans.
J. P. Carrara & Sons, Inc.....	N. Clarendon, Vt. 05759.....	Pit.....	Rutland.
William E. Dailey, Jr.....	N. Bennington, Vt. 05257.....	Pit.....	Bennington.
S. T. Griswold, Inc.....	P.O. Box 8 Williston, Vt. 05495	Pit.....	Chittenden.
Albert S. Nadeau.....	Johnson, Vt. 05656.....	Pit.....	Lamoille.
Lawrence Sangravco, Inc.....	138 Portland St. Johnsbury, Vt. 05819	Pit.....	Essex.
Vermont Sand & Gravel Corp.....	Box 429 Bellows Falls, Vt. 05101	Pit.....	Rutland.
Stone:			
Granite (dimension):			
Rock of Ages Corp.....	Barre, Vt. 05641.....	Quarry.....	Orange, Washington, Windsor.
Wells-Lamson Quarry Co., Inc.	102 N. Main St. Barre, Vt. 05641	....do.....	Washington.
Granite (crushed):			
Wells-Lamson Quarry Co., Inc.	Framingham, Mass. 01701.....	....do.....	Washington.
Limestone (crushed and broken):			
L.A. Demers Crushed Rock Co.	Upper Main St. Winooski, Vt. 05404	....do.....	Chittenden.
Perini Corp.....	Framingham, Mass. 01701.....	Crushing plant, quarry.	Windsor.
Swanton Lime Works, Inc.....	Swanton, Vt. 05488.....	Quarry.....	Franklin.
Vermarco Ground Products Division of Vermont Marble Co.	W. Rutland, Vt. 05777.....	....do.....	Rutland.
Marble (dimension):			
Vermont Marble Co. ²	Proctor, Vt. 05765.....	....do.....	Rutland, Windsor.
Marble (crushed):			
F. W. Whitcomb Const. Corp.	Box 429 Bellows Falls, Vt. 05101	....do.....	Rutland.
Slate (dimension):			
Green Mountain Slate Corp.	Granville, N.Y. 12832.....	....do.....	Do.
John G. Hadeka.....	25 College St. Poultney, Vt. 05764	....do.....	Do.
Hilltop Slate Co.....	Middle Granville, N.Y. 12849..	....do.....	Do.
Rising & Nelson Slate Co., Inc.	West Pawlet, Vt. 05775.....	....do.....	Do.
Somich Brothers.....	Granville, N.Y. 12832.....	....do.....	Do.
Taran Brothers, Inc.....	No. Poultney, Vt. 05764.....	....do.....	Do.
Tatko Brothers Slate Co.....	Middle Granville, N.Y. 12849..	....do.....	Do.
Vermont Structural Slate Co., Inc.	Prospect St. Fair Haven, Vt. 05743	....do.....	Do.
Talc:			
Eastern Magnesia Talc Co.....	Johnston, Vt. 05656.....	Underground..	Lamoille.
Vermont Talc Co.....	Chester, Vt. 05149.....	....do.....	Windham.
Windsor Minerals, Inc.....	P.O. Box 680 Windsor, Vt. 05089	....do.....	Windsor.

¹ Also miscellaneous stone.² Also crushed marble.

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 Charles E. Vannoy¹

Virginia's mineral production rose \$10.9 million (2.9 percent) in 1971, to a new high of \$385.2 million. This was the ninth consecutive year that mineral values have increased. Three commodities were primarily responsible for the gain in output value; coal, stone, and sand and gravel. Although the output of coal declined 13 percent because of a 44-day strike, the output value increased 4 percent owing to an 18-percent increase in the average unit value. Six commodities gained in output, and eight gained in output value. Of the total 1971 mineral production value approximately 66 percent was contributed by fuels, 2 percent by metals, and 32 percent by nonmetals.

Studies of the geology and mineral resources of Virginia include an open file report issued in August 1971 by the Virginia Division of Mineral Resources of an aeromagnetic survey that covers approximately 3,360 square miles in central Virginia. This survey joins two previous aeromagnetic surveys that were flown and released in 1969 and 1970. The division also published reports on the geology of two Virginia quadrangles.²

¹ Mining engineer, Division of Fossil Fuels.

² Bartlett, Charles, S. Jr. and Harry W. Webb. Geology of the Bristol and Wallace Quadrangles, Virginia. Virginia Div. Miner. Res. (Charlottesville, Va.), Rept. of Inv. 25, 1971, 93 pp.

Henika, William S. Geology of the Bassett Quadrangle, Virginia. Virginia Div. of Miner. Res. (Charlottesville, Va.), Rept. of Inv. 26, 1971, 43 pp.

Table 1.—Mineral production in Virginia¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays..... thousand short tons..	1,633	\$1,672	1,710	\$1,800
Coal (bituminous)..... do.....	35,016	246,181	30,628	254,870
Gem stones.....	NA	7	NA	12
Lead (recoverable content of ores, etc.)..... short tons..	3,356	1,048	3,386	934
Lime..... thousand short tons..	1,046	14,090	759	11,049
Natural gas..... million cubic feet..	2,805	864	2,619	822
Petroleum (crude)..... thousand 42-gallon barrels..	1	W	1	W
Sand and gravel..... thousand short tons..	11,126	15,229	12,796	20,201
Soapstone..... short tons..	3,760	9	3,704	8
Stone..... thousand short tons..	35,415	60,477	34,643	63,482
Zinc ² (recoverable content of ores, etc.)..... short tons..	18,063	5,534	16,829	5,419
Value of items that cannot be disclosed: Aplite, cement, feldspar, gypsum, kyanite, salt, titanium concentrate, and values indicated by symbol W.....	XX	29,210	XX	26,564
Total.....	XX	374,321	XX	385,161
Total 1967 constant dollars.....	XX	334,830	XX	p 334,628

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

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

² Recoverable zinc valued at the yearly average price of prime western slab zinc, East St. Louis market. Value established after transportation, smelting, and manufacturing charges have been added to the value of ore at the mine.

Table 2.—Value of mineral production in Virginia, by county ¹
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Accomack	W	\$1	Sand and gravel.
Albemarle	W	W	Stone, sand and gravel.
Alleghany	W	W	Stone.
Amherst	W	W	Stone, titanium concentrate, sand and gravel.
Appomattox	\$30	W	Stone.
Augusta	868	870	Stone, sand and gravel.
Bath	(²)	W	
Bedford	W	W	Feldspar.
Bland	W	W	Stone.
Botetourt	W	W	Cement, stone, clays.
Brunswick	W	W	Stone, clays.
Buchanan	* 104,064	105,925	Coal, natural gas, sand and gravel, stone.
Buckingham	W	W	Stone, kyanite.
Campbell	W	W	Stone, sand and gravel.
Caroline	W	269	Sand and gravel.
Carroll	W	8	Stone.
Charles City	W	W	Sand and gravel.
Chesapeake (City)	W	W	Sand and gravel, cement.
Chesterfield	3,619	5,133	Sand and gravel, stone, clays.
Clarke	W	W	Stone.
Craig	W	W	Stone, sand and gravel.
Culpeper	W	W	Stone.
Dickenson	54,931	W	Coal, natural gas.
Dinwiddie	W	W	Stone.
Fairfax	W	W	Sand and gravel, stone.
Fauquier	W	378	Stone.
Franklin	W	W	Soapstone.
Frederick	5,504	6,293	Stone, lime, sand and gravel, clays.
Giles	W	W	Lime, stone.
Goochland	1,767	W	Stone.
Grayson	W	W	Stone, sand and gravel.
Greensville	W	W	Stone, clays.
Halifax	W	W	Stone, sand and gravel.
Hampton (City)	7	W	Sand and gravel, stone.
Hanover	W	W	Aplite, stone.
Henrico	3,059	3,211	Sand and gravel.
Henry	W	W	Stone.
Highland	16	56	Do.
Isle of Wight	202	W	Sand and gravel, lime.
King George	W	W	Sand and gravel.
King William	W	W	Do.
Lee	⁴ 7,674	6,743	Coal, stone, petroleum.
Loudoun	3,991	W	Stone.
Louisa	W	W	Do.
Madison	W	W	Do.
Mecklenburg	W	W	Do.
Middlesex	W	W	Sand and gravel.
Montgomery	W	W	Stone, clays.
Nansemond	W	W	Stone, clays, sand and gravel.
Nelson	W	W	Aplite, sand and gravel.
New Kent	W	W	Sand and gravel.
Newport News (City)	W	W	Do.
Norfolk (City)	51	5,340	Cement.
Northampton	W	(²)	Sand and gravel.
Nottaway	W	W	Stone.
Orange	W	W	Clays.
Page	W	W	Stone, sand and gravel.
Patrick	(²)	W	
Pittsylvania	W	W	Stone, sand and gravel.
Prince Edward	W	W	Kyanite, stone.
Prince George	W	753	Sand and gravel.
Prince William	W	W	Stone, clays.
Pulaski	W	W	Stone.
Rappahannock	W	W	Do.
Richmond	W	14	Sand and gravel.
Roanoke	W	W	Stone, clays.
Rockbridge	823	892	Stone, sand and gravel, clays.
Rockingham	W	W	Stone, sand and gravel.
Russell	20,868	24,688	Coal, stone, clays.
Scott	1,356	1,207	Stone, coal.
Shenandoah	W	W	Lime, stone.
Smyth	W	2,575	Lime, salt, stone, clays, sand and gravel.
Spotsylvania	W	W	Sand and gravel, stone.
Stafford	460	W	Sand and gravel.
Tazewell	⁵ 8,425	14,302	Coal, stone, natural gas, clays, lime.
Virginia Beach (City)	803	886	Sand and gravel.
Warren	W	W	Cement, stone, sand and gravel.
Washington	W	2,694	Stone, gypsum, sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Virginia, by county ¹—Continued
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Wise.....	\$52,423	\$58,138	Coal, stone, natural gas.
Wythe.....	W	8,074	Zinc, stone, lead, sand and gravel.
York.....	W	8	Sand and gravel.
Undistributed ⁶	103,383	136,697	
Total ⁷	374,321	385,161	

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

¹ The following counties and cities are not listed because no production was reported: Amelia, Arlington, Charlotte, Cumberland, Essex, Floyd, Fluvanna, Gloucester, Greene, James City, King and Queen, Lancaster, Lunenburg, Lynchburg (City), Mathews, Northumberland, Powhatan, Southampton, Surry, Sussex, and Westmoreland.

² Less than ½ unit.

³ Excludes sand and gravel; included with "Undistributed."

⁴ Excludes petroleum; included with "Undistributed."

⁵ Excludes stone and clays; included with "Undistributed."

⁶ Includes sand and gravel and stone that cannot be assigned to specific counties, gem stones, natural gas, and values indicated by symbol W.

⁷ Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Virginia business activity

	1970 ^r	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force.....	1,841.8	1,893.8	+2.8
Unemployment.....	58.2	68.3	+17.4
Nonagricultural employment:			
Manufacturing.....	365.0	362.2	-.8
Mining.....	15.3	15.1	-1.3
Construction.....	95.0	97.4	+2.5
Transportation and public utilities.....	97.4	97.5	+1
Wholesale and retail trade.....	303.6	311.8	+2.7
Finance, insurance, and real estate.....	68.0	70.9	+4.3
Services.....	220.0	227.3	+3.3
Government ¹	300.8	315.0	+4.7
Personal income:			
Total.....	\$16,827.0	\$18,225.0	+8.3
Per capita.....	\$3,616.0	\$3,866.0	+6.9
Construction activity:			
Value of nonresidential construction.....	\$339.9	\$470.1	+38.3
New housing units authorized.....	43,698.0	71,887.0	+64.5
Portland cement shipments to and within Virginia thousand 376-pound barrels.....	9,424.0	10,037.0	+6.5
Mineral production value.....	\$374.3	\$385.2	+2.9

^p Preliminary. ^r Revised.

¹ Excludes Federal Government workers in the Virginia portion of the Washington, D.C. metropolitan area.

Sources: Employment and Earnings; Survey of Current Business; Construction Review; Area Trends in Employment and Unemployment; and U.S. Bureau of Mines.

The strippable coal reserves of Virginia plus a brief discussion summarizing past and present production, historical background, and outlook for the State are included in a Bureau of Mines publication. The publication contains reserve data by State, county, seam, and sulfur contents.³

A new stratigraphic unit in northeastern Virginia was described in a Geological Survey Bulletin.⁴

A directory of the mineral industry in Virginia is issued annually by the Virginia Division of Mineral Resources.⁵ The 1971 edition of this publication lists 223 compa-

nies and individuals, exclusive of coal producers, on record as of March 1, 1971. The listing includes portable crushing plants, some captive and intermittent operations, and some processors of the out-of-State or

³ U.S. Bureau of Mines. Strippable Reserves of Bituminous Coal and Lignite in the United States. IC 8531, 1971, 148 pp.

⁴ Southwick, D. L., J. C. Reed, Jr., and R. B. Mixon. The Chopawamsic Formation—A new stratigraphic unit in the Piedmont of northeastern Virginia. U. S. Geol. Survey Bull. 1324-D, 1971, 11 pp.

⁵ Levan, D. C. Directory of the Mineral Industry in Virginia, Virginia Div. Miner. Res. (Charlottesville, Va.) 1971, 46 pp.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Coal.....	10,715	219	2,349	18,757	27	1,143	62.38	12,709
Metal.....	288	259	75	598	--	37	61.90	1,476
Nonmetal.....	563	278	156	1,255	--	34	27.09	3,232
Sand and gravel.....	553	237	131	1,200	1	24	20.83	6,911
Stone.....	3,538	261	924	7,656	3	148	19.72	3,497
Total.....	15,657	232	3,635	29,466	31	1,386	48.09	9,448
1971: ^p								
Coal.....	10,080	210	2,113	16,951	16	928	55.69	8,479
Metal.....	280	248	69	551	1	40	74.43	11,832
Nonmetal.....	735	271	200	1,606	--	20	12.45	4,126
Sand and gravel.....	530	250	132	1,165	--	21	18.03	746
Stone.....	3,540	262	929	7,782	3	213	27.76	3,931
Total.....	15,165	227	3,442	28,055	20	1,222	44.27	6,713

^p Preliminary.¹ Data does not add to total shown because of independent rounding.

imported materials. The names of producers and processors are arranged by county or city under the appropriate raw material or commodity. The locations of the various operations are given with respect to a nearby city or town. An alphabetical listing of the names of companies and individuals is provided as a reference index.

Trends and Developments.—Westmoreland Coal Co., Stonega Division, started construction of a 1,200-ton-per-hour preparation plant for the Bullitt mine near Appalachia. The company will increase production by 1.4 million tons per year, and, when the expansion program is completed in 1973, the mine will produce 2.3 million tons of clean coal per year. At the company's Pine Branch mine, railroad track was extended 1.2 miles, opening up a new mining area.

Island Creek Coal Co.'s Virginia Pocahontas No. 4 mine shafts were completed in 1971. The program of drilling vertical ventilation holes at the Beatrice mine to drain methane from the gob area is being continued.

Clinchfield Coal Co.'s Jewell Ridge Division opened one new mine in Buchanan County and two in Tazewell County in 1971.

Virginia Electric & Power Co. (VEPCO) announced plans to build an 845,000-kilowatt fossil-fuel powerplant in northern Virginia. It is scheduled for operation in 1976. VEPCO also confirmed plans for two more

945,000-kilowatt atomic power units to be added to its North Anna plant, where two units are now under construction for start up dates of 1974 and 1975. The two new units are slated for 1977 and 1978.

The Mined Land Conservation Conference reported that Virginia treated 3,013 acres of mined land last year, using more than 390,000 pounds of fertilizer, 118,230 pounds of grass and legume seed, 4,446 pounds of locust seed, and more than 160,000 tree seedlings.

Legislation and Government Programs.—A contractual agreement between Southwest Virginia Community College, Richlands, and the Departments of Interior and Health, Education, and Welfare was announced in June 1971. Initially, the contract provides for the training of 150 miners over a period of 140 hours. The training curriculum will be oriented toward upgrading the skills of electricians in basic industrial electricity and electrical control systems, as well as health and safety training in mine gases, ventilation, health and safety equipment (instruments and apparatus), mine fires, mine explosions, explosives, general mining practices, first aid, and mining law (as it pertains to Virginia mining law). The contract is an effort to develop new approaches to helping the present labor force acquire new skills that will upgrade potential and make them work more effectively and safely.

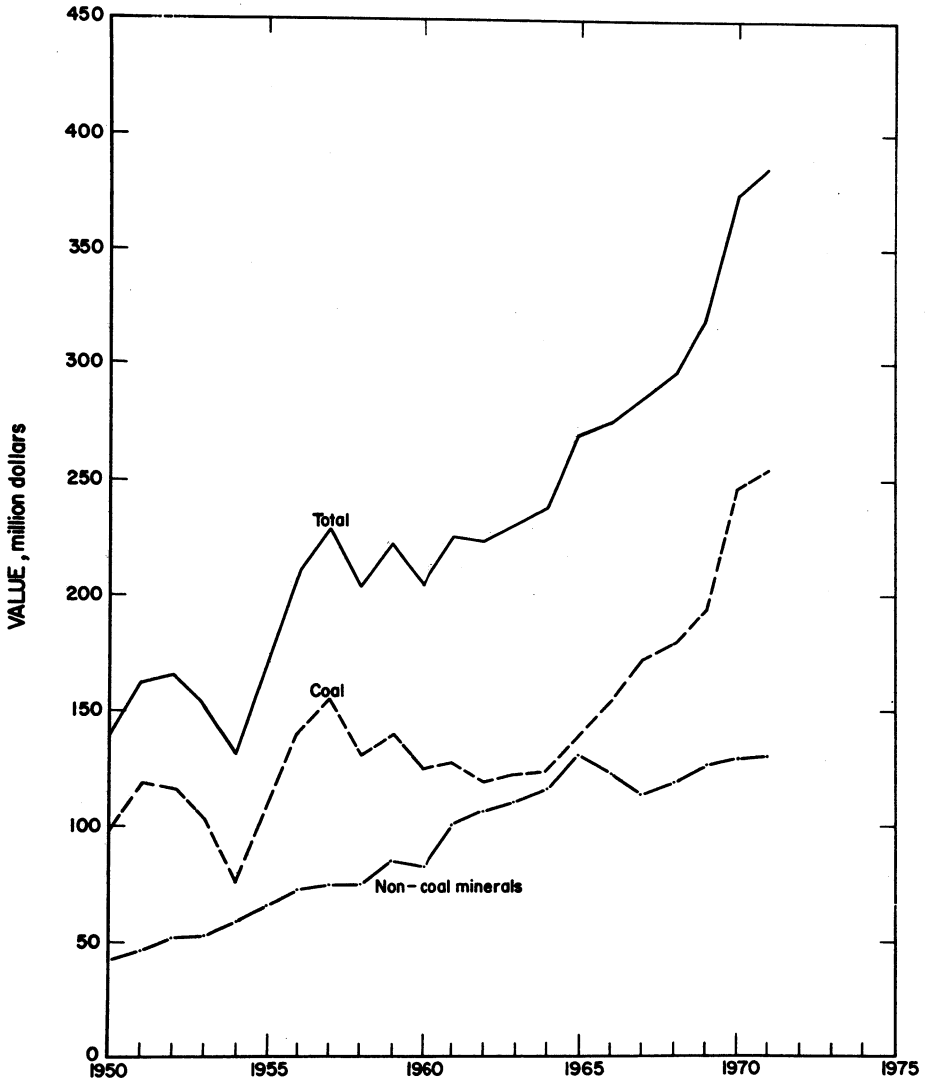


Figure 1.—Value of non-coal minerals, value of coal, and total value of all mineral production in Virginia.

REVIEW OF MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—Coal, the most important mineral commodity produced in Virginia, accounted for 66 percent of the value of the State's mineral production in 1971, the same percentage as in 1970. Mine output declined 13 percent, and output

value increased 4 percent. The average value of 1 short ton increased to \$8.32 from \$7.03 in 1970. Production data include coal produced from deposits within Virginia, whether the mine opening is or is not inside the State boundary, and exclude operations producing less than

1,000 tons per year. Consequently, production data published by the Federal Bureau of Mines differ somewhat from data published by the State.

Both high- and low-volatile bituminous coals were produced for electric power generation, coke manufacture, industrial uses, and exports. No production of semi-anthracite coal, mined in Montgomery County, was reported in 1971.

Four of the seven southwestern counties in which coal was mined accounted for 92 percent of the total output. These counties were Buchanan (40 percent), Wise (26 percent), Dickenson (18 percent), and Russell (8 percent). Of the total coal production, 71 percent was from underground mines, 23 percent from strip mines, and 6 percent from auger mines. Coal was produced by underground mines in all of the seven coal producing counties and also by strip and auger mines in six counties. In order of output, Buchanan, Wise, Dickenson, and Russell Counties led in underground mine tonnage; Wise, Buchanan, and Dickenson Counties in strip mine output; and Buchanan, Wise and Dickenson Counties in auger mine production. Seams mined included the Blair, Clintwood, Eagle, Hagy, High Splint, Imboden, Jawbone, Jewell, Kelly, Lyons, Parsons Pocahontas No. 3, Splash Dam, Taggart, Tiller, Upper and Lower Banner, and Widow Kennedy.

The total underground output from 355 mines was 21.63 million tons, compared with 28.02 million tons produced by 566 mines in 1970. The decrease of 23 percent, however, was primarily due to a 44-day strike, which affected underground mining

to a greater degree than it did other types of mining. The average value received was \$9.46 per ton, an increase of \$1.84 over the \$7.62-per-ton average value in 1970.

A total of 266 mobile loading machines produced 10.75 million tons, or 50 percent of the underground output. Continuous miners numbered 139 and produced 9.24 million tons for 43 percent. Seven plow-type longwall installations produced 1.14 million tons at \$4.66 per ton in 1970. The der was loaded by all other methods.

Strip mine output increased 40 percent to 7.17 million tons with an average value of \$5.58 per ton, compared with 5.10 million tons at \$4.66 per ton in 1970. The number of strip mines increased by 58 to a total of 212. Equipment used by these strip mines included 214 power shovels, 177 bulldozers, three carryall scrapers, 96 front-end loaders, 20 horizontal drills, 40 vertical drills, and 14 motorgraders.

Auger mines produced 1.83 million tons having an average value of \$5.66 per ton, compared with \$4.64 per ton for the 1.89 million tons produced in 1970. Equipment used in the 103 auger mines, an increase of 20 mines over 1970, included 106 augers, 65 bulldozers, 34 front-end loaders, and two motorgraders.

Thirty mechanical cleaning plants received 21.21 million tons of raw coal from which 5.04 million tons of refuse were removed and 16.17 million tons salable coal (53 percent of the State's total production) were recovered. The coal cleaning methods employed were dense medium, 43 percent; tables, 34 percent; jigs, 12 percent; froth flotation, 10 percent; and pneumatic equipment, 1 percent.

Table 5.—Bituminous coal production, by type of mine and county

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

County	Number of mines				Production (thousand short tons)				Value ¹ (thousands)
	Under-ground	Strip	Auger	Total	Under-ground	Strip	Auger	Total	
Buchanan	235	59	43	337	9,944	1,371	960	12,275	\$105,689
Dickenson	26	29	16	71	4,134	1,276	208	5,618	50,584
Lee	24	12	7	43	476	326	73	875	6,057
Russell	11	12	7	30	1,817	636	76	2,529	23,246
Scott	1	--	--	1	15	--	--	15	100
Tazewell	10	12	2	24	837	501	41	1,379	11,305
Wise	48	88	28	164	4,408	3,059	470	7,937	57,889
Total	355	212	103	670	21,631	7,169	1,823	30,628	254,870

¹ Value received or charged f.o.b. mine. Includes a value for coal not sold but used by producers, such as mine fuel and coal coked, as estimated by producers at average prices that might have been received if such coal had been sold commercially.

Twenty-three thermal drying units in 10 cleaning plants produced 6.98 million tons, or 43 percent of the mechanically cleaned coal.

Transportation of coal to market was 29.34 million tons by rail (including 2.53 by unit-train) and 1.28 million tons by truck.

Coke.—Coal was converted to coke in two beehive oven plants; no byproduct recovery was made. The plants were located in Buchanan and Wise Counties. Total coke production increased 22.4 percent, and average coke yield was 60.9 percent.

Petroleum and Natural Gas.—Natural gas production data as reported by pipeline companies totaled 2,634 million cubic feet. Production was from four counties as follows: Tazewell, 1,511 million; Buchanan, 703 million; Dickenson, 411 million; and Wise, 9 million cubic feet. The volume of gas utilized for commercial use totaled 2,619 million cubic feet, 6.6 percent less than that of 1970. Reserves of natural gas were 31,075 million cubic feet, as reported by the American Gas Association.⁶ This was 1,436 million cubic feet less than reserves in 1970.

Development and exploratory drilling by the Columbia Gas Transmission Corp. continued during 1971 with the drilling of 13 wells, which had a combined total footage of 57,769 feet. Additionally, two wells were drilled by other operations bringing the total footage drilled during 1971 to more than 64,000 feet. The 13 wells drilled by Columbia Gas Transmission Corp. had a combined total openflow, after fracture, of more than 21 million cubic feet in the Berea and Maxon sands and Big Lime (Greenbrier). An important test well was completed in May 1971 in Accomack County near the Virginia-Maryland boundary. The well was drilled to a depth of 6,272 feet in the "basement" complex after penetrating the entire section of Coastal Plain sediments and more than 100 feet of Triassic "red beds".⁷

During 1971, production of crude petroleum in Virginia totaled 542 barrels. All production was from Lee County, with one well in the Ben Hur field and two in the Rose Hill field. The American Oil Co. operated a coking and catalytic cracking and reforming refinery at Yorktown, York County. Operating capacity was 52,900 barrels per day.

NONMETALS

Aplite.—Output of apelite increased 8 percent although value remained substantially the same. Production of this commodity, chiefly for use in glassmaking was from two operations, International Minerals & Chemical Corp in Nelson County and The Feldspar Corp. in Hanover County. A limited quantity of the material for use as aggregate was produced in Amherst and Nelson Counties (Dominion Stone Plant Inc.).

Cement.—Shipments of portland cement decreased 1 percent in quantity and 7 percent in value and masonry cement shipments increased 11 percent in quantity and 18 percent in value. Ninety-two percent of the portland cement shipped was type I and II (general use and moderate heat), the remainder was type III (high-early-strength) white cement. Consumption of cement in the State totaled 10 million 376-pound barrels of portland grade and 1.4 million 280-pound barrels of masonry grade.

Three plants were active, one each in Botetourt and Warren Counties and one at Chesapeake City. One plant produced portland cement only, another made colored and natural masonry cement only, and the third made both kinds of cement. Two plants used the dry process and the third used the wet process. The three plants operated eight kilns. Raw material used in making portland cement included limestone and marl, clay and shale, sand, gypsum, and iron-bearing materials.

Clays.—Clay production increased 4.7 percent over that of 1970, and the value rose 7.7 percent because of an increase in the average value per short ton to \$1.05. Of the total production, 76 percent was classed as shale, 20 percent as common clay, and 4 percent as undifferentiated clay and shale. The principal use was in manufacturing heavy clay products. Other major uses were cement plants and as lightweight aggregate. Some clay was used for clay dummies (shot-hole tampers) and miscellaneous products.

Clay production was reported by 12 companies operating 30 mines in 14 counties. In order of output the chief producing counties were Botetourt, Orange, Rus-

⁶ The Oil and Gas Journal, v. 70, No. 14, Apr. 3, 1972, p. 19.

⁷ Young, David M. Oil and Gas Development in Virginia During 1971. Virginia Minerals (Virginia Div. of Mineral Resources, Charlottesville, Va.) v. 18, No. 2, May 1972, pp. 13-14.

sell, Chesterfield, and Nansemond; in order of output value they were Botetourt, Orange, Chesterfield, Nansemond, and Russell. The above five counties accounted for over three-quarters of the State output and output value. Webster Brick Co., Inc., and Lone Star Cement Corp., accounted for 50 percent of the output and 54 percent of the output value.

Feldspar.—Production and value decreased approximately 6 percent in 1971. North-western Feldspar Corp. produced feldspar from five mines in Bedford County. Mixed feldspar (soda and potash) was processed at the company's mill in Bedford. The mill output was marketed principally to pottery and ceramic enamel manufacturers. Virginia ranked seventh in U.S. feldspar production.

Gem Stones.—Hobbyists and mineral fanciers collected a variety of semiprecious gems and mineral specimens in various areas in the State.

Gypsum.—The output of crude gypsum decreased 6 percent, and value decreased 4 percent in 1971. The raw gypsum, mined at Plasterco, Washington County, was calcined or otherwise processed and manufactured into plasterboard and other gypsum products by United States Gypsum Co. at its Plasterco plant. The company also processed gypsum at Norfolk for use in its products.

Table 6.—Clays sold or used by producers
(Thousand short tons and thousand dollars)

Year	Quantity	Value
1965	1,415	\$1,657
1966	1,486	1,813
1967	1,382	1,623
1968	1,462	1,714
1969	1,677	1,504
1970	1,633	1,672
1971	1,710	1,800

Kyanite.—Although production of crude kyanite ore remained substantially the same, value increased 5 percent over that of 1970. Shipments were primarily to manufacturers of refractories and other ceramic products. Two mines and four processing plants in adjacent Buckingham and Prince Edward Counties were operated by Kyanite Mining Corp.

Only a small portion of the beneficiated kyanite (Al_2SiO_5) is used in the raw state; the bulk of production is calcined to mullite, one of the most important refractory materials used in the ceramic industry. Quartzite sand, recovered during the milling of kyanite, was marketed for industrial and construction uses. Virginia is North America's leading producer of kyanite.

Lime.—The total lime production (quick and hydrate) decreased 28 percent in output and 22 percent in value compared with 1970. Lime consumed for water purification and sewage treatment uses increased, construction use remained static, and all other uses showed substantial declines. Agricultural use continued to decline, and over 98 percent of lime sold or used was consumed in industrial applications.

In 1971, primary lime output was reported by eight companies operating eight plants in six counties. The principal producing counties in order of output and value were Giles, Shenandoah, and Frederick. Over 88 percent of the State's 1971 output and value of lime was accounted for by these three counties. The major producing companies were National Gypsum Co., Chemstone Corp., and Foote Mineral Co.

Processing equipment used in limemaking included pot, shaft, and rotary kilns

Table 7.—Lime sold or used by producers, by use
(Short tons)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Steel, BOF	345,002	\$4,493,573	304,485	\$4,373,562
Paper and pulp	106,458	1,365,700	88,436	1,182,000
Steel, electric	105,418	1,357,000	53,935	773,000
Water purification	37,823	559,200	50,634	777,995
Sewage	36,087	477,340	37,053	529,500
Construction	15,056	201,623	15,063	214,728
Agriculture	17,265	209,008	14,872	200,107
Other uses ¹	333,382	5,426,676	199,159	3,047,652
Total	1,046,491	14,090,120	758,637	11,048,544

¹ Includes alkalis, calcium carbide (1970), other metallurgy, open-hearth steel furnaces, ore concentration, sugar refining, tanning, petroleum refining, and acid mine water neutralization.

and batch and continuous hydrators. Raw materials included high-calcium limestone (predominately), dolomitic limestone, and oystershell. Fuels included bituminous coal, coke, and natural gas.

Virtually the entire output was high-calcium lime. Quicklime accounted for 92 percent of the total production and averaged \$14.48 per ton in value, hydrate lime equaling 8 percent of the total output, averaged \$15.50 per ton. The average value of all lime increased from \$13.47 per ton in 1970 to \$14.56 per ton in 1971.

Lime consumption in Virginia was 182,087 tons, equal to 24 percent of the State's production. The remaining output was shipped to Pennsylvania, West Virginia, and other States.

Lithium Compounds.—Lithium compounds were prepared by the Foote Mineral Co. at Sunbright in Scott County using limestone mined at Sunbright and spodumene from North Carolina.

Manganese.—Imported ore was processed in a plant at Newport News by the Consumer Products Division of Union Carbide Corp. for company use. A grinding plant for imported ore was operated by C-E Minerals Division of Combustion Engineering, Inc., at Lynchburg.

Mica.—Mica was processed in two Newport News plants. One operation is a mica-fabricating plant, and the other is a plate-mica plant.

Nitrogen Compounds.—Allied Chemical Corp., Nitrogen Division, Hopewell, Prince George County, using reformed natural gas, produced ammonia, urea, ammonium nitrate, and ammonium sulfate for use chiefly as fertilizer or fertilizer ingredients. The capacity of the plant at Hopewell is rated at 350,000 short tons ammonia per year.

Salt.—Production of salt decreased owing to the closure in July 1971 by the Olin Corp., Saltville, Smyth County, of their 375,000-ton-per-year soda ash plant, which employed 600 workers. The shutdown was attributed by company officials to inability to meet new water pollution standards imposed by the Federal and State Governments. Olin's chlorine-caustic soda plant, which employs 260 persons, will cease operations by March 1, 1972.

Sand and Gravel.—Accelerated building and highway construction in Virginia in 1971 increased the demand for aggregates;

sand and gravel rose 15 percent in output and 33 percent in value. Commercial output comprised more than 99 percent of total production and value; the remainder was State and local Government output, primarily for use in highway maintenance. Ninety percent of the commercial output was used as construction aggregate in building (62 percent) and paving (28 percent).

Sand comprised 66 percent of the commercial sand and gravel production and 57 percent of the total commercial value. Although only 9 percent of the sand output was for industrial uses; classed as glass, engine, fire or furnace, abrasives, filler, and miscellaneous, 16 percent of the value of sand output was attributed to these uses.

Eighty-six percent of the total sand and gravel output was screened, washed, or otherwise processed at 39 stationary plants, 13 portable plants, and four dredges. Eighty-five percent of the commercial production was transported to market by truck, 13 percent by waterway, and 2 percent by railroad.

Production of sand and gravel was reported from 36 counties and four independent cities. In order of output the principal sand and gravel producing areas were Henrico, Fairfax, Chesterfield, Charles City Counties, and the City of Virginia Beach.

Thirty-nine of the 75 sand and gravel operations had an annual output range of up to 50,000 tons and accounted for 5 percent of the total tonnage; 29 operations had an output range of from 50,000 to 500,000 tons and accounted for 44 percent; five had an output range of from 500,000 to 1,000,000 tons and accounted for 32 percent; and two had an output range over 1,000,000 tons and accounted for 19 percent. The bulk of the sand and gravel recovery was by dredging and open pit mining; a sizable tonnage of industrial silica sand was produced from crushed sandstone and quartzite, and a limited amount was obtained in the processing of kyanite.

Soapstone and Talc.—Crushed and ground soapstone was produced by Blue Ridge Talc Co., Inc., near Henry, Franklin County, principally for use in insecticides and foundry facings. Output declined mod-

Table 8.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	4,116	\$5,226	4,617	\$6,816
Fill	357	173	425	186
Paving	2,497	2,212	2,703	2,641
Other uses ¹	702	1,627	730	1,838
Total ²	7,671	9,237	8,475	11,481
Gravel:				
Building	2,670	5,009	3,242	6,874
Paving	564	758	882	1,535
Other uses ³	157	203	177	307
Total ²	3,391	5,970	4,301	8,717
Government-and-contractor operations:				
Sand:				
Fill	51	18	14	1
Paving	6	1	--	--
Other uses	--	--	2	2
Total	57	19	16	3
Gravel:				
Fill	5	2	5	(4)
Paving	3	1	--	--
Total ²	7	3	5	(4)
Total sand and gravel ²	11,126	15,229	12,796	20,201

¹ Includes railroad ballast, glass, molding (1971), blast (1971), fire or furnace, engine, filtration, fill (1971), and other sands.

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

³ Includes fill, railroad ballast (1971), miscellaneous, and other gravel.

⁴ Less than ½ unit.

erately, and value decreased approximately 11 percent. The ground material was sold for about \$17.00 per short ton.

Dimension soapstone was produced by Alberne Stone Division, Georgia Marble Co.

Stone.—Ranking next to coal in importance to the mineral economy of Virginia, stone accounted for 16 percent of the State's total value of mineral production in 1971. Total stone output declined slightly, but value rose 5 percent from that of 1970. Substantially increased output of dimension stone and a slight increase in the average unit value of crushed stone were responsible for the rise in total stone value.

Varied types of stone were mined or quarried in the State; in order of output value they were limestone, granite, traprock, dolomite, slate, miscellaneous stone (including marl, marble, quartz, and quartzite) and sandstone. Both crushed and broken stone and dimension stone were produced.

Crushed stone was produced from all the stone types and comprised virtually all of the stone output (99.9 percent) and the major portion of the total value (93.8 percent). Of the total crushed stone output, 74 percent was used for building purposes (concrete aggregate and roadstone), 6 percent for cement, 5 percent for lime, 4 percent for agricultural limestone, and the remainder as railroad ballast, flux stone, riprap, and jetty stone, and miscellaneous and unspecified applications. Crushed stone declined slightly in output and gained slightly in value compared with 1970 levels. Increases in output value were reported for granite, sandstone, slate, and traprock. The average value per ton for crushed stone rose to \$1.72 from \$1.61 in 1970.

Dimension stone was produced at 11 operations in eight counties. Although a low-output commodity in terms of tonnage (0.1 percent of total stone production), it accounted for 6.2 percent of the total stone output value. Three operations were active

in quartzite; two operations each in slate, traprock, and other stone; and one each in limestone and quartz. The use of dimension stone in decreasing order of quantities produced were structural, flagging, roof slate, rubble, irregular shapes, cut, sawed, and monumental.

Commercial stone was produced at 143 operations in 54 counties and one independent city. In terms of tonnage, the principal stone producing counties were Loudoun (traprock and granite), Frederick (limestone), Fairfax (traprock and granite), Botetourt (limestone and dolomite), Montgomery (limestone), and Tazewell (limestone). In terms of output value the most important counties were Loudoun, Frederick, Fairfax, Botetourt, Buckingham, and Tazewell. Thirty-two percent of the total stone quantity was contributed by six counties, and six counties accounted for 32 percent of the output value.

In 1971, the number of operations in limestone was 69, nine in dolomite, 30 in granite, one in marble, 11 in traprock, six in quartzite, five in sandstone, four in slate, three in quartz, two in marl, and three in other stone. Twelve counties pro-

Table 9.—Stone sold or used by producers, by use
(Thousand short tons and thousand dollars)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Dimension stone total.....	23	\$3,437	45	\$3,955
Crushed and broken stone:				
Bituminous aggregate.....	2,777	4,643	2,511	4,271
Concrete aggregate.....	2,968	4,614	5,250	8,551
Dense graded road base stone.....	12,319	19,723	11,755	20,219
Macadam aggregate.....	906	1,281	1,135	2,307
Surface treatment aggregate.....	1,483	2,575	1,739	3,138
Unspecified aggregate and roadstone.....	5,779	9,367	3,377	4,973
Agricultural limestone.....	1,145	2,079	1,220	12,694
Cement.....	1,714	1,925	2,099	2,637
Flux.....	W	W	393	826
Lime.....	1,843	2,993	1,559	2,668
Railroad ballast.....	671	933	432	599
Riprap and jetty stone.....	W	W	121	231
Stone sand.....	354	629	127	318
Other uses ²	3,432	6,278	2,879	6,094
Crushed total ³	35,392	57,040	34,598	59,527
Grand total.....	35,415	60,477	34,643	63,482

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

¹ Agricultural limestone for 1971 includes poultry grit.

² Includes stone used for agricultural marl and other soil conditioners (1970), poultry grit and mineral food (1970), filter stone, terrazzo (1971), chemical stone, mine dusting, asphalt filler, other filler, chemicals, drain fields, glass, lightweight aggregates, roofing aggregates, and other uses not specified.

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

Table 10.—Stone sold or used by producers, by kind
(Thousand short tons and thousand dollars)

Kind of stone	1970		1971	
	Quantity	Value	Quantity	Value
Dolomite.....	2,563	\$3,599	2,303	\$3,373
Granite.....	10,675	18,290	10,532	18,826
Limestone.....	16,369	26,420	15,998	26,405
Quartzite.....	W	239	W	W
Sandstone.....	735	1,305	817	1,558
Slate.....	W	2,322	614	3,160
Traprock.....	3,387	6,154	3,553	7,222
Undistributed ¹	1,186	2,143	826	2,937
Total.....	35,415	60,477	34,643	² 63,482

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

¹ Includes marble, marl, quartz, shell, and other stone.

² Data does not add to total shown because of independent rounding.

duced more than 1 million tons each, and 26 counties had output valued in excess of \$1 million each.

Shipments of crushed stone products in million short tons by methods of transportation were distributed as follows: 25.8 by truck, 6.1 by railroad, 0.5 by waterway, and 2.2 by other and unspecified methods.

Marl produced in Nansemond County by the Lone Star Cement Corp. was used in the manufacture of cement at the company plant at Chesapeake City. The company has announced plans to phase out the quarry at Chuckatuck and eliminate a major part of the Chesapeake City plant within the first 3 months of 1972. The company cited new State air pollution laws as a reason for the decision. Marl was also produced in Clarke County for agricultural purposes and in York County and the City of Hampton for fill purposes.

Sulfur.—Hydrogen sulfide, recovered from fuel gas, was converted to elemental sulfur by the American Oil Co. at its Yorktown refinery. Shipments were higher than in 1970, but the value of shipments declined owing to a lower average unit value in 1971. Production and sales were approximately equal.

METALS

Iron Ore (Pigment Material).—Natural iron-oxide pigments were produced by Blue Ridge Talc Co., Inc. at Henry,

Franklin County, utilizing hematite obtained from out of State Natural iron-oxide pigments were also produced by Hercules, Inc., Imperial Color and Chemical Dept., at Hiwassee, Pulaski County, from local deposits of earthy forms of hydrous and anhydrous iron-oxides, including ocher, sienna, and umber. Manufactured iron-oxides were also produced at the company's Pulaski facilities. The finished iron-oxide pigments are used in paint manufacture, cements, printing inks, and other products. Total marketed output increased 13 percent, and total value increased over 34 percent above the previous year.

Lead and Zinc.—Lead and zinc were recovered from two mines in Wythe County operated by the same company. The ratio of zinc recovery to that of lead was about 5 to 1. Lead production remained substantially the same, and value decreased approximately 11 percent. Zinc production decreased approximately 7 percent, and value declined only 2 percent.

Titanium Concentrates.—Production of ilmenite ceased with the closure by American Cyanamid Corp. of their mine and plant in Amherst County. The Piney River operation, which employed 380 people, produced ilmenite for use in the manufacture of titanium dioxide pigments. The closure was attributed to the depletion of easily accessible soft ores and ecological problems.

Table 11.—Mine production of recoverable lead and zinc

Year	Lead		Zinc	
	Short tons	Value (thousands)	Short tons	Value (thousands) ¹
1965	3,651	\$1,139	20,491	\$5,942
1966	3,078	930	17,666	5,123
1967	3,430	960	18,846	5,088
1968	3,573	944	19,257	5,199
1969	3,358	1,000	18,704	5,462
1970	3,356	1,048	18,063	5,534
1971	3,386	934	16,829	5,419

¹ Recoverable zinc valued at the yearly average price of prime western-slab zinc, East St. Louis market. Value established after transportation, smelting, and manufacturing charges have been added to the value of the ore at the mine.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Aplite (crude):			
International Minerals & Chemical Corp., Industrial Minerals Div.	Piney River, Va. 22964	Quarry	Nelson.
The Feldspar Corp.	Route 1, Box 23 Montpelier, Va. 23192	do	Hanover.
Cement:			
Lone Star Industries, Inc. ¹	3315 W. Broad St. Richmond, Va. 23230	Plant and quarry	Botetourt.
Lone Star Industries, Inc. ²	do	Plant	Chesapeake (City).
Riverton Corp. ³	Riverton, Va. 22651	Quarry and plant	Warren.
Clays (miscellaneous and shale):			
Brick and Tile Corp. of Lawrenceville.	P.O. Box 45 Lawrenceville, Va. 23868	Pit and plant	Brunswick.
Do	do	Pit	Greensville.
Daniels Brick and Tile Co., Inc.	P.O. Box 4237 Richmond, Va. 23224	Pit and plant	Chesterfield (City of Richmond).
Do	do	Pit	Dinwiddie.
General Shale Prod. Corp.	Box 3547 Johnson City, Tenn. 37601	Pits and plants	Chesterfield (City of Richmond), Smyth, Tazewell.
Clinchfield Coal Company, Div. of The Pittston Co. ⁴	Dante, Va. 24237	Plant	Russell.
Locher Brick Co., Inc.	Route 1, Box 1 Glasgow, Va. 24555	Pit and plant	Rockbridge.
Old Virginia Brick Co., Inc.	P.O. Box 508 Salem, Va. 24153	do	Roanoke.
Do	do	Pit	Montgomery.
Redford Brick Co.	Box 4096 Richmond, Va. 23224	Pit and plant	Chesterfield (City of Richmond).
Weblite Corp.	Box 780 Roanoke, Va. 24004	do	Botetourt.
Webster Brick Co., Inc.	do	Pits	Botetourt, Nansemond, Orange.
Woodbridge Clay Products Co.	Rt. 3, Box 240 Manassas, Va. 22110	Pit	Prince William.
Coal (bituminous):			
Betty B. Coal Co.	Clintwood, Va. 24228	Underground mine.	Dickenson.
Clinchfield Coal Co. ⁵	Dante, Va. 24237	do	Buchanan.
Clinchfield Coal Co. ⁶	do	do	Dickenson.
Clinchfield Coal Co. ⁷	do	do	Russell.
Coal Processing Corp.	Box 497 Norton, Va. 24273	do	Wise.
Harman Mining Corp. ⁸	Harman, Va. 24618	do	Buchanan.
Island Creek Coal Co. ⁹	Box 113 Keen Mountain, Va. 24624	do	Do.
Westmoreland Coal Co. ⁵	P.O. Box 229 Big Stone Gap, Va. 24219	do	Wise.
Contracting Enterprises, Inc.	Clintwood, Va. 24228	Strip mine	Dickenson.
Stamach Mining Corp. ⁹	P.O. Drawer 389 Appalachia, Va. 24216	Strip and auger mine.	Wise.
Sterling Mining Co.	Box 1187 Wise, Va. 24293	Strip mine	Do.
Coke:			
Christie Coal and Coke Co., Inc.	P.O. Box 409 Norton, Va. 24273	Plant	Do.
Jewell Smokeless Coal Corp.	Jewell Valley, Va. 24623	do	Buchanan.
Feldspar (crude):			
Northwestern Feldspar Corp.	P.O. Box 706 Custer, S.D. 57730	Mine	Bedford.
Gypsum:			
United States Gypsum Co. ¹⁰	101 S. Wacker Drive Chicago, Ill. 60606	Plant	Chesapeake (City).
United States Gypsum Co.	do	Mine and plant	Washington.
Iron-oxide pigments (crude):			
Hercules, Inc., Imperial Color & Chemical Dept. ¹¹	Hiwassee, Va. 24347	do	Fulaski.
Iron-oxide pigments (finished):			
Blue Ridge Talc Co., Inc.	P.O. Box 7 Henry, Va. 24102	Plant	Franklin.
Kyanite:			
Kyanite Mining Corp. ¹²	Dillwyn, Va. 23936	Mine and plants	Buckingham.
Do	do	do	Prince Edward.

See footnotes at end of table.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Lime:			
Battery Park Fish & Oyster Co. ¹³	Battery Park, Va. 23304	Plant	Isle of Wight.
Blue Grass Lime Co. ¹⁴	Route 3 Tazewell, Va. 24651	do	Tazewell.
Chemstone Corporation ¹⁴	Menlo Park Edison, N.J. 08817	do	Shenandoah.
Foote Mineral Co. ¹⁴	Rt. 100 Exton, Pa. 19341	do	Giles.
W. S. Frey Co., Inc. ¹⁴	257 E. Market St. York, Pa. 17403	do	Frederick.
M. J. Grove Lime Co., Div. of The Flintkote Co. ¹⁴	Lime Kiln, Md. 21763	do	Do.
National Gypsum Co. ¹⁴	325 Delaware Ave. Buffalo, N.Y. 14202	do	Giles.
Natural Gas:			
Ashland Oil and Refining Co.	Box 67 Vansant, Va. 24656	Gas wells	Buchanan.
Cabot Corp.	P.O. Box 1473 Charleston, W. Va. 25325	do	Do.
Clinchfield Coal Co., Div. of the Pittston Co.	Dante, Va. 24237	do	Dickenson.
Consol-Ray Corp.	Pocahontas, Va. 24635	do	Tazewell.
P and S Oil and Gas Corp.	305 Nelson Bldg. Charleston, W. Va. 25301	do	Buchanan.
Columbia Gas Transmission Corp.	P.O. Box 1273 Charleston, W. Va. 25325	do	Buchanan, Tazewell.
Petroleum refineries:			
American Oil Company ¹⁵	Yorktown, Va. 23490	Plant	York.
Salt:			
Olin Corp. ¹⁶	120 Long Ridge Rd. Stamford, Conn. 06905	Brine wells	Smyth.
Sand and gravel:			
Fredericksburg Sand & Gravel Co.	Rt. 4, Box 57 Fredericksburg, Va. 22401	Pit	Stafford.
Locher Silica Corp. ¹⁷	Glasgow, Va. 24555	Pits	Rockbridge, Wythe.
Massaponax Sand & Gravel Corp.	P.O. Box 270 Fredericksburg, Va. 22401	Pit	Spotsylvania.
Jobe Newton.....	Box 412 Fredericksburg, Va. 22401	Pit	Stafford.
Sadler Materials Corp.	P.O. Box 5417 Virginia Beach, Va. 23455	Pit	Henrico.
Solite Corp.	P.O. Box 883 Fredericksburg, Va. 22401	Pit	King George.
Southern Materials Co., Inc.	2125 Kimball Terrace Norfolk, Va. 23504	Pit and dredge	Chesterfield (City of Richmond).
Do.....	do	Dredge	Henrico.
Do.....	do	Pits	Isle of Wight, Prince George, Frederick.
Unsil Corp. ¹⁷	P.O. Box 445 Winchester, Va. 22601	Pit	Frederick.
Virginia Concrete Co., Inc.	P.O. Box 666 Springfield, Va. 22150	Pit	Fairfax.
E. V. Williams Co., Inc.	P.O. Box 938 Norfolk, Va. 23501	Pit	Virginia Beach (City).
Williams Paving Co., Inc.	do	Pit	Halifax.
Soapstone (talc):			
Blue Ridge Talc Co., Inc. ¹⁸	P.O. Box 8 Henry, Va. 24102	Mine and plant	Franklin.
Stone:			
Granite-crushed and broken:			
Boscobel Granite Corp.	Box 1775 Richmond, Va. 23221	Quarry	Goochland.
Bull Run Stone Co., Inc.	Box 469 Manassas, Va. 22110	do	Loudoun.
Burkeville Stone Corp.	Box 1775 Richmond, Va. 23221	do	Nottoway.
The General Crushed Stone Co.	712 Drake Bldg. Easton, Pa. 18042	do	Hanover.
Martinsville Stone Corp.	Route 2, Box 31 Martinsville, Va. 24113	do	Henry.
Southern Materials Co., Inc.	2125 Kimball Terrace Norfolk, Va. 23501	Quarries	Brunswick, Chesterfield (City of Richmond), Dinwiddie.
Superior Stone Co., Div. of Martin Marietta Corp.	Box 2568 Raleigh, N.C. 27602	do	Albemarle, Louisa.
Tidewater Crushed Stone & Asphalt Co., Inc.	Deepwater Terminal Rd. Richmond, Va. 23234	Quarry	Chesterfield (City of Richmond).

See footnotes at end of table.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Granite—Crushed and broken—Continued			
Trego Stone Corp.....	P.O. Box 2459 Roanoke, Va. 24010	Quarry.....	Greensville.
Vulcan Materials Co.....	P.O. Box 7506 Winston-Salem, N.C. 27106	Quarries.....	Brunswick, Fairfax, Goochland, Halifax, Pittsylvania, Prince William.
Limestone—crushed and broken:			
Blue Ridge Stone Corp.....	Box 2459 Roanoke, Va. 24010	....do.....	Botetourt, Campbell.
Foote Mineral Co.....	Duffield, Va. 24244.....	Underground mine.	Scott.
James River Limestone Co....	Box 355 Buchanan, Va. 24066	Quarry.....	Botetourt.
Liberty Limestone Corp.....	Box 453 Buchanan, Va. 24066	Quarries.....	Allegheny, Botetourt.
Penn-Dixie Cement Corp.....	P.O. Box 152 Nazareth, Pa. 18064	Quarry.....	Scott.
Stuart M. Perry, Inc.....	Box 738 Winchester, Va. 22601	Quarries.....	Clarke. Frederick.
Pounding Mill Quarry Corp....	Box 2459 Roanoke, Va. 24010	....do.....	Tazewell.
Radford Stone Corp.....	Route 1, Box 235 Radford, Va. 24141	....do.....	Pulaski.
Rockydale Stone Service Corp..	Rt. 8, Box 635 Roanoke, Va. 24004	....do.....	Campbell.
Rockydale Quarries Corp.....	....do.....	....do.....	Roanoke.
Salem Stone Corp.....	P.O. Box 1121 Roanoke, Va. 24153	Quarries.....	Montgomery, Roanoke.
Vulcan Materials Co.....	Box 7 Knoxville, Tenn. 37901	....do.....	Washington, Allegheny, Augusta.
Marble—crushed:			
Jamison Black Marble Co.....	P.O. Box 1198 Roanoke, Va. 24006	Quarry.....	Rockingham.
Marl—calcareous:			
J. C. Digges & Sons.....	White Post, Va. 22663.....	Pit.....	Clarke.
Wm. M. Rice & Son.....	29 Harris Creek Rd. Hampton, Va. 23360	Pit.....	Hampton (City).
Miscellaneous stone—dimension:			
Alberene Stone, Div. of the Georgia Marble Co. ¹⁹	Schuyler, Va. 22969.....	Quarry and plant.	Nelson.
Miscellaneous stone—crushed:			
Dominion Stone Plant, Inc....	Piney River, Va. 22964.....	....do.....	Do.
Oystershell:			
Battery Park Fish & Oyster Co.	Battery Park, Va. 23304.....	Plant.....	Isle of Wight.
Quartz and quartzite—crushed and broken:			
H. D. Crowder & Sons.....	Route 1 Austinville, Va. 24312	Quarry.....	Carroll.
The Economy Cast Stone Co....	P.O. Box 3-P Richmond, Va. 23207	....do.....	Albemarle.
Lone Jack Limestone Co., Inc..	P.O. Box 752 Lynchburg, Va. 24505	....do.....	Rockbridge.
Quartzite—dimension:			
Leesville Stone Corp.....	Leesville, Va. 24571.....	....do.....	Campbell.
Lofton Lambert.....	The Plains, Va. 22171.....	....do.....	Fauquier.
Musselman Bros.....	110 White Oak Rd. Fredericksburg, Va. 22401	....do.....	Do.
Sandstone—crushed and broken:			
Castle Sands Co.....	New Castle, Va. 24127.....	....do.....	Craig.
Culpeper Stone Co., Inc.....	Box 650 Culpeper, Va. 22701	....do.....	Culpeper.
Newman Brothers Quarry, Inc..	Route 3 Hillsville, Va. 24343	....do.....	Wythe.
Slate—crushed:			
Solite Corp. ²⁰	Box 9138 Richmond, Va. 23227	Plant.....	Buckingham.
Slate—dimension:			
Arvonja-Buckingham Slate Co., Inc. ²¹	Arvonja, Va. 23004.....	Quarry and plant.	Do.
Le Sueur-Richmond Slate Corp. ²¹	....do.....	....do.....	Do.
Traprock (diabase)—dimension:			
Buena Black Granite Corp.....	Box 74 Rapidan, Va. 22733	Quarry.....	Culpeper.
Virginia Granite Corp.....	P.O. Box 250 Elberton, Ga. 30635	....do.....	Do.

See footnotes at end of table.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Traprock (diabase)—crushed and broken:			
Chantilly Crushed Stone, Inc.	Box 112 Chantilly, Va. 22021	Quarry	Loudoun.
Fairfax Quarries, Inc.	Box 7155 Richmond, Va. 23211	do	Fairfax.
Sanders Quarry, Inc.	335 Waterloo St. Warrenton, Va. 22816	do	Fauquier.
Virginia Trap Rock, Inc.	Box 705 Leesburg, Va. 22075	do	Loudoun.
Traprock (basalt)—crushed:			
Charlottesville Stone Corp.	Box 7155 Richmond, Va. 23221	do	Albemarle.
Titanium concentrate (ilmenite):			
American Cyanamid Co.	Wayne, N.J. 07470	Mine and plant	Amherst.

¹ Portland and masonry cement; also captive production of limestone and shale.

² Portland cement only; also captive production of marl and clay in Nansemond County.

³ Masonry cement only; also produce limestone.

⁴ Shale obtained from coal preparation plant as a coproduct.

⁵ 8 mines.

⁶ 5 mines.

⁷ 3 mines.

⁸ 2 mines.

⁹ 4 mines.

¹⁰ Process imported gypsum.

¹¹ Also finished iron oxide pigments.

¹² Coproduct: quartz sand.

¹³ Calcine oystershell.

¹⁴ Also captive production of limestone.

¹⁵ Coproducts: sulfur and coke.

¹⁶ Various chemicals manufactured from salt and lime at plant; captive limestone converted to lime for use in chemical manufacturing.

¹⁷ Mainly industrial silica (crushed sandstone).

¹⁸ Also process out-of-State hematite at plant for pigment manufacture.

¹⁹ Stone variety is soapstone.

²⁰ Lightweight aggregate.

²¹ Also crushed slate produced.

The Mineral Industry of Washington

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

By Robert A. Whitman ¹

The value of mineral production in Washington was \$94.6 million in 1971. The increase in value reflected increased unit values and a resumption of the large-scale production of coal. The four metals with the greatest value of production, lead, zinc, gold, and uranium, declined in tonnage. Of the principal nonmetallic commodities, the State's industry produced less cement, sand and gravel, diatomite, and stone. There were increases in the production of clays, lime, olivine, talc, and gypsum. The total value of nonmetallics produced declined 1 percent.

Washington State produced about 89,000 tons less aluminum than in 1970. Total output in the State was about 23.8 percent of total U.S. production and about 9 per-

cent less than the amount of aluminum produced in Washington in 1970.

In June, Marshall T. Hunting, Supervisor of the State Division of Mines and Geology, retired after 30 years of service in the Division.

The University of Washington announced plans to phase out the mining engineering curriculum over a 4-year period. The 1971 freshman class was the last one to be enrolled in mining engineering.

Economic Activity and Employment.—Two companies with employment of 30,000 man-hours or more annually, the Columbia Cement Co., a division of PPG Industries Inc., and Pioneer Sand & Gravel Co.,

¹ Physical scientist, Division of Nonferrous Metals.

Table 1.—Mineral production in Washington ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland.....thousand 376-pound barrels..	6,495	\$24,832	6,113	\$23,735
Masonry.....thousand 280-pound barrels..	41	158	37	145
Clays ².....thousand short tons	240	436	255	549
Coal (bituminous).....do	37	470	1,134	7,614
Copper.....short tons	9	11	W	W
Gem stones.....	NA	150	NA	155
Lead (recoverable content of ores, etc.).....short tons	6,784	2,119	5,177	1,429
Peat.....thousand short tons	17	71	17	72
Sand and gravel.....do	25,089	27,902	22,702	26,658
Stone.....do	13,701	19,100	12,436	20,489
Zinc (recoverable content of ores, etc.).....short tons	11,956	3,663	5,782	1,862
Value of items that cannot be disclosed:				
Abrasives (1971), bauxite (1970), diatomite, gold, gypsum, lime, mercury (1970), olivine, pumice, silver, talc, uranium, and values indicated by symbol W.....	XX	12,010	XX	11,893
Total	XX	90,922	XX	94,601
Total 1967 constant dollars	XX	81,330	XX	82,189

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

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

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

Table 2.—Value of mineral production in Washington, by county
(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Adams	W	W	Sand and gravel, stone.
Asotin	\$13	\$2	Sand and gravel.
Benton	W	W	Sand and gravel, stone.
Chelan	W	340	Sand and gravel.
Clallam	659	1,360	Stone, clays, sand and gravel.
Clark	W	W	Stone, sand and gravel, clays.
Columbia	W	W	Stone.
Cowlitz	883	449	Stone, sand and gravel, clays.
Douglas	W	W	Sand and gravel, clays.
Ferry	W	W	Gold, silver, stone, copper, lead.
Franklin	W	W	Sand and gravel, stone.
Garfield	630	W	Stone.
Grant	2,702	2,789	Diatomite, lime, stone, sand and gravel.
Grays Harbor	1,308	1,049	Sand and gravel, stone.
Island	W	W	Do.
Jefferson	W	W	Stone, sand and gravel.
King	24,363	21,729	Cement, sand and gravel, stone, coal, clays, peat, copper, silver, gold.
Kitsap	W	W	Sand and gravel, stone, peat.
Kittitas	W	226	Stone, clays, sand and gravel.
Klickitat	483	W	Sand and gravel, stone.
Lewis	W	W	Coal, sand and gravel, stone, clays.
Lincoln	148	W	Stone, sand and gravel.
Mason	326	217	Sand and gravel, stone, peat.
Okanogan	489	W	Stone, sand and gravel, gypsum.
Pacific	321	766	Stone.
Pend Oreille	W	9,090	Cement, zinc, lead, stone, sand and gravel, silver, copper, gold.
Pierce	W	6,255	Sand and gravel, lime, stone, clays, peat.
San Juan	W	W	Sand and gravel.
Skagit	1,432	1,913	Olivine, sand and gravel, stone, talc.
Skamania	W	W	Stone, sand and gravel, pumice.
Snohomish	5,375	3,299	Sand and gravel, stone, peat, clays.
Spokane	W	2,955	Sand and gravel, stone, clays, peat.
Stevens	W	5,619	Uranium, stone, sand and gravel, clays, lead, gold, silver, copper, zinc, abrasives.
Thurston	W	W	Sand and gravel, stone, peat.
Wahkiakum	W	1	Sand and gravel.
Walla Walla	453	407	Sand and gravel, stone.
Whatcom	W	W	Cement, sand and gravel, stone, clays.
Whitman	1,375	1,458	Stone, sand and gravel.
Yakima	W	2,257	Stone, sand and gravel, lime.
Undistributed ¹	49,964	32,421	
Total ²	90,922	94,601	

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

¹ Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

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

received certificates of achievement from the National Safety Competition for having an outstanding safety record in 1971.

Economic and employment data for the State are listed in tables 3 and 4.

Legislation and Government Programs.

—The Spokane Mining Research Center (SMRC) has been remodeling a former Atlas missile site north of Reardon in Lincoln County for use as an auxiliary laboratory. Although the remodeling started about 5 years ago, major growth has occurred in the last 2 years. SMRC had 30 in-house research projects in 1971, with five major projects underway at the auxiliary laboratory. These were being carried out by 15 permanent and 30 part-time employees.

One project was testing the feasibility of pneumatic stowing for backfilling mined-

out areas using waste shale. The pneumatic stowing machine projects 100 tons of material per hour at a speed of 150 feet per second.

In an electro-osmosis project, electricity is conducted through mine-mill tailings to withdraw the water content through the principle of osmosis. This increases the density of the tailings for use as backfilling of old underground mined-out areas. Other projects are testing the use of plastics to strengthen coal mine roofs and shotcrete to add support to mine openings.

There were no new contracts issued by the Office of Minerals Exploration during 1971.

Ecology.—In July, the administrator of the Mined-Land Reclamation Act of Washington State, Title 76 RCW, reported excellent cooperation from open pit operators

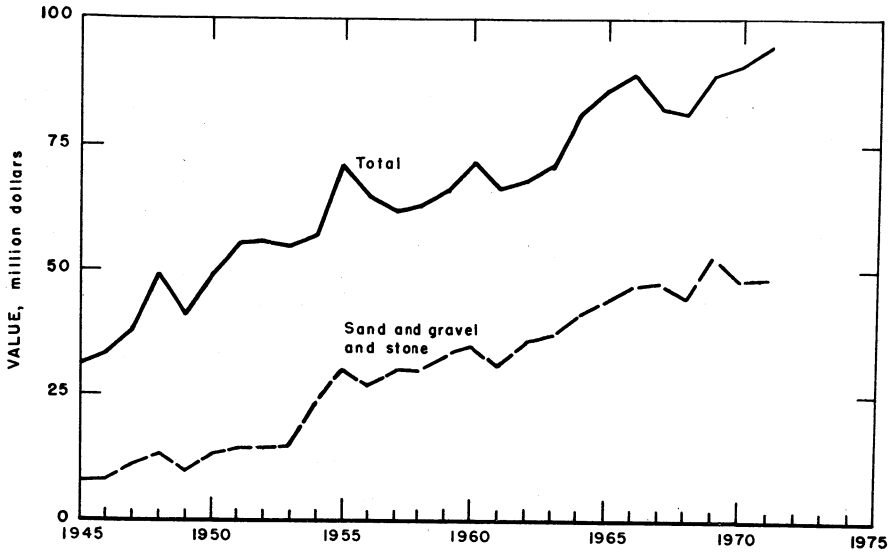


Figure 1.—Value of sand and gravel and stone, and total value of mineral production in Washington.

Table 3.—Indicators of Washington business activity

	1970	1971 ^p	Change, percent
Annual average labor force and employment:			
Total labor force.....	thousands .. r 1,400.4	1,413.9	+1.0
Unemployment.....	do .. r 116.2	155.4	+33.7
Employment:			
Aerospace.....	do .. r 61.5	40.5	-34.1
Lumber and wood products.....	do .. r 42.2	42.6	+9
Food processing.....	do .. r 28.9	28.1	-2.8
All manufacturing.....	do .. r 289.4	213.2	-10.9
All industries.....	do .. r 1,284.2	1,258.5	-2.0
Factory payrolls.....	millions .. \$6,049.5	NA	NA
Personal income:			
Total.....	do .. r \$13,671.0	\$14,260.0	+4.3
Per capita.....	do .. r \$4,004.0	\$4,135.0	+3.3
Construction activity:			
Value of nonresidential construction.....	millions .. r \$213.1	\$211.0	-1.0
State highway commission: Value of contracts awarded.....	do .. \$100.0	NA	NA
Cement shipments to and within Washington.....	thousand 376-pound barrels .. 6,041.0	6,470.0	+7.1
Farm marketing receipts.....	millions .. \$787.7	NA	NA
Mineral production value.....	do .. \$90.9	\$94.6	+4.1

^p Preliminary. r Revised. NA Not available.

Sources: State of Washington Employment Security Department, Research and Statistics Bureau; Survey of Current Business; Farm Income Situation; Construction Review; and U.S. Bureau of Mines.

during the first 6 months of operation. Estimates of the average cost of reclamation for gravel mining operations were from 1 to 1.5 cents per cubic yard of material mined. Underground mining is not now included in the Act. Three modifications were expected to be introduced in the next legislature to include smaller open pit

operations and underground mining which disturbs the surface and to raise the permit fee to increase coverage of administrative costs.

The administrator also reported that the total acreage disturbed to date by surface mining in the State amounted to 0.02 percent of the total 42.8 million acres in the

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours		
					Fatal	Non-fatal	Frequency	Severity	
1970:									
Coal.....	69	235	16	130	--	10	77.14	1,651	
Peat.....	15	112	2	11	--	--	--	--	--
Metal.....	277	265	74	589	3	42	76.34	32,229	
Nonmetal.....	57	161	9	74	--	--	--	--	--
Sand and gravel.....	1,176	196	231	1,852	1	44	24.29	4,163	
Stone.....	991	205	203	1,625	--	36	22.15	1,164	
Total ¹	2,585	207	535	4,282	4	132	31.76	6,730	
1971: ^p									
Coal.....	75	228	17	139	--	12	86.23	1,811	
Metal.....	265	265	70	561	--	35	62.42	2,490	
Nonmetal ²	95	161	16	125	--	3	23.94	734	
Sand and gravel.....	1,100	197	217	1,753	2	50	29.66	7,767	
Stone.....	1,155	182	211	1,689	3	27	17.77	11,040	
Total ¹	2,695	197	531	4,267	5	127	30.94	7,968	

^p Preliminary.

¹ Data may not add to totals shown because of independent rounding.

² Beginning in 1971, data concerning peat operations are included in the nonmetals industry.

State. Distributed on a commodity basis the disturbances were as follows: Clay mining, 500 acres; stone quarrying, 1,300 acres; sand and gravel, 5,700 acres; gold mining, 400 acres; and other, 820 acres. The Centralia open pit coal mine, the largest so far in the State, would increase the total disturbed land by about 4,000 acres.

The city of Issaquah suspended all permits for construction in an area known to overlie long-abandoned coal mine workings. The action was taken because of the occurrence of subsidence and the danger inherent in the possibility of additional

ground collapse in the area. The suspension was based on a report by the State Division of Mines and Geology and the Federal Bureau of Mines.

The U.S. Geological Survey reported no unacceptable levels of dissolved metal ions in their sampling of Washington State waters.

The directors of the Puget Sound Air Pollution Agency gave the Tacoma smelter of The American Smelting and Refining Co. until December 31, 1974, to commit itself to the removal of 90 percent of the sulfur dioxide from plant stack gas.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasives.—A small quantity of special grinding pebbles were produced in Stevens County. The Carborundum Co., Vancouver, continued to manufacture silicon carbide.

Cement.—Portland cement shipments by four companies from four producing plants totaled 6.1 million barrels valued at \$23.7 million. There were also shipments of 36,672 barrels of masonry cement, of 280 pounds each, valued at \$145,246. These quantities were 6 and 10 percent less than in 1970, respectively. About 87 percent of the total shipments of portland cement

were of types I and II, the general use classifications. The remainder was type III, in which are high-early-strength and specialty cements.

Of the 6.5 million barrels of portland cement used in the State, 46 percent went into ready-mix plants, 12 percent into concrete products, 10 percent for use by contractors, and the rest was sold for other uses.

Raw materials used in making portland cement comprised nearly 1.5 million tons of limestone and cement rock, 139,403 tons of sand, and 231,794 tons of slag, clay, gypsum, and iron-bearing materials. There were also 161,215,000 kilowatt-hours of

electrical energy used to produce the 5.8 million 376-pound barrels of clinker.

Clays.—There was 6 percent more common clay sold or used by producers in 1971 than in 1970, but from only 12 counties. Value increased by 26 percent. The principal uses for clay were for cement and building brick. Two counties produced fire clay.

Gypsum.—Mining of crude gypsum in Okanogan County by Agro Minerals, Inc., of Tonasket, was resumed in 1971.

Lime.—Domtar Chemicals Ltd., and Utah-Idaho Sugar Co. produced lime in Grant, Pierce, and Yakima Counties for sugar refining, paper and pulp, calcium carbide, and other uses. Output increased 9 percent but was 7 percent below the 1969 record. The lime was consumed primarily in Washington, Oregon, Montana, and Canada. Total apparent consumption of lime in Washington was 86,382 tons.

Sand and Gravel.—The total quantity of

sand and gravel produced in 1971 decreased 10 percent and the value decreased 4 percent. Production was reported from 35 counties, but 53 percent of the total was from King, Pierce, Spokane, and Snohomish Counties. Most of the sand and gravel was produced by commercial operations, with 13 percent from Government crews or contractors.

Commercial production of sand increased 38 percent but production of gravel remained constant. There was a 37 percent decrease in sand and 59 percent decrease in gravel produced by Government operations.

Distribution of the combined output of sand and gravel by use was as follows:

Paving, 51 percent; building, 33 percent; fill, 13 percent; and other, 3 percent. Trucks transported 84 percent of the commercial production, 13 percent was shipped by water, with only 3 percent carried by railroads.

Table 5.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	2,281	\$3,334	3,093	\$4,277
Fill.....	604	342	752	685
Paving.....	1,062	1,238	1,746	2,037
Other uses ¹	149	715	61	503
Total.....	4,096	5,629	5,652	7,502
Gravel:				
Building.....	3,990	5,524	3,990	5,412
Fill.....	1,520	1,225	1,911	1,323
Paving.....	7,680	9,733	7,676	9,663
Railroad ballast.....	W	W	322	240
Miscellaneous.....	W	W	15	23
Other uses.....	880	1,016	82	96
Total ²	14,070	17,496	13,996	16,757
Government-and-contractor operations:				
Sand:				
Building.....	13	22	382	263
Fill.....	694	348	12	2
Paving.....	266	266	210	305
Other uses.....	114	67	81	53
Total ²	1,087	703	684	622
Gravel:				
Building.....	17	37	36	61
Fill.....	964	332	291	106
Paving.....	4,776	3,665	2,028	1,607
Other uses.....	79	40	15	1
Total ²	5,836	4,074	2,370	1,776
Total sand and gravel ²	25,089	27,902	22,702	26,658

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

¹ Includes blast (1970), glass (unground and ground), and other sands.

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

Stone.—The total quantity of stone sold or used by producers declined for 1971 by 9 percent. The value increased by 7 percent. There were 244 quarries in 34 counties but 80 quarries in seven counties produced 45 percent of the total. Seven counties each had production valued at over \$1 million. Trucks transported 78 percent, waterways carried 8 percent, and railroads moved 5 percent of the stone.

Traprock was produced in 31 counties and accounted for 75 percent of the total. It was used principally for aggregate, road material, and riprap.

Granite was produced at 15 quarries in nine counties. Over one-half was used for road surface and about one-sixth was used

for construction. Use of the rest was unspecified.

Seven quarries in five counties produced limestone. Over 75 percent of the total was used for making cement, and nearly 15 percent for lime manufacture. The rest was divided between agricultural and industrial uses. Both granite and limestone accounted for about 14 percent of total stone production.

There were 23 other quarries in Washington that produced dolomite, marble, sandstone, quartz, quartzite, and other stone.

Road construction uses 71 percent of stone produced and riprap takes 14 percent.

Table 6.—Stone sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Dimension stone total.....	5	\$196	2	\$188
Crushed and broken:				
Bituminous aggregate.....	1,423	2,709	911	1,437
Concrete aggregate.....	W	W	91	143
Macadam aggregate.....	643	892	196	333
Dense graded road base stone.....	1,336	2,054	3,051	5,335
Surface treatment aggregates.....	3,434	4,492	1,779	2,313
Unspecified aggregate and roadstone.....	2,756	2,152	2,888	3,314
Agricultural limestone.....	14	77	8	W
Metallurgical purposes ¹	137	671	54	142
Fill.....	1,435	750	W	W
Paper manufacturing.....	53	218	W	W
Riprap and jetty stone.....	1,227	2,267	1,708	3,327
Other ²	1,239	2,623	1,747	3,507
Crushed total ³	13,696	18,904	12,434	20,351
Grand total.....	13,701	19,100	12,436	20,489

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

¹ Data includes flux stone and ferrosilicon; 1970 data also includes dead-burned dolomite and refractory stone.

² Data includes stone used in cement and lime manufacture, railroad ballast, stone sand, filter stone, terrazzo and roofing aggregate, abrasives, building products, glass, and other uses in smaller quantities.

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

METALS

Aluminum.—Primary production of aluminum declined 8.7 percent in tonnage and 9.3 percent in value from 1970 to 1971. The State's share of the total national production also declined by 2 percent. Despite the decline in production, capacity was increased by 135,000 tons during 1971, mainly as a result of the new 110,000-ton-per-year plant of Harvey Aluminum, Inc., at Goldendale, which had no production until November. In addition, Aluminum Company of America increased the capacity of their Vancouver plant by 15,000 tons and Reynolds Metals Co. in-

creased the capacity of their Longview plant by 10,000 tons.

Copper.—The output of copper was more than double that of 1970. Over half was byproduct production. Most of the new metal came from King County. Four counties reported copper production.

Gold-Silver.—Production of gold was mostly from Ferry County. The average value of the gold increased about 13 percent.

Production of silver remained about the same as in 1970, but the average price declined about 5 percent.

Lead-Zinc.—The quantity of lead production decreased nearly 24 percent while

Table 7.—Primary aluminum plant capacity and production data

Year	Rated primary capacity (thousand short tons)	Primary production			Average U.S. ingot price per pound, cents
		Quantity (thousand short tons)	Percent of national total	Value (thousands)	
1967	770	746	23	\$370,287	25.0
1968	988	775	24	394,261	25.1
1969	1,012	1,003	26	541,834	26.5
1970	1,012	1,023	26	569,377	27.8
1971	1,147	934	24	516,407	27.6

the value decreased over 32 percent from 1970. The production of zinc decreased nearly 52 percent and the value about 49 percent.

A prospect-development program on the Van Stone lead-zinc mine was started during the year by the new owner, the Callahan Mining Corp. The Van Stone was a leading zinc producer in the State when operated as an open pit mine by The American Smelting and Refining Co. The company hopes to develop an ore body of adequate size and grade to mine underground through an inclined shaft.

Uranium.—Uranium ore from Alaska was mixed with ore from the Midnight mine to give a richer feed for the mill at Ford. The shipment of 56,700 tons of ore from Alaska, averaging 0.8 percent U_3O_8 was shipped by barge from Kendrick Bay on Prince of Wales Island to Seattle and then transferred to railroad cars for transportation to Ford.

MINERAL FUELS

Coal.—The new coal strip mine of the Washington Irrigation & Development Co. at Centralia produced 96.3 percent of the coal output in the State. This mine is owned by a consortium of eight electrical power companies: The Pacific Power & Light Co., the Washington Water Power Co., Seattle City Light, Snohomish County Public Utilities District, Tacoma City Light, Puget Sound Power & Light Co., Portland General Electric Co., and the Grays Harbor Public Utility District. Production from the open pit averaged about 120,000 tons per month for the first 9 months of 1971 and had not yet reached capacity which should be around 400,000 tons per month.

The majority of current coal production at Centralia was from the Big Dirty seam and the balance from the Smith seam. The coal averaged 8,100 and 8,300 Btu per ton

from the respective seams. All mined waste as well as fly ash and bottom ash from the generating plant will be used to reclaim the mined area. The Centralia project was the first of a planned 20-year expansion of electric power generation for the Pacific Northwest with participation by both public utility and private power firms.

The coal was used to power one 700-megawatt steam-electric generator, which was placed onstream in September. The second generator was due onstream in September 1972.

A proposal to use the mined-out land as a repository for solid waste disposal from western Washington and Oregon was made by Washington State officials.

The Number 10 Franklin mine, near Black Diamond in King County, which at one time had employed around 2,000 miners, ceased production in January and the mine opening and shaft were closed by a dynamite blast in order that the area may be used for a wilderness recreational park. The Franklin mine was one of the last underground coal mines in the State.

California-Time Petroleum Co. of California leased the Burlington-Northern's Rosslyn-Cle Elum coalfields. These coalfields, approximately 8 miles long and 4 miles wide, produced a high-volatile, grade A, bituminous coal with low moisture, about 13 percent ash and a very low sulfur content. The Btu range is between 11,840 and 15,000. A report by Northern Pacific engineers estimated economically recoverable reserves at about 121.5 million tons. Conversion of the railroad locomotive to diesel power diminished the demand for coal and caused the shutdown of the mines in 1963.

In February, the Rainier Coke and Chemical Co., Ltd., of Vancouver, British Columbia, announced plans to reopen the Glacier Coal mine north of Mt. Baker. Ini-

tial production of about 200,000 tons per year from the underground mine will be trucked to Bellingham and shipped to Japan.

Peat.—Thurston County had the largest production of peat during 1971. Production in the State increased about 6 percent. Spokane and Snohomish Counties were other large producers. Peat produced in Washington is sold in bulk mostly for soil conditioner. There were eight operations in seven counties.

Petroleum and Natural Gas.—The Standard Oil Company of California made a seismographic investigation on Vashon Island to delineate potential oil-bearing structures. There were no reports of results issued by yearend.

A representative of the Western Oil and Gas Association announced in January that exploration for possible oil and gas sites continued although no producing wells have been discovered since 1961.

The Jackson Prairie underground storage field was drilled at 52 different places and at the end of October had about 15 billion cubic feet of gas in storage. The storage field operators were able to inject about 5 billion cubic feet of gas during the previous 6-month period.

Geophysical surveys were made in the Puget Sound area during the summer months. There was leasing activity by major companies in the Puget Sound area, the Wishkah area of Grays Harbor, and the Forks area of Clallam County.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
NONMETALS			
Cement:			
Columbia Cement Co.	Marietta Road, P.O. Box 37 Bellingham, Wash. 98225	Plant	Whatcom.
Ideal Cement Co., Div. of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	...do.....	King.
Lehigh Portland Cement Co.	718 Hamilton St. Allentown, Pa. 18105	...do.....	Pend Oreille.
Lone Star Cement Corp.	P.O. Box 2047 Seattle, Wash. 98111	...do.....	King.
Clays:			
Chehalis Brick & Tile Co.	P.O. Box 868 Chehalis, Wash. 98532	Pit and plant	Lewis.
Cle Elum Cement Products, Inc.	P.O. Box 336 Cle Elum, Wash. 98922	...do.....	Kitititas.
R. L. Fleshman	2804 Spirit Lake Highway Castle Rock, Wash. 98611	Pit	Cowlitz.
Hidden Brick Co.	2610 Kauffman Ave. Vancouver, Wash. 98660	Pit and plant	Clark.
Jim Hoy Co.	1757 W. Bakerview Road Bellingham, Wash. 98225	Pit	Whatcom.
Ideal Cement Co., Div. of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	Pit and plant	Clallam.
Interpace Corp.	2901 Los Feliz Blvd. Los Angeles, Calif. 90039	3 pits and plants	King.
		2 pits and plants	Spokane.
		Pit and plant	Stevens.
		Pit	Whatcom.
Lind Gravel Co.	1530 State St. Bellingham, Wash. 98225	Pit and plant	Snohomish.
Lowell Brick Co.	Box 3005 Everett, Wash. 98201	...do.....	King, Pierce.
Mutual Materials Co.	P.O. Box 3547 Seattle, Wash. 98124	Pit	Douglas.
Wenatchee Silica Sand	Box 1668 Wenatchee, Wash. 98801		
Diatomite:			
Kenite Corp.	2 Overhill Road, Overhill Building Scarsdale, N.Y. 10583	Mine and plant	Grant.
Gypsum:			
Kaiser Gypsum Co., Inc.	300 Lakeside Drive Oakland, Calif. 94612	Plant	King.
Lime:			
Domtar Chemicals Ltd.	Tacoma, Wash. 98421 .....	...do.....	Pierce.
Olivine:			
Northwest International	329 Kincaid Mount Vernon, Wash. 98273	Mine and plant	Skagit.
Olivine Corp.	1015 Hilton Bellingham, Wash. 98225	...do.....	Do.

See footnotes at end of table.

Table 8.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
NONMETALS—Continued			
Pumice and pumicite:			
W. L. Marenakos Co.....	Rt. 1, Box 921 Issaquah, Wash. 98027	Plant.....	Kittitas.
Weyerhaeuser Co.....	Longview, Wash. 98632.....	do.....	Skamania.
Roofing granules:			
Northwest Talc & Magnesium Co..	P.O. Box 324 Clear Lake, Wash. 98235	do.....	Skagit.
Sand and gravel:			
Ace Concrete Co.....	N. 302 Park Road Dishman, Wash. 99206	Pit and plant....	Spokane.
Associated Sand & Gravel Co. Inc.	6300 Glenwood Ave. Everett, Wash. 98202	do.....	Snohomish.
Cadman Gravel Co.....	Redmond, Wash. 98052.....	do.....	King.
Central Pre-Mix Concrete.....	805 N. Division St. Spokane, Wash. 99202	do.....	Spokane, Adams, Franklin.
DeAtley Corp. ²	Box 648 Lewiston, Idaho 83501	do.....	Various.
Friday Harbor Sand & Gravel....	Box 8 Bellingham, Wash. 98225	do.....	San Juan.
Glacier Sand & Gravel Co.....	5975 E. Marginal Way Seattle, Wash. 98134	do.....	King, Pierce.
Klineline Sand & Gravel Co.....	1112 N.E. Hazel Dell St. Vancouver, Wash. 98665	do.....	Clark.
Lakeside Gravel Co., Inc.....	Box 7, Bellevue, Wash. 98004..	do.....	King.
Miles Sand & Gravel.....	Box 130, Auburn, Wash. 98002..	do.....	Do.
North Kitsap Gravel Asphalt Co. ²	Rt. 2, Box 305 Poulsbo, Wash. 98370	do.....	Kitsap.
North Star Sand & Gravel Corp....	Box 398, Everett, Wash. 98036..	do.....	Snohomish.
Olympia Oil & Wood.....	State and Washington Sts. Olympia, Wash. 98501	do.....	Thurston.
Pacific Sand & Gravel Co.....	Box 699, Centralia, Wash. 98531..	do.....	Lewis.
Quigg Bros. McDonald, Inc.....	1500 Riverside Ave. Hoquiam, Wash. 98550	do.....	Grays Harbor.
Reid Sand & Gravel Co.....	Box 922 Bellevue, Wash. 98004	do.....	King.
Stoneway Concrete, Inc.....	Box 509, Renton, Wash. 98005..	do.....	Do.
D. A. Sullivan Co. ²	Parkwater Station, Box 37 Spokane, Wash. 99211	do.....	Various.
S & S Sand & Gravel Co. ²	Box 938 Ephrata, Wash. 98823	do.....	Do.
Ray Weist Construction Co. ¹	Box 191, Yakima, Wash. 98901..	do.....	Yakima.
Woodworth & Co., Inc.....	1200 East D St. Tacoma, Wash. 98421	do.....	Pierce.
Yakima Cement Products Co.....	1202 S. First St. Yakima, Wash. 98901	do.....	Yakima.
Silicon carbide:			
The Carborundum Co.....	P.O. Box 423 Niagara Falls, N.Y. 14302	Plant.....	Clark.
Stone:			
Associated Sand & Gravel Co., Inc.	6300 Glenwood Ave. Everett, Wash. 98202	Quarry and plant.	Skagit, Snohomish.
Carl Carbon, Inc.....	Box 5153 N. Central Station Spokane, Wash. 99205	do.....	Spokane, Whitman.
Cascade Asphalt Paving Co. ³	6328 S. Tacoma Way Tacoma, Wash. 98409	do.....	Pierce.
Columbia Cement Co.....	Marietta Road Bellingham, Wash. 98225	do.....	Whatcom.
Crow Rock Products.....	1384 Walela Drive Moscow, Idaho 83843	do.....	Whitman.
General Construction Co.....	Box 3845 Seattle, Wash. 98124	do.....	Jefferson.
Roy L. Houck Sons.....	1158 Chemeketa N.E. Salem, Oreg. 97301	do.....	Lewis, Various.
Lehigh Portland Cement Co.....	718 Hamilton St. Allentown, Pa. 18105	do.....	Pend Oreille.
Lockheed Shipbuilding & Construction.	12020 E. Marshall Way Seattle, Wash. 98168	do.....	King.
Materne Bros.....	Box 0—Rosewood Station Spokane, Wash. 99208	do.....	Various.
Stoen Construction Co.....	2210 E. 95th St. Seattle, Wash. 98115	do.....	Snohomish.
Umpqua River Navigation Co.....	2280 Oakmont Way Eugene, Oreg. 97401	do.....	Clark.
Vinnell-Mannix-Fuller-Dillingham.	Star Route Pomeroy, Wash. 99347	do.....	Whitman.
R. Wamberg Construction Co.....	7404 S. Tacoma Way Tacoma, Wash. 98408	do.....	Grays Harbor.
Weyerhaeuser Co.....	Longview, Wash. 98632.....	do.....	Cowlitz, Lewis, Pacific.

See footnotes at end of table.

Table 8.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
NONMETALS—Continued			
Sulfuric acid:			
American Smelting and Refining Co	Box 1605 Tacoma, Wash. 98401	Smelter.....	Pierce.
Talc and soapstone:			
Northwest Talc & Magnesium Co.	Clearlake, Wash 98235.....	Quarry.....	Skagit.
Herman Smith.....	Marblemount, Wash. 98267....	do.....	Do.
Vermiculite (exfoliated):			
Vermiculite-Northwest, Inc.....	P.O. Box A Auburn, Wash. 98002	Plant.....	Spokane.
METALS			
Aluminum:			
Aluminum Company of America..	Vancouver, Wash. 98600.....	do.....	Clark.
	Wenatchee, Wash. 98801.....	do.....	Chelan.
Intalco Aluminum Corp.....	Bellingham, Wash. 98225.....	do.....	Whatcom.
Kaiser Aluminum & Chemical Corp	Spokane, Wash. 99200.....	do.....	Spokane.
	Tacoma, Wash. 98400.....	do.....	Pierce.
Reynolds Metals Co.....	Longview, Wash. 98632.....	do.....	Cowlitz.
Copper:			
American Smelting and Refining Co	Box 1605 Tacoma, Wash. 98401	Smelter.....	Pierce.
Pend Oreille Mines & Metals Co..	923 Old National Bank Bldg. Spokane, Wash. 99201	Mine and mill....	Pend Oreille.
Ferroalloys:			
Footo Mineral Co.....	Wenatchee, Wash. 98801.....	Plant.....	Douglas.
Ohio Ferro-Alloys Corp.....	Tacoma, Wash. 98400.....	do.....	Pierce.
Gold:			
Knob Hill Mines, Inc.....	160 Sansome St. San Francisco, Calif. 94104	Mine and mill....	Ferry.
Lead-zinc:			
Pend Oreille Mines & Metals Co..	923 Old National Bank Bldg. Spokane, Wash. 99201	do.....	Pend Oreille.
Steel:			
Bethlehem Steel Co., Pacific Coast Division.	Seattle, Wash. 98134.....	Plant.....	King.
Northwest Steel Rolling Mills, Inc.	do.....	do.....	Do.
Zinc:			
American Smelting and Refining Co	Wallace, Idaho 83873.....	Mine and mill....	Stevens.
MINERAL FUELS			
Coal:			
Black Prince Coal Co.....	Rt. 2, Box 59 Centralia, Wash. 98531	Mine.....	Lewis.
Palmer Coking Coal Co., Inc.....	P.O. Box 8 Black Diamond, Wash. 98010	do.....	King.
Peat:			
Cunningham Sand & Gravel Co., Inc.	N. 6315 Cedar St. Spokane, Wash. 99208	Bog.....	Spokane.
Harbor Heights Humus Co.....	Gig Harbor, Wash. 98335.....	Bog.....	Pierce.
Maple Valley Humus.....	Renton, Wash. 98055.....	Bog.....	King.
Plant Food Co.....	Bothell, Wash. 98011.....	Bog.....	Snohomish.
Petroleum refining:			
Mobil Oil Corp.....	Ferndale, Wash. 98248.....	Refinery.....	Whatcom.
Shell Oil Co.....	Anacortes, Wash. 98221.....	do.....	Skagit.
Sound Refining, Inc.....	Tacoma, Wash. 98400.....	do.....	Pierce.
Texaco, Inc.....	Anacortes, Wash. 98221.....	do.....	Skagit.
Union Oil Co. of California.....	Edmonds, Wash. 98020.....	do.....	Snohomish.
U.S. Oil & Refining Co.....	Tacoma, Wash. 98400.....	do.....	Pierce.

¹ Also clay.² Also traprock.³ Also sand and gravel.

The Mineral Industry of West Virginia

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

By R. E. Harris ¹

In 1971, West Virginia was the second leading producer of bituminous coal in the Nation. Coal accounted for 88.6 percent of the State's mineral output value. Coal production was 118 million tons, compared

with 144 million tons in 1970. The value of total mineral output in the State fell \$11.4 million, a decrease of almost 1 percent.

¹ Mining engineer, Division of Fossil Fuels.

Table 1.—Mineral production in West Virginia ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ² thousand short tons ..	191	\$238	232	\$336
Coal (bituminous)..... do.....	144,072	1,142,245	118,258	1,128,282
Gem stones.....	NA	W	NA	2
Lime..... thousand short tons.....	262	3,757	197	3,073
Natural gas..... million cubic feet.....	242,452	61,583	234,027	60,613
Petroleum (crude)..... thousand 42-gallon barrels.....	3,124	11,871	2,969	11,609
Salt..... thousand short tons.....	1,190	5,171	1,174	4,778
Sand and gravel..... do.....	4,396	11,473	7,107	16,756
Stone ³ do.....	9,740	16,722	9,880	18,066
Value of items that cannot be disclosed: Cement (portland and masonry), fire clay, natural gas liquids, stone and value indicated by symbol W.....	XX	32,304	XX	30,445
Total.....	XX	1,285,364	XX	1,273,960
Total 1967 constant dollars.....	XX	1,149,758	XX	^p 1,106,816

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

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

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

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

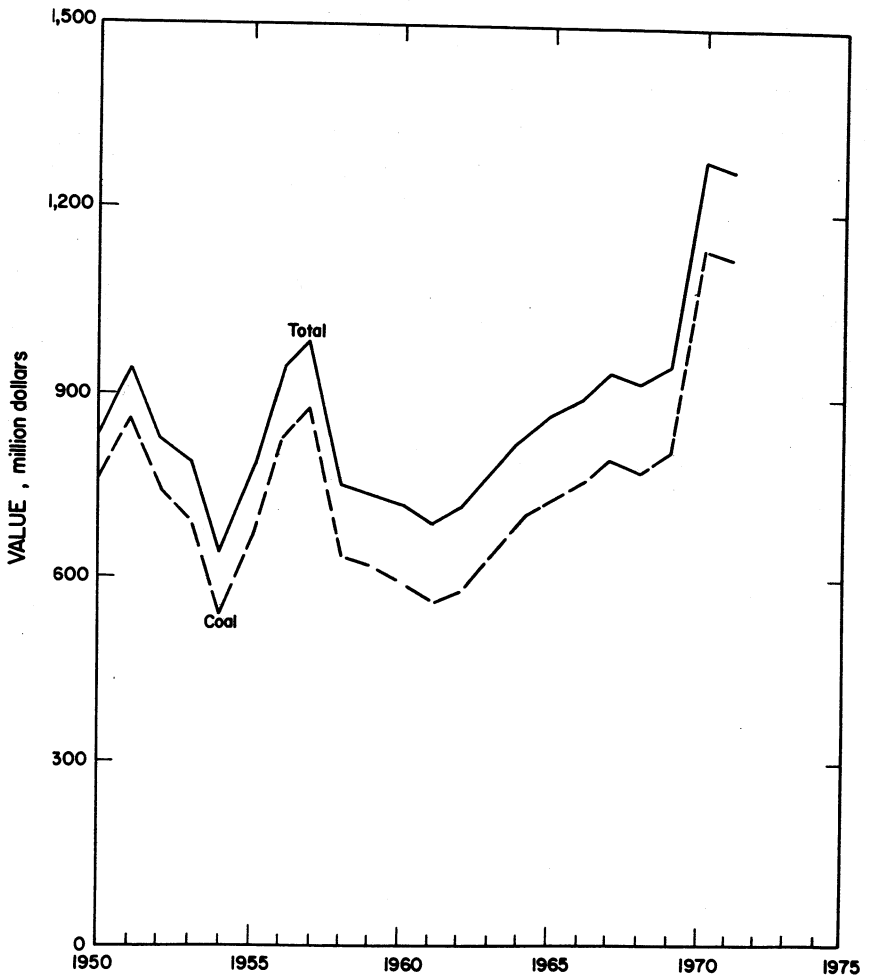


Figure 1.—Value of coal and total value of mineral production in West Virginia.

Table 2.—Value of mineral production in West Virginia, by county ¹

(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Barbour.....	\$27,839	\$25,171	Coal.
Berkeley.....	W	W	Cement, stone, lime, clays.
Boone.....	W	85,972	Coal.
Braxton.....	W	W	Stone, coal.
Brooke.....	W	W	Coal, sand and gravel.
Cabell.....	W	W	Clays.
Clay.....	W	883	Coal.
Fayette.....	W	46,790	Do.
Gilmer.....	498	620	Do.
Grant.....	W	14,523	Coal, stone.
Greenbrier.....	5,244	7,360	Do.
Hancock.....	5,173	W	Sand and gravel, clays.
Hardy.....	43	43	Stone.
Harrison.....	W	W	Coal, stone.
Jackson.....	W	W	Stone.
Jefferson.....	W	W	Stone, lime.
Kanawha.....	W	W	Coal, stone.
Lewis.....	2,272	W	Do.
Lincoln.....	W	W	Stone, clays.
Logan.....	118,303	113,177	Coal.
McDowell.....	191,149	192,372	Do.
Marion.....	61,423	54,983	Do.
Marshall.....	W	W	Coal, salt.
Mason.....	W	W	Coal, sand and gravel.
Mercer.....	W	11,052	Coal.
Mineral.....	W	W	Coal, stone.
Mingo.....	16,823	28,514	Coal.
Monongalia.....	W	W	Coal, stone.
Monroe.....	--	W	Sand and gravel.
Morgan.....	W	W	Do.
Nicholas.....	W	W	Coal, sand and gravel.
Ohio.....	W	W	Coal.
Pendleton.....	W	W	Stone, lime.
Pleasants.....	W	W	Sand and gravel.
Pocahontas.....	W	W	Stone, coal.
Preston.....	W	W	Coal, stone.
Raleigh.....	W	W	Do.
Randolph.....	W	W	Do.
Roane.....	W	W	Stone.
Summers.....	209	--	
Taylor.....	1,329	W	Coal, clays.
Tucker.....	W	W	Coal, stone.
Tyler.....	W	W	Sand and gravel, salt.
Upshur.....	4,884	7,845	Coal.
Wayne.....	W	W	Coal, stone.
Webster.....	2,448	1,622	Coal.
Wetzel.....	W	W	Sand and gravel.
Wirt.....	--	W	Stone.
Wood.....	W	2,525	Sand and gravel.
Wyoming.....	110,569	W	Coal, sand and gravel.
Undistributed ²	737,150	680,505	
Total ³	1,285,364	1,273,960	

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

¹ Calhoun, Doddridge, Hampshire, Putnam, and Ritchie Counties are not listed because no production was reported.

² Includes gem stones, natural gas, natural gas liquids, and petroleum that cannot be assigned to specific counties, and values indicated by symbol W.

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

Legislation and Government Programs.

—In September 1971, the Bureau of Mines opened the new Federal Mine Health and Safety Academy at Beckley to provide formal professional training for mine inspectors.

At the Bureau of Mines Morgantown Energy Research Center, research was completed, continued, or started on a number of projects. Among the completed projects were: Pyrolysis of coal; liquid fuels from tar; sulfur modes in coal; removal of pyrite from coal by dry methods; and me-

chanical properties of packed coal. Some of the continuing projects are: Pneumatic transportation of coal; coal hydrogenation; corrosion of fireside surfaces in coal-fired boilers; utilization and processing of solid waste from combustion and mining; SO₂ removal from stack gas; sampling stack gas emissions; producer gas clean-up and purification; pressurized gas producer; natural gas production and storage; minerals in coal, fly ash, and related materials; rate of gasification of coal and char; and fluidized-bed gasification by hot recycled rog.

Among the newly started projects are: Formcoke; use of heat pipes in fluid-bed gasification; reactivity of chars in underground gasification; and increasing oil recovery from appalachian oilfields by reservoir stimulation.

The West Virginia Geological and Economic Survey continued their cooperative programs with the U.S. Geological Survey on topographic mapping and ground-water resources. Additional new

7.5-minute quadrangle maps were published; three river basin studies were completed, continued, or started; a salt water-fresh water interface study was started; and the collection of basic ground-water information was continued. Studies were continued on the quantity and the quality of the coal reserves in West Virginia. The cooperative shale and clay program with the Bureau of Mines was continued.

Table 3.—Indicators of West Virginia business activity

	1970 ^r	1971 ^p	Change, percent
Employment and labor force, annual average: ^{1 2}			
Total labor force.....thousands..	632.9	647.3	+2.3
Unemployment.....percent of work force..	6.3	6.9	+9.5
Employment:			
Manufacturing.....thousands..	126.5	122.8	-2.9
Transportation and public utilities.....do..	41.5	40.9	-1.4
Wholesale and retail trade.....do..	91.8	96.5	+5.1
Finance, insurance, and real estate.....do..	15.7	16.0	+1.9
Mining.....do..	49.9	48.4	-3.0
Services.....do..	66.8	67.0	+0.3
Contract construction.....do..	28.6	30.5	+6.6
Government.....do..	95.9	98.1	+2.3
Payroll average weekly earnings: ²			
Manufacturing.....	\$136.12	\$132.96	-2.3
Personal income: ³			
Total.....millions..	\$5,259	\$5,655	+7.5
Per capita.....	\$3,612	\$3,228	-10.6
Construction activity:			
Cement shipments to and within West Virginia ⁴			
thousand 376-pound barrels..	2,496	3,400	+36.2
Mineral production value ⁴.....millions..	\$1,285.4	\$1,274.0	-0.9

^p Preliminary. ^r Revised.

¹ Source: Area Trends in Employment and Unemployment, U.S. Department of Labor.

² Source: Employment and Earnings, U.S. Department of Labor.

³ Source: Survey of Current Business, U.S. Department of Commerce.

⁴ Source: U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Coal.....	46,171	215	9,943	78,825	66	4,445	57.23	8,119
Nonmetal.....	184	231	42	338	--	7	20.70	121
Sand and gravel.....	307	223	68	625	--	15	24.01	360
Stone.....	1,182	256	303	2,455	1	52	21.59	3,221
Total ¹	47,844	216	10,357	82,243	67	4,519	55.76	7,881
1971: ^p								
Coal.....	45,700	207	9,457	75,019	40	4,220	56.79	6,142
Nonmetal.....	160	229	37	293	--	4	13.64	317
Sand and gravel.....	285	222	64	698	--	22	31.51	1,431
Stone.....	1,315	248	326	2,661	2	58	22.55	6,282
Total ¹	47,470	208	9,883	78,672	42	4,304	55.24	6,083

^p Preliminary.

¹ Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—West Virginia, after 40 years as the leading coal-producing State in the Nation, dropped to second place in 1971. The 1971 production was 118 million tons, compared with 144 million tons in 1970, a decrease of 26 million tons or 18 percent. The value of the coal produced decreased only 1.2 percent to \$1,128 million.

The production of open-market coal totaled 105 million tons valued at \$953 million, a decrease of 20 million tons or 16 percent in quantity and a decrease of \$5 million or 0.5 percent in value. The production of captive coal was 13.2 million tons valued at \$175 million, a decrease of 5.6 million tons or 30 percent in quantity and a decrease of \$8.9 million or 4.8 percent in value. The average value per ton of coal climbed to \$9.54 from \$7.93 in 1970, an increase of 20 percent.

There were 1,050 active mines with production in excess of 1,000 tons, a decrease of 269 mines from 1970. Of the total number of mines, 624 or 59 percent were underground, 313 or 30 percent were strip, and 113 or 11 percent were auger. Of the total output, 92.4 million tons or 78.2 percent was produced from underground mines, 21.7 million tons or 18.4 percent from strip mines, and 4.1 million tons or 3.4 percent from auger mines. The value of coal produced was \$930 million from underground mines, a decrease of 1 percent; \$163 million from strip mines, an increase of 5 percent; and \$35 million from auger mines, a decrease of 27 percent.

Equipment used at underground mines included 581 cutting machines, 193 less than in 1970; 462 hand-held and post-mounted coal drills, a decrease of 247; 238 mobile coal drills, a decrease of 73; 754 rotary rock drills, an increase of 38; and 208 percussion rock drills, an increase of 32.

At strip mines equipment used included 433 power shovels, 117 more than in 1970; 35 draglines, a decrease of two; 13 carryall scrapers, a decrease of seven; 466 bulldozers, an increase of 14; 46 horizontal power drills, an increase of seven; and 117 vertical power drills, an increase of 22.

Equipment used at auger mines included 122 augers, 32 less than in 1970; one power shovel, a decrease of one; four

power drills, a decrease of 19; and 82 bulldozers; a decrease of 69.

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

Year	Quantity	Value
1967	153,749	\$800,683
1968	145,921	775,720
1969	141,011	807,811
1970	144,072	1,142,245
1971	118,258	1,128,282

Of the total underground production, more than 98 percent was mechanically loaded. Continuous mining machines produced 57.3 million tons or 63 percent of the coal mechanically loaded, and mobile loading machines produced 31 million tons or 34.1 percent. Longwall machines produced 2.5 million tons or 2.7 percent with the remainder of the mechanically loaded tonnage being produced by duckbill or scraper loaders. The 681 continuous mining machines, 86 more than were used in 1970, were reportedly used as follows: 409 loaded into shuttle cars or rubber-tired mine cars, 85 loaded onto conveyors or mine cars; and 187 deposited coal directly onto the mine bottom. The 710 mobile loading machines, 139 less than were used in 1970, were reportedly used as follows: 484 loaded into shuttle cars or rubber-tired mine cars; 36 loaded onto conveyors or mine cars; and 190 were used in conjunction with continuous mining machines for loading that coal deposited directly onto the mine bottom.

In 1971, 142 cleaning plants, six more than in 1970, cleaned 69 percent of the total production, 2 percent less than in 1970. Of the total amount cleaned, 26 percent was cleaned by jigs, 69 percent by wet washing other than jigs, and 5 percent by pneumatic methods. Of the total amount cleaned, 29 percent was dried in 53 thermal drying plants.

Of the total production, 93 percent was shipped by rail or water and the remainder by truck and other methods. Of the total production, 23 percent was shipped by unit train.

In 1971, West Virginia was the leading State in the Nation in reclaiming lands that had been surface mined for coal with a reclamation acreage of 20,369 acres, compared with 13,245 acres in 1970.

Table 6.—Bituminous coal production, by type of mine and county
(Excludes mines producing less than 1,000 short tons per year)

County	Number of mines				Production (thousand short tons)				Value (thousands)
	Under-ground	Strip	Auger	Total	Under-ground	Strip	Auger	Total ¹	
Barbour.....	17	20	--	37	1,395	1,952	--	3,347	\$25,171
Boone.....	44	22	23	89	7,032	1,956	785	9,773	85,972
Braxton.....	--	1	--	1	--	22	--	22	W
Brooke.....	2	8	--	10	511	282	--	793	4,763
Clay.....	2	1	--	3	44	74	--	118	883
Fayette.....	31	18	3	52	2,442	2,434	57	4,932	46,790
Gilmer.....	3	2	--	5	25	80	--	104	620
Grant.....	3	7	--	10	1,519	467	--	1,986	14,257
Greenbrier.....	10	3	--	13	208	284	--	492	4,395
Harrison.....	15	24	2	41	4,529	1,171	43	5,744	41,529
Kanawha.....	46	17	26	89	6,386	1,671	1,172	9,229	77,105
Lewis.....	1	10	5	16	3	468	87	557	3,757
Logan.....	45	12	15	72	8,353	1,206	799	10,358	113,177
Marion.....	117	18	5	140	12,474	982	28	13,484	192,372
Marshall.....	9	4	--	13	6,905	157	--	7,062	54,983
Mason.....	4	--	--	4	4,805	--	--	4,805	29,750
Mercer.....	2	--	--	2	420	--	--	420	3,571
Mineral.....	4	3	1	8	750	81	2	833	11,052
Mingo.....	1	9	--	10	111	259	--	371	2,045
Monongalia.....	31	14	9	54	2,050	903	487	3,440	28,514
Nicholas.....	18	10	--	28	10,160	418	--	10,578	69,130
Ohio.....	47	14	3	64	4,418	836	87	5,342	53,222
Pocahontas.....	1	--	--	2	1,797	--	--	1,797	W
Preston.....	24	26	--	50	656	1,366	--	2,022	11,950
Raleigh.....	39	15	11	65	5,148	1,531	309	6,988	83,796
Randolph.....	15	10	--	25	335	525	--	860	6,558
Taylor.....	--	6	--	6	--	190	--	190	1,427
Tucker.....	--	3	--	3	--	376	--	376	2,257
Upshur.....	4	16	--	20	287	889	--	1,176	7,845
Wayne.....	2	1	1	4	275	9	1	284	3,102
Webster.....	11	3	--	14	120	52	--	171	1,622
Wyoming.....	74	16	9	99	9,271	1,106	215	10,594	132,527
Undistributed ²	--	--	--	--	--	--	--	--	14,142
Total ¹	624	313	113	1,050	92,437	21,747	4,074	118,258	1,128,282

W Withheld to avoid disclosing individual company confidential data.

¹ Data may not add to totals shown because of independent rounding.

² Includes value indicated by symbol W.

Coke and Coal Chemicals.—Production of coke at three oven-coke plants was slightly over 3.0 million tons, compared with slightly over 3.2 million tons in 1970. When compared with 1970 values, the total value of the coke decreased by roughly \$8.4 million, but the average value per ton increased by \$0.39.

At the oven-coke plants, 4.5 million tons of coal (0.5 million tons less than 1970) were carbonized with a coke-yield of 67.22 percent per ton. Of the total coal receipts, 2.7 million tons were from Pennsylvania, 1.7 million tons from West Virginia, and the remainder from Kentucky and Virginia.

A total of 234 thousand tons of coke breeze were recovered at oven-coke plants. Coal-chemical materials, exclusive of coke breeze, produced at oven-coke plants included 37.8 million gallons of coke-oven tar, 47.9 billion cubic feet of coke-oven gas, 40 thousand tons of ammonium sulfate, and 19.1 million gallons of crude

light oil from which benzene, toluene, xylene, and solvent naphtha were recovered.

Natural Gas Liquids.—The quantity and total value of natural gas liquids produced in 1971 showed decreases of 10 percent and 13.5 percent, respectively. Reserves of natural gas liquids at yearend were 82.3 million 42-gallon barrels, 800,000 barrels more than the reserves of 1970.²

Petroleum and Natural Gas.—Crude oil production in 1971 was slightly less than 3.0 million barrels, a decrease of 5 percent from 1970. The average price paid for Penn-grade crude in West Virginia was \$3.91 per barrel, 2.9 percent more than in 1970. Natural gas production was 234,027 million cubic feet, 3.5 percent less than that of 1970. The total value of the natural gas production was \$60.6 million, 1.6 percent less than that of 1970. The average wellhead value for natural gas (includes the value of natural gas liquids contained

² Oil and Gas Journal, v. 70, No. 14, Apr. 3, 1972, p. 20.

therein) was 25.9 cents per thousand cubic feet, 2 percent more than that of 1970. The estimated number of producing wells in the State at yearend was 12,112 oil wells, a decrease of 638 or 5 percent from that of 1970, and 21,025 gas wells, an increase of 323 or 1.6 percent.

According to the West Virginia Geological and Economic Survey, the total number of oil and gas well completions, including workovers, declined by 7 percent from that of 1970. Well completions were reported in 39 of the 55 counties with Walton the most active oilfield and Ripley the most active gasfield. The Oil and Gas Division of the West Virginia Department of Mines issued 838 permits to drill new wells and/or deepen old wells and 126 permits to fracture old wells. The Survey reported a total of 65 exploratory wells, 11 less wells than in 1970, a decline of 14.5 percent. This included 34 wildcat wells, of which 10 were successful; 10 deeper pool test wells, of which two were successful; 18 outpost wells, of which four were successful extensions; and two shallow-pool test wells, of which one was successful. One shallow pool was discovered by one unsuccessful development well.

According to the American Petroleum Institute, there were 702 development well completions, of which 610 were successful. The total footage drilled in completing these wells was 2,348,248 feet, compared with 2,785,547 feet in 1970, a decrease of 15.7 percent. Of this total footage, development drilling accounted for 2,054,452 feet or 87 percent; exploratory drilling accounted for 293,796 feet or 13 percent.

Shallow wells accounted for 86.3 percent of all well completions reported, with wells in the Mississippian Big Injun interval again dominating this type of drilling. Although deep drilling activity increased by 20.7 percent from 1970, its principal target continued to be the Silurian Williamsport (Newburg) interval. Perhaps the most significant gas discovery was made in Tucker County in the Lower Silurian Sandstone.

According to the Oil and Gas Journal, estimated proved crude oil reserves at yearend were 51.7 million barrels, a decrease of 1.5 million barrels or 2.8 percent from 1970. The estimated proved reserves of natural gas at yearend were 2,412 billion cubic feet, a decrease of 24 billion cubic feet or 1 percent.³

According to the American Gas Associa-

tion, at yearend, the State had an underground gas storage capacity of 422,561 million cubic feet with an estimated 392,726 million cubic feet of gas in storage.⁴

At yearend, the West Virginia Geological and Economic Survey reported that a total of 3,425,000 undeveloped acres in the State were under lease by 13 large companies. Additional acreage was under lease by independent operators and lease brokers.

In September 1971, Columbia Gas Transmission Corp. started drilling a deep test well in Mingo County that was scheduled for the basement, between 17,000 and 20,000 feet. This well could exceed the present depth record for the State.

The Big Injun waterflood in the Granny-Stockly field in Clay County remains the only full-scale waterflood project in operation, although five pilot waterflood projects continued in operation. It is estimated that 20 percent of the oil production in the State is obtained by secondary recovery projects.

NONMETALS

Cement.—When compared with 1970, shipments of portland cement in 1971 increased 2 percent and shipments of masonry cement increased 6 percent. The total value of portland cement increased 17 percent and the total value of masonry cement increased 22 percent. The average price per barrel of both products was higher. Capitol Cement Co., Division of Martin Marietta Corp., at Martinsburg, Berkeley County, is the sole producer and operates three coal-fired rotary kilns. Most of the cement was used in ready-mix concrete, concrete products, and building and highway construction.

Clays.—Production of miscellaneous clays increased 21.6 percent from 1970 and the production of the fire clays decreased 15 percent. These clays were produced from five counties and seven operating mines (five strip mines and two deep mines); Berkeley County was the leading producer of miscellaneous clays, and Hancock County was the only producer of fire clays. Miscellaneous clay was chiefly used in the manufacture of cement and building brick. Fire clay was mostly used for producing firebrick and block.

³ Oil and Gas Journal, v. 70 No. 14, Apr. 3, 1972, pp. 18 and 19.

⁴ 1971 American Gas Association annual report on statistics titled The Underground Storage of Gas in the United States and Canada.

Lime.—Lime production was 197,000 tons, compared with 262,000 tons in 1970, a decrease of 25 percent. The total value of this production was \$3.1 million, a decrease of 18 percent. The average price per ton increased by 8.8 percent. The chief uses were for steel production, construction, agriculture, chemical-industrial prod-

ucts, and sewage and water softening treatment. Three lime plants were in production, one each in Berkeley, Jefferson, and Pendleton Counties. The lime output was consumed in Pennsylvania, Maryland, Ohio, and other States. The consumption of lime in West Virginia was 374,000 tons.

Table 7.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	1,233	\$1,775	2,124	\$3,526
Fill.....	W	W	54	84
Paving.....	343	568	576	984
Other uses ¹	1,378	6,912	1,391	7,257
Total.....	2,954	9,255	4,145	11,851
Gravel:				
Building.....	978	1,520	1,505	2,685
Fill.....	38	56	50	76
Paving.....	425	641	W	W
Other uses ²	--	--	1,409	2,145
Total ³	1,442	2,218	2,964	4,906
Total sand and gravel ³	4,396	11,473	7,107	16,757

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

¹ Includes glass, molding, grinding and polishing, blast, fire or furnace engine, filtration, abrasives, chemical, enamel, fill, foundry, pottery and other sands.

² Includes paving and railroad ballast.

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

Salt.—Production of salt was 1.2 million short tons, a decrease of 1.3 percent from that of 1970. The total value of this production decreased 7.6 percent, and the average value per ton decreased 6.4 percent. The salt was used by the producers in the manufacture of chlorine and caustic soda. The salt was produced from brines obtained by deep well solution mining in Marshall and Tyler Counties.

Sand and Gravel.—The output of sand and gravel was 7.1 million short tons, an increase of 62 percent from that of 1970. The total value of this output increased 46 percent, and the average value per ton decreased 9.6 percent. Of the total output, 58 percent was sand and 42 percent was gravel. About 72 percent was shipped by barge and the balance was shipped by railroad or truck.

Production was reported from 11 counties with the three leading counties, in descending order by quantity produced, being Hancock, Tyler, and Wood. The production was obtained from six station-

ary plants, one portable plant, and 11 dredges.

Slag.—Weirton Steel Division, National Steel Corp., produced crushed air-cooled blast furnace slag for aggregate use.

Stone.—The total crushed stone (limestone and sandstone) production was 9.9 million short tons, an increase of 1.4 percent from that of 1970. The total value of this production was \$18.1 million, an increase of 8 percent, and the average value per ton increased 6.4 percent. Crushed limestone output increased 25 percent and crushed sandstone output decreased 71 percent.

The major uses for the limestone were cement manufacture, mine dusting, construction aggregate, lime manufacture, flux in iron and steel production, and agricultural purposes. Limestone production was reported from 14 counties. The four leading limestone producing counties were, in descending order by quantity produced, Berkeley, Greenbrier, Jefferson, and Monongalia. Crushed sandstone, whose produc-

tion was mostly used for construction aggregate, was produced in 11 counties. The four leading sandstone producing counties, in descending order by quantity produced, were Wayne, Raleigh, Lincoln, and Kanawha.

Of the total stone production, 49 percent was shipped by truck and 32 percent was shipped by railroad.

The production of dimension stone and its total value decreased from that of 1970.

Table 8.—Crushed and broken stone sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Bituminous aggregate.....	755	\$1,228	801	\$1,425
Concrete aggregate.....	982	1,608	528	995
Dense graded road base stone.....	1,525	2,483	890	1,737
Macadam aggregate.....	15	W	W	W
Surface treatment aggregate.....	411	588	648	1,214
Unspecified aggregate and roadstone.....	603	1,109	1,259	2,076
Agricultural purposes.....	87	201	98	222
Lime.....	W	W	251	500
Mine dusting.....	231	1,036	227	880
Railroad ballast.....	696	784	779	1,022
Refractory stone.....	W	W	72	205
Other uses ¹	4,433	7,683	4,333	7,790
Total ²	9,740	16,722	9,880	18,066

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

¹ Includes dead-burned dolomite, stone used in cement and glass manufacture, abrasive, filter, chemical and flux stone, riprap, stone sand, and other miscellaneous stone in smaller quantities.

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

METALS

Aluminum.—The production of aluminum from alumina, at the Kaiser Aluminum & Chemical Corp. smelter in Ravenswood, Jackson County, was slightly less than in 1970. Imported bauxite was processed into alumina at Baton Rouge and Gramercy, La., and transported by rail to Ravenswood for smelting.

Ferroalloys.—Smelters, using electric furnaces, were operated by the following companies: Union Carbide Corp. at Alloy, Fayette County, for producing various ferroalloys; Foote Mineral Co., Inc. at Graham Station, Mason County, for producing various ferroalloys; and Chemetals Division, Diamond-Shamrock Corp. at Kingwood, Preston County, for producing ferromanganese. Most of the mineral raw materials used at these plants were obtained from other States or imported.

Magnesium Compounds.—Amax Specialty Metals Division of American Metal Climax, Inc., produced anhydrous magnesium chloride at their plant near Parkersburg, Wood County.

Nickel.—Huntington Alloy Products Division, International Nickel Products Co., Inc., produced nickel and various types of high-nickel alloys at its plant in Huntington, Cabell and Wayne Counties. Principal products include nickel and high-nickel alloys in mill forms such as strip, sheet, plate, tube, wire rod, and bar and welding products, such as nickel and high-nickel bare welding filler wire, coated electrodes, and welding fluxes.

Zinc.—The zinc smelting plant operated by the Matthiessen and Hegeler Zinc Co. at Meadowbrook, Harrison County, ceased operations at midyear 1971. This plant was a producer of slab zinc, zinc dust, and ball anodes.

Zirconium and Hafnium.—Amax Specialty Metals, Inc., produced zirconium sponge metal from zircon sands at their plant near Parkersburg, Wood County. Hafnium oxide is also manufactured at this plant. Corhart Refractories Co. made zirconium refractories at their plant near Buckhannon, Upshur County. Union Carbide Corp. made zirconium alloys at their plant at Alloy.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Cement (portland and masonry): Capitol Cement Co., Div. of Martin-Marietta Corp. ¹	Box 5618 Baltimore, Md. 21210	Plant.....	Berkeley.
Clays:			
Fire clay:			
Crescent Brick Co., Inc.	Box 368 New Cumberland, W. Va. 26047	Underground.....	Hancock.
Globe Refractories, Inc.	Box D Newell, W. Va. 26050	---- do.....	Do.
Common clay and shale:			
Barboursville Clay Manufacturing Co.	Box 1048 Charleston, W. Va. 25324	Pit.....	Cabell.
Continental Clay Products Co.	931 Investment Bldg. 1511 K St. N.W. Washington, D.C. 20005	Pit.....	Berkeley.
Sanders Dummy Co.	Midkiff, W. Va. 25540	Pit.....	Lincoln.
Coal (bituminous):			
Amherst Coal Co. ²	Lundale, W. Va. 25631	Underground and auger.....	Logan.
Amherst Coal Co.	---- do.....	Auger.....	Wyoming.
Armo Steel Corp. ³	Montcoal, W. Va. 25135	Underground.....	Boone and Raleigh.
Badger Coal Co., Inc. ³	Philippi, W. Va. 26416	---- do.....	Barbour.
Bethlehem Mines Corp.	701 East 3d St. Bethlehem, Pa. 18015	---- do.....	Boone, Kanawha, Marion.
Bethlehem Mines Corp. ⁴ ..	---- do.....	Underground, strip, auger.....	Raleigh.
Bishop Coal Co.	Pocahontas, Va. 24635	Underground.....	McDowell.
Blacksville Div., Con- solidation Coal Co. ⁵	Box 100 Blacksville, W. Va. 26521	---- do.....	Monongalia.
Boone County Coal Corp. ³	824 4th Ave. Huntington, W. Va. 25721	---- do.....	Logan.
Buffalo Mining Co. ⁶	Lyburn, W. Va. 25632	Underground, strip, auger.....	Logan and Wyoming.
Cannelton Coal Co. ²	Cannelton, W. Va. 25036	Underground and strip	Kanawha and McDowell.
Carbon Fuel Co.	1310 Kanawha Valley Bldg. Charleston, W. Va. 25301	Underground.....	Boone.
Do. ⁷	---- do.....	Underground and auger.....	Kanawha.
Carbon Fuel Co.	---- do.....	Auger.....	Raleigh.
Central Appalachian Coal Co. ⁴	Box 18 Bowling Green Station New York, N.Y. 10004	Underground.....	Kanawha.
Christopher Coal Co., Div. of Consolidation Coal Co. ⁸	Box 100 Osage, W. Va. 26543	---- do.....	Monongalia.
Clinchfield Coal Co. ³	Box 472 Clarksburg, W. Va. 26301	---- do.....	Harrison.
Eastern Associated Coal Corp. ⁸	Koppers Bldg. Pittsburgh, Pa. 15219	---- do.....	Boone, Marion, McDowell, Monongalia, Wyoming.
Island Creek Coal Co. ⁹ ...	Holden, W. Va. 25625	---- do.....	Boone, Grant, Logan, Marion, Monongalia, Nicholas, Raleigh, Wyoming.
Itmann Coal Co. ⁴	Pocahontas, Va. 24635	---- do.....	Wyoming.
King Knob Coal Co. ⁷	Box 268 Clarksburg, W. Va. 26301	Strip.....	Barbour, Harrison, Marion, Monongalia.
Mountaineer Coal Co., Div. of Consolidation Coal Co. ⁵	Box 1632 Fairmont, W. Va. 26555	Underground.....	Harrison.
Mountaineer Coal Co., Div. of Consolidation Coal Co.	---- do.....	Underground and strip	Marion.
National Coal Mining Co.	Drawer L Holden, W. Va. 25625	Underground.....	Mingo.
Ohio Valley Div. Con- solidation Coal Co. ⁵	Moundsville, W. Va. 26041	---- do.....	Marshall.
Olga Coal Co.	Box 900 Youngstown, Ohio 44500	---- do.....	McDowell.
Omar Mining Co. ¹⁰	Box 338 Madison, W. Va. 25130	Underground, strip, auger.....	Boone.
Pocahontas Fuel Co., Div. of Consolidation Coal Co. ¹¹	Pocahontas, Va. 24635	Underground.....	Mercer and Wyoming.

See footnotes at end of table.

Table 9.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Coal (bituminous)—Continued			
Pocahontas Fuel Co., Div. of Consolidation Coal Co. ⁴	Pocahontas, Va. 24635	Underground and strip	McDowell.
Powellton Co. ⁷	Mallory, W. Va. 25634	Underground	Logan.
Ranger Fuel Corp. ⁴	Drawer V Beckley, W. Va. 25801	Strip and auger	Boone.
Ranger Fuel Corp. ⁷	do	Underground and strip	Raleigh and Wyoming.
Rowland Coal Co., Div. of Consolidation Coal Co. ¹⁰	Box 169 Beckley, W. Va. 25801	Underground, strip, auger.	Raleigh.
Semet-Solvay Div. Allied Chemical Corp. ³	40 Rector St. New York, N.Y. 10006	Underground	Fayette, McDowell, Wyoming.
Slab Fork Coal Co.	Slab Fork, W. Va. 25920	do	Raleigh and Wyoming.
The Valley Camp Coal Co. ²	Shrewsbury, W. Va. 25184	Underground and strip	Kanawha.
The Valley Camp Coal Co. ⁵	Box 218 Triadelphia, W. Va. 26059	Underground	Ohio and Marshall.
The Youngstown Mines Corp.	Box 900 Youngstown, Ohio 44501	do	Logan.
Union Carbide Corp., Ferroalloys.	Box 38 Mammoth, W. Va. 25132	do	Kanawha and Mason.
United States Steel Corp. ⁸	525 William Penn Place Pittsburgh, Pa. 15219	Underground and strip	McDowell, Mingo, Wyoming.
Westmoreland Coal Co. ¹⁰	123 South Broad St. Philadelphia, Pa. 19109	Underground	Boone and Nicholas.
Winding Gulf Coals, Inc. ¹²	Tams, W. Va. 25933	do	Fayette, Raleigh, Wyoming.
Lime:			
Germany Valley Limestone Co., Div. of Greer Limestone Co. ¹³	Riverton, W. Va. 26814	Plant	Pendleton.
Jones & Laughlin Steel Corp., Blair Limestone Div. ¹³	R.D. 3 Martinsburg, W. Va. 25401	do	Berkeley.
Standard Lime & Refractories Co., Div. Martin-Marietta Corp. ¹⁴	2000 First National Bank Bldg. Baltimore, Md. 21203	do	Jefferson.
Magnesium Compounds: Amx Specialty Metals, Inc.	Box 1728 Parkersburg, W. Va. 26101	do	Wood.
Petroleum refineries:			
Elk Refining Co.	Falling Rock, W. Va. 25079	do	Kanawha.
Quaker State Oil Refining Corp.	St. Marys, W. Va. 26170	do	Pleasants.
Salt:			
Industrial Chemicals Div. Allied Chemical Corp.	Box 70 Morristown, N.J. 07960	do	Marshall.
Inorganic Chemical Div. FMC Corp.	Box 8127 South Charleston, W. Va. 25303	Mine	Tyler.
PPG Industries, Inc., Chemical Div.	1 Gateway Center Pittsburgh, Pa. 15222	Plant	Marshall.
Sand and gravel:			
Delta Concrete Co.	41st and Noble St. Bellaire, Ohio 43906	Pit	Ohio.
Dravo Corp., Keystone Div.	5th and Liberty Ave. Pittsburgh, Pa. 15222	Dredge	Hancock.
Duquesne Sand Co.	East Beaver St. Glenfield, Pa. 15115	do	Brooke.
Iron City Sand & Gravel Corp., Div. of McDonough Co.	Box 538 Parkersburg, W. Va. 26100	Pit	Hancock.
Ohio River Sand & Gravel Div. of McDonough Co.	do	Dredges	Pleasants, Tyler, Wetzel, Wood.
Ohio Valley Sand Co., Inc.	Box 99 New Martinsville, W. Va. 26155	Pit	Wetzel.
Pennsylvania Glass Sand Corp.	Berkeley Springs, W. Va. 25411	Pit	Morgan.
Pfaff & Smith Builders Supply Co.	Box 2508 Charleston, W. Va. 25329	Dredge	Wood.
Smelters:			
Kaiser Aluminum & Chemical Corp.	300 Lakeside Dr. Oakland, Calif. 94626	Plant	Jackson.
Matthiessen & Hegeler Zinc Co.	9th and Sterling St. La Salle, Ill. 61301	do	Harrison.

See footnotes at end of table.

Table 9.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone:			
Limestone (crushed and broken):			
Aeme Limestone Co.	Fort Spring, W. Va. 24936	Mine and quarry	Greenbrier.
Aurora Stone Co., Inc.	Route 3	Quarry	Mineral.
Appalachian Stone Div., Martin-Marietta Corp.	Keyser, W. Va. 26726 Box 120	do	Berkeley.
Elkins Limestone Co.	Elkins, W. Va. 26241	Mine	Randolph.
The H. Frazier Co., Inc.	Box 1377	Quarry	Greenbrier.
Green Bag Cement Co., Div. of Marquette Cement Manufacturing Co.	Richmond, Va. 23211 20 North Wacker Dr. Chicago, Ill. 60606	Mine	Monongalia.
Greer Limestone Co. ¹⁰	Greer Building Morgantown, W. Va. 26505	Mine and quarry	Monongalia and Pendleton.
Paul Harrold	Route 1 Wolf Summit, W. Va. 26462	Quarry	Harrison.
Jones & Laughlin Steel Corp., Blair Limestone Div.	R.D. 3 Martinsburg, W. Va. 25401	do	Jefferson.
Manheim Quarries, Inc.	P.O. Box 2187 Morgantown, W. Va. 26505	do	Preston.
United States Steel Corp.	Millville, W. Va. 25432	do	Jefferson.
Sandstone (dimension):			
Rhine Creek Stone Co.	Box 265 Eglen, W. Va. 26716	do	Preston.
Sandstone (crushed):			
Fairfax Sand & Crushed Stone Co.	Thomas, W. Va. 26292	do	Tucker.
Mazzella Quarries, Inc.	2087 Oakridge Dr. Charleston, W. Va. 25311	do	Kanawha.
Meadows Stone & Paving, Inc.	Box 518 Gassaway, W. Va. 26624	do	Braxton.
Raleigh Stone Co. of Beckley, W. Va.	Box 1387 Roanoke, Va. 24001	do	Raleigh.
Stone Co. Inc.	5347 Route 60E Huntington, W. Va. 25705	do	Kanawha.
		do	Lincoln and Wayne.
Tony Pacifico Stone Quarry, Inc.	1417 Camden Drive Charleston, W. Va. 25302	do	Kanawha.

¹ Also limestone and shale.² 9 mines.³ 3 mines.⁴ 4 mines.⁵ 2 mines.⁶ 7 mines.⁷ 6 mines.⁸ 14 mines.⁹ 22 mines.¹⁰ 5 mines.¹¹ 8 mines.¹² 13 mines.¹³ Also limestone.¹⁴ Also dolomite.

The Mineral Industry of Wisconsin

This chapter has been prepared by the Bureau of Mines, U.S. Department of the Interior, and the Geological and Natural History Survey of Wisconsin, under a memorandum of understanding for collecting information on all minerals except coal and liquid fuels.

By Grace N. Broderick ¹

The mineral production of Wisconsin in 1971 was valued at \$84.0 million, a decrease of 4.1 percent from that of 1970. Production of masonry cement, clays, lead, sand and gravel, stone, and zinc declined in quantity and value. Lime and peat registered decreases in quantity but increases in value. Portland cement and iron ore increased in both quantity and value. The major part of the State's total mineral value continued to be accounted for by non-

metallic minerals, with sand and gravel representing 39.0 percent of this total and stone constituting an additional 29 percent.

Mineral exploration in Wisconsin was at a high level in 1971. Companies have been attracted to the State because of the possibility of sizable deposits of copper, lead, and zinc.

¹ Physical scientist, Division of Ferrous Metals.

Table 1.—Mineral production in Wisconsin ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays..... thousand short tons..	8	\$14	4	\$8
Iron ore (usable)..... thousand long tons, gross weight..	806	W	824	W
Lead (recoverable content of ores, etc.)..... short tons..	761	238	752	207
Lime..... thousand short tons..	247	4,503	246	4,570
Peat..... do.....	2	W	2	153
Sand and gravel..... do.....	41,103	35,107	38,561	32,748
Stone..... do.....	17,577	25,167	15,568	25,105
Zinc (recoverable content of ores, etc.)..... short tons..	20,634	6,322	10,645	3,423
Value of items that cannot be disclosed: Abrasive stone (grinding pebbles) (1970), cement, gem stones, and values indicated by symbol W.....	XX	16,319	XX	17,817
Total.....	XX	87,670	XX	84,036
Total 1967 constant dollars.....	XX	78,421	XX	^p 73,010

^p Preliminary. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

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

Table 2.—Value of mineral production in Wisconsin, by county ¹

(Thousands)			
County	1970	1971	Minerals produced in 1971 in order of value
Adams.....	W	W	Sand and gravel.
Ashland.....	\$292	\$220	Do.
Barron.....	485	480	Do.
Bayfield.....	257	W	Do.
Brown.....	W	W	Stone, lime, sand and gravel.
Buffalo.....	W	W	Stone, sand and gravel.
Burnett.....	W	W	Sand and gravel.
Calumet.....	W	W	Stone, sand and gravel.
Chippewa.....	545	316	Sand and gravel.
Clark.....	757	W	Sand and gravel, stone.
Columbia.....	2,226	2,132	Do.
Crawford.....	W	W	Stone, sand and gravel.
Dane.....	3,974	3,065	Sand and gravel, stone.
Dodge.....	W	W	Sand and gravel, lime, stone.
Door.....	W	W	Sand and gravel, stone.
Douglas.....	W	W	Lime, sand and gravel, stone.
Dunn.....	W	175	Stone, sand and gravel.
Eau Claire.....	W	W	Sand and gravel.
Florence.....	W	52	Do.
Fond du Lac.....	W	W	Stone, sand and gravel, lime, clays.
Forest.....	209	W	Sand and gravel.
Grant.....	3,169	2,019	Zinc, stone, sand and gravel, lead.
Green.....	W	W	Stone, sand and gravel.
Green Lake.....	554	W	Sand and gravel, stone.
Iowa.....	W	332	Stone.
Iron.....	W	W	Sand and gravel.
Jackson.....	W	W	Iron ore, sand and gravel.
Jefferson.....	W	W	Sand and gravel, stone.
Juneau.....	W	W	Stone, sand and gravel.
Kenosha.....	388	503	Sand and gravel.
Kewaunee.....	637	628	Sand and gravel, stone.
La Crosse.....	197	W	Do.
Lafayette.....	4,556	3,309	Zinc, stone, lead, sand and gravel.
Langlade.....	W	467	Sand and gravel.
Lincoln.....	W	468	Do.
Manitowoc.....	2,295	2,445	Cement, stone, lime, sand and gravel.
Marathon.....	2,407	3,066	Stone, sand and gravel.
Marinette.....	1,194	1,696	Do.
Marquette.....	W	W	Do.
Milwaukee.....	W	5,560	Cement, stone, sand and gravel.
Monroe.....	304	W	Stone, sand and gravel.
Oconto.....	W	W	Sand and gravel, stone.
Oneida.....	255	W	Do.
Outagamie.....	1,243	W	Stone, sand and gravel.
Ozaukee.....	578	W	Sand and gravel, stone.
Pepin.....	W	W	Stone, sand and gravel.
Pierce.....	W	W	Sand and gravel, stone.
Polk.....	W	W	Do.
Portage.....	W	447	Sand and gravel.
Price.....	143	W	Do.
Racine.....	W	W	Stone, sand and gravel, clays.
Richland.....	443	215	Stone, sand and gravel.
Rock.....	2,039	1,105	Sand and gravel, stone.
Rusk.....	W	W	Sand and gravel.
St. Croix.....	W	W	Stone, sand and gravel.
Sauk.....	W	1,419	Do.
Sawyer.....	149	W	Sand and gravel.
Shawano.....	W	W	Sand and gravel, stone.
Sheboygan.....	626	W	Do.
Taylor.....	595	243	Sand and gravel.
Trempealeau.....	W	W	Stone, sand and gravel.
Vernon.....	W	481	Do.
Vilas.....	228	W	Sand and gravel.
Walworth.....	W	W	Sand and gravel, stone.
Washburn.....	W	W	Sand and gravel.
Washington.....	1,766	1,130	Do.
Waukesha.....	W	7,468	Sand and gravel, stone, peat.
Waupaca.....	W	W	Sand and gravel, stone.
Wausara.....	128	86	Do.
Winnebago.....	W	2,481	Stone, sand and gravel.
Wood.....	454	187	Do.
Undistributed ²	54,572	41,841	
Total ³	87,670	84,036	

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

¹ No production reported for Menominee County.

² Includes gem stones, quantities of sand and gravel, and stone that cannot be assigned to specific counties, and values indicated by symbol W.

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

Table 3.—Indicators of Wisconsin business activity

	1970	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force..... thousands.....	1,939.5	1,929.8	-0.5
Unemployment..... do.....	89.7	99.6	+11.0
Employment:			
Manufacturing..... do.....	r 500.9	478.4	-4.5
Construction..... do.....	r 62.0	61.4	-1.0
Mining..... do.....	2.6	2.4	-7.7
Transportation and public utilities..... do.....	r 80.9	80.9	--
Wholesale and retail trade..... do.....	r 327.4	333.6	+1.9
Finance, insurance, and real estate..... do.....	r 60.5	61.8	+2.1
Services..... do.....	r 230.7	236.6	+2.6
Government..... do.....	r 265.5	270.2	+1.8
Personal income:			
Total..... millions.....	r \$16,351	\$17,366	+6.2
Per capita..... do.....	r \$3,688	\$3,880	+5.2
Construction activity:			
Valuation of authorized nonresidential construction..... millions.....	r \$197.1	\$200.7	+1.8
Number of private and public residential units authorized.....	r 23,175	29,813	+23.6
State highway commission contracts awarded..... millions.....	\$104.7	\$101.1	-3.4
Portland cement shipments to and within Wisconsin..... thousand 376-pound barrels.....	r 8,138	8,381	+3.0
..... millions.....	\$87.7	\$84.0	-4.2
Mineral production value.....			
International trade: ¹			
Value of exports through Wisconsin..... do.....	\$156.2	\$251.3	+60.9
Value of imports through Wisconsin..... do.....	\$136.0	\$147.6	+8.5

^p Preliminary. ^r Revised.

¹ Includes Milwaukee Customs District.

Sources: Survey of Current Business; Employment and Earnings and Annual Report on the Labor Force; Construction Review; Roads and Streets; Area Trends in Employment and Unemployment; Highlights of U.S. Export and Import Trade; U.S. Bureau of Mines.

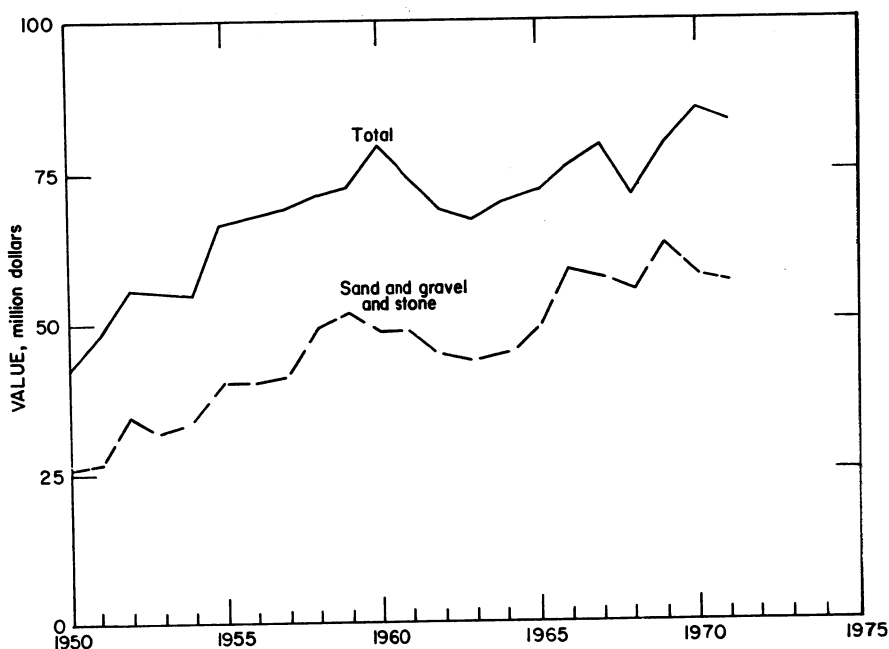


Figure 1.—Value of sand and gravel, stone, and total value of mineral production in Wisconsin.

On March 4, 1971, a bill was signed into law making galena the official State mineral and red granite the official State rock.

Employment and Injuries.—Final statis-

tics for 1970 on employment and injuries in the mineral industry and preliminary data for 1971 compiled by the Federal Bureau of Mines are given in table 4.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Peat.....	9	212	2	15	--	--	--	--
Metal.....	329	279	92	740	--	37	49.99	1,952
Nonmetal.....	21	96	2	17	--	1	58.43	2,454
Sand and gravel.....	1,977	187	370	3,274	1	68	21.07	2,947
Stone.....	1,711	218	373	3,133	2	97	31.59	4,622
Total ¹	4,047	207	838	7,181	3	203	28.69	3,568
1971: ^p								
Metal.....	245	269	66	527	--	12	22.75	595
Nonmetal ²	30	140	4	85	--	--	--	--
Sand and gravel.....	1,725	190	327	2,820	2	71	25.89	4,974
Stone.....	1,805	214	386	3,301	--	95	28.78	607
Total ¹	3,805	206	783	6,683	2	178	26.93	2,445

^p Preliminary.

¹ Data may not add to totals shown because of independent rounding.

² Beginning in 1971, data concerning peat operations are included in the nonmetals industry.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Medusa Portland Cement Co. continued to produce portland white cement at its Manitowoc plant. Raw materials used in this production included clay from Kentucky, limestone from Michigan, and silica sand from Wisconsin. Marquette Cement Manufacturing Co. operated the State's other cement plant at Milwaukee, producing Types I and II (general use and moderate heat) and Type III (high-early-strength) portland cement and masonry cement. Shipments of portland cement increased in quantity and value in 1971. Most of the cement shipments were by truck in bulk form with lesser amounts shipped by truck in packaged form and by rail in both bulk and packaged forms. Shipments of masonry cement declined 14.5 percent in quantity and 7.4 percent in value.

Most of the cement shipments were to points in Wisconsin with lesser amounts to other States. Building material dealers, concrete product manufacturers, and ready-mix concrete manufacturers were the major users.

Clays.—Output of clay and shale in Wisconsin decreased for the fifth consecutive year. Companies producing were the Oak-

field Shale Brick & Tile Co. in Fond du Lac County, which produced shale for its own use in making brick, and the Union Grove Drain Tile Co. in Racine County, which mined clay for its own use in manufacturing drain tile.

Gem Stones.—Small quantities of semi-precious gem stones and mineral specimens continued to be collected from old mines, quarries, slag piles, and dumps. Specimens collected in 1971 included native copper, epidote, quartz, red and black jasper, serpentine, and malachite. A nephrite deposit in Marathon County was being marketed under the name of Li Chang Yu or Rib River Jade.²

Lime.—Cutler-LaLiberte-McDougall Corp., Western Lime & Cement Co., Rockwell Lime Co., and Mayville White Lime Works produced lime in Brown, Dodge, Douglas, Fond du Lac, and Manitowoc Counties, for paper and pulp, mason's lime, water purification, and other uses. Output was about the same as in 1970, the record year. The lime was consumed in Wisconsin, Minnesota, North Dakota, and other States.

Perlite.—Expanded perlite was produced at Milwaukee and Appleton from crude

² Gems and Minerals. Nephrite Discovery in Wisconsin. No. 412, January 1972, p. 16.

material mined outside the State. Material was used for lightweight aggregate in concrete, tile, and building plaster; loose fill insulation; soil conditioning; additive in paint; foundry purposes; and textured granules. Production increased in quantity and value from that of 1970.

Sand and Gravel.—Wisconsin contributed 4.2 percent of the total sand and gravel production in the United States and ranked sixth in quantity and tenth in value of sand and gravel produced. Among all min-

eral commodities produced in Wisconsin, sand and gravel ranked first, representing nearly 39 percent of the State's total mineral output value. Production, which decreased 6.2 percent in quantity and 6.7 percent in value from the 1970 figures, was reported from 70 of the 72 counties. Counties with production of more than 1 million tons of sand and gravel, in descending order of quantity, were Waukesha, Dane, Washington, and Walworth.

Table 5.—Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Blast	73	\$253	W	W
Building	3,640	3,439	3,479	\$3,703
Fill	1,945	1,090	1,998	1,150
Molding	782	2,190	673	2,058
Paving	2,451	1,947	2,766	2,719
Other uses ¹	240	588	267	726
Total ²	9,131	9,506	9,183	10,356
Gravel:				
Building	4,292	4,402	4,067	4,442
Fill	1,443	799	1,238	700
Paving	15,488	13,401	11,506	10,610
Railroad ballast	158	99	W	W
Other uses ³	18	22	709	487
Total ²	21,399	18,722	17,520	16,239
Government-and-contractor operations:				
Sand:				
Fill	142	62	676	85
Paving	2,359	1,274	1,305	493
Other uses ⁴	177	102	297	106
Total ²	2,678	1,438	2,278	690
Gravel:				
Fill	459	229	466	71
Paving	7,437	5,213	8,826	5,234
Other uses ⁵	--	--	288	159
Total ²	7,896	5,443	9,579	5,464
Total sand and gravel ²	41,103	35,107	38,561	32,748

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

¹ Includes engine, filtration, foundry (1970), glass, oil (hydrafrac), railroad ballast (1971), other sands, and data indicated by symbol W.

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

³ Includes railroad ballast (1971) and other gravel.

⁴ Includes building (1971), and other sands.

⁵ Includes building (1971), and other gravel (1971).

Table 6.—Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Ashland.....	3	W	W	4	310	\$220
Barron.....	11	657	485	9	580	480
Bayfield.....	6	248	257	4	W	W
Brown.....	12	629	538	5	518	544
Buffalo.....	1	65	27	2	52	8
Chippewa.....	6	625	545	6	348	316
Clark.....	10	749	757	5	887	787
Dane.....	33	2,339	2,480	27	2,028	2,508
Dodge.....	16	845	666	15	823	785
Door.....	5	302	263	4	W	W
Douglas.....	14	581	418	6	83	50
Florence.....	1	W	W	1	79	52
Fond du Lac.....	7	343	250	10	392	334
Forest.....	4	257	209	2	W	W
Green Lake.....	9	312	524	11	378	606
Jackson.....	4	132	113	4	213	264
Jefferson.....	7	266	174	6	W	W
Kenosha.....	10	420	388	6	718	503
Kewaunee.....	4	674	W	5	W	W
Lafayette.....	--	--	--	--	W	195
Langlade.....	2	W	W	3	495	467
Lincoln.....	6	589	480	6	539	468
Manitowoc.....	10	960	687	7	739	516
Marathon.....	10	342	352	10	495	398
Marquette.....	--	--	--	3	W	69
Milwaukee.....	3	W	W	--	18	9
Monroe.....	1	W	77	1	W	W
Oconto.....	7	748	600	6	386	479
Oneida.....	9	345	255	5	322	347
Outagamie.....	4	W	415	5	549	467
Ozaukee.....	8	631	578	9	638	571
Pierce.....	5	130	145	6	129	127
Polk.....	5	465	300	5	W	W
Portage.....	6	804	733	4	578	447
Price.....	2	113	148	3	W	W
Racine.....	10	936	797	7	924	1,039
Rock.....	8	1,982	1,706	9	607	686
Sauk.....	8	249	318	11	540	500
Sawyer.....	4	207	149	3	W	W
Shawano.....	7	392	320	8	347	290
Sheboygan.....	9	854	595	6	282	282
Taylor.....	9	770	595	4	304	243
Trempealeau.....	1	W	37	3	104	4
Vernon.....	2	53	31	5	81	W
Vilas.....	4	287	228	2	W	W
Walworth.....	18	1,050	838	18	1,145	834
Washington.....	18	2,437	1,766	15	1,664	1,130
Waukesha.....	38	5,532	4,053	35	4,855	3,826
Waupaca.....	7	W	381	6	W	W
Waushara.....	5	184	128	5	W	W
Winnebago.....	3	W	W	13	759	751
Wood.....	4	W	W	1	407	83
Undistributed ¹	44	11,597	10,251	45	13,746	11,126
Total ²	440	41,103	35,107	401	38,561	32,748

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

¹ Includes Adams, Burnett, Calumet, Columbia, Crawford, Dunn, Eau Claire, Grant, Green, Iron, Juneau, La Crosse, Marinette, Pepin, Richland, Rusk, St. Croix, and Washburn Counties.² Data may not add to totals shown because of independent rounding.

Stone.—Wisconsin, with a production of over 15 million tons, ranked 21st in the Nation's output of stone. Among the State's mineral commodities, stone ranked second in value, representing 29.9 percent of the total mineral value. Production was 11.4 percent lower than in 1970, while value declined slightly from \$25,167,000 to \$25,105,000.

Vermiculite.—Exfoliated vermiculite was produced by Zonolite Division of W. R. Grace & Co. at Milwaukee from crude material mined outside the State. The exfoliated material was used for loose fill insulation, lightweight aggregate in concrete and plaster, and for agricultural purposes.

Table 7.—Limestone and dolomite sold or used by producers, by use

(Thousand short tons and thousand dollars unless otherwise specified)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Dimension:				
Rough architectural..... thousand cubic feet..	59	\$44	123	122
Irregular-shaped stone.....	7	97	9	139
Rubble.....	19	179	22	204
Cut stone..... thousand cubic feet..	27	104	25	95
House stone veneer..... do..	217	543	181	499
Sawed stone..... do..	21	65	23	62
Construction..... do..	99	123	135	178
Flagging..... do..	85	103	127	151
Total (approximate thousand short tons).....	67	1,263	72	1,350
Crushed and broken:				
Bituminous aggregate.....	734	930	748	1,007
Concrete aggregate.....	962	1,216	794	1,238
Dense graded road base stone.....	6,184	7,103	5,146	6,466
Macadam aggregate.....	984	1,407	1,232	1,331
Surface treatment aggregate.....	2,908	3,510	1,594	1,956
Unspecified aggregate & roadstone.....	2,087	2,349	3,068	3,990
Agricultural limestone.....	797	1,436	616	1,336
Flux.....	28	36	W	W
Riprap and jetty stone.....	90	259	W	W
Other ²	548	813	397	1,041
Total ³	15,321	19,060	13,644	18,866
Grand total.....	15,388	20,323	13,716	20,216

¹ Includes monumental and other rough stone (1971).² Includes stone used for asphalt filler (1970) and other fillers or extenders; filter stone; lime; railroad ballast; stone sand (1970); other unspecified uses; and data indicated by symbol W.³ Data may not add to totals shown because of independent rounding.

Table 8.—Stone sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1970			1971			Kind of stone produced in 1971 ¹
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value	
Brown.....	10	554	\$754	7	573	\$768	Limestone.
Calumet.....	5	106	170	3	W	W	Do.
Crawford.....	16	356	383	13	210	229	Do.
Dane.....	33	1,341	1,494	21	476	557	Do.
Dodge.....	4	231	494	5	338	557	Do.
Douglas.....	1	249	249	2	W	W	Limestone, traprock.
Dunn.....	4	68	33	3	W	W	Limestone.
Fond du Lac.....	13	480	1,085	13	276	976	Do.
Grant.....	23	735	868	24	791	939	Do.
Green.....	26	705	798	25	489	669	Do.
Green Lake.....	1	23	30	4	W	W	Limestone, other stone.
Iowa.....	20	334	338	20	373	332	Limestone.
Kewaunee.....	1	32	W	1	W	W	Do.
Lafayette.....	24	532	494	17	461	545	Do.
Manitowoc.....	2	W	W	2	267	694	Do.
Marathon.....	14	848	2,055	20	1,030	2,668	Granite, quartzite, sandstone.
Monroe.....	6	173	227	9	197	257	Limestone, other stone.
Outagamie.....	9	596	328	5	W	W	Limestone.
Pepin.....	4	W	392	1	W	W	Do.
Polk.....	2	W	W	1	23	39	Do.
Rock.....	14	298	333	15	290	419	Do.
St. Croix.....	7	256	290	10	240	277	Do.
Sauk.....	23	W	W	18	W	919	Limestone, quartzite, sandstone.
Shawano.....	3	93	W	3	W	W	Limestone.
Sheboygan.....	1	13	31	1	W	W	Do.
Walworth.....	1	W	W	1	20	W	Do.
Waukesha.....	21	1,535	2,592	27	W	3,489	Do.

See footnotes at end of table.

Table 8.—Stone sold or used by producers, by county—Continued
(Thousand short tons and thousand dollars)

County	1970			1971			Kind of stone produced in 1971 ¹
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value	
Waupaca.....	2	W	W	3	33	\$54	Do.
Winnebago.....	14	1,021	\$1,407	14	1,045	1,730	Do.
Wood.....	3	W	W	3	68	104	Granite, sandstone.
Undistributed ²	129	6,948	9,773	117	8,362	8,885	
Total ³	436	17,577	25,167	408	15,568	25,105	

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

¹ "Limestone" used generally to include dolomite.

² Includes production for Ashland (1970), Buffalo, Clark (1971), Columbia, Door, Jefferson, Juneau, La Crosse, Marinette, Marquette, Milwaukee, Oconto (1971), Oneida (1971), Ozaukee (1971), Pierce, Portage (1970), Racine, Richland, Trempealeau, Vernon and Waushara (1971) Counties and production for which no county breakdown is available and data indicated by symbol W.

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

METALS

Copper.—In 1971, Great Lakes Exploration Co., a wholly owned subsidiary of Kennecott Copper Corp., continued evaluating its copper prospect in Rusk County near Ladysmith. Other mineral exploration companies have been conducting surveys in several counties in northern and central Wisconsin, including Douglas, Rusk, Marathon, and Marinette Counties.

Iron Ore.—Output of taconite pellets produced by the Jackson County Iron Co., a wholly owned subsidiary of Inland Steel Co., increased from 806,000 long tons in 1970 to 824,000 long tons in 1971. Pellets were shipped by rail to Inland's Indiana Harbor Works in East Chicago, Ind.

Lead and Zinc.—Output of 752 short tons of lead and 10,645 short tons of zinc (in terms of recoverable metals), compared with 761 short tons of lead and 20,634 short tons of zinc in 1970, represented decreases of 1.2 and 48.4 percent, respectively. In terms of total value, lead production decreased 13 percent and zinc production declined nearly 46 percent. Average yearly weighted prices, used in calculating 1971 values in table 1, were 13.8 cents per pound for lead and 16.1 cents per pound for zinc, compared with 1970 average prices of 15.62 cents per pound for lead and 15.32 cents per pound for zinc.

In May, the New Jersey Zinc Co., whose parent company is Gulf and Western Industries, Inc., terminated production at its Wisconsin operations. In Grant County the Elmo mine and mill, which had been in operation only 4 years, and the Kopp #3 mine, which started on production in July 1969, were closed. The Elmo #2 mine, in Lafayette County, had ceased operating in June 1969. Ivey Construction Co. shut down its mill in September 1970 and its Graysville #2 mine in Iowa County in March 1971. Eagle-Picher Industries, Inc., continued to operate its Shullsberg mine and mill in Lafayette County. It is the only major lead-zinc operation left in Wisconsin.

MINERAL FUELS

Peat.—Although peat is classed as a mineral fuel, its principal use in the United States is for agricultural purposes. Sales of peat in Wisconsin in 1971 totaled 1,575 short tons, a decrease of 4.6 percent from the 1970 figure of 1,650 short tons. More than 96 percent of the peat sold was used for seed inoculant with the remainder being used for general soil improvement. Most of the peat was sold in packaged form.

Only one company was active in Wisconsin during the year. This was Demilco, Inc., which produced humus peat in Waukesha County. Superior Brand Peats, Lincoln County, had no production in 1971.

Table 9.—Mine production (recoverable) of lead and zinc

	1969	1970	1971
Mines producing: Lode.....	9	8	8
Material sold or treated: Zinc ore.....	846	749	414
Production (recoverable):			
Lead.....	1,102	761	752
Zinc.....	22,901	20,634	10,645
Value:			
Lead.....	\$328	\$238	\$207
Zinc.....	6,687	6,322	3,428
Total.....	7,015	16,559	3,635

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

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Marquette Cement Mfg. Co.	20 N. Wacker Dr. Chicago, Ill. 60606	Portland and masonry, dry process.	Milwaukee.
Medusa Portland Cement Co.	Box 5668 Cleveland, Ohio 44101	White, dry process..	Manitowoc.
Clays and shale:			
Oakfield Shale Brick & Tile Co.	Oakfield, Wis. 53065	Pit and plant.....	Fond du Lac.
Union Grove Drain Tile Co.	Box 848 Union Grove, Wis 53182	.....do.....	Racine.
Coke:			
Milwaukee Solvay Coke Div., Pickands Mather & Co.	311 E. Greenfield Ave. Milwaukee, Wis. 53204	Coke ovens.....	Milwaukee.
Iron ore:			
Jackson County Iron Co.-Inland Steel Co.: Black River Falls.	30 W. Monroe St. Chicago, Ill. 60603	Mine, concentrator, agglomerator.	Jackson.
Lead and zinc:¹			
Eagle-Picher Industries, Inc.: Shullsburg.....	Box 406 Galena, Ill. 61036	Mine and mill.....	Lafayette.
Lime:			
Cutler-LaLiberte-McDougall Corp.	12th Ave. & Waterfront Duluth, Minn. 55802	Quick and hydrated, two rotary kilns, one continuous hydrator.	Douglas.
Mayville White Lime Works.	Box 25 Mayville, Wis. 53050	Quicklime, one shaft kiln.	Dodge.
Rockwell Lime Co.....	228 N. LaSalle St. Chicago, Ill. 60601	Quick and hydrated, one rotary kiln, one continuous hydrator.	Manitowoc.
The Western Lime & Cement Co.: Green Bay plant.....	Box 2076 Milwaukee, Wis. 53201	Quick and hydrated, five shaft kilns, one batch hydrator.	Brown.
Knowles plant.....	.....	Hydrated, five shaft kilns, one continuous hydrator.	Dodge.
Eden plant.....	.....	Quick and hydrated, five shaft kilns, one batch hydrator.	Fond du Lac.
Peat:			
Demilco, Inc.....	3101 W. Custer Ave. Milwaukee, Wis. 53209	Bog, processing plant.	Waukesha.
Expanded perlite:			
Midwest Perlite Co.....	912 College Ave. Appleton, Wis. 54911	Processing plant....	Outagamie.
Zonolite Division, W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	.....do.....	Milwaukee.
Sand and Gravel:			
Eau Claire Sand & Gravel Co.	104 Gibson St. Eau Claire, Wis. 54701	Pits; portable and stationary plants.	Chippewa, Dunn, Eau Claire.
Genesee Sand & Gravel Co. Inc., Jaeger Sand & Gravel Co., Inc.	8532 W. Schlinger Ave. Milwaukee, Wis. 53214	Pit; portable and stationary plants.	Waukesha.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand & Gravel—Continued			
Janesville Sand & Gravel Co.	1110 Harding St. Janesville, Wis. 53545	Pit; stationary plant.	Rock.
Johnson Sand & Gravel Inc.	22750 W. Bluemound Rd. Waukesha, Wis. 53186	Pits; portable plants.	Waukesha.
Edward Kraemer & Sons, Inc.	Plain, Wis. 53577	do	Brown, Barron, Chippewa, Eau Claire, Forest, Oconto, Ozaukee, Polk, Portage, Racine, Sauk, Sawyer, Sheboygan, Walworth, Washington, Waukesha.
C. C. Linck, Inc.	1226 N. Center St. Beaver Dam, Wis. 53916	do	Calumet, Columbia, Dane, Dodge, Fond du Lac, Green Lake, Racine, Waushara.
Manley Sand Division, Martin Marietta Corp.	Rockton, Ill. 61072	Pit; stationary plant; industrial sand.	Columbia.
Plautz Brothers, Inc.	Route 1 Willard, Wis. 54493	Pit; portable plants.	Chippewa, Clark.
Rein, Schultz & Dahl, Inc.	6217 Nesbitt Rd. Madison, Wis. 53711	do	Dane, Jackson, Jefferson, Waukesha.
State Sand & Gravel Co.	10833 W. Watertown Plank Rd. Milwaukee, Wis. 38326	Pits; stationary plants.	Waukesha.
Wisota Sand & Gravel Co.	313 One Half Eau Claire Eau Claire, Wis. 54701	do	Barron, Bayfield, Eau Claire, Washington.
Stone:			
Granite:			
Anderson Bros. & Johnson Co.	Box 26 E. Manson St. Wausau, Wis. 54401	Quarries; stationary plant.	Marathon.
Lawrence Ladick, Inc.	Route 1 Vesper, Wis. 54489	Quarry	Do.
Lake Wausau Granite Co.	Box 397 Wausau, Wis. 54401	Quarry; stationary plant.	Do.
Limestone and dolomite:			
Courtney & Plummer, Inc.	Box 351 Neenah, Wis. 54956	Quarries; stationary and portable plants.	Calumet, Waupaca, Winnebago.
Daanen & Janssen	124 S. Huron St. De Pere, Wis. 54115	Quarries; portable plants.	Brown.
Franklin Stone Products, Inc.	7220 S. 68th St. Hales Corners, Wis. 53130	Quarry; stationary plant.	Milwaukee.
Halquist Lannon Stone Co.	Sussex, Wis. 53039	Quarries; stationary plant.	Waukesha.
Edward Kraemer & Sons, Inc.	Plain, Wis. 53577	Quarries; portable plants.	Buffalo, Columbia, Crawford, Douglas, Dunn, Green, Juneau, La Crosse, Marquette, Monroe, Pierce, Richland, St. Croix, Sauk, Trempealeau, Vernon.
Arthur Overgaard, Inc.	Box 87 Elroy, Wis. 53929	Quarries; stationary and portable plants.	Juneau. Various counties.
Vulcan Materials Co., Midwest Division.	29 N. Wacker Dr. Chicago, Ill. 60606	Quarries; stationary plants.	Milwaukee, Racine, Waukesha, Winnebago.
Waukesha Lime & Stone Co.	Box 708 Waukesha, Wis. 53186	Quarry; stationary and portable plants.	Waukesha.
Wingra Stone Co., Inc., Stewart Watson Construction Co.	Route 2, Box 4284 Madison, Wis. 53711	Portable plants	Dane.
Quartzite:			
Foley Bros., Inc.	450 Endicott Bldg. on 4th St. Paul, Minn. 55101	Quarry; stationary plant.	Sauk.
Minnesota Mining & Mfg. Co.	2501 Hudson Rd. St. Paul, Minn. 55119	Quarries; stationary plant.	Marathon.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Sandstone:			
Ellis Quarries, Inc.	Stevens Point, Wis. 55481 ..	Quarries; stationary plant.	Marathon, Wood.
Traprock (basalt):			
Bryan Rock Products Inc.	Box 215 Shakopee, Minn. 55379	Quarry; stationary and portable plants.	Polk.
GAF Corp.	Pembine, Wis. 54156	Quarry; stationary plant.	Marinette.
McLean Construction Co.	314 Ogden Ave. Superior, Wis. 54880	Quarry; portable plant.	Douglas.
Vermiculite, exfoliated			
Zonolite Div., W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	Processing plant....	Milwaukee.

¹ All lead-zinc mining was by underground methods.

The Mineral Industry of Wyoming

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

By Eugene R. Slatick ¹

Wyoming's mineral industry continued to comprise a major sector of the State's economy in 1971. The total value of mineral production during the year rose to \$718 million, compared with \$705 million in 1970. The principal minerals in 1971, as in 1970, were crude oil, natural gas, sodium carbonate, uranium, and coal. Together they accounted for 89 percent of the total mineral value. The energy minerals (mineral fuels and uranium) accounted for about 84 percent of the total value.

Wyoming remained the chief producer of crude oil in the Rocky Mountain Region. Although the State's crude oil production declined during the year, it comprised

about 56 percent of the region's total, the same as in 1970. Petroleum activity was mainly in the Powder River Basin. Production of both natural gas and natural gas liquids increased during the year.

The continued rise in coal production enabled the State to remain the region's leading coal producer, with a 26-percent share of the total production in both 1970 and 1971. New investment in the coal industry was directed at utilizing the State's large reserves of low-sulfur coal. About 43 percent of the coal produced in 1971 was used in the State to generate electric power.

¹ Mineral specialist, Division of Fossil Fuels.

Table 1.—Mineral production in Wyoming ¹

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays..... thousand short tons.....	1,950	\$18,829	1,798	\$17,378
Coal (bituminous)..... do.....	7,222	24,423	8,052	27,335
Gem stones.....	NA	180	NA	185
Gypsum..... thousand short tons.....	216	868	233	918
Iron ore (usable)..... thousand long tons, gross weight.....	W	W	1,808	W
Lime..... thousand short tons.....	22	W	27	W
Natural gas (marketed)..... million cubic feet.....	338,520	49,762	380,105	58,156
Natural gas liquids:				
LP gases..... thousand 42-gallon barrels.....	4,556	7,472	5,474	10,127
Natural gasoline and cycle products..... do.....	2,597	7,085	2,514	7,415
Petroleum (crude)..... do.....	160,345	469,811	148,114	459,079
Sand and gravel..... thousand short tons.....	9,447	9,298	9,820	8,750
Stone..... do.....	1,266	2,758	2,894	4,789
Uranium..... thousand pounds.....	6,346	² 38,768	6,986	² 43,311
Value of items that cannot be disclosed:				
Cement, feldspar, phosphate rock, sodium carbonate, sodium sulfate (1970), and values indicated by symbol W.....	XX	76,329	XX	80,544
Total.....	XX	705,533	XX	717,937
Total 1967 constant dollars.....	XX	631,099	XX	^p 623,744

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

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

² Bureau of Mines estimate.

Table 2.—Value of mineral production in Wyoming, by county
(Thousands)

County	1970	1971	Minerals produced in 1971, in order of value
Albany.....	\$7,317	\$6,877	Cement, stone, petroleum, sand and gravel, gypsum, iron ore.
Big Horn.....	23,346	27,790	Petroleum, clays, sand and gravel, gypsum, natural gas, lime, stone.
Campbell.....	142,193	128,441	Petroleum, natural gas, natural gas liquids, coal, sand and gravel.
Carbon.....	26,397	35,601	Uranium, coal, petroleum, natural gas, natural gas liquids, sand and gravel, natural gas.
Converse.....	20,704	22,293	Petroleum, coal, natural gas liquids, sand and gravel, natural gas.
Crook.....	22,954	21,693	Petroleum, clays, natural gas, sand and gravel.
Fremont.....	82,688	83,175	Petroleum, uranium, iron ore, natural gas, natural gas liquids, sand and gravel, feldspar.
Goshen.....	588	458	Sand and gravel, lime, petroleum.
Hot Springs.....	36,932	33,811	Petroleum, coal, natural gas, sand and gravel.
Johnson.....	17,804	16,870	Petroleum, gas, natural gas, natural gas liquids, sand and gravel.
Laramie.....	3,104	2,739	Petroleum, stone, sand and gravel.
Lincoln.....	12,122	14,135	Coal, natural gas liquids, phosphate rock, natural gas, petroleum, sand and gravel, stone.
Natrona.....	51,222	51,014	Petroleum, uranium, natural gas, natural gas liquids, clays, sand and gravel, stone.
Niobrara.....	W	1,916	Petroleum, natural gas, sand and gravel, natural gas liquids.
Park.....	112,090	109,934	Petroleum, natural gas, natural gas liquids, sand and gravel, gypsum, stone.
Platte.....	4,820	4,727	Iron ore, stone, sand and gravel.
Sheridan.....	6,685	8,026	Coal, petroleum, sand and gravel, stone.
Sublette.....	22,047	24,581	Petroleum, natural gas, sand and gravel, natural gas liquids.
Sweetwater.....	86,457	97,076	Sodium carbonate, petroleum, natural gas, coal natural gas liquids, sand and gravel, stone.
Teton.....	W	209	Sand and gravel, stone.
Uinta.....	2,435	1,674	Natural gas, natural gas liquids, sand and gravel, clays, stone.
Washakie.....	10,046	11,020	Petroleum, natural gas, natural gas liquids, sand and gravel, lime.
Weston.....	11,334	12,452	Petroleum, clays, sand and gravel, natural gas stone.
Yellowstone National Park.....	W		
Undistributed ¹	2,250	1,424	
Total ²	705,533	717,937	

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

¹ Includes gem stones, some stone, and sand and gravel that cannot be assigned to specific counties and values indicated by symbol W.

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

Most of the coal shipped out of the State was sent to powerplants.

The State's reserves and production of uranium continued to rank as the second largest in the nation in 1971. The steady development of the deposits was accompanied by 10 percent increase in production.

The sodium carbonate industry, the State's most important nonmetallic mineral industry, continued to expand at a high rate. Several million tons of new productive capacity were under construction.

A significant environmental rule for utilities became effective in November, and a proposal pertaining to air-quality standards was released in December. The Governor of Wyoming asked a commission to examine the possibility of establishing an environ-

mental agency within the State Government.

A survey conducted by the Employment Security Commission of Wyoming indicated that an additional 1,037 employees will be needed by July 1975 to meet manpower needs in the mining industry. Coal mining will require most of the additional workers.

Government Programs.—The Wyoming Public Service Commission's environmental rules went into effect November 5. Anyone planning to build a powerplant of 10-megawatt or larger capacity is required to file an application at least 2 years before construction begins. The application is to include plans for complying with the State's air and water quality standards. A 1-year filing requirement applies to the construction of electric transmission facilities of 230 kilowatts or larger.

Table 3.—Indicators of Wyoming business activity

	1970	1971 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force..... thousands.....	142.8	144.9	+1.4
Employment..... do.....	136.5	138.4	+1.4
Unemployment..... do.....	6.3	6.5	+3.2
Nonagricultural employment:			
Mining..... do.....	11.5	11.1	-3.5
Contract construction..... do.....	7.0	7.9	+12.9
Manufacturing..... do.....	7.4	7.3	-1.4
Government..... do.....	28.6	29.6	+3.5
Services..... do.....	16.2	16.6	+2.4
Wholesale and retail trade..... do.....	24.0	24.3	+1.2
Transportation and public utilities..... do.....	10.6	10.7	+0.9
Finance, insurance and real estate..... do.....	3.7	3.6	-2.7
Personal income:			
Total..... millions.....	\$1,181	\$1,276	+8.0
Per capita.....	\$3,535	\$3,753	+6.2
Construction activity:			
Number of new residential units authorized.....	1,112	1,159	+4.2
Value of authorized nonresidential construction..... millions.....	\$6.4	\$7.9	+23.4
Highway construction contracts awarded..... do.....	\$44.3	\$48.4	+9.3
Cement shipments to and within the State thousand 376-pound barrels.....	989.0	888.0	-10.2
Farm marketing receipts..... millions.....	\$226.5	NA	NA
Mineral production value..... do.....	\$705.5	\$717.9	+1.8

^p Preliminary. ^r Revised. NA Not available.

Sources: Survey of Current Business; Employment and Earnings and Annual Report on the Labor Force; Area Trends in Employment and Unemployment; Construction Review; Roads and Streets Magazine; Farm Income Situation; and U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1970:								
Coal.....	526	233	123	936	--	26	27.78	1,528
Metal.....	1,932	265	511	4,491	1	118	26.50	2,118
Nonmetal.....	1,452	303	441	3,572	--	34	9.52	331
Sand and gravel.....	770	197	151	1,211	--	24	19.82	541
Stone.....	215	235	50	410	1	5	14.63	14,929
Total.....	4,895	261	1,276	10,620	2	207	19.68	1,780
1971:^p								
Coal.....	575	226	130	1,001	1	31	31.97	7,723
Metal.....	1,985	284	564	5,065	3	112	22.71	4,168
Nonmetal.....	1,535	293	450	3,670	--	36	9.81	116
Sand and gravel.....	660	179	118	977	--	27	27.64	1,099
Stone.....	275	209	57	474	--	12	25.33	445
Total ¹	5,030	262	1,320	11,187	4	218	19.85	2,731

^p Preliminary.

¹ Data may not add to totals shown because of independent rounding.

In December the air-quality section of the State Division of Health and Medical Services released a proposed implementation plan for air-quality control in Wyoming. The plan calls for a 77-percent reduction in particulates in each of the State's three pollution control regions so they can comply with national standards. The proposal was to be discussed and then submitted to the Federal Environmental Protection Agency (EPA).

EPA made a 10-day study of radiation levels in Riverton, where radioactive mill tailings from the abandoned Susquehanna plant were used as construction and fill material. Although no serious problems were found, EPA scheduled a more detailed radiation survey for 1972.

In December the U.S. Bureau of Mines awarded a \$47,324 contract to Western Wyoming College, Rock Springs, to establish a 2-year miners' training program to

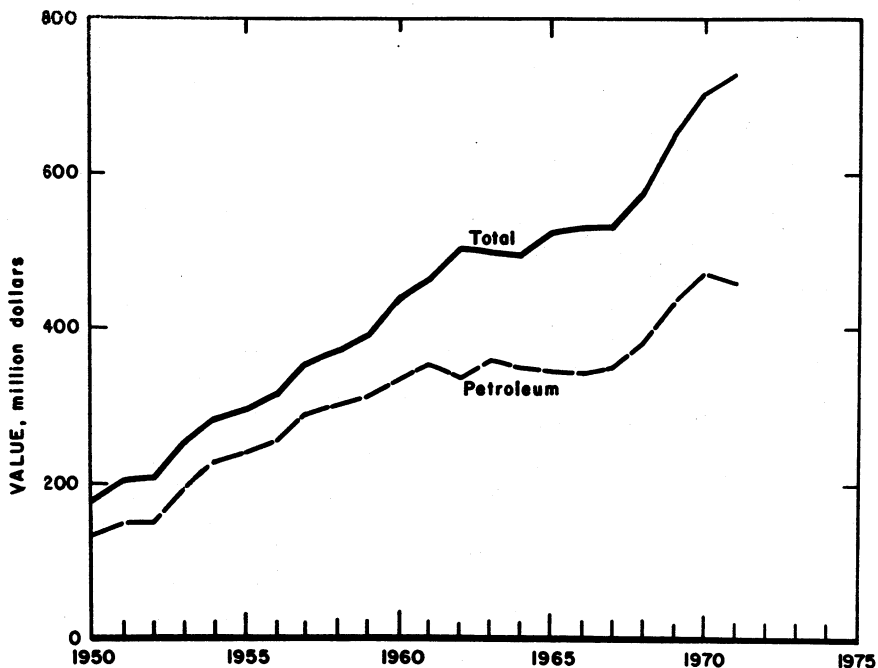


Figure 1.—Value of petroleum, and total value of mineral production in Wyoming.

provide training in health and safety and mining skills. Classes were scheduled for January 1972.

Research on the production of synthetic fuels, specifically on shale gas-oil hydrogenation, at the University of Wyoming was extended another year by a new grant from the U.S. Bureau of Mines. The project is an extension of the research at the Bureau's Energy Research Center at Laramie, which devotes about 80 percent of its research to oil shale. The Bureau has a 10-ton and a 150-ton retort at Laramie, and in situ retort sites near Rock Springs and Green River.

Research on coal gasification and liquefaction continued at the Natural Resources Research Institute, University of Wyoming, under a \$600,000 grant from the Office of Coal Research. The Institute estimates that

a coal gasification pilot plant would cost \$15 million, and a small commercial plant, \$30 million.

In November the Bureau of Land Management released a preliminary study on the possible use of public land in the Red Desert area. The study recommends that coal mining be prohibited or limited in two-thirds of the northern part and in one-third of the southern part of the 4.5-million-acre region. The region would be open to petroleum development, but there could be restrictions in certain areas.

The Mineral Development Division of the State Department of Economic Planning and Development published the first edition (1971) of the Wyoming Minerals Yearbook. It consists of a series of graphs that show the quantity and value of mineral production by county from 1962

through 1970 with projections through 1972.

The U.S. Geological Survey and the U.S. Bureau of Mines jointly published reports on the mineral resources of the Glacier Primitive Area, along the northeast flank of the Wind River Range, and the Popo Agie Primitive Area, on the southeast flank

of the Wind River Range.² No exploitable mineral deposits were found in either area.

Several other pertinent reports and maps were published by the U.S. Geological Survey, the Wyoming Geological Survey, and the State Inspector of Mines of Wyoming.³ Reports by the U.S. Bureau of Mines are listed in the review by mineral commodities.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—Wyoming's coal production in 1971 totaled about 8.1 million tons, compared with 7.2 million tons in 1970. The value increased to \$27.3 million from \$24.4 million the previous year. A little more than half of the production was from the Powder River Basin. Stripping continued to be the principal mining method. Production would have been higher, but operations were curtailed by a nationwide strike of coal miners for nearly 2 months late in the year.

According to estimates made by the U.S. Bureau of Mines, Wyoming's recoverable coal reserves (assuming a 50-percent recovery) totaled 60.3 billion tons as of January 1, 1970. They comprised almost 8 percent of the total U.S. coal reserves. Wyoming's coal is ranked as low sulfur.

Wyoming strip-coal-mining operators put up higher reclamation performance bonds in accordance with a recommendation from the State Commissioner of Public Lands. Reclamation costs were placed at \$200 per acre plus \$15 per acre for seeding.

Union Pacific Railroad and Eastern Gas & Fuel Associates formed the Rocky Mountain Associated Coal Corp. As part of a \$10 million investment to develop coal deposits, the corporation acquired the Reliance Mine near Rock Springs from Rocky Mountain Energy Co., a subsidiary of Union Pacific. The mine output is to be increased from about 650,000 tons to about 1.5 million tons per year. During the year Rocky Mountain Energy Co. produced about one-unit train of coal each week, totaling about 10,000 tons, for shipment to Wisconsin Electric Power Co., Oak Creek, Wis.

Arch Mineral Corp. signed a contract to provide Commonwealth Edison Co. of Chicago with 5.5 million tons of coal from a

new mine near Hanna. Most of the deliveries will be by unit train at the rate of about 20,000 tons per week. In December the company began operating a dragline with a 275-foot boom and a 65-cubic-yard capacity bucket, the largest in Wyoming.

Energy Development Co., a subsidiary of Iowa Public Service Co., announced that it planned to ship 1 million tons of coal per year from the Hanna area to Sioux City, Iowa, by 1972. The company was opening an underground mine, the "Vanguard",

² Granger, H. C., E. J. McKay, R. E. Mattick, Lowell L. Patten, and Paul McIlroy. Mineral Resources of the Glacier Primitive Area, Wyoming. U.S. Geol. Survey Bull. 1319-F, 1971, 113 pp.

³ Pearson, Robert C., Thor H. Kiilgaard, and Lowell L. Patten. Mineral Resources of the Popo Agie Primitive Area, Fremont and Sublette Counties, Wyoming. U.S. Geol. Survey Bull. 1353-B, 1971, 55 pp.

³ Blackstone, D. L., Jr. Traveler's Guide to the Geology of Wyoming. Wyoming Geol. Survey Bull. 55, 1971, 90 pp.

Mello, J. F. Foraminifera From the Pierre Shale (Upper Cretaceous) at Red Bird, Wyoming. U.S. Geol. Survey Prof. Paper 393-C, 1971, 54 pp.

Merewether, E. A. Geologic Map of the Wild Horse Mountain Quadrangle, Carbon County, Wyoming. U.S. Geol. Survey Quadrangle Map GQ-887, 1971.

Pierce, W. G., and W. H. Nelson. Geologic Map of the Beartooth Butte Quadrangle, Park County, Wyoming. U.S. Geol. Survey Quadrangle Map GQ-935, 1971.

Reynolds, M. W. Geologic Map of the Lamont Quadrangle, Carbon County, Wyoming. U.S. Geol. Survey Quadrangle Map GQ-912, 1971.

Reynolds, M. W. Geologic Map of the Bairoil Quadrangle, Sweetwater and Carbon Counties, Wyoming. U.S. Geol. Survey Quadrangle Map GQ-913, 1971.

Richmond, G. M., and K. L. Pierce. Surficial Geologic Map of the Two Ocean Pass Quadrangle, Yellowstone National Park and adjoining area, Wyoming. U.S. Geol. Survey Quadrangle Map I-635, 1971.

Richmond, G. M., and K. L. Pierce. Surficial Geologic Map of the Mount Hancock Quadrangle, Yellowstone National Park and adjoining area, Wyoming. U.S. Geol. Survey Quadrangle Map I-636, 1971.

Waldrop, H. A. Thermal infrared detection of glacial gravel, Yellowstone National Park, Wyoming, in Geological Survey Research 1971. Ch. B; U.S. Geol. Survey Prof. Paper 750-B, 1971, p. B202-B206.

Wyoming, State Inspector of Mines. Annual Report for the Year Ending Dec. 31, 1971. 1972, 87 pp.

which is scheduled to produce about 1 million tons per year. The company operated an open pit mine during the year.

In October, Kemmerer Coal Co. gave Morrison-Knudsen (M-K) Company, Inc., a 23-year contract to continue operating its mine near Kemmerer. M-K has operated Kemmerer's mines since 1950. The new contract, valued at more than \$200 million, calls for production of between 1 to 3 million tons annually. Production during 1971 was about 600,000 tons. An article published during the year described the use of rubber-tired tractors to load coal at Kemmerer's Sorenson mine.⁴

Ayrshire Collieries Corp., a subsidiary of American Metal Climax Inc. (AMAX), was building a unitized loading facility on their lease on Federal land in Campbell county. The company was preparing to develop an open pit mine. It plans to have an annual production of 1.5 million tons the first year and 2.5 million tons the second year. Most of the output will be for the Colorado Public Service Co.

The Black Hills Power & Light Co., in cooperation with Pacific Power & Light Co., plans to build an air-cooled, coal-fired steam powerplant east of Gillette. It will be supplied from the nearby Wyodak mine. The plant, which will cost about \$60 million, is scheduled to be completed by 1976. A power rating of 200,000 kilowatts will make it the largest of its type in the world. The 20,000-kilowatt Neil Simpson powerplant is presently operating on the site. It is the first air-cooled steam powerplant to be built in the Western Hemisphere. The powerplant and the coal mine at Wyodak were described in an article published during the year.⁵

The 1.5 million-kilowatt Jim Bridger Powerplant was under construction. The first 500,000-kilowatt unit of the \$300 million plant is scheduled for service in mid-1974. Pacific Power & Light Co., which has a two-third interest in the plant, reports that the plant will meet air pollution standards. The company was engaged in a \$44 million power development program that includes the replacement and addition of mining equipment and the installation of scrubber systems to provide air quality control at the No. 4 power unit of the Dave Johnston steam-electric plant near Glenrock.

The FMC Corp. reported that the capacity of its coke plant near Kemmerer will be

increased. An air pollution control system was installed at the plant in August.

Two companies placed bids on coal reserves in Campbell County for possible development as sources of synthetic fuels. Cordero Mining Co., a subsidiary of Sun Oil Co., bid \$3.3 million for 6,500 acres of Federal land for a possible coal gasification project. Mobil Oil Co. bid \$1.7 million for 4,000 acres of coal leases for a possible coal liquefaction project.

The washability characteristics of 14 coal samples collected in Wyoming were published during the year.⁶ Another report describes the models developed to predict low-temperature carbonization yields for coals from major fields in Wyoming.⁷

Natural Gas.—Marketed natural gas totaled 380 billion cubic feet in 1971, up from 338 billion in 1970. It was valued at \$58.2 million, compared with \$49.8 million in 1970. Total production of natural gas in 1971 reached 384.3 billion cubic feet, an increase of almost 6 percent over that of 1970.

The Hilight field, Campbell County, was the chief producer during the year. Its output of 38.2 billion cubic feet was more than double that of the previous year. Other major gasfields were: Elk Basin, Park County, 20.6 billion cubic feet; Beaver Creek, Fremont County, 19.2 billion cubic feet; Hogsback, Sublette County, 17.4 billion cubic feet; and Canyon Creek, Sweetwater County, 16.6 billion cubic feet. The major gas-producing strata according to geological age were the Upper Cretaceous, which accounted for 46 percent of the total, mainly because of the high productivity from the Frontier Formation; and the Lower Cretaceous, which produced 29 percent of the total, chiefly from the Muddy Formation.

According to the American Gas Association (AGA), Wyoming's natural gas reserves totaled 4.1 trillion cubic feet at yearend 1971, compared with 4.2 trillion cubic feet the previous year. New fields and new pools added 31.4 billion cubic feet,

⁴ Coal Mining and Processing. Rubber-tired Tractor Takes Over Coal Loading Job. *Coal Mining and Processing*. V. 8, No. 2, February 1971, pp. 48-49.

⁵ Levene, Harold D. An Unusual Coal mine/Power Plant Complex. *Coal Mining and Processing*. V. 8, No. 10, October 1971, pp. 57-61.

⁶ Deurbrouck, A. W. Washability Examinations of Wyoming Coals. *BuMines RI 7525*, 1971, 47 pp.

⁷ Gomez, Manuel, and Donald J. Donaven. Prediction of Low-Temperature Carbonization Properties of Coal in Advance of Mining. *BuMines RI 7561*, 1971, 88 pp.

Table 5.—Bituminous coal production in 1971, by type of mine and county

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

County	Number of Mines ¹			Production (thousand short tons)			Value (thousands)
	Under-ground	Strip	Total	Under-ground	Strip	Total	
Campbell.....	--	1	1	--	647	647	\$964
Carbon.....	1	2	3	46	1,813	1,859	W
Converse.....	--	1	1	--	1,730	1,730	W
Hot Springs.....	2	--	2	8	--	8	W
Lincoln.....	--	2	2	--	1,504	1,504	W
Sheridan.....	--	2	2	--	1,777	1,777	5,893
Sweetwater.....	1	1	13	88	429	2,529	W
Total ²	4	9	14	141	7,899	28,052	27,335

W Withheld to avoid disclosing individual company confidential data; included in total.

¹ Includes one auger mine.² Includes 12,000 tons from auger mining.³ Data may not add to totals shown because of independent rounding.

and extensions and revisions added 213.7 billion cubic feet. The State's gas reserves ranked first in the Rocky Mountain Region, with over half of the Region's total.

During the year the Federal Power Commission approved the plans of Colorado Interstate Gas Co. to increase deliveries of natural gas to customers in the Rocky Mountain area. The company's supply system will be increased initially through pipeline connections to the Elk Basin, Oregon Basin, and Silver Tip fields, where proven reserves total about 145 billion cubic feet.

Northern Utilities Inc. and Northern Gas Co. announced plans to jointly construct and operate a natural gas storage reservoir with a capacity of 26 billion cubic feet at the East Mahoney Dome in Carbon County. Northern Utilities will have 16 billion cubic feet of storage, and Northern Gas Company, 10 billion cubic feet. The cost of the project is \$7.5 million.

The Kansas-Nebraska Natural Gas Co. proposed a \$9 million project to build a 16-inch pipeline from Douglas, Wyo. to Mitchell, Neb. The line will parallel an existing 12-inch segment of the company's interstate pipeline system.

In November the Wyoming Oil and Gas Commission reviewed the problem of flaring natural gas at the State's oilfields. It recommended reducing the length of time allowed for flaring before the wells are shut down. The existing rules permit 48 hours of flaring if the natural gas processing plants are not operating. The committee suggested that the time limit be reduced to 4 or 6 hours.

El Paso Natural Gas Co. conducted water and environmental impact studies between

Pinedale and Big Piney, Sublette County, the site for a proposed nuclear test explosion to stimulate the recovery of natural gas. The project, called Wagon Wheel, is planned for 1973 or later.

Analyses of 14 samples of natural gas from Wyoming were published by the Bureau of Mines.³

According to the AGA, Wyoming had 5,920 miles of natural gas pipeline at the beginning of 1971. The total included 1,006 miles of field and gathering line, 3,239 miles of transmission line, and 1,675 miles of distribution line.

Natural Gas Liquids.—During 1971 the 32 operating gas processing plants in the State produced almost 8 million barrels of natural gas liquids, which were valued at \$17.5 million. According to the AGA, Wyoming's productive capacity of natural gas liquids was 40,000 barrels per day at year-end 1971.

Wyoming's proved reserves of natural gas liquids, as reported by the AGA, totaled 97.6 million barrels at yearend 1971, compared with 111 million barrels the previous year. They comprised more than 40 percent of the reserves in the Rocky Mountain Region.

Montana-Dakota Utilities Company, in cooperation with Northern Utilities and Kansas-Nebraska Gas Co., completed a \$1 million, 50-million-cubic-foot-per-day gas processing plant southeast of Riverton. Located in the East Riverton field of Continental Oil Company, the new plant is expected to bring the field into full production. The plant will process about 30 mil-

³ Cardwell, L. E., and L. F. Benton. Analyses of Natural Gas, 1970. BuMines IC 8518, 1971, 130 pp.

lion cubic feet of sweet gas and 20 million cubic feet of sour gas per day, from which it is expected to extract 70 barrels of condensate and about 36 tons of sulfur per day. Montana-Dakota, the builder and operator of the plant, has a 50-percent interest; its partners each have 25-percent interest.

Panhandle Eastern Pipe Line Co. underwent a \$6 million expansion that increased its average daily field purchases of casing-head gas from 40 million cubic feet to 125 million cubic feet. The company constructed 72 miles of field-gathering pipeline and 38 field compressors. Gas is purchased from the Hilight field and processed at the Douglas gas plant of Phillips Petroleum Co. The capacity of the plant was scheduled to be increased from about 60 million cubic feet per day to about 125 million cubic feet per day. Phillips also was constructing a 6-inch pipeline to carry natural gas liquids to its plant in Borger, Tex.

During the year the McCulloch Hilight gas plant in Campbell County was damaged, allegedly by sabotage. The repair work took several weeks and cost about \$250,000. The plant began operations in 1970.

The Elk Basin plant of Amoco Production Co. was expanding its gas compression facilities by 20 million cubic feet per day and its treating facilities by 40 million cubic feet per day.

The Lance Creek plant of Marathon Oil Co. discontinued operations in August.

Oil Shale.—In June the U.S. Department of the Interior released a proposed prototype oil-shale-leasing program and an environmental-impact statement in anticipation of future development of oil shale reserves on Federal lands. The area of principal concern in Wyoming is Sweetwater County. Private companies have indicated an interest in participating in the prototype leasing program. Wyoming's oil shale deposits contain about 430 billion barrels of oil in place, but only about 4 billion are estimated to be recoverable with present-day technology.

At the request of the Governor and the U.S. Department of the Interior, the Wyoming Oil Shale Environmental Planning Committee prepared an environmental and economic report that evaluated three oil shale sites in Sweetwater County. A site called the Sandy Creek prototype area,

about 33 miles northwest of Rock Springs, was proposed for in situ development. The oil yield is estimated at 200,000 barrels per acre. A site called the Kinney prototype area, about 45 miles southeast of Rock Springs, was proposed as a surface mining operation. The oil yield is estimated at 180,000 barrels per acre. Most of the land at both sites is owned by the Federal Government. The third proposed site, which would be suitable for surface mining, is the Green River prototype area, located about 12 miles southwest of Green River. The oil yield is estimated at 100,000 barrels per acre. However, development in the area reportedly may be precluded by environmental and land ownership problems.

Data from 183 oil and gas wells and one corehole, all in areas classified as prospectively valuable for oil shale, were made available for public inspection by the Rock Springs regional office of the U.S. Geological Society. The well records are from leases that have expired.

A study of a technique for estimating the oil yields of oil shale in the Green River Basin and the Washakie Basin, as well as in parts of Colorado and Utah, was released during the year.⁹

Petroleum.—Although crude oil production rose in a few counties, the total production in the State dropped to 148.1 million barrels, compared with 160.3 million barrels in 1970. Approximately 57 percent of the production was from public land, about the same as in 1970. The crude oil shipped out of the State amounted to 110.9 million barrels. The principal destinations were: Indiana, 24.9 million barrels; Kansas, 17.4 million barrels; Utah, 14.8 million barrels; Montana, 14.8 million barrels; and Colorado, 11.5 million barrels.

The four major oilfields, each producing over 10 million barrels during the year, were the Oregon Basin and Elk Basin, both in Park County; Hilight, Campbell County; and Salt Creek, Natrona County. Together these fields accounted for about 32 percent of the State's production in 1971, the same as in 1970. The fields also held about 35 percent of Wyoming's reserves. Oregon Basin had about 83 million barrels; Elk Basin, 80 million barrels (including part of field situated in Montana); Hilight, 109

⁹ Decora, A. W., F. R. McDonald and G. L. Cook. Using Broad-line Nuclear Resonance Spectrometry to Estimate Potential Oil Yields of Oil Shales. BuMines RI 7523, 1971, 30 pp.

million barrels; and Salt Creek, 77 million barrels.¹⁰

The State's major oil reservoirs and their approximate shares of production in 1971 were the Tensleep (Pennsylvanian), 23 percent; Muddy (Lower Cretaceous), 17 percent; Minnelusa (Pennsylvanian), 8 percent; Embar-Tensleep (Triassic), 7 percent; Wall Creek (Upper Cretaceous), 6 percent; and the Madison (Mississippian), 5 percent.

Wyoming's petroleum basins were evaluated in a memoir published during the year.¹¹ The results of an investigation of the sulfur and carbon isotopes in petroleum from the Wind River Basin were also published.¹²

Wyoming's crude oil reserves at yearend 1971 were estimated by the American Petroleum Institute to total 996,985,000 barrels, down from 1,017,359,000 barrels in 1970. New fields and pools added oil reserves of 1.3 million barrels, compared with about 5 million barrels in 1970. Revisions and extensions added 121.8 million barrels, compared with 171.1 million barrels in 1970. Wyoming's crude oil reserves in 1971 ranked 6th in the United States, accounting for 2.6 percent of the total. They comprised a little more than half of the crude oil reserves in the Rocky Mountain Region.

The number of exploratory and development wells drilled during the year declined sharply to 893, compared with 1,399 in 1970. The total drilling footage was 5.3 million feet (exploratory drilling, 2.2 million feet; development drilling, 3.1 million feet) as compared with 9.9 million feet in 1970. Of the 345 exploratory wells drilled, 43, or 12 percent, were successful. The 548 development wells drilled resulted in 405 producers, a success ratio of about 74 percent. Most of the drilling in the State, as well as in the Rocky Mountain Region, was in Campbell County. The Powder River Basin accounted for about 64 percent of the total wells drilled and about 79 percent of the exploratory discoveries in the State. In December, 61 drilling rigs were operating, including about 40 in the Powder River Basin.

In 1971, Wyoming's nine operating refineries had a total crude oil throughput capacity of 139,925 barrels per calendar day. During the year the refineries processed 48.7 million barrels of crude oil, including 46.7 million barrels from the State's

oilfields. Refinery processing of crude oil, unfinished oils, and natural gas liquids yielded about 52 million barrels of petroleum products.

During the year Husky Oil Company, at Cheyenne, was increasing the daily capacity of its catalytic hydrotreating facility from 3,400 barrels to 6,200 barrels, and its catalytic reforming facility from 2,000 barrels to 5,200 barrels. The expansion program will cost about \$10 million. The Sage Creek Refining Company, at Cowley, was increasing its daily crude oil throughput capacity from 500 barrels to 1,500 barrels. It was also adding a 1,000-barrel-per-day vacuum distillation facility and a 1,000-barrel-per-day visbreaking facility.

At the beginning of 1971, Wyoming had 6,644 miles of pipeline, which included 3,911 miles of crude oil trunkline, 1,548 miles of gathering line, and 1,185 miles of product pipeline.

NONMETALS

Cement.—In December the Monolith Portland Midwest Company in Laramie dedicated a \$1.1 million electrostatic precipitator to reduce air pollution. Its efficiency is reported at 99.7 percent. The precipitated dust was being used to backfill a limestone quarry. The company was studying the feasibility of returning the dust to the kiln.

The State Inspector of Mines reported that the company, the only cement producer in Wyoming, had an output of about 191,000 tons during the year. Consumption of cement in the State totaled 888,000 barrels of portland cement and 12,000 barrels of masonry cement.

Clays.—The production of clays, chiefly bentonite, dropped about 8 percent from 1970. However, Wyoming continued to be the nation's principal source of bentonite. Most of the output is for iron ore pelletizing. The State's bentonite reserves are expected to find an important market when oil activities increase in Alaska. The link

¹⁰ Oil and Gas Journal. V. 70, No. 5, Jan. 31, 1972, p. 100.

¹¹ Cram, Ira H. (ed.). Future Petroleum Provinces of the United States—Their Geology and Potential. Am. Assoc. of Petrol. Geol. (Tulsa, Okla.), Memoir 15, v. 1, 1971, pp. 591-691.

¹² Vredenburg, L. D., and E. S. Cheney. Sulfur and Carbon Isotopic Investigation of Petroleum, Wind River Basin, Wyoming. Am. Assoc. of Petrol. Geol. Bull., v. 55, No. 11, November 1971, pp. 1954-1975.

Table 6.—Oil and gas well drilling completions in 1971, by county

County	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Albany.....	2	--	--	--	--	5	7	27,466
Big Horn.....	8	--	--	1	--	5	14	59,458
Campbell.....	113	3	57	17	2	80	272	2,205,409
Carbon.....	--	--	2	--	1	14	17	106,701
Converse.....	28	--	4	3	1	24	60	367,657
Crook.....	4	1	5	2	--	13	25	126,085
Fremont.....	24	5	11	1	3	17	61	286,054
Goshen.....	--	--	--	--	--	2	2	13,065
Hot Springs.....	12	--	2	--	--	7	21	85,463
Johnson.....	5	--	1	--	--	1	7	71,953
Laramie.....	--	--	1	--	--	7	8	58,265
Lincoln.....	1	--	1	--	--	2	4	27,785
Natrona.....	32	--	15	3	--	33	133	425,140
Niobrara.....	8	--	4	4	--	10	26	130,783
Park.....	35	1	4	--	--	12	52	245,363
Sheridan.....	--	--	3	1	--	7	11	90,823
Sublette.....	10	9	6	--	3	19	47	257,505
Sweetwater.....	5	13	11	--	--	22	51	346,821
Uinta.....	--	1	--	--	--	2	3	13,826
Washakie.....	13	--	1	--	--	5	19	165,212
Weston.....	22	--	15	1	--	15	53	215,155
Total.....	372	33	143	33	10	302	893	5,325,999

Source: American Petroleum Institute.

Table 7.—Crude petroleum production, by county¹
(Thousand 42-gallon barrels)

County	1970	1971
Albany.....	300	277
Big Horn.....	5,698	6,643
Campbell.....	42,390	36,424
Carbon.....	1,576	1,426
Converse.....	4,677	4,144
Crook.....	4,183	4,107
Fremont.....	10,936	10,119
Goshen.....	7	7
Hot Springs.....	12,532	10,849
Johnson.....	5,149	4,700
Laramie.....	445	407
Lincoln.....	293	248
Natrona.....	15,448	14,743
Niobrara.....	532	595
Park.....	36,392	34,093
Sheridan.....	572	536
Sublette.....	4,323	4,181
Sweetwater.....	9,117	8,923
Uinta.....	50	--
Washakie.....	2,325	2,071
Weston.....	3,400	3,606
Total.....	160,345	148,114

¹ Based on data from the Wyoming Ad Valorem Tax Division, State Board of Equalization, and the Wyoming Oil and Gas Conservation Commission.

to Alaska is through the Burlington North-ern Railroad.

Wyo-Ben Products, Inc., completed construction of a plant in Lovell. The new plant and the company's existing plant in Greybull started operating midyear on a four-day, 10-hour work schedule.

Concern over possible health hazards associated with bentonite mining arose during the year. The bentonite producers in Wyoming and other States formed a na-

tional organization to deal with the matter. In Wyoming the industry had an average of 350 employees in 1971.

Dresser Industries, Inc., and Wyo-Ben installed filter systems at their plants to trap bentonite dust and reduce stack emission.

Feldspar.—In December, Northwestern Feldspar Corp. went bankrupt after less than 2 years of operation. Production during the year, all from Fremont County,

Table 8.—Production of crude petroleum in 1971, by major field

(Thousand 42-gallon barrels)

Field	County	Year of discovery	Production
Oregon Basin	Park	1912	12,230
Elk Basin	Park	1915	12,154
Hilight	Campbell	1969	11,803
Salt Creek	Natrona	1906	11,165
Lost Soldier	Sweetwater	1916	4,870
Hamilton Dome	Hot Springs	1918	4,475
Grass Creek	Hot Springs	1914	3,733
Little Buffalo Basin	Hot Springs	1914	3,713
Garland	Big Horn	1906	3,668
Winkleman	Fremont	1917	3,319
Frannie	Park	1928	2,842
Monell	Sweetwater	1964	2,022
Glenrock, South	Converse	1950	2,010
Recluse	Campbell	1967	1,972
Big Sand Draw	Fremont	1918	1,906
Byron	Big Horn	1918	1,883
Kitty	Campbell	1965	1,818
Wertz	Carbon	1920	1,674
Steamboat Butte	Fremont	1943	1,664
Cole Creek, South	Converse	1948	1,591
Gas Draw	Campbell	1968	1,542
Sussex	Johnson	1948	1,538
Osage	Crook	1919	1,487
Raven Creek	Campbell	1956	1,446
Springen Ranch	Campbell	1968	1,399
Other fields	--	--	51,190
Total	--	--	148,114

Source: The Wyoming Oil and Gas Conservation Commission.

was about 37 percent less than in 1970. The company's mill at Bonneville has a capacity of 100 tons per day of finished products. Feldspar was mined from the Quien Sabe mine on Copper Mountain.

Gypsum.—The tonnage and value of gypsum produced by the State's four mines increased 8 percent and 6 percent, respectively. The output was from Albany, Big Horn, and Park counties. Big Horn Gypsum Co., in Park County, remained the principal producer. According to the State Inspector of Mines, the company mined and processed about 128,000 tons during the year.

Lime.—Holly Sugar Corp. and Great Western Sugar Co. produced lime in Big Horn, Goshen, and Washakie counties. The output was 27,207 tons, an increase of 23 percent, but still 3 percent less than the record produced in 1968. All the lime was used in Wyoming for sugar refining.

Phosphate Rock.—Production of phosphate rock increased approximately 32 percent in both tonnage and value. The Lefe mine of Stauffer Chemical Co., in Lincoln County, continued to be the State's only producer. The State Inspector of Mines reported that mine production of phosphate rock totaled about 300,000 tons. The company's processing plant continued to treat

ores from Utah as well as Wyoming. A large part of the plant's output of phosphoric acid was exported. During the year the company installed dust collection systems in two plants and reseeded inactive waste dumps.

Sand and Gravel.—Although the number of mines declined during the year, the production of sand and gravel increased by about 4 percent. The increase was due to a 28-percent rise in the output of sand, which rose from 2,515,000 tons in 1970 to 3,218,000 tons in 1971. By comparison, the output of gravel dropped from 6,932,000 tons in 1970 to 6,602,000 tons in 1971. The value of total production in 1971 declined by about 5 percent. The average price of sand was 84 cents per ton, down from \$1.04 in 1970. The average price of gravel was about 92 cents per ton, compared with 96 cents in 1970. Government-and-contractor operations rose during the year, but commercial operations declined.

Production in Fremont County increased sharply, mainly because of an increased output of sand and gravel for use in paving. Other counties reporting increases in production were: Big Horn, Converse, Lincoln, Park, Sheridan, and Washakie.

Sodium Carbonate.—Wyoming's deposits of trona, the largest in the United States,

Table 9.—Principal oil and gas discoveries in 1971

County and field	Well	Operator	Location			Producing formation	Total depth (feet)	Initial production		Remarks
			Section	Township	Range			Barrels of oil per day	Thousand cubic feet of gas per day	
Big Horn:										
Unnamed.....	No. 1-14 U.S.A.....	Cleary Petroleum Co.....	14	50N	92W	Unknown	5,978	28	--	Pumping.
Campbell:										
Breen.....	No. 44-14 Haight.....	Shell Oil Co.....	14	47N	72W	Mowry	10,950	173	--	Flowing.
Hines.....	No. 1 Hines.....	Ranger Oil Co.....	34	50N	73W	Muddy	9,400	49	--	Pumping.
Mill, South.....	No. 1-Z Russell.....	Davis Oil Co. & Petroleum Research.....	32	50N	72W	do.	8,884	144	--	Do.
Quinn.....	No. 2 Quinn-Federal.....	Davis Oil Co.....	27	56N	72W	do.	6,875	115	--	Do.
Simpson Ranch.....	No. 21-15 Simpson Ranch.....	R. J. Ackerman & Westrans Petroleum Co.....	15	51N	69W	Minnelusa	8,050	38	--	Do.
Toland.....	No. 1 Toland-State.....	Petrochem Exploration Co.....	35	50N	70W	do.	8,920	700	--	Do.
Unnamed.....	No. 58-1 Government-Eason	W. B. Osborn, Jr. & Rain-	19	47N	71W	do.	10,829	197	--	Do.
Carbon:										
Sugar Creek.....	No. 2 Unit.....	Tenneco Oil Co.....	35	19N	90W	Muddy	10,876	--	6,500	Flowing.
Converse.....	No. 1, 44-2 (88-78) Angel-	Champlin Petroleum Co.....	2	38N	73W	Frontier	--	--	1,000	Do.
Dry Fork.....	U.S.A.....							155	--	Pumping.
Crook:										
Wind Creek, North.....	No. 1 Barton.....	L. & R. Drilling Co.....	14	49N	66W	Dakota	787	40	--	Do.
Fremont.....	No. 2 Bonneville Unit.....	William G. Helis Estate.....	27	39N	93W	Fort Union	13,505	--	2,168	Flowing.
Natrona.....	No. 15-1 U.S. Government.....	Ferguson Oil Co.....	15	37N	78W	Dakota	7,296	200	--	Pumping.
Niobrara:										
Boggy Creek.....	No. 1 Tresner-Federal.....	Walter Van Norman.....	29	40N	64W	Muddy	6,525	762	--	Flowing.
Hat Creek.....	No. 22-18 Hat Creek.....	William G. Helis Estate.....	18	34N	66W	Carvon Springs	10,949	250	--	Pumping.
Sweetwater:										
Lost Springs.....	No. 1-3 Bower.....	Apache Corp.....	3	34N	67W	Teapot	6,019	26	--	Do.
Masterson.....	No. 43-24-20-102 Govern-	Prenalta Corp.....	24	20N	102W	Dakota	7,390	--	8,428	Flowing.
Red Desert.....	ment.....									
Robb.....	No. 1-4 Federal.....	Buttes G & O Co.....	4	22N	96W	Almond	10,257	--	1,356	Do.
	No. 1 Government-Union	Texaco, Inc.....	8	19N	97W	do.	7,335	--	1,600	Do.

Source: Petroleum Information Corp., 1971 Resume, Oil and Gas Operations in the Rocky Mountain Region.

Table 10.—Sand and gravel sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	1970			1971		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Albany.....	10	1,517	\$1,563	14	732	\$597
Big Horn.....	5	236	194	6	466	378
Carbon.....	9	W	1,016	5	W	W
Converse.....	5	133	130	3	332	309
Crook.....	4	W	W	2	151	W
Fremont.....	13	233	320	11	1,645	1,328
Hot Springs.....	3	W	38	5	35	43
Johnson.....	12	958	880	6	363	213
Laramie.....	16	656	675	13	406	417
Lincoln.....	12	609	567	7	761	742
Natrona.....	7	697	600	12	472	275
Niobrara.....	3	W	W	2	19	21
Park.....	13	502	434	10	644	634
Platte.....	7	349	377	6	112	52
Sheridan.....	10	128	99	5	337	302
Sweetwater.....	10	767	771	5	370	408
Teton.....	4	135	109	3	103	133
Uinta.....	4	59	54	2	W	W
Washakie.....	5	76	237	7	419	419
Undistributed ¹	29	2,391	1,234	15	2,354	2,479
Total².....	181	9,447	9,298	139	9,820	8,750

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

¹ Includes Campbell, Goshen, Sublette, Weston, Yellowstone National Park (1970), and some sand and gravel that cannot be assigned to specific counties.

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

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

Class of operations and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	145	\$227	228	\$299
Fill.....	82	61	22	13
Paving.....	561	600	176	145
Other uses.....	W	W	25	25
Total¹.....	788	889	451	482
Gravel:				
Building.....	217	384	332	424
Fill.....	60	46	60	40
Paving.....	3,673	3,608	2,810	2,669
Railroad ballast.....	295	110	W	W
Miscellaneous.....	137	37	207	43
Other uses.....	168	127	449	342
Total¹.....	4,550	4,312	3,856	3,524
Government-and-contractor operations:				
Sand:				
Building.....			1	2
Paving.....	1,726	1,725	2,765	2,220
Other uses.....	1	1	1	3
Total¹.....	1,727	1,725	2,767	2,223
Gravel:				
Building.....	23	43	25	17
Fill.....	29	26	19	9
Paving.....	2,329	2,300	2,700	2,493
Other uses.....	1	1	2	2
Total¹.....	2,382	2,370	2,746	2,520
Total sand and gravel¹.....	9,447	9,298	9,820	8,750

W Withheld to avoid disclosing individual company confidential data; included with fill sand (1970), and other gravel (1971).

¹ Data may not add to totals shown because of independent rounding.

continued to be the State's most important nonmetallic mineral. The mine production of trona, as reported by the State Inspector of Mines, totaled about 4.6 million tons in 1971. The total sodium carbonate processed from the trona rose about 8 percent in both tonnage and value. A mineral industry forecast by Cameron Engineers of Denver estimated that the annual production will reach 3.25 million tons in 1972—4.5 million tons by 1980 and 10 million tons by 2020.¹³ According to the State Inspector of Mines, the trona industry had an average of 1,663 employees during the year, compared with 1,125 in 1970.

FMC Corp., the State's largest and oldest producer of sodium carbonate, continued work on its first expansion program, which includes the construction of a fourth shaft by late 1972. A contract was awarded in 1971 for the construction of a ventilation shaft. The expansion program will increase the plant's annual production capacity from 1.25 million tons to 1.75 million tons initially and to 2.25 million tons in the future.

Stauffer Chemical Co. plans to build a fourth refinery unit at a cost of about \$15 million. When it is completed about mid-1972, the company's production capacity will be raised to 1.5 million tons per year. The completion of a third refinery unit in 1970 increased the capacity to 950,000 tons per year.

Allied Chemical Corp. plans to build new facilities to increase its capacity to 1.1 million tons per year, about double the present capacity of its plant in Green River. The expansion program is scheduled to be completed early in 1973.

Texas Gulf Sulphur Co. continued developing a trona mine near its plant northeast of Granger. It is reportedly working on a process to refine the trona.

Church & Dwight Co., Inc., a processor of trona, announced plans to construct a \$7.5 million addition to increase production. The first phase, which will raise the annual capacity from 20,000 tons to about 40,000 tons, is expected to be completed during the first part of 1972. The second phase, which will increase the annual capacity to about 75,000 tons, is scheduled for completion by mid-1973.

An increased demand for natural gas in November due to unusually stormy and cold weather hampered the operations and expansion activities of the trona plants, which

use natural gas but are supplied on an "interruptible" service basis. During the shortages, the plants generally used fuel oil, which reportedly increased production costs.

An official of the Union Pacific Railroad announced that freight rates for the shipment of soda ash from Wyoming will be reduced by 7½ percent if the ash is hauled in jumbo hopper cars. The reduced rate applies to soda ash hauled to Illinois, Minnesota, and Missouri.

The Wyoming Department of Economic Planning and Development reported that water storage projects in the lower Green River area could hamper the development of trona deposits in the area. A study was underway to evaluate the possible adverse effects of the projects.

During the year, the U.S. Bureau of Mines published a report on sampling and analyzing trona dust.¹⁴

Sodium Sulfate.—No production of sodium sulfate was reported during the year.

Stone.—The production of stone in 1971 was more than twice of that in 1970. The average unit price, however, declined to \$1.65 per ton, compared with \$2.18 in 1970. Limestone, granite, and quartzite together accounted for more than 80 percent of the total stone produced. Limestone comprised a little more than half the total output. It was used chiefly for manufacturing cement and lime, and as railroad ballast. The granite was used mainly as railroad ballast, whereas the quartzite was for road material.

Sulfur.—Shipments of recovered elemental sulfur, a coproduct of sour natural gas, declined to 41,208 long tons, about 7 percent less than in 1970. The value in 1971 was \$709,000, a 10-percent drop from the previous year. Park County was the major producer, followed by Fremont, Carbon, and Washakie Counties. Six plants operated during the year, the same as in 1970.

METALS

Gold.—Gale Creek Co., a subsidiary of Bradlaner Enterprises, announced it would start placer mining for gold as soon as possible in the Snake River Basin between Jackson Lake and Flagg Ranch. The company filed 35 mining claims in June 1970

¹³ Wyoming Department of Economic Planning and Development. Big Wyoming Progress Report. V. 3, No. 5, May 1971, p. 1.

¹⁴ Jacobson, Murray, and Samuel L. Terry. A Method for Sampling and Analyzing Trona Dust. BuMines RI 7506, 1971, 4 pp.

Table 12.—Stone sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	1970			1971			Kind of stone produced in 1970
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value	
Big Horn.....	1	60	\$80	2	W	W	Limestone, other stone.
Campbell.....	1	W	W	--	--	--	--
Carbon.....	2	W	W	--	--	--	--
Crook.....	3	W	W	--	--	--	--
Fremont.....	2	W	W	--	--	--	--
Goshen.....	2	W	W	--	--	--	--
Johnson.....	1	W	W	--	--	--	--
Laramie.....	3	W	W	2	W	W	Limestone, granite.
Lincoln.....	2	W	W	1	283	\$266	Quartzite.
Natrona.....	1	W	W	1	80	84	Granite.
Sublette.....	1	W	W	--	--	--	--
Sweetwater.....	--	--	--	1	146	213	Traprock.
Teton.....	1	W	W	2	51	76	Limestone, traprock.
Uinta.....	1	W	W	1	W	18	Other Stone.
Washakie.....	1	W	W	--	--	--	--
Weston.....	1	W	W	1	54	W	Limestone.
Undistributed ¹	13	1,206	2,678	19	2,280	4,132	Limestone, other stone.
Total.....	36	1,266	2,758	30	2,894	4,789	

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

¹ Includes production for Albany, Park, Platte, and Sheridan Counties and for counties for which no county breakdown is available.

on Forest Service Land in the area, which is in the corridor between Teton National Park and Yellowstone National Park. Environmentalists protested the mining claims because the corridor has been proposed for a National Recreational Area. The company indicated that it would take measures to protect the environment.

Iron Ore.—Three companies continued to mine ore. According to the State Inspector of Mines, the Atlantic City operation of United States Steel Corp. was the principal producer during the year, with shipments totaling about 1.3 million tons. CF&I Steel Corporation shipped about 480,000 tons to its plant at Pueblo, Colo. Maxwell Mining Co., the smallest producer, continued to mine magnetite for U.S. Aggregate.

Platinum.—Little Goose Creek Mining and Milling Corporation discovered platinum in a two-mile vein in the Bighorn Mountains, near Sheridan. Assays reportedly indicated the presence of about 3,600 ounces of gold, 1,500 ounces of platinum, together with platinum alloys.¹⁵

Uranium.—In 1971 Wyoming produced 7 million pounds of uranium, compared with 6.3 million pounds in 1970. The State's production ranked second in the nation in quantity and value.

Total drilling for uranium dropped to 6.1 million feet in 1971, from 9.8 million feet the previous year. However, Wyoming continued to rank first in the nation in

footage drilled for uranium, accounting for 40 percent of the total. At yearend, 8.6 million acres were leased for uranium mining and exploration in the State. This comprised 45 percent of the total acreage held in the country.

The Atomic Energy Commission reported that Wyoming's uranium reserves (at \$8.00 per pound U₃O₈) at yearend 1971 totaled 51.2 million tons of ore averaging 0.19 percent U₃O₈. The reserves, which rank second in the nation after New Mexico, contain 94,900 tons of recoverable U₃O₈.

Western Nuclear Inc. started mining at its Jeffrey City mine with a specially designed Serpentix conveyor attached to a continuous mining machine. The conveyor, a convoluted belt 110 feet long and 20 inches wide, will be pulled behind the continuous mining machine and will transport mined material into ore cars. The combination of equipment is expected to increase the efficiency of the mining machine and result in increased production. The conveyor has a load capacity of 75 cubic yards per hour and operates at a rate of 160 feet per minute. In May, Western Nuclear became a wholly owned subsidiary of Phelps Dodge Corp.

Western Standard Uranium, Inc., at Riverton, announced plans to increase explora-

¹⁵ Riverton Ranger. V. 65, No. 83, June 24, 1971, p. E-2.

tion on the Kaycee uranium project in the Powder River Basin, Johnson County. The company transferred its interest in more than 60,000 acres about 12 miles east of Kaycee to the Westan Kaycee Special Partnership. Western Standard Uranium holds a 51 percent interest in the partnership, which will provide about \$800,000 for an exploration program of about 18 months in Wyoming.

Federal American Partners stopped open pit operations in August and stated that they will not resume until the nuclear power industry improves and the market strengthens. The company continued underground mining at the Table Stakes pit floor. A new underground mine was started in the Russ Buss pit area. The company's operations were hampered by an employee strike during the year.

Fluor Utah Engineers and Constructors

Inc. began work on a multimillion dollar uranium mill near Douglas for the Highland Project of Humble Oil and Refining Co. Scheduled for completion late in 1972, the mill is expected to process 2,000 tons of ore per day, using an acid leach-solvent extraction technique. During the year 9.8 million cubic yards of overburden were removed from the mine site. Mine production is scheduled to start July 1972.

The mill of Utah Construction & Mining Co. in the Shirley Basin, Carbon County, was officially completed in February. The first barrel of uranium concentrate was produced in March.

A joint exploration venture covering 5 years was announced by Union Pacific Railroad and Southern California Edison Co. Union Pacific reportedly has promising uranium prospects.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Monolith Portland Midwest Co.	3326 San Fernando Road Los Angeles, Calif. 90065	Plant.....	Albany.
Clays:			
American Colloid Co.....	5100 Suffield Court Skokie, Ill. 60076	Open pit mine and plant.	Big Horn.
		Open pit mine.....	Crook.
		Open pit mine and plant.	Weston.
Black Hills Bentonite Co.....	Box 1, Mills, Wyo. 82644...	.....do.....	Johnson.
Dresser Industries, Inc., Greybull Dresser Minerals Division.	Box 832 Greybull, Wyo. 82426	.....do.....	Big Horn.
		Open pit mines and plant.	Do.
International Minerals & Chemical Corp., Eastern Clay Products Dept.	Administration Center Old Orchard Road Skokie, Ill. 60079	.....do.....	Do.
NL Industries Inc., Baroid Division.	Box 1675 Houston, Tex. 77001	Open pit mines.....	Weston.
Wyo-Ben Products, Inc.....	Box 1979 Billings, Mont. 59103	Open pit mine and plant.	Big Horn.
Youghiogheny & Ohio Coal Co., Federal Bentonite Co. Division.	4614 Prospect Ave. Cleveland, Ohio 44103	.....do.....	Crook.
		.....do.....	Weston.
Coal:			
The Kemmerer Coal Co.....	Frontier, Wyo. 83121.....	2 strip mines, crushing and oil treatment plant.	Lincoln.
Pacific Power & Light Co.....	920 S.W. 6th Avenue Portland, Oreg. 97204	Strip mine.....	Converse.
Gypsum:			
Big Horn Gypsum Co.....	Box 590 Cody, Wyo. 82414	Open pit mine and wallboard plant.	Park.
Iron Ore:			
CF & I Steel Corp.....	Box 316 Pueblo, Colo. 81002	Underground mine and beneficiation mill.	Platte.
United States Steel Corp., Western Ore Operations.	Lander, Wyo. 82520.....	Open pit mine and agglomerator.	Fremont.
Lime:			
The Great Western Sugar Co...	Box 5308 Denver, Colo. 80217	Pot kiln at beet-sugar plant.	Big Horn.
Holly Sugar Corp.....	Holly Sugar Bldg. Colorado Springs, Colo. 80902	Shaft kiln at beet- sugar plant.	Goshen.
Natural gas and petroleum:¹			
Phosphate rock:			
Stauffer Chemical Company of Wyoming.	636 California Street San Francisco, Calif. 94108	Open pit mine and beneficiation plant.	Lincoln.

See footnotes at end of table.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel (commercial):			
Boatright-Smith-----	Box 1129 Casper, Wyo. 82602	Pits and plants-----	Natrona.
Gilpatrick Construction Co., Inc.	Box 973 Riverton, Wyo. 82501	Pit-----	Sublette.
		Pit-----	Sweetwater.
		Pit-----	Washakie.
Teton Construction Co.-----	Box 3243 Cheyenne, Wyo. 82001	Pit-----	Carbon.
		Pit-----	Johnson.
		Pit-----	Laramie.
Union Pacific Railroad Co.-----	1416 Dodge Street Omaha, Nebr. 68102	Pit-----	Albany.
Sodium Carbonate:			
Allied Chemical Corp., Industrial Chemicals Div.	Box 70 Morristown, N.J. 07960	Underground mine and refinery.	Sweetwater.
FMC Corp., Inorganic Chemicals Division.	Box 872 Green River, Wyo. 82935	-----do-----	Do.
Stauffer Chemical Company of Wyoming.	Box 513 Green River, Wyo. 82935	-----do-----	Do.
Stone:			
The Great Western Sugar Co.---	Box 5308 Denver, Colo. 80217	Quarry and plant.----	Laramie.
Guernsey Stone Co.-----	Box 337 Guernsey, Wyo. 82214	-----do-----	Platte.
Monolith Portland Midwest Co.	Box 40 Laramie, Wyo. 82070	2 quarries and plants--	Albany.
Union Pacific Railroad Co.-----	1416 Dodge Street Omaha, Nebr. 68102	Quarry and plant.----	Laramie.
Uranium:			
Federal American Partners-----	Box 991 Riverton, Wyo. 82501	3 open pit mines and mill.	Fremont.
Petrotomies Co.-----	Drawer 2450 Casper, Wyo. 82601	Open pit mine and mill.	Carbon.
Utah Construction & Mining Co.	Box 911 Riverton, Wyo. 82501	2 open pit mines, leaching operation.	Do.
		2 open pit mines, 2 under-ground mines, and mill.	Fremont.
Western Nuclear, Inc.-----	1700 Broadway, Suite 1900 Denver, Colo. 80202	5 underground mines, 1 open pit mine, leaching operation, and mill.	Do.

¹ Most of the major oil and gas companies and many smaller companies operate in Wyoming, and several commercial directories contain complete lists of them.

