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Minerals Yearbook

1980

Volume II

AREA REPORTS: DOMESTIC

Prepared by staff of the

BUREAU OF MINES

UNITED STATES DEPARTMENT OF THE INTERIOR • James G. Watt, Secretary

BUREAU OF MINES • Robert C. Horton, Director

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities to protect and conserve our land and water, energy and minerals, fish and wildlife, and park and recreation areas, and for the wise use of all those resources. The Department also has a major responsibility for American Indian reservation communities and for the people who live in Island Territories under U.S. administration.

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Foreword

Through the Minerals Yearbook and its predecessor volumes, the Federal Government has reported annually on mineral industry activities since 1882. This edition discusses the performance of the worldwide mineral industry during 1980 and provides background information to assist in interpreting developments during the year being reviewed. Content of the individual volumes follows:

Volume I, Metals and Minerals, contains chapters on virtually all metallic and nonmetallic mineral commodities important to the U.S. economy. In addition, it includes a chapter on mining and quarrying 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, and the Commonwealth of Puerto Rico. This volume also has a statistical summary.

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

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

Robert C. Horton, *Director*

Acknowledgments

The chapters of this volume were written by the State Mineral Specialists of the Bureau of Mines, located throughout the country.

The Statistical Summary chapter and the tabular material covering total State mineral production, value of mineral production by county, and economic indicators were prepared in the Branch of Domestic Data. The Division of Publication reviewed the manuscripts upon which this volume was based to insure statistical consistency among the tables, figures, and text between this volume and Volume I, and between this volume and those of former years.

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

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

Alabama: Geological Survey of Alabama.
Alaska: Alaska Department of Natural Resources.
Arizona: Arizona Bureau of Geology and Mineral Technology.
Arkansas: Arkansas Geological Commission.
California: California Division of Mines and Geology, Department of Conservation.
Colorado: Division of Mines of the State of Colorado.
Connecticut: Geological and Natural History Survey of Connecticut, Department of Environmental Protection.
Delaware: Delaware Geological Survey.
Florida: Bureau of Geology.
Georgia: Georgia Department of Natural Resources, Environmental Protection Division, Georgia Geologic Survey.
Hawaii: Department of Land and Natural Resources.
Idaho: Idaho Bureau of Mines and Geology, Idaho Department of Lands.
Illinois: State Geological Survey Division, Illinois Institute of Natural Resources.
Indiana: Geological Survey, Indiana Department of Natural Resources.
Iowa: Iowa Geological Survey.
Kansas: State Geological Survey of Kansas.
Kentucky: Kentucky Geological Survey.
Louisiana: Louisiana Geological Survey.
Maine: Maine Geological Survey.
Maryland: Maryland Geological Survey.
Massachusetts: Office of the State Geologist, Massachusetts Department of Environmental Quality.
Michigan: Geological Survey Division, Michigan Department of Natural Resources.
Minnesota: Mineral Resources Research Center, University of Minnesota.
Mississippi: Bureau of Geology and Energy Resources, Mississippi Department of Natural Resources.

Missouri: Department of Natural Resources, Division of Geology and Land Survey.
Montana: Montana Bureau of Mines and Geology.
Nebraska: Conservation and Survey Division of the University of Nebraska, Nebraska Geological Survey.
Nevada: Nevada Bureau of Mines and Geology.
New Hampshire: New Hampshire Department of Resources and Economic Development.
New Jersey: New Jersey Division of Natural Resources, Bureau of Geology and Topography.
New Mexico: New Mexico Department of Energy and Minerals.
New York: New York Geological Survey.
North Carolina: Division of Land Resources, North Carolina Department of Natural Resources and Community Development.
North Dakota: North Dakota Geological Survey.
Oklahoma: Oklahoma Geological Survey.
Oregon: Department of Geology and Mineral Industries.
Pennsylvania: Pennsylvania Bureau of Topographic and Geologic Survey, Department of Environmental Resources.
Puerto Rico: Department of Natural Resources.
Rhode Island: Department of Environmental Management.
South Carolina: South Carolina Geological Survey, State Division of Research and Statistical Services.
South Dakota: South Dakota Geological Survey.
Tennessee: Tennessee Division of Geology.
Texas: Bureau of Economic Geology, The University of Texas at Austin.
Utah: Utah Geological and Mineral Survey.
Vermont: Office of the State Geologist, Agency of Environmental Conservation.
Virginia: Virginia Division of Mineral Resources.
Washington: Washington Division of Geology and Earth Resources.
West Virginia: West Virginia Geological and Economic Survey.
Wisconsin: Wisconsin Geological and Natural History Survey.
Wyoming: Wyoming Geological Survey.

Albert E. Schreck, *Chief, Division of Publication*

Contents

Statistical Summary

By Rose L. Ballard[1]

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

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

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

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

[1]Statistical specialist, Branch of Domestic Data.

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

(Million dollars)

	Metals	Nonmetals	Total
1978	r6,298	13,525	r19,823
1979	r8,540	r15,440	r23,980
1980	8,875	16,233	25,108

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

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

Mineral	1978		1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS						
Antimony ore and concentrate short tons, antimony content	W	W	722	W	343	W
Bauxite thousand metric tons, dried equivalent	1,669	$23,186	1,821	$24,875	1,559	$22,353
Copper (recoverable content of ores, etc.) metric tons	r1,357,586	1,990,323	r1,443,556	r2,960,675	1,168,311	2,638,020
Gold (recoverable content of ores, etc.) troy ounces	998,832	193,325	r969,920	r298,250	951,348	582,758
Iron ore, usable (excluding byproduct iron sinter) thousand long tons, gross weight	82,826	2,387,965	86,130	2,811,574	69,562	2,543,484
Iron oxide pigments, crude short tons	75,967	2,799	74,548	2,578	62,642	4,043
Lead (recoverable content of ores, etc.) metric tons	529,661	393,516	525,569	609,929	549,484	514,363
Manganiferous ore (5% to 35% Mn) short tons, gross weight	312,124	3,074	240,696	2,902	173,887	2,444
Mercury 76-pound flasks	24,163	3,705	29,519	8,299	30,657	11,939
Molybdenum (content of concentrate) thousand pounds	130,694	607,950	143,504	871,067	149,311	1,344,181
Nickel (content of ore and concentrate) short tons	13,509	W	15,065	W	14,653	W
Silver (recoverable content of ores, etc.) thousand troy ounces	39,385	212,681	r38,087	r422,386	31,327	646,585
Titanium concentrate: Ilmenite short tons, gross weight	580,878	25,629	646,399	32,965	593,704	32,041
Tungsten ore and concentrate thousand pounds contained W	6,901	56,691	6,646	55,785	6,036	50,575
Vanadium (recoverable in ore and concentrate) short tons	4,272	56,776	5,520	73,892	4,806	64,370
Zinc (recoverable content of ores, etc.) metric tons	302,669	206,854	267,341	219,841	334,862	276,325
Combined value of beryllium, magnesium chloride for magnesium metal, platinum-group metals (1980), rare-earth metals, tin, titanium (rutile), zircon concentrate, and values indicated by symbol W	XX	133,849	XX	144,962	XX	141,492
Total metals	XX	r6,298,000	XX	r8,540,000	XX	8,875,000
NONMETALS (EXCEPT FUELS)						
Abrasive stones[2] short tons	487	1,283	r2,094	r2,064	2,131	2,233
Asbestos do.	102,632	27,987	102,903	28,925	88,271	30,599
Asphalt and related bitumens, native: Bituminous limestone, sandstone, gilsonite thousand short tons	1,697	19,283	1,614	25,622	1,252	25,030
Barite do.	2,112	43,981	r2,113	r53,581	2,245	65,957
Boron minerals do.	1,554	279,927	1,590	310,211	1,545	366,760
Bromine thousand pounds	446,543	100,003	r497,000	r114,500	381,600	92,600
Calcium chloride short tons	773,138	53,869	719,709	51,884	581,012	47,950
Carbon dioxide, natural thousand cubic feet	2,014,914	2,568	2,028,045	3,243	1,628,424	2,561
Cement:						
Portland thousand short tons	80,010	3,239,580	78,978	3,650,436	71,612	3,613,332
Masonry do.	4,123	208,566	3,748	204,797	3,040	188,456
Clays do.	56,822	717,274	54,689	846,089	48,790	898,947
Diatomite do.	651	72,429	717	90,323	689	100,610
Emery short tons	W	W	e10,005	e204	7,284	153
Feldspar do.	734,870	18,185	740,472	21,474	e710,000	e23,200
Fluorspar do.	129,428	13,262	109,299	12,162	92,635	12,611
Garnet (abrasive) do.	29,732	2,335	21,240	r3,746	26,909	3,957
Gem stones[e]	NA	8,930	NA	8,230	NA	6,930
Gypsum thousand short tons	14,891	92,726	14,630	99,868	12,376	103,061

See footnotes at end of table.

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

Mineral	1978		1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NONMETALS (EXCEPT FUELS) — Continued						
Helium:						
Crude ____ million cubic feet	549	$6,582	r537	r$6,444	299	$3,588
High-purity ____ do ____	1,001	25,276	r1,080	r24,840	1,159	26,657
Lime ____ thousand short tons	20,443	749,667	20,945	862,459	19,010	842,922
Mica:						
Scrap ____ do ____	182	8,035	r134	r7,708	117	5,296
Peat ____ do ____	750	12,988	798	15,517	788	16,190
Perlite ____ short tons	641,000	13,740	660,000	16,435	638,000	16,500
Phosphate rock thousand metric tons	50,037	928,820	51,611	1,045,655	54,415	1,256,947
Potassium salts ____ thousand metric tons, K_2O equivalent	2,307	226,468	2,388	279,199	2,217	353,862
Pumice ____ thousand short tons	4,757	14,455	r4,411	r15,509	3,755	15,484
Pyrites ____ thousand metric tons	778	12,336	1,049	17,087	847	13,812
Salt ____ thousand short tons	42,869	499,345	45,793	538,352	40,352	656,164
Sand and gravel ____ do ____	996,200	2,302,000	979,000	2,427,000	794,400	2,302,000
Sodium carbonate (natural) ____ do ____	6,790	371,255	W	W	W	W
Sodium sulfate (natural) ____ do ____	605	27,866	533	29,689	583	33,389
Stone[3] ____ do ____	1,050,960	2,885,689	r1,097,621	r3,388,058	981,620	3,393,478
Sulfur, Frasch process thousand metric tons	5,736	279,918	7,507	449,433	7,400	720,511
Talc and pyrophyllite thousand short tons	1,384	15,767	e1,453	e20,364	1,473	25,626
Tripoli ____ short tons	118,671	756	4116,009	46,279	121,233	676
Vermiculite ____ thousand short tons	337	19,734	346	21,955	337	23,483
Combined value of aplite, emery (1978), graphite, iodine, kyanite, lithium minerals, magnesite, magnesium compounds, greensand marl, olivine, staurolite, wollastonite, and values indicated by symbol W ____	XX	222,567	XX	r740,271	XX	941,112
Total nonmetals ____	XX	13,525,000	XX	r15,440,000	XX	16,233,000
Grand total ____	XX	r19,823,000	XX	r23,980,000	XX	25,108,000

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Combined value" figure. XX Not applicable.

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

[2]Grindstones, pulpstones, grinding pebbles, sharpening stones, and tube mill liners.

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

[4]Data represent prepared tripoli.

Table 3.—Nonfuel minerals produced in the United States and principal producing States in 1980

Mineral	Principal producing States, in order of quantity	Other producing States
METALS and NONMETALS		
Antimony ore and concentrate	Mont. and Idaho.	
Aplite	Va.	
Asbestos	Calif., Vt., Ariz.	
Asphalt (native)	Tex., Utah, Ala., Mo.	
Barite	Nev., Mo., Ark., Ga	Alaska, Ill., Mont., N. Mex., Tenn.
Bauxite	Ark., Ala., Ga.	
Beryllium concentrate	Utah.	
Boron minerals	Calif.	
Bromine	Ark. and Mich.	
Calcium-chloride	Mich. and Calif.	
Carbon dioxide (natural)	Colo., N. Mex., Utah, Calif.	
Cement	Tex., Calif., Pa., Mich	All other States except Alaska, Conn., Del., Mass., Minn., N.H., N.J., N. Dak., R.I., Vt.
Clays	Ga., Tex., Wyo., N.C	All other States except Alaska, Del., Hawaii, R.I., Vt.
Copper (mine)	Ariz., Utah, N. Mex., Mont	Calif., Colo., Idaho, Mich., Mo., Nev., Tenn.
Diatomite	Calif., Nev., Wash., Oreg.	
Emery	N.Y.	
Feldspar	N.C., Conn., Ga., Calif.	Okla., S. Dak.
Fluorspar	Ill., Nev.	
Garnet, abrasive	Idaho, N.Y., Maine.	
Gold (mine)	Nev., S. Dak., Utah, Ariz	Alaska, Calif., Colo., Idaho, Mo., Mont., N. Mex., Oreg., Wash.
Gypsum	Tex., Calif., Iowa, Mich.	Ariz., Ark., Colo., Idaho, Ind., Kans., La., Mont., Nev., N. Mex., N.Y., Ohio, Okla., S. Dak., Utah, Va., Wash., Wyo.
Helium	Kans., Okla., Tex., N. Mex.	
Iodine	Okla. and Mich.	
Iron ore	Minn., Mich., Calif., Wyo	Colo., Mo., Nev., N.Y., S. Dak., Tex., Utah, Wis.
Iron oxide pigments (crude)	Mich., Mo., Ga., Va.	
Kyanite	Va. and Ga.	
Lead (mine)	Mo., Idaho, Colo., Va	Alaska, Ariz., Calif., Ill., Mont., Nev., N.Y., Wash.
Lime	Ohio, Pa., Mo., Tex	All other States except Alaska, Del., Ga., Maine, N.H., N.J., N.C., R.I., S.C., Vt.
Lithium minerals	N.C. and Nev.	
Magnesite	Nev.	
Magnesium chloride	Tex.	
Magnesium compounds	Mich., Calif., Fla., N.J.	Del., Miss., Tex., Utah.
Manganiferous ore	Minn., N. Mex., S.C.	
Marl, greensand	N.J.	
Mercury	Nev. and Calif.	
Mica, scrap	N.C., N. Mex., S.C., Conn	Ala., Ga., Pa., S. Dak.
Molybdenum	Colo., Ariz., Utah, N. Mex	Calif.
Nickel	Oreg.	
Olivine	N.C., Wash.	
Peat	Mich., Fla., Ind., Ill	Calif., Colo., Ga., Iowa, Maine, Md., Mass., Minn., Mont., N.J., N. Mex., N.Y., N. Dak., Ohio, Pa., Wash., Wis.
Perlite	N. Mex., Ariz., Calif., Idaho	Colo., Nev., Utah.
Phosphate rock	Fla., Idaho, N.C., Tenn	Ala., Mont., Utah.
Platinum-group metals	Alaska.	
Potassium salts	N. Mex., Utah, Calif.	
Pumice	Oreg., Ariz., Calif., N. Mex	Colo., Hawaii, Idaho, Kans., Nev., Okla., Utah, Wash.
Pyrites, ore and concentrate	Tenn., Colo., Ariz.	
Rare-earth metal concentrate	Calif. and Fla.	
Salt	La., Tex., N.Y., Ohio	Ala., Ariz., Calif., Colo., Hawaii, Kans., Mich., Nev., N. Mex., N. Dak., Okla., Utah, W. Va.
Sand and gravel	Calif., Tex., Alaska, Ohio	All other States.
Silver (mine)	Idaho, Ariz., Colo., Mo	Alaska, Calif., Ill., Mich., Mont., Nev., N. Mex., N.Y., Oreg., S. Dak., Tenn., Utah, Wash.
Sodium carbonate (natural)	Wyo. and Calif.	
Sodium sulfate (natural)	Calif., Tex., Utah.	
Staurolite	Fla.	
Stone	Tex., Fla., Pa., Ill	All other States except Del. and N. Dak.
Sulfur (Frasch)	Tex. and La.	
Talc and pyrophyllite	Tex., Vt., Mont., N.Y	Ark., Calif., Ga., Nev., N.C., Oreg., Va.
Tin	Alaska and Colo.	
Titanium concentrate	Fla., N.J., N.Y.	
Tripoli	Ill., Okla., Ark., Pa.	
Tungsten concentrate	Calif., Colo., Nev., Utah	Alaska, Ariz., Idaho, Mont.
Vanadium	Colo., Utah, Idaho, Ark	N. Mex.
Vermiculite	Mont., S.C., Va.	
Wollastonite	N.Y.	
Zinc (mine)	Tenn., Mo., N.Y., N.J.	Ariz., Colo., Idaho, Ill., Mont., Nev., N. Mex., Pa., Va.
Zircon concentrate	Fla.	

Table 4.—Value of nonfuel mineral production in the United States and principal nonfuel minerals produced in 1980

State	Value (thousands)	Rank	Percent of U.S. total	Principal minerals, in order of value
Alabama	$328,633	22	1.31	Cement, stone, lime, clays.
Alaska	113,445	38	.45	Sand and gravel, stone, gold, tin.
Arizona	2,425,714	1	9.66	Copper, molybdenum, cement, silver.
Arkansas	286,631	25	1.14	Bromine, stone, cement, sand and gravel.
California	1,885,695	2	7.51	Cement, sand and gravel, boron minerals, stone.
Colorado	1,264,515	7	5.04	Molybdenum, cement, sand and gravel, silver.
Connecticut	65,763	43	.26	Stone, sand and gravel, feldspar, lime.
Delaware	[1]2,398	50	.01	Magnesium compounds, sand and gravel.
Florida	1,508,754	5	6.01	Phosphate rock, stone, cement, sand and gravel.
Georgia	770,688	9	3.07	Clays, stone, cement, sand and gravel.
Hawaii	59,676	44	.24	Stone, cement, sand and gravel, pumice.
Idaho	522,095	16	2.08	Silver, phosphate rock, lead, zinc.
Illinois	443,281	18	1.77	Stone, sand and gravel, cement, lime.
Indiana	288,470	24	1.15	Stone, cement, sand and gravel, lime.
Iowa	251,876	28	1.00	Cement, stone, sand and gravel, gypsum.
Kansas	261,593	27	1.04	Cement, salt, stone, sand and gravel.
Kentucky	204,300	32	.81	Stone, lime, cement, sand and gravel.
Louisiana	583,766	14	2.33	Sulfur, salt, sand and gravel, cement.
Maine	36,967	46	.15	Cement, sand and gravel, stone, gem stones.
Maryland	186,135	34	.74	Stone, cement, sand and gravel, clays.
Massachusetts	91,211	41	.36	Stone, sand and gravel, lime, clays.
Michigan	1,485,450	6	5.92	Iron ore, cement, magnesium compounds, salt.
Minnesota	1,782,310	3	7.10	Iron ore, sand and gravel, stone, lime.
Mississippi	103,940	40	.41	Cement, sand and gravel, clays, stone.
Missouri	1,056,756	8	4.21	Lead, cement, stone, lime.
Montana	279,550	26	1.11	Copper, silver, cement, gold.
Nebraska	80,474	42	.32	Cement, sand and gravel, stone, lime.
Nevada	386,149	20	1.54	Gold, barite, diatomite, sand and gravel.
New Hampshire	25,406	47	.10	Sand and gravel, stone, clays, gem stones.
New Jersey	149,448	37	.60	Stone, sand and gravel, zinc, titanium concentrate.
New Mexico	765,211	10	3.05	Copper, potassium salts, molybdenum, silver.
New York	497,891	17	1.98	Stone, cement, salt, sand and gravel.
North Carolina	379,366	21	1.51	Phosphate rock, stone, sand and gravel, cement.
North Dakota	22,376	48	.09	Sand and gravel, salt, lime, clays.
Ohio	562,340	15	2.24	Stone, lime, sand and gravel, salt.
Oklahoma	224,133	30	.89	Stone, cement, sand and gravel, gypsum.
Oregon	149,722	36	.60	Stone, sand and gravel, cement, nickel.
Pennsylvania	667,606	13	2.66	Cement, stone, lime, sand and gravel.
Rhode Island	6,170	49	.02	Sand and gravel, stone, gem stones.
South Carolina	194,779	33	.78	Cement, stone, clays, sand and gravel.
South Dakota	227,701	29	.91	Gold, stone, cement, sand and gravel.
Tennessee	407,837	19	1.62	Stone, zinc, cement, sand and gravel.
Texas	1,734,651	4	6.91	Cement, sulfur, stone, sand and gravel.
Utah	758,918	12	3.02	Copper, gold, molybdenum, silver.
Vermont	42,637	45	.17	Stone, asbestos, sand and gravel, talc.
Virginia	305,306	23	1.22	Stone, cement, lime, sand and gravel.
Washington	207,362	31	.83	Cement, sand and gravel, stone, lime.
West Virginia	106,286	39	.42	Stone, sand and gravel, cement, salt.
Wisconsin	152,284	35	.61	Stone, sand and gravel, iron ore, lime.
Wyoming	760,546	11	3.03	Sodium carbonate, clays, iron ore, stone.
Total	25,108,000	XX	100.00	

XX Not applicable.
[1]Incomplete total.

Table 5.—Value of nonfuel mineral production per capita and per square mile in 1980, by State

State	Area (square miles)	1980 population (thousands)	Value of mineral production				
			Total (thousands)	Per square mile		Per capita	
				Dollars	Rank	Dollars	Rank
Alabama	51,609	3,890	$328,633	6,368	26	84	22
Alaska	586,412	400	113,445	193	50	284	11
Arizona	113,909	2,718	2,425,714	21,295	3	892	2
Arkansas	53,104	2,286	286,631	5,398	30	125	17
California	158,693	23,669	1,885,695	11,883	14	80	24
Colorado	104,247	2,889	1,264,515	12,130	12	438	7
Connecticut	5,009	3,108	65,763	13,129	10	21	46
Delaware	2,057	595	[1]2,398	1,166	46	4	50
Florida	58,560	9,740	1,508,754	25,764	1	155	14
Georgia	58,876	5,464	770,688	13,090	11	141	15
Hawaii	6,450	965	59,676	9,252	18	62	27
Idaho	83,557	944	522,095	6,248	29	553	4
Illinois	56,400	11,418	443,281	7,860	21	39	40
Indiana	36,291	5,490	288,470	7,949	20	53	34
Iowa	56,290	2,913	251,876	4,475	33	86	21
Kansas	82,264	2,363	261,593	3,180	38	111	19
Kentucky	40,395	3,661	204,300	5,058	32	56	32
Louisiana	48,523	4,204	583,766	12,031	13	139	16
Maine	33,215	1,125	36,967	1,113	47	33	42
Maryland	10,577	4,216	186,135	17,598	6	44	38
Massachusetts	8,257	5,737	91,211	11,047	15	16	48
Michigan	58,216	9,258	1,485,450	25,516	2	160	13
Minnesota	84,068	4,077	1,782,310	21,201	4	437	8
Mississippi	47,716	2,521	103,940	2,178	43	41	39
Missouri	69,686	4,917	1,056,756	15,165	7	215	12
Montana	147,138	787	279,550	1,900	44	355	9
Nebraska	77,227	1,570	80,474	1,042	48	51	36
Nevada	110,540	799	386,149	3,493	36	483	6
New Hampshire	9,304	921	25,406	2,731	41	28	45
New Jersey	7,836	7,364	149,448	19,072	5	20	47
New Mexico	121,666	1,300	765,211	6,289	27	589	3
New York	49,576	17,557	497,891	10,043	16	28	44
North Carolina	52,586	5,874	379,366	7,214	24	65	26
North Dakota	70,665	653	22,376	317	49	34	41
Ohio	41,222	10,797	562,340	13,642	9	52	35
Oklahoma	69,919	3,025	224,133	3,206	37	74	25
Oregon	96,981	2,633	149,722	1,544	45	57	30
Pennsylvania	45,333	11,867	667,606	14,727	8	56	31
Rhode Island	1,214	947	6,170	5,082	31	7	49
South Carolina	31,055	3,119	194,779	6,272	28	62	28
South Dakota	77,047	690	227,701	2,955	40	330	10
Tennessee	42,244	4,591	407,837	9,654	17	89	20
Texas	267,338	14,228	1,734,651	6,489	25	122	18
Utah	84,916	1,461	758,918	8,937	19	519	5
Vermont	9,609	511	42,637	4,437	34	83	23
Virginia	40,817	5,346	305,306	7,480	23	57	29
Washington	68,192	4,130	207,362	3,041	39	50	37
West Virginia	24,181	1,950	106,286	4,395	35	55	33
Wisconsin	56,154	4,705	152,284	2,712	42	32	43
Wyoming	97,914	471	760,546	7,767	22	1,615	1
Total[2]	3,615,055	225,864	25,108,000	6,944	XX	111	XX

XX Not applicable.
[1]Incomplete total.
[2]Excludes Washington, D.C., with an area of 67 square miles and a population of 642,000 (which had no mineral production).

Table 6.—Nonfuel mineral production[1] in the United States, by State

Mineral	1978		1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
ALABAMA						
Cement:						
Masonry thousand short tons	356	$17,293	303	$13,930	242	$13,012
Portland do	2,837	108,972	2,578	103,187	2,491	108,438
Clays[2] do	2,782	24,885	2,571	33,824	2,022	29,832
Gem stones	NA	1	NA	2	NA	1
Lime thousand short tons	1,264	49,021	1,273	54,182	1,128	53,685
Sand and gravel do	r15,294	r35,692	13,747	31,319	11,165	25,763
Stone:						
Crushed do	26,572	82,767	26,443	83,566	23,433	82,270
Dimension do	13	1,739	12	2,071	11	2,259
Combined value of asphalt (native), bauxite, clays (bentonite), mica (crude), phosphate rock, and salt	XX	10,871	XX	14,286	XX	13,373
Total	XX	r331,241	XX	336,367	XX	328,633
ALASKA						
Gem stones	NA	60	NA	60	NA	50
Gold (recoverable content of ores, etc.) troy ounces	18,652	3,610	6,675	2,053	9,826	6,019
Lead metric tons	--	--	--	--	31	29
Sand and gravel thousand short tons	r69,295	r145,271	50,900	104,905	44,911	85,214
Silver (recoverable content of ores, etc.) troy ounces	2,000	11	(3)	5	8	172
Stone (crushed) thousand short tons	3,437	14,649	3,656	15,458	3,990	19,978
Combined value of barite (1979-80), copper (1978), platinum-group metals (1980), tin, and tungsten	XX	31	XX	r1,384	XX	1,983
Total	XX	r163,632	XX	r123,865	XX	113,445
ARIZONA						
Clays thousand short tons	143	731	138	642	151	1,151
Copper (recoverable content of ores, etc.) metric tons	r891,405	1,306,866	946,002	1,940,211	757,314	1,709,997
Gem stones	NA	4,600	NA	4,000	NA	3,100
Gold (recoverable content of ores, etc.) troy ounces	92,989	17,998	101,840	31,316	72,773	44,578
Gypsum thousand short tons	184	955	231	1,245	209	2,017
Lead (recoverable content of ores, etc.) metric tons	416	309	354	411	401	375
Lime thousand short tons	498	19,743	673	27,186	514	23,904
Molybdenum (content of concentrate) thousand pounds	W	W	35,101	213,065	35,668	341,965
Pumice thousand short tons	1,135	3,130	940	2,367	990	3,228
Sand and gravel do	r28,314	r69,096	430,520	474,716	24,399	73,773
Silver (recoverable content of ores, etc.) thousand troy ounces	6,638	35,844	7,479	82,941	5,668	116,984
Stone:						
Crushed thousand short tons	5,306	17,669	5,769	21,401	5,224	21,565
Dimension do	5	101	5	110	W	45
Combined value of asbestos, cement, feldspar (1978), fluorspar (1978-79), perlite, pyrites, salt, sand and gravel (industrial, 1979), tungsten, zinc, and value indicated by symbol W	XX	227,586	XX	90,870	XX	83,032
Total	XX	r1,704,628	XX	2,490,481	XX	2,425,714
ARKANSAS						
Abrasives short tons	W	W	273	1,520	280	1,686
Bauxite thousand metric tons	1,446	21,103	1,430	20,555	1,299	19,252
Clays thousand short tons	1,137	5,119	1,044	7,686	1,150	14,402
Gem stones	NA	150	NA	150	NA	140
Lime thousand short tons	171	5,708	160	6,287	175	7,785
Sand and gravel do	r16,896	r36,505	16,465	35,200	13,017	31,651
Stone:						
Crushed do	19,960	53,461	19,978	53,723	20,666	61,399
Dimension do	11	223	14	528	8	355
Combined value of barite, bromine, cement, gypsum, talc (soapstone), tripoli, vanadium, and value indicated by symbol W	XX	142,791	XX	r179,447	XX	149,961
Total	XX	r265,060	XX	r305,096	XX	286,631

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1978		1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
CALIFORNIA						
Asbestos ____ short tons	70,728	$19,281	76,332	$20,434	W	W
Boron minerals ____ thousand short tons	1,554	279,927	1,590	310,211	1,545	$366,760
Cement, portland ____ do.	9,290	473,486	9,724	541,815	8,797	542,487
Clays ____ do.	2,479	15,106	2,531	18,621	2,558	17,766
Diatomite ____ do.	379	48,998	422	60,989	W	W
Gem stones	NA	240	NA	240	NA	200
Gold (recoverable content of ores, etc.) troy ounces	7,480	1,448	3,195	982	3,651	2,236
Gypsum ____ thousand short tons	1,578	9,017	1,624	10,354	1,644	12,763
Lead (recoverable content of ores, etc.) metric tons	W	W	2	2	W	W
Lime ____ thousand short tons	522	21,691	564	25,545	554	29,444
Mercury ____ 76-pound flasks	--	--	151	43	226	88
Pumice ____ thousand short tons	831	3,458	r794	r3,478	568	3,159
Sand and gravel ____ do.	r115,091	r281,362	129,348	347,385	116,426	381,005
Silver (recoverable content of ores, etc.) thousand troy ounces	58	313	64	712	49	1,017
Stone:						
Crushed ____ thousand short tons	37,856	93,377	r38,593	r103,342	37,250	116,321
Dimension ____ do.	24	921	41	2,258	36	1,967
Talc ____ do.	106	3,795	176	6,960	100	1,863
Zinc (recoverable content of ores, etc.) metric tons	W	W	W	W	--	--
Combined value of calcium chloride, carbon dioxide, cement (masonry) (1978-79), copper, feldspar, iron ore, lithium compounds (1978), magnesium compounds, molybdenum, peat, perlite, potassium salts, rare-earth concentrates, salt, sodium carbonates, sodium sulfate, tungsten, and values indicated by symbol W ____	XX	259,232	XX	r312,925	XX	408,619
Total ____	XX	r1,511,652	XX	r1,766,296	XX	1,885,695
COLORADO						
Clays ____ thousand short tons	2548	2,753	2521	2,717	336	2,223
Copper (recoverable content of ores, etc.) metric tons	1,191	1,747	362	742	461	1,041
Gem stones	NA	75	NA	70	NA	70
Gold (recoverable content of ores, etc.) troy ounces	32,094	6,212	13,850	4,259	39,447	24,164
Gypsum ____ thousand short tons	235	882	275	1,727	227	3,409
Lead (recoverable content of ores, etc.) metric tons	15,151	11,257	7,554	8,767	10,272	9,615
Molybdenum ____ thousand pounds	W	W	W	W	102,498	915,304
Peat ____ thousand short tons	30	188	33	299	29	327
Sand and gravel ____ do.	r26,493	r58,596	25,680	456,263	427,433	474,452
Silver (recoverable content of ores, etc.) thousand troy ounces	4,217	22,773	2,809	31,151	2,987	61,653
Stone:						
Crushed ____ thousand short tons	6,229	15,683	6,835	19,435	6,277	20,068
Dimension ____ do.	5	178	3	163	6	259
Zinc (recoverable content of ores, etc.) metric tons	22,208	15,178	9,910	8,149	13,823	11,406
Combined value of beryllium (1978), carbon dioxide, cement, clays (bentonite) (1978-79), feldspar (1978), iron ore, lime, perlite, pumice, pyrites, salt, sand and gravel (industrial, 1979-80), tin, tungsten concentrate, vanadium, and values indicated by symbol W	XX	506,304	XX	692,356	XX	140,524
Total ____	XX	r641,826	XX	826,098	XX	1,264,515
CONNECTICUT						
Clays ____ thousand short tons	105	324	112	435	92	482
Lime ____ do.	29	1,564	33	2,053	19	1,352
Sand and gravel ____ do.	r11,011	r26,557	49,990	423,612	47,103	418,692
Stone:						
Crushed ____ do.	7,364	22,301	8,271	38,767	7,977	40,283
Dimension ____ do.	9	240	13	475	15	723
Combined value of feldspar, gem stones, mica, and industrial sand (1979-80) ____	XX	2,623	XX	3,894	XX	4,231
Total ____	XX	r53,609	XX	69,236	XX	65,763

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1978 Quantity	1978 Value (thousands)	1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
DELAWARE						
Clays thousand short tons	10	$8	11	$9	--	--
Sand and gravel do	1,449	2,468	1,674	3,281	1,075	$2,398
Total	XX	[5]2,476	XX	[5]3,290	XX	[5]2,398
FLORIDA						
Cement:						
Masonry thousand short tons	W	W	255	13,098	285	22,074
Portland do	2,766	111,892	2,957	126,562	3,574	182,590
Clays do	601	28,850	681	[2]31,308	614	[2]24,164
Gem stones	NA	5	NA	4	NA	5
Lime thousand short tons	180	8,182	210	11,440	195	12,434
Peat do	158	2,246	153	2,190	154	2,398
Sand and gravel do	[r]21,855	[r]36,946	21,708	39,520	[4]14,464	[4]28,831
Stone (crushed) do	57,354	128,905	[r]63,787	[r]188,896	66,209	215,972
Combined value of clays (kaolin, 1979-80), magnesium compounds, phosphate rock, rare-earth concentrate, sand and gravel (industrial, 1980), staurolite, titanium concentrates (ilmenite and rutile), zircon concentrates, and values indicated by symbol W	XX	781,742	XX	[r]856,589	XX	1,020,286
Total	XX	[r]1,098,768	XX	[r]1,269,607	XX	1,508,754
GEORGIA						
Cement:						
Masonry thousand short tons	W	W	102	5,172	89	5,464
Portland do	1,435	51,504	1,335	55,117	1,231	55,463
Clays do	8,476	358,654	8,322	437,671	8,283	500,555
Gem stones	NA	20	NA	20	NA	20
Sand and gravel thousand short tons	5,378	[r]12,552	[4]5,014	[4]10,792	[4]4,858	[4]11,898
Stone:						
Crushed do	41,572	131,959	40,902	154,021	40,884	162,642
Dimension do	277	15,879	244	17,908	231	17,466
Talc do	W	W	W	W	25	116
Combined value of barite, bauxite, feldspar, iron oxide pigments (crude), kyanite, mica, peat, sand and gravel (industrial, 1979-80), and values indicated by symbol W	XX	[r]18,394	XX	[r]18,870	XX	17,064
Total	XX	[r]588,962	XX	[r]699,571	XX	770,688
HAWAII						
Cement:						
Portland thousand short tons	441	25,626	469	29,346	358	23,722
Masonry do	11	828	12	1,077	13	960
Pumice do	272	658	359	1,240	314	1,200
Sand and gravel do	706	1,582	1,081	3,063	1,035	2,855
Stone:						
Crushed do	6,027	23,845	6,868	28,969	6,341	30,634
Dimension do	W	W	1	W	W	11
Combined value of other nonmetals and values indicated by symbol W	XX	209	XX	209	XX	294
Total	XX	52,748	XX	63,904	XX	59,676
IDAHO						
Antimony ore and concentrate, antimony content short tons	W	W	W	W	83	W
Clays thousand short tons	27	148	28	263	27	301
Copper (recoverable content of ores, etc.) metric tons	3,888	5,701	3,618	7,421	3,103	7,006
Gem stones	NA	50	NA	60	NA	60
Gold (recoverable content of ores, etc.) troy ounces	20,492	3,966	24,140	7,423	W	W
Lead (recoverable content of ores, etc.) metric tons	44,761	33,256	42,636	49,479	38,607	36,139
Phosphate rock thousand metric tons	4,461	80,765	4,880	95,728	4,991	100,873

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1978 Quantity	1978 Value (thousands)	1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
IDAHO—Continued						
Sand and gravel thousand short tons	8,112	r$19,294	47,719	4$18,149	45,299	4$14,203
Silver (recoverable content of ores, etc.) thousand troy ounces	18,379	99,249	17,144	190,129	13,695	282,663
Stone[6] thousand short tons	2,624	6,670	2,952	8,787	2,007	7,240
Zinc (recoverable content of ores, etc.) metric tons	32,353	22,111	29,660	24,391	27,722	22,876
Combined value of barite (1978), cement, garnet (abrasives), gypsum, lime, perlite, pumice, sand and gravel (industrial, 1979-80), stone (dimension), tungsten ore (1980), vanadium, and values indicated by symbol W	XX	28,021	XX	36,055	XX	50,734
Total	XX	r$299,231	XX	437,885	XX	522,095
ILLINOIS						
Cement, portland thousand short tons	2,112	80,242	1,889	79,604	1,649	75,315
Clays[2] do	742	3,185	542	2,355	459	1,919
Fluorspar short tons	115,859	12,452	W	W	W	W
Gem stones	NA	15	NA	15	NA	15
Peat thousand short tons	84	1,594	86	1,610	79	1,505
Sand and gravel do	r43,447	r127,914	45,448	134,190	31,725	122,332
Stone:						
Crushed do	62,453	160,352	63,551	188,130	53,309	180,656
Dimension do	3	122	3	128	2	103
Combined value of barite, cement (masonry), clays (fuller's earth), lead, lime, silver, tripoli, zinc, and values indicated by symbol W	XX	53,692	XX	70,498	XX	61,436
Total	XX	r$439,568	XX	476,530	XX	443,281
INDIANA						
Cement, portland thousand short tons	W	W	2,389	95,549	1,769	73,049
Clays do	1,277	2,495	1,185	2,341	932	1,930
Peat do	57	789	76	1,242	84	1,414
Sand and gravel do	r27,602	r$54,375	427,050	4$55,842	22,031	52,939
Stone:						
Crushed do	33,394	80,523	r34,147	r$92,630	30,910	92,106
Dimension do	234	12,972	r181	r$10,504	161	14,046
Combined value of abrasives (natural), cement (masonry), gypsum, lime, sand and gravel (industrial, 1979), and value indicated by symbol W	XX	139,830	XX	59,036	XX	52,986
Total	XX	r$290,984	XX	r$317,144	XX	288,470
IOWA						
Cement:						
Masonry thousand short tons	88	5,390	69	3,844	48	3,340
Portland do	2,646	107,335	2,371	109,628	1,998	101,008
Clays do	894	2,694	870	2,883	754	2,555
Gypsum do	1,602	12,175	1,695	13,777	1,468	13,136
Peat do	6	182	11	270	11	276
Sand and gravel do	r 417,672	r 437,312	17,495	39,686	412,683	432,722
Stone:						
Crushed do	31,310	88,618	32,471	103,215	26,542	92,603
Dimension do	10	480	10	508	10	509
Combined value of other nonmetals	XX	5,376	XX	4,090	XX	5,727
Total	XX	r$259,562	XX	277,901	XX	251,876
KANSAS						
Cement:						
Masonry thousand short tons	96	4,558	89	4,525	60	3,310
Portland do	2,083	78,717	2,086	88,619	1,835	86,103
Clays do	21,161	22,314	21,061	22,636	886	2,325
Pumice do	W	W	W	W	(3)	W
Salt[7] do	1,661	48,097	1,900	61,184	1,572	64,276
Sand and gravel do	r 414,257	r 424,329	14,280	26,490	412,124	423,817

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1978		1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
KANSAS—Continued						
Stone:						
Crushed thousand short tons	18,578	$48,803	19,308	$56,038	17,398	$54,731
Dimension do	W	W	W	W	18	937
Combined value of clays (bentonite), gypsum, helium (crude and high purity), lime, salt (brine), sand and gravel (industrial, 1978 and 1980), and values indicated by symbol W	XX	23,197	XX	r25,074	XX	26,094
Total	XX	r230,015	XX	r264,566	XX	261,593
KENTUCKY						
Clays thousand short tons	676	2,672	794	3,259	748	3,692
Gem stones	NA	1	NA	1	NA	1
Sand and gravel[4] thousand short tons	r13,177	23,900	11,726	23,721	7,767	17,637
Stone (crushed) do	40,772	107,949	W	W	W	W
Zinc (recoverable content of ores, etc.) metric tons	52	35	--	--	--	--
Combined value of cement, clays (ball clay), fluorspar (1978), lead (1978), lime, sand and gravel (industrial), and values indicated by symbol W	XX	56,790	XX	180,946	XX	182,970
Total	XX	191,347	XX	207,927	XX	204,300
LOUISIANA						
Clays thousand short tons	517	4,786	416	6,073	380	5,841
Salt do	14,263	110,472	14,207	113,167	12,662	132,182
Sand and gravel do	r22,007	r56,081	r20,446	r54,081	18,505	66,413
Stone (crushed) do	9,130	26,921	W	W	W	W
Sulfur (Frasch) thousand metric tons	1,984	W	2,858	W	2,590	W
Combined value of cement, gypsum, lime, sand and gravel (1979), and values indicated by symbol W	XX	157,996	XX	281,955	XX	379,330
Total	XX	r356,256	XX	455,276	XX	583,766
MAINE						
Clays thousand short tons	100	164	90	163	78	174
Gem stones	NA	W	NA	W	NA	W
Peat thousand short tons	4	153	3	202	8	534
Sand and gravel do	r11,526	r22,467	11,022	20,534	6,978	15,434
Stone (crushed) do	1,655	5,510	2,069	7,492	1,130	3,969
Combined value of other nonmetals and values indicated by symbol W	XX	14,485	XX	r17,507	XX	16,856
Total	XX	r42,779	XX	r45,898	XX	36,967
MARYLAND						
Clays[2] thousand short tons	948	2,642	975	2,854	733	2,267
Lime do	12	436	12	444	12	497
Peat do	W	W	3	W	4	W
Sand and gravel do	r13,306	r34,947	13,988	39,033	10,732	33,625
Stone:						
Crushed do	19,427	66,263	21,561	80,550	18,945	77,431
Dimension do	28	1,048	30	1,150	15	612
Combined value of cement, clays (ball clay), and values indicated by symbol W	XX	59,296	XX	68,931	XX	71,703
Total	XX	r164,632	XX	192,962	XX	186,135
MASSACHUSETTS						
Clays thousand short tons	155	333	156	367	210	870
Lime do	199	8,478	198	9,918	180	10,806
Peat do	2	65	2	56	W	W
Sand and gravel[4] do	r17,855	37,460	16,705	37,164	13,925	34,459
Stone:						
Crushed do	8,398	36,360	8,586	39,570	7,316	36,804
Dimension do	68	6,411	48	4,389	51	7,018

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1978 Quantity	1978 Value (thousands)	1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
MASSACHUSETTS—Continued						
Combined value of other nonmetals and value indicated by symbol W	XX	$961	XX	$1,082	XX	$1,254
Total	XX	90,068	XX	92,546	XX	91,211
MICHIGAN						
Cement:						
Masonry thousand short tons	294	13,621	262	16,455	206	14,292
Portland do	r5,917	211,786	5,682	252,058	4,651	224,685
Clays do	2,122	6,993	2,072	7,430	1,982	7,212
Gem stones	NA	10	NA	10	NA	10
Gypsum thousand short tons	2,765	15,526	2,526	14,633	1,383	8,605
Iron ore (usable), thousand long tons, gross weight	17,538	556,954	17,196	596,478	15,895	634,355
Lime thousand short tons	1,291	45,814	1,057	43,373	836	36,750
Peat do	220	3,851	258	4,847	253	4,739
Salt do	3,741	83,872	3,080	82,540	2,406	104,842
Sand and gravel do	r48,262	r107,574	50,169	116,597	36,597	98,354
Stone:						
Crushed do	40,129	r90,981	39,809	99,832	32,121	91,727
Dimension do	8	155	9	166	7	144
Combined value of bromine, calcium chloride, copper, iodine, iron oxide pigments (crude), silver, and magnesium compounds	XX	r223,205	XX	r272,107	XX	259,735
Total	XX	r1,360,342	XX	r1,506,526	XX	1,485,450
MINNESOTA						
Clays thousand short tons	2174	2,090	2135	21,905	94	1,206
Gem stones	NA	5	NA	5	NA	5
Iron ore (usable), thousand long tons, gross weight	56,473	1,627,099	59,682	1,965,710	45,472	1,686,839
Lime thousand short tons	116	4,263	140	5,133	162	3,562
Manganiferous ore short tons	253,399	W	181,503	W	119,029	W
Peat thousand short tons	20	716	21	827	25	1,140
Sand and gravel[4] do	31,080	r54,967	30,939	55,427	25,110	49,180
Stone:						
Crushed do	9,666	20,734	9,751	22,175	8,606	21,731
Dimension do	35	9,356	38	11,543	44	14,189
Combined value of abrasive stone (1979-80), clays (kaolin) (1978-79), sand and gravel (industrial), and values indicated by symbol W	XX	5,502	XX	5,265	XX	4,458
Total	XX	r1,724,732	XX	2,067,990	XX	1,782,310
MISSISSIPPI						
Clays thousand short tons	1,960	19,623	1,820	21,841	1,596	21,714
Lime do	49	1,108	70	1,571	31	707
Sand and gravel[4] do	r15,951	r33,515	16,940	37,797	11,710	31,606
Stone (crushed) do	2,409	5,176	W	W	W	W
Combined value of cement, magnesium compounds, sand and gravel (industrial), and values indicated by symbol W	XX	37,397	XX	46,480	XX	49,913
Total	XX	r96,819	XX	107,689	XX	103,940
MISSOURI						
Barite thousand short tons	121	4,661	89	3,679	117	5,570
Cement:						
Masonry do	89	4,112	82	4,159	62	3,117
Portland do	4,733	175,962	4,430	194,285	3,515	156,368
Clays do	22,258	216,880	2,351	20,522	1,817	16,798
Copper (recoverable content of ores, etc.) metric tons	10,818	15,861	13,021	26,705	13,576	30,655
Gem stones	NA	15	NA	10	NA	15
Gold (recoverable content of ores, etc.) troy ounces	--	--	32	10	W	W
Lead (recoverable content of ores, etc.) metric tons	461,762	343,070	472,054	547,824	497,170	465,393

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1978 Quantity	1978 Value (thousands)	1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
MISSOURI—Continued						
Lime thousand short tons	1,791	$63,642	r1,790	$70,187	1,667	$63,733
Sand and gravel do	r15,564	33,660	12,558	31,310	8,900	26,753
Silver (recoverable content of ores, etc.) thousand troy ounces	2,056	11,103	2,201	24,410	2,357	48,653
Stone:						
Crushed thousand short tons	57,265	130,568	56,380	139,944	48,296	130,254
Dimension do	1	208	(3)	85	W	W
Zinc (recoverable content of ores, etc.) metric tons	59,038	40,349	61,682	50,723	65,214	53,814
Combined value of asphalt (native), clays (fuller's earth, 1978), iron ore, iron oxide pigments (crude), and values indicated by symbol W	XX	r27,406	XX	r46,706	XX	55,633
Total	XX	r867,497	XX	r1,160,559	XX	1,056,756
MONTANA						
Antimony short tons	W	W	W	W	260	W
Clays thousand short tons	217	3,699	424	11,508	626	22,200
Copper (recoverable content of ores, etc.) metric tons	67,325	98,705	69,854	143,268	37,749	85,236
Gem stones	NA	100	NA	100	NA	90
Gold (recoverable content of ores, etc.) troy ounces	19,967	3,865	24,050	7,395	48,366	29,627
Lead (recoverable content of ores, etc.) metric tons	132	98	258	299	295	276
Lime thousand short tons	204	7,030	216	8,965	223	9,001
Sand and gravel do	6,391	14,230	7,012	15,106	6,639	16,057
Silver (recoverable content of ores, etc.) thousand troy ounces	2,918	15,759	3,302	36,618	2,024	41,773
Stone:						
Crushed thousand short tons	3,188	7,733	2,527	7,806	1,962	6,302
Talc do	319	5,152	343	5,940	312	11,310
Zinc (recoverable content of ores, etc.) metric tons	79	54	104	86	71	59
Combined value of barite, cement, gypsum, iron ore (1978-79), peat, phosphate rock, sand and gravel (industrial, 1978 and 1980), stone (dimension), tungsten, vermiculite, and values indicated by symbol W	XX	49,375	XX	54,196	XX	57,619
Total	XX	205,800	XX	291,287	XX	279,550
NEBRASKA						
Clays thousand short tons	146	418	156	454	154	456
Gem stones	NA	W	NA	W	NA	W
Sand and gravel thousand short tons	r16,719	r31,906	16,197	33,001	10,538	22,981
Stone (crushed) do	4,201	14,758	4,995	19,362	3,775	16,301
Combined value of cement, lime, and values indicated by symbol W	XX	36,287	XX	46,364	XX	40,736
Total	XX	r83,369	XX	99,181	XX	80,474
NEVADA						
Barite thousand short tons	1,788	30,034	r1,804	r35,707	1,918	47,800
Cement, portland do	431	22,613	W	W	W	W
Clays do	51	514	76	1,163	64	2,082
Copper (recoverable content of ores, etc.) metric tons	20,453	29,986	W	W	W	W
Gem stones	NA	1,000	NA	1,000	NA	900
Gold (recoverable content of ores, etc.) troy ounces	260,895	50,496	r250,097	r76,905	274,382	168,075
Gypsum thousand short tons	1,335	7,883	1,075	6,771	852	8,276
Lead (recoverable content of ores, etc.) metric tons	653	485	24	28	26	24
Mercury 76-pound flasks	24,163	3,705	29,368	8,256	30,431	11,851
Molybdenum pounds	99,311	469	39,826	242	--	--
Perlite thousand short tons	6	75	5	71	6	92
Pumice do	706	1,282	W	W	W	W
Sand and gravel[4] do	r10,035	r22,622	10,498	21,387	8,439	18,360

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1978		1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NEVADA—Continued						
Silver (recoverable content of ores, etc.) thousand troy ounces	804	$4,341	r560	r$6,215	671	$13,842
Stone (crushed) thousand short tons	1,426	5,489	1,602	6,439	1,809	7,407
Zinc (recoverable content of ores, etc.) metric tons	1,371	937	W	W	2	2
Combined value of diatomite, fluorspar, iron ore, lime, lithium compounds, magnesite, salt, sand and gravel (industrial), talc, tungsten, and values indicated by symbol W	XX	55,930	XX	96,062	XX	107,438
Total	XX	r237,411	XX	r260,246	XX	386,149
NEW HAMPSHIRE						
Sand and gravel thousand short tons	7,859	r16,295	7,086	15,301	6,334	15,837
Stone:						
Crushed do	914	2,634	866	2,172	590	2,281
Dimension do	61	4,077	86	5,774	103	7,167
Combined value of other nonmetals	XX	161	XX	11	XX	121
Total	XX	r23,167	XX	23,258	XX	25,406
NEW JERSEY						
Clays thousand short tons	68	376	67	559	63	525
Gem stones	NA	1	NA	1	NA	1
Lime thousand short tons	17	787	W	W	--	--
Peat do	24	568	23	549	20	564
Sand and gravel do	10,430	40,840	10,781	44,682	8,596	45,535
Stone, crushed[6] do	13,192	50,181	13,950	63,174	11,830	61,886
Zinc (recoverable content of ores, etc.) metric tons	28,915	19,761	31,118	25,589	28,859	23,814
Combined value of iron ore (1978), magnesium compounds, marl (greensand), stone (dimension), titanium concentrate (ilmenite), and value indicated by symbol W	XX	15,342	XX	17,135	XX	17,123
Total	XX	127,856	XX	151,689	XX	149,448
NEW MEXICO						
Clays[2] thousand short tons	65	108	74	124	60	114
Copper (recoverable content of ores, etc.) metric tons	127,827	187,405	164,281	336,934	149,394	337,328
Gem stones	NA	180	NA	180	NA	150
Gold (recoverable content of ores, etc.) troy ounces	9,879	1,912	22,976	7,065	15,787	9,670
Gypsum thousand short tons	263	2,649	251	3,244	182	1,688
Lead (recoverable content of ores, etc.) metric tons	W	W	43	49	--	--
Manganiferous ore (5% to 35% Mn) short tons	36,443	W	33,152	W	35,198	W
Mica (scrap) thousand short tons	16	W	17	W	W	W
Peat do	2	60	2	40	2	40
Perlite do	576	12,510	588	14,874	539	14,404
Potassium salts thousand metric tons	1,943	183,554	2,005	228,776	1,869	289,011
Pumice thousand short tons	631	2,706	r603	3,550	448	3,028
Salt do	180	1,617	W	W	W	W
Sand and gravel do	8,239	r17,853	7,141	18,245	7,050	17,676
Stone:						
Crushed do	2,438	6,157	2,589	6,743	2,217	7,259
Dimension do	18	115	20	117	18	91
Tin metric tons	W	W	--	--	--	--
Combined value of barite (1979-80), carbon dioxide, cement, clays (fire clay), helium (high-purity, 1978 and 1980), lime, molybdenum, silver, vanadium, zinc, and values indicated by symbol W	XX	60,736	XX	74,507	XX	84,752
Total	XX	r477,562	XX	694,448	XX	765,211

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1978		1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NEW YORK						
Clays[2] thousand short tons	659	$2,121	836	$3,027	596	$2,479
Emery short tons	W	W	10,005	204	7,284	153
Gem stones	NA	20	NA	20	NA	20
Lead (recoverable content of ores, etc.) metric tons	990	735	458	532	876	820
Peat thousand short tons	49	770	38	630	43	917
Salt do.	5,879	77,236	6,387	77,751	5,509	99,395
Sand and gravel[4] do.	r28,755	r59,275	26,242	55,889	21,918	53,276
Silver (recoverable content of ores, etc.) thousand troy ounces	21	113	11	117	21	427
Stone:						
Crushed thousand short tons	35,748	98,530	r37,499	r114,174	34,483	120,764
Dimension do.	25	2,586	27	2,626	25	2,414
Zinc (recoverable content of ores, etc.) metric tons	26,463	18,086	12,133	9,977	33,629	27,750
Combined value of cement, clays (ball clay), garnet (abrasive), gypsum, iron ore, lime, sand and gravel (industrial), talc, titanium concentrate (ilmenite), wollastonite, and value indicated by symbol W	XX	159,065	XX	r192,377	XX	189,476
Total	XX	r418,537	XX	r457,324	XX	497,891
NORTH CAROLINA						
Clays[2] thousand short tons	3,542	9,067	3,308	8,385	2,852	7,308
Feldspar short tons	509,291	11,178	523,663	e14,531	e499,600	e15,062
Gem stones	NA	50	NA	50	NA	40
Mica, scrap thousand short tons	97	5,729	r84	r5,847	78	3,680
Sand and gravel do.	11,446	28,080	11,203	29,733	9,309	28,735
Stone:						
Crushed do.	37,687	108,867	39,864	125,319	34,764	125,019
Dimension do.	40	3,050	49	3,932	55	4,536
Talc and pyrophyllite do.	W	W	e130	e692	W	W
Combined value of asbestos (1978), cement, clays (kaolin), lithium compounds, mica (sheet, 1978), olivine, phosphate rock, and values indicated by symbol W	XX	128,557	XX	153,752	XX	194,986
Total	XX	294,578	XX	r342,241	XX	379,366
NORTH DAKOTA						
Gem stones	NA	1	NA	1	NA	2
Peat thousand short tons	(3)	W	(3)	W	W	31
Sand and gravel do.	7,407	r17,166	6,648	15,128	5,173	14,457
Combined value of clays, lime, salt, and values indicated by symbol W	XX	4,966	XX	6,105	XX	7,886
Total	XX	r22,133	XX	21,234	XX	22,376
OHIO						
Cement:						
Masonry thousand short tons	196	10,955	170	10,869	126	8,549
Portland do.	2,022	75,637	1,921	87,483	1,625	77,696
Clays do.	3,778	15,394	3,374	13,495	2,718	11,516
Gypsum do.	171	1,375	W	W	136	1,346
Lime do.	3,467	129,316	3,392	141,663	2,786	122,817
Peat do.	10	90	8	191	10	166
Salt do.	3,897	74,572	4,135	79,598	3,228	87,371
Sand and gravel do.	47,158	112,157	45,944	121,048	36,972	114,291
Stone:						
Crushed do.	49,316	130,472	50,717	149,819	42,441	136,929
Dimension do.	90	3,295	50	1,702	35	1,558
Combined value of abrasives, gem stones, and value indicated by symbol W	XX	86	XX	1,452	XX	101
Total	XX	553,349	XX	607,320	XX	562,340
OKLAHOMA						
Clays thousand short tons	1,019	1,874	949	1,999	972	2,249
Gypsum do.	1,398	8,097	r1,480	r9,770	1,326	11,230

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1978		1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
OKLAHOMA—Continued						
Helium:						
High purity ____ million cubic feet	418	$11,771	r395	r$9,085	349	$8,027
Crude ____ do ____	68	822	r35	r420	23	276
Pumice ____ thousand short tons	1	W	1	W	1	W
Sand and gravel ____ do ____	r 4 10,846	r 4 19,056	12,101	32,502	11,881	37,162
Stone:						
Crushed ____ do ____	26,649	57,173	28,312	66,666	28,173	76,267
Dimension ____ do ____	24	902	38	1,383	16	678
Combined value of cement, feldspar, iodine, lime, salt, sand and gravel (industrial, 1978), tripoli, and values indicated by symbol W ____	XX	85,008	XX	80,696	XX	88,244
Total ____	XX	r184,703	XX	r202,521	XX	224,133
OREGON						
Cement:						
Masonry ____ thousand short tons	1	75	W	W	W	W
Portland ____ do ____	574	29,104	W	W	W	W
Clays ____ do ____	140	261	139	263	172	321
Copper (recoverable content of ores, etc.) metric tons	W	W	2	4	--	--
Gem stones ____	NA	600	NA	500	NA	450
Gold (recoverable content of ores, etc.) troy ounces	340	66	W	W	187	115
Lead (recoverable content of ores, etc.) metric tons	--	--	(3)	(3)	--	--
Nickel (content of ores and concentrates) short tons	13,509	W	15,065	W	14,653	W
Pumice ____ thousand short tons	915	2,016	r722	r1,555	1,090	2,734
Sand and gravel ____ do ____	r19,133	44,510	17,874	45,829	16,005	47,300
Silver (recoverable content of ores, etc.) thousand troy ounces	2	9	2	17	1	17
Stone:						
Crushed ____ thousand short tons	17,685	39,509	25,738	65,074	18,380	48,190
Dimension ____ do ____	W	W	(2)	4	15	231
Talc and soapstone ____ short tons	W	W	W	W	W	W
Combined value of diatomite, lime, stone (dimension, 1977-78), talc, tungsten concentrate (1977), and values indicated by symbol W ____	XX	12,693	XX	51,872	XX	50,364
Total ____	XX	128,843	XX	r165,118	XX	149,722
PENNSYLVANIA						
Cement:						
Masonry ____ thousand short tons	445	22,803	415	24,177	324	20,298
Portland ____ do ____	6,750	228,568	6,508	259,756	5,570	237,684
Clays[2] ____ do ____	2,571	18,175	2,468	20,099	1,650	12,112
Lime ____ do ____	2,126	83,869	2,153	96,569	1,768	84,291
Mica (scrap) ____ do ____	2	W	4	W	3	W
Peat ____ do ____	23	435	24	531	26	552
Sand and gravel ____ do ____	r 4 19,135	r 4 51,243	20,150	71,740	15,603	68,257
Stone:						
Crushed ____ do ____	69,041	194,518	r71,432	r224,014	61,143	218,231
Dimension ____ do ____	70	5,215	77	5,961	65	6,397
Zinc (recoverable content of ores, etc.) metric tons	19,099	13,053	21,447	17,636	22,556	18,613
Combined value of clays (kaolin), sand and gravel (industrial, 1978), tripoli, and values indicated by symbol W ____	XX	11,637	XX	1,237	XX	1,171
Total ____	XX	r629,516	XX	r721,720	XX	667,606
RHODE ISLAND						
Sand and gravel ____ thousand short tons	2,978	6,176	3,537	6,737	2,506	4,945
Stone, crushed ____ do ____	300	1,316	249	1,148	203	1,208
Combined value of other nonmetals ____	XX	1	XX	1	XX	17
Total ____	XX	7,493	XX	7,886	XX	6,170

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1978		1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
SOUTH CAROLINA						
Cement, portland thousand short tons	W	W	1,831	$79,377	1,704	$74,539
Clays[2] do.	2,358	$22,538	2,272	24,492	2,211	25,169
Gem stones	NA	5	NA	5	NA	5
Manganiferous ore thousand short tons	22	W	26	W	20	W
Mica (scrap) do.	49	782	rW	rW	W	W
Peat do.	16	W	W	W	--	--
Sand and gravel do.	8,344	r22,529	8,321	26,665	5,556	22,855
Stone:						
Crushed do.	16,997	44,237	16,589	48,352	16,107	49,207
Dimension do.	10	567	9	482	12	703
Combined value of cement (masonry), clays (fuller's earth), vermiculite, and values indicated by symbol W	XX	92,142	XX	r22,277	XX	22,301
Total	XX	r182,800	XX	r201,650	XX	194,779
SOUTH DAKOTA						
Cement:						
Masonry thousand short tons	W	W	7	434	6	377
Portland do.	W	W	670	31,273	459	23,042
Clays do.	2216	2268	205	292	2169	2283
Gem stones	NA	50	NA	50	NA	50
Gold (recoverable content of ores, etc.) troy ounces	285,512	55,261	245,912	75,618	267,392	163,794
Mica, scrap thousand short tons	(3)	4	(3)	2	(3)	4
Sand and gravel do.	6,404	r11,104	6,001	10,119	4,209	8,243
Silver (recoverable content of ores, etc.) thousand troy ounces	53	287	58	643	51	1,058
Stone:						
Crushed thousand short tons	3,693	8,376	3,891	10,317	3,151	8,942
Dimension do.	36	11,859	36	13,268	42	15,035
Combined value of clays (bentonite, 1978 and 1980), feldspar, gypsum, iron ore, lime, and values indicated by symbol W	XX	27,554	XX	6,670	XX	6,873
Total	XX	r114,763	XX	148,686	XX	227,701
TENNESSEE						
Cement:						
Masonry thousand short tons	217	10,443	170	8,600	132	7,241
Portland do.	1,568	60,223	1,335	57,146	1,304	58,827
Clays do.	1,760	21,719	1,561	26,071	1,188	22,844
Copper (recoverable content of ores, etc.) metric tons	11,289	16,550	W	W	W	W
Gem stones	NA	1	NA	1	NA	1
Phosphate rock thousand metric tons	1,709	14,047	1,873	14,770	1,582	12,765
Sand and gravel thousand short tons	r11,961	r28,631	11,210	29,056	8,921	24,930
Stone:						
Crushed do.	45,460	117,271	45,718	133,727	38,584	126,993
Dimension do.	12	1,035	12	1,000	10	883
Zinc (recoverable content of ores, etc.) metric tons	87,906	60,078	85,119	69,995	128,722	106,220
Combined value of barite, gold (1978), lead (1979), lime, pyrites, silver, and values indicated by symbol W	XX	16,845	XX	45,378	XX	47,133
Total	XX	r346,843	XX	385,744	XX	407,837
TEXAS						
Cement:						
Masonry thousand short tons	290	17,248	268	15,593	241	18,310
Portland do.	8,808	401,220	9,353	475,836	9,517	535,690
Clays do.	4,189	19,818	3,871	21,533	3,763	27,022
Gem stones	NA	170	NA	170	NA	160
Gypsum thousand short tons	1,864	11,060	1,903	11,438	1,681	14,124
Helium (high-purity) million cubic feet	32	1,132	r38	r874	35	805
Lime thousand short tons	1,408	48,882	1,507	59,520	1,515	67,075
Salt do.	9,100	49,153	11,283	67,602	9,978	93,414
Sand and gravel do.	56,925	149,599	52,846	167,076	46,704	171,576
Stone:						
Crushed do.	69,095	150,868	74,612	188,746	76,483	220,265
Dimension do.	28	4,192	17	3,636	37	7,095

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1978		1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
TEXAS—Continued						
Sulfur (Frasch) thousand metric tons	3,752	W	4,649	W	4,810	W
Talc and pyrophyllite thousand short tons	288	$1,520	207	$1,544	401	$4,295
Combined value of asphalt (native), fluorspar (1978-79), gold (1978), graphite (1978-79), helium (crude), iron ore, lead (1978), magnesium chloride, magnesium compounds, silver (1978), sodium sulfate, vermiculite (1978), zinc (1978), and values indicated by symbol W	XX	299,298	XX	r391,071	XX	574,820
Total	XX	1,154,160	XX	r1,404,639	XX	1,734,651
UTAH						
Clays thousand short tons	265	913	355	1,246	365	1,517
Copper (recoverable content of ores, etc.) metric tons	186,329	273,175	193,082	396,003	157,775	356,251
Gem stones	NA	75	NA	75	NA	70
Gold (recoverable content of ores, etc.) troy ounces	235,929	45,664	260,916	80,232	179,538	109,978
Gypsum thousand short tons	316	2,777	r292	r2,450	287	2,612
Iron ore (usable), thousand long tons, gross weight	1,961	21,224	1,618	19,391	1,307	18,540
Lead (recoverable content of ores, etc.) metric tons	2,541	1,888	W	W	--	--
Lime thousand short tons	225	7,196	198	8,250	259	13,293
Perlite do.	--	--	W	W	(3)	2
Pumice do.	28	270	28	280	35	347
Salt do.	956	13,532	1,204	14,723	1,157	19,373
Sand and gravel[4] do.	r12,585	r21,835	10,363	18,621	8,906	17,234
Silver (recoverable content of ores, etc.) thousand troy ounces	2,885	15,579	2,454	27,216	2,087	43,083
Stone:						
Crushed thousand short tons	2,817	9,716	3,424	11,059	2,919	11,776
Dimension do.	7	264	5	216	3	272
Tungsten thousand pounds	11	80	W	W	W	W
Zinc (recoverable content of ores, etc.) metric tons	r3,509	2,398	W	W	--	--
Combined value of asphalt (native), beryllium concentrate, carbon dioxide (natural), cement, magnesium compounds, molybdenum, phosphate rock, potassium salts, sand and gravel (industrial), sodium sulfate, vanadium, and values indicated by symbol W	XX	136,041	XX	169,520	XX	164,570
Total	XX	r552,627	XX	r749,282	XX	758,918
VERMONT						
Sand and gravel thousand short tons	3,726	6,425	3,660	6,240	1,900	4,171
Stone:						
Crushed do.	1,971	13,178	2,077	13,927	1,320	4,787
Dimension do.	137	17,681	180	23,006	169	23,649
Talc do.	315	2,238	346	2,755	318	2,753
Combined value of other nonmetals	XX	8,311	XX	8,208	XX	7,277
Total	XX	47,833	XX	54,136	XX	42,637
VIRGINIA						
Clays thousand short tons	1,043	3,266	1,059	3,512	762	3,172
Gem stones	NA	15	NA	15	NA	15
Lead (recoverable content of ores, etc.) metric tons	1,803	1,339	1,596	1,852	1,563	1,463
Lime thousand short tons	832	30,578	872	34,935	824	33,872
Sand and gravel[4] do.	r11,427	r29,073	11,803	32,268	8,264	29,508
Stone:						
Crushed do.	50,442	141,601	51,080	165,223	44,615	167,839
Dimension do.	10	1,943	9	2,042	27	2,287
Zinc (recoverable content of ores, etc.) metric tons	10,974	7,500	11,406	9,380	12,308	9,934
Combined value of aplite, cement, gypsum, iron oxide pigments, crude, kyanite, sand and gravel (industrial, 1979-80), talc, and vermiculite (1979-80)	XX	r49,727	XX	r60,562	XX	57,216
Total	XX	r265,042	XX	r309,789	XX	305,306

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1978		1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
WASHINGTON						
Cement:						
Masonry ____ thousand short tons	W	W	10	$741	W	W
Portland ____ do	1,760	$86,671	1,761	98,659	1,546	$89,208
Clays[2] ____ do	357	1,418	339	1,549	301	1,571
Gem stones	NA	170	NA	170	NA	150
Peat ____ thousand short tons	10	124	11	148	W	W
Pumice ____ do	50	63	r63	r202	23	W
Sand and gravel[4] ____ do	22,150	r49,442	24,258	59,382	19,019	46,731
Stone:						
Crushed ____ do	9,789	22,059	15,192	35,783	11,062	29,024
Dimension ____ do	5	454	4	268	6	248
Zinc (recoverable content of ores, etc.) metric tons	W	W	--	--	--	--
Combined value of clays (fire clay), copper (1978-79), diatomite, gold, gypsum, lead, lime, olivine, sand and gravel (industrial), silver, talc (1978), tungsten (1978-79), and values indicated by symbol W ____	XX	20,034	XX	28,248	XX	40,430
Total ____	XX	r180,435	XX	r225,150	XX	207,362
WEST VIRGINIA						
Clays[2] ____ thousand short tons	343	575	330	592	291	642
Salt ____ do	1,030	W	1,078	W	W	W
Sand and gravel[4] ____ do	3,264	r13,053	4,138	18,501	2,728	11,454
Stone (crushed) ____ do	11,582	32,897	11,713	37,624	9,766	36,305
Combined value of cement, clays (fire clay), lime, sand and gravel (industrial), stone (dimension, 1978-79), and values indicated by symbol W ____	XX	56,996	XX	61,878	XX	57,885
Total ____	XX	r103,521	XX	118,595	XX	106,286
WISCONSIN						
Gem stones	--	--	--	--	--	--
Iron ore (usable), thousand long tons, gross weight	W	W	736	W	679	W
Lime ____ thousand short tons	430	17,301	429	19,060	357	17,287
Peat ____ do	12	201	11	720	11	535
Sand and gravel ____ do	r30,474	r53,012	32,046	58,576	22,014	47,565
Stone:						
Crushed ____ do	24,385	46,990	23,924	52,804	20,603	49,245
Dimension ____ do	64	4,562	54	4,204	45	4,501
Combined value of abrasive stone, cement, clays, lead, (1978-79), zinc (1978-79), and values indicated by symbol W ____	XX	37,162	XX	44,318	XX	33,151
Total ____	XX	r159,228	XX	179,682	XX	152,284
WYOMING						
Clays ____ thousand short tons	3,632	66,975	3,471	75,096	3,081	71,512
Gem stones	NA	200	NA	200	NA	190
Gypsum ____ thousand short tons	370	2,995	366	3,100	312	2,731
Pumice ____ do	7	W	--	--	--	--
Sand and gravel ____ do	5,101	r11,242	e5,265	e11,419	e5,454	e12,523
Stone ____ do	e2,661	e8,037	5,013	15,634	4,374	14,835
Combined value of cement, feldspar (1978-79), iron ore, lime, phosphate rock (1978-79), sand and gravel (industrial, 1979-80), sodium carbonate (natural), stone (dimension, 1978), and value indicated by symbol W ____	XX	403,622	XX	484,727	XX	658,755
Total ____	XX	r493,071	XX	590,176	XX	760,546

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data. XX Not applicable.

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

[2]Excludes certain clays; value included with "Combined value" figure.

[3]Less than 1/2 unit.

[4]Excludes industrial sand and gravel; value included with "Combined value" figure.

[5]Total of items listed.

[6]Excludes certain stones; value included with "Combined value" figure.

[7]Excludes salt in brines; value included with "Combined value" figure.

Table 7.—Mineral production[1] in the islands administered by the United States

(Thousand short tons and thousand dollars)

Area and mineral	1978		1979		1980	
	Quantity	Value	Quantity	Value	Quantity	Value
American Samoa:						
Pumice	4	24	2	15	3	32
Stone	5	27	r1	r6	W	167
Total	XX	51	XX	r21	XX	199
Guam: Stone	824	3,433	669	2,483	529	2,163
Virgin Islands: Stone	258	1,816	W	2,828	W	W

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

Table 8.—Mineral production[1] in the Commonwealth of Puerto Rico

(Thousand short tons and thousand dollars)

Mineral	1978		1979		1980	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement	1,442	78,981	1,406	70,197	1,482	102,872
Clays	286	544	260	556	291	677
Lime	41	3,249	37	3,307	27	4,131
Salt	27	639	27	639	—	—
Sand and gravel	NA	NA	NA	NA	NA	NA
Stone	13,908	49,509	r14,119	r59,659	24,046	104,179
Total	XX	[2]132,922	XX	r [2]134,358	XX	[2]211,859

rRevised. NA Not available. 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 not available.

Table 9.—U.S. exports of principal minerals and products, excluding mineral fuels

Mineral	1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
METALS				
Aluminum:				
Ingots, slabs, crude ---- short tons	200,650	$264,296	714,906	$1,107,398
Scrap ---- do	307,080	290,316	444,681	483,138
Plates, sheets, bars, etc ---- do	248,027	501,850	306,214	715,899
Castings and forgings ---- do	7,404	35,671	7,496	30,626
Aluminum sulfate ---- metric tons	24,000	2,706	11,200	2,476
Other aluminum compounds ---- do	36,000	28,000	48,000	41,200
Antimony, metals and alloys, crude ---- short tons	485	675	453	1,186
Bauxite, including bauxite concentrate thousand metric tons	24	4,700	28	6,761
Beryllium ---- pounds	72,152	3,686	58,455	3,867
Bismuth, metals and alloys ---- do	427,809	1,408	128,732	942
Cadmium ---- metric tons	211	550	236	464
Chromium:				
Ore and concentrate:				
Exports ---- thousand short tons	27	2,514	6	1,447
Reexports ---- do	28	2,860	44	8,544
Ferrochromium ---- do	15	14,558	32	22,233
Cobalt ---- thousand pounds	726	17,845	583	14,576
Copper:				
Ore, concentrate, composition metal, and unrefined (copper content) ---- metric tons	57,225	85,085	117,508	226,145
Scrap ---- do	54,080	70,624	61,225	93,059
Refined copper and semimanufactures ---- do	173,006	486,053	105,377	440,967
Other copper manufactures ---- do	19,460	40,462	41,071	94,760
Ferroalloys not elsewhere listed:				
Ferrophosphorus ---- short tons	37,292	3,678	44,692	6,778
Ferroalloys, n.e.c ---- do	6,441	12,616	4,710	10,130
Gold:				
Ore and base bullion ---- troy ounces	901,527	287,361	1,416,634	860,501
Bullion, refined ---- do	15,589,872	4,620,503	4,702,197	2,787,431
Iron ore ---- thousand long tons	5,148	178,749	5,689	230,568
Iron and steel:				
Pig iron ---- short tons	105,116	10,058	73,000	8,016
Iron and steel products (major):				
Steel mill products ---- do	2,817,943	1,878,437	4,100,718	2,556,619
Other steel products ---- do	r374,011	r701,325	407,101	947,094
Iron and steel scrap:				
Ferrous scrap, including rerolling materials thousand short tons	11,197	1,158,064	11,423	1,257,049
Lead and zinc ores and concentrates ---- metric tons	32,902	19,677	27,615	11,118
Lead:				
Pigs, bars, anodes, sheets, etc ---- do	10,646	r13,929	164,458	164,835
Scrap ---- do	119,748	53,514	119,651	62,221
Magnesium, metal and alloys, scrap, semimanufactured forms, n.e.c ---- short tons	54,280	113,828	56,761	127,706
Manganese:				
Ore and concentrate ---- do	58,323	5,698	52,537	6,328
Ferromanganese ---- do	25,344	19,252	11,686	7,657
Silicomanganese ---- do	5,243	2,627	6,489	3,468
Metal ---- do	6,634	7,463	12,320	11,460
Mercury:				
Exports ---- 76-pound flasks	NA	NA	NA	NA
Reexports ---- do	NA	NA	NA	NA
Molybdenum:				
Ore and concentrate (molybdenum content) thousand pounds	72,242	658,882	68,217	715,431
Metals and alloys, crude and scrap ---- do	1,142	9,997	614	4,870
Wire ---- do	664	11,022	705	15,984
Semimanufactured forms, n.e.c ---- do	289	5,548	306	7,471
Powder ---- do	296	2,982	425	4,103
Ferromolybdenum ---- do	1,681	10,030	1,760	17,104
Compounds ---- do	10,293	110,163	10,154	89,303
Nickel:				
Alloys and scrap (including unwrought metal, ingots, bars, sheets, anodes, etc.) ---- short tons	38,570	220,943	45,204	285,545
Catalysts ---- do	5,197	19,993	3,530	18,559
Nickel-chrome electric resistance wire ---- do	733	7,993	1,087	11,766
Semifabricated forms, n.e.c ---- do	6,310	48,304	6,854	55,613
Platinum-group metals:				
Ore and scrap ---- troy ounces	189,218	47,394	173,053	68,836
Palladium, rhodium, iridium, osmiridium, ruthenium, and osmium (metal and alloys including scrap) ---- do	502,548	77,810	302,457	99,494
Platinum (metal and alloy) ---- do	207,832	76,953	289,454	172,876
Rare earths:				
Ferrocerium and alloys ---- short tons	42	273	17	196
Compounds ---- pounds	NA	NA	NA	NA

See footnotes at end of table.

Table 9.—U.S. exports of principal minerals and products, excluding mineral fuels —Continued

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
METALS —Continued					
Selenium	thousand pounds	333	$3,870	180	$1,689
Silicon:					
Ferrosilicon	short tons	22,357	14,740	27,488	18,572
Silicon carbide, crude and in grains	do	196,000	62,702	170,000	64,346
Silver:					
Ore, concentrate, waste, sweepings	thousand troy ounces	19,231	233,620	23,645	582,855
Bullion, refined	do	16,332	237,542	57,206	1,326,878
Tantalum:					
Ore, metal, other forms	thousand pounds	656	35,679	950	65,329
Powder	do	296	26,060	251	39,880
Tin:					
Ingots, pigs, bars, etc.:					
Exports	metric tons	568	8,074	595	10,194
Reexports	do	2,849	42,783	3,699	62,382
Tinplate and ternplate	do	399,525	204,986	641,401	440,671
Titanium:					
Ore and concentrate	short tons	9,903	2,057	17,830	3,444
Unwrought and scrap metal	do	5,302	20,409	3,757	16,660
Intermediate mill shapes and mill products, n.e.c	do	3,300	52,368	5,123	113,551
Pigments and oxides	do	51,456	48,151	45,795	49,357
Tungsten (tungsten content):					
Ore and concentrate	thousand pounds	1,929	12,909	2,029	15,454
Carbide powder	do	1,392	22,096	1,440	22,716
Alloy powder	do	662	10,907	1,138	18,308
Vanadium:					
Ore and concentrate (vanadium content)	do	201	824	92	517
Vanadium pentoxide, etc	do	1,891	5,139	1,448	2,728
Ferrovanadium	do	1,759	7,881	1,605	6,995
Zinc:					
Slabs, pigs, or blocks	metric tons	279	553	302	664
Sheets, plates, strips, other forms n.e.c	do	1,824	3,385	2,103	3,810
Waste, scrap, and dust (zinc content)	do	29,115	15,592	34,054	21,612
Semifabricated forms, n.e.c	do	1,827	2,671	1,289	2,580
Zirconium:					
Ore and concentrate	thousand pounds	17,712	2,589	15,455	2,732
Oxide	do	2,981	3,384	4,778	3,680
Metals, alloys, other forms	do	1,853	33,912	1,388	29,408
NONMETALS					
Abrasives:					
Industrial diamond, natural or synthetic, powder or dust	thousand carats	27,769	72,816	28,534	70,248
Industrial diamond, natural or synthetic, other	do	2,738	47,325	3,569	51,229
Diamond grinding wheels	do	589	6,638	730	7,437
Other natural and artificial metallic abrasives and products		NA	151,746	NA	112,428
Asbestos:					
Exports:					
Unmanufactured	metric tons	r44,695	r23,394	50,914	29,347
Products	do	NA	128,163	NA	132,689
Reexports:					
Unmanufactured	do	r1,155	r871	452	330
Products	do	NA	r2,743	NA	354
Barite:					
Natural barium sulfate and carbonate	short tons	108,841	10,861	96,819	13,794
Boron:					
Boric acid	do	41,956	22,938	45,318	23,735
Sodium borates, refined	do	332,308	e94,000	324,862	e64,737
Calcium:					
Other calcium compounds, including precipitated calcium carbonate	do	20,417	11,874	25,068	15,589
Chloride	do	30,307	5,723	49,215	9,754
Dicalcium phosphate	do	r55,996	24,114	43,314	27,577
Cement: Hydraulic	do	150,846	14,572	186,404	16,997
Clays:					
Kaolin or china clay	thousand short tons	1,583	125,946	1,392	133,716
Bentonite	do	853	55,252	898	62,207
Other	do	769	62,524	924	67,224
Diatomite	do	170	26,496	173	32,238
Feldspar, leucite, nepheline syenite	thousand pounds	24,572	1,025	25,998	896
Fluorspar	short tons	14,454	1,339	17,865	1,660
Gem stones:					
Diamond	thousand carats	1,196	884,600	1,325	1,041,200
Pearls		NA	800	NA	5,063
Other		NA	54,600	NA	71,460
Graphite	short tons	8,623	3,741	8,880	3,695

See footnotes at end of table.

Table 9.—U.S. exports of principal minerals and products, excluding mineral fuels —Continued

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
NONMETALS —Continued				
Gypsum:				
Crude, crushed or calcined thousand short tons	91	$10,891	88	$11,774
Manufactures, wallboard and plaster articles	NA	11,497	NA	15,448
Helium million cubic feet	e245	10,607	e298	10,629
Lithium hydroxide thousand pounds	5,798	7,728	6,681	9,600
Lime short tons	45,421	3,827	41,843	3,990
Magnesium compounds:				
Magnesite, dead-burned do	33,035	8,183	56,038	13,279
Magnesite, crude, caustic calcined, lump or ground do	68,375	16,433	51,703	17,692
Mica:				
Sheet, waste and scrap, and ground do	11,673	3,047	14,462	4,200
Manufactured pounds	NA	5,224	NA	7,664
Mineral-earth pigments, iron oxide, natural and synthetic short tons	4,852	7,359	5,046	9,132
Nitrogen compounds (major) thousand short tons	9,218	1,171,494	11,121	1,842,383
Phosphate rock thousand metric tons	14,787	431,981	14,320	508,524
Phosphatic fertilizers:				
Superphosphates do	r27,594	188,898	34,412	287,366
Ammonium phosphates do	r4,026	r676,194	4,995	1,095,944
Elemental phosphorus metric tons	29,604	35,675	30,443	45,631
Mixed chemical fertilizers thousand metric tons	NA	69,152	NA	NA
Pigments and compounds: Zinc oxide (metal content) do	r1	r1,139	(1)	344
Potash:				
Potassium chloride metric tons	891,200	66,050	1,175,000	134,140
Potassium sulfate do	227,800	13,410	113,900	18,970
Pumice and pumicite short tons	e2,000	NA	e1,000	NA
Quartz, crystal, natural thousand pounds	NA	NA	91	366
Salt:				
Crude and refined thousand short tons	697	r8,990	e903	13,254
Shipments to noncontiguous territories do	21	3,924	e19	e3,550
Sand and gravel:				
Construction:				
Sand do	324	r3,753	587	6,661
Gravel do	566	r1,171	687	1,480
Industrial:				
Sand do	r1,186	r27,517	1,177	32,519
Sodium compounds:				
Sodium sulfate thousand short tons	102	8,516	129	12,740
Sodium carbonate do	997	86,663	1,094	121,945
Stone:				
Crushed do	4,236	22,910	3,084	21,239
Dimension do	e225	17,275	e187	15,171
Sulfur:				
Crude thousand metric tons	1,963	142,966	1,673	185,866
Talc, crude and ground thousand short tons	316	15,210	275	14,963
Total	XX	r18,275,593	XX	23,310,898

eEstimated. rRevised. NA Not available. XX Not applicable.
1Less than 1/2 unit.

Table 10.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels

Mineral	1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
METALS				
Aluminum:				
Metal, short tons	570,634	$645,769	580,515	$777,606
Scrap, do	68,316	59,430	59,802	59,718
Plates, sheets, bars, etc, do	201,016	343,310	72,723	152,136
Aluminum oxide (alumina), metric tons	3,837,000	620,422	4,358,000	782,902
Antimony:				
Ore and concentrate (antimony content), short tons	7,732	11,860	5,235	11,646
Needle or liquated sulfide, do	r50	r255	34	216
Metal, do	3,022	r7,011	2,590	7,277
Oxide, do	13,679	17,921	12,224	15,771
Arsenic:				
White (As_2O_3 content), do	12,325	5,562	12,528	7,352
Metallic, do	405	1,881	266	1,524
Bauxite, crude, thousand metric tons	13,780	NA	14,087	NA
Beryllium ore, short tons	1,037	488	1,703	1,168
Bismuth, metal and alloys, gross weight, pounds	2,167,278	5,418	2,217,359	5,364
Cadmium:				
Metal, metric tons	2,572	13,840	2,617	14,181
Calcium:				
Metal, pounds	717,726	1,015	227,814	582
Chloride, short tons	58,091	3,018	46,439	2,071
Cesium compounds, pounds	23,182	928	11,823	619
Chromium:				
Ore and concentrate (Cr_2O_3 content), thousand short tons	416	55,604	410	56,525
Ferrochromium (gross weight), do	242	116,591	297	153,487
Ferrochromium-silicon, do	(1)	21	5	2,300
Metal, do	4	19,939	4	28,400
Cobalt:				
Metal, thousand pounds	18,887	462,250	14,992	358,583
Oxide (gross weight), do	505	9,429	414	7,630
Salts and compounds (gross weight), do	r331	r1,922	655	3,570
Columbium ore, do	3,564	13,083	4,595	20,289
Copper (copper content):				
Ore and concentrate, metric tons	30,416	48,146	52,361	72,636
Matte, do	414	543	392	719
Blister, do	24,701	39,709	44,537	86,284
Refined in ingots, etc, do	387,570	388,640	426,948	935,262
Scrap, do	22,198	33,805	22,768	40,865
Ferroalloys not elsewhere listed, short tons	r6,864	r33,349	6,083	36,213
Gallium, kilograms	6,401	2,672	6,175	2,637
Germanium, do	4,029	1,296	3,329	3,004
Gold:				
Ore and base bullion, troy ounces	255,896	79,534	451,509	243,230
Bullion, do	4,373,802	1,400,669	4,090,488	2,506,889
Hafnium, pounds	116	5	600	32
Indium, thousand troy ounces	294	3,779	299	5,103
Iron ore, thousand long tons	33,776	923,426	25,058	772,844
Iron and steel:				
Pig iron, short tons	476,342	63,251	400,031	63,036
Iron and steel products (major):				
Steel mill products, do	r17,518,189	r6,966,738	15,495,075	6,887,462
Other products, do	787,417	776,928	753,181	825,702
Scrap (including tinplate), thousand short tons	760	70,804	582	61,192
Lead:				
Ore flue dust, matte (lead content), metric tons	44,401	33,026	29,615	23,927
Base bullion (lead content), do	1,681	1,691	296	509
Pigs and bars (lead content), do	182,550	209,451	81,300	87,629
Reclaimed scrap, etc. (lead content), do	4,006	3,782	2,868	2,905
Sheet, pipe, shot, do	215	328	950	1,508
Magnesium:				
Metallic and scrap, short tons	r4,271	6,085	3,324	5,048
Alloys (magnesium content), do	412	1,767	344	1,770
Sheets, tubing, ribbons, wire, other forms (magnesium content), do	125	1,190	89	1,443
Manganese:				
Ore (35% or more contained manganese), do	499,782	27,485	697,516	46,413
Ferromanganese, do	821,213	254,843	605,703	211,365
Silicomanganese, do	94,671	34,756	74,975	29,291
Metal, do	6,683	5,545	7,915	7,767
Mercury:				
Compounds, pounds	109,515	489	32,371	222
Metal, 76-pound flasks	26,448	5,207	9,416	2,841
Molybdenum:				
Ore and concentrate (molybdenum content), thousand pounds	2,329	26,211	1,825	10,475
Waste and scrap (gross weight), do	336	5,596	373	7,246

See footnotes at end of table.

Table 10.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels —Continued

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
METALS —Continued					
Molybdenum —Continued					
Metal:					
Unwrought (molybdenum content)	thousand pounds	85	$1,566	163	$2,637
Wrought (gross weight)	do	104	2,305	137	4,031
Ferromolybdenum (gross weight)	do	62	636	45	243
Material in chief value molybdenum	do	690	12,060	1,953	18,701
Compounds	do	2,326	20,334	4,431	27,034
Nickel:					
Ore	short tons	4,977	12	1,124	13
Pigs, ingots, shot, cathodes	do	113,280	510,535	116,193	708,693
Plates, bars, etc	do	5,376	46,507	5,831	54,947
Slurry	do	r61,291	r123,060	77,459	208,742
Scrap	do	3,596	16,634	3,572	18,481
Powder and flakes	do	14,177	70,203	15,244	98,666
Ferronickel	do	62,593	91,340	51,741	104,156
Oxide	do	1,820	8,079	4,182	21,753
Platinum-group metals:					
Unwrought:					
Grains and nuggets (platinum)	troy ounces	8,232	3,074	15,427	6,768
Sponge (platinum)	do	1,352,054	482,206	1,191,803	560,642
Sweepings, waste, scrap	do	156,674	38,199	376,500	76,543
Iridium	do	33,166	8,617	26,090	12,974
Palladium	do	1,435,808	160,048	1,202,342	252,075
Rhodium	do	104,337	73,575	109,591	84,421
Ruthenium	do	124,887	5,786	98,488	4,220
Other platinum-group metals	do	103,640	33,801	122,454	105,559
Semimanufactured:					
Platinum	do	73,925	26,638	230,344	130,537
Palladium	do	68,626	8,482	114,246	23,256
Rhodium	do	4,681	1,266	686	594
Other platinum-group metals	do	13,098	345	13,811	2,834
Rare-earth metals:					
Ferrocerium, other cerium alloys	short tons	62	680	72	902
Monazite	do	6,931	1,677	5,674	1,850
Metals, including scandium and yttrium	pounds	8,974	186	8,469	307
Rhenium:					
Metal, including scrap	do	927	608	513	668
Ammonium perrhenate	do	8,299	3,259	4,991	7,889
Selenium and selenium compounds	do	683,903	11,123	625,472	7,966
Silicon:					
Metal (over 96% silicon content)	short tons	27,642	47,702	21,839	53,117
Ferrosilicon	do	113,553	57,621	71,152	42,640
Silver:					
Ore and base bullion	thousand troy ounces	9,928	83,266	9,700	187,019
Bullion	do	78,372	840,731	64,859	1,331,877
Sweepings, waste, dore	do	4,081	37,764	4,237	87,114
Tantalum ore	thousand pounds	1,532	30,135	2,510	78,829
Tellurium	pounds	167,760	3,189	64,860	1,629
Thallium	do	949	31	176	14
Tin:					
Concentrate (tin content)	metric tons	4,529	54,018	840	11,089
Dross, skimmings, scrap, residue and tin alloys, n.s.p.f.	do	1,350	11,011	1,312	4,215
Tinfoil, powder, flitters, etc		NA	16,732	NA	9,154
Tin scrap and other tin-bearing material excluding tinplate scrap		NA	12,513	NA	13,819
Tin compounds	metric tons	202	2,473	171	2,285
Titanium:					
Ilmenite[2]	short tons	295,688	13,946	552,482	27,088
Rutile	do	283,479	49,559	281,605	62,619
Metal	do	9,908	49,850	10,052	108,777
Ferrotitanium and ferrosilicon titanium	do	964	r2,702	623	1,679
Pigments	do	104,968	88,310	97,590	91,986
Tungsten (tungsten content):					
Ore and concentrate	thousand pounds	11,352	84,661	11,372	87,129
Vanadium (content):					
Ferrovanadium	do	1,033	5,967	525	3,477
Vanadium pentoxide	do	1,814	7,306	1,711	8,364
Vanadium-bearing materials	do	4,883	9,000	3,572	9,535
Zinc:					
Ore (zinc content)	metric tons	87,499	37,104	182,370	74,033
Blocks, pigs, slabs	do	524,130	390,599	410,163	319,288
Sheets, etc	do	244	267	1,342	1,041
Fume (zinc content)	do	28	2	25	7
Waste and scrap	do	3,259	1,530	3,470	1,361
Old, dross, skimmings	do	4,454	1,735	4,062	1,732
Dust, powder, flakes	do	3,586	3,440	3,928	3,672
Manufactures		NA	214	NA	254

See footnotes at end of table.

Table 10.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels —Continued

Mineral	1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
METALS —Continued				
Zirconium:				
Ore, including zirconium sand, short tons	110,842	$16,963	113,784	$10,595
Metal, scrap, compounds, do	2,078	25,955	1,934	25,026
NONMETALS				
Abrasives:				
Diamond (industrial), thousand carats	25,325	110,934	21,848	110,566
Other abrasives	NA	r159,665	NA	158,296
Asbestos, metric tons	513,084	135,210	327,296	91,809
Barite:				
Crude and ground, thousand short tons	1,515	66,287	1,854	102,401
Witherite, short tons	441	106	22,207	736
Chemicals, do	35,291	11,891	25,097	10,623
Boron:				
Boric acid, do	7,704	4,267	9,938	6,393
Calcium borate, crude, do	81,228	10,946	63,389	6,218
Cement: Hydraulic and clinker, thousand short tons	r9,413	r302,358	5,263	195,573
Clays, short tons	51,198	3,972	34,052	6,688
Cryolite, do	13,692	7,195	17,086	9,442
Feldspar:				
Crude, do	49	6	232	112
Ground and crushed, do	217	25	172	21
Fluorspar, do	1,021,085	80,090	899,219	94,103
Gem stones:				
Diamond, thousand carats	4,467	1,859,095	4,161	2,251,195
Emeralds, do	2,277	105,064	3,601	141,413
Other	NA	206,745	NA	432,635
Graphite, short tons	86,185	13,035	61,318	15,765
Gypsum:				
Crude, ground, calcined, thousand short tons	7,775	34,289	7,367	35,895
Manufactures	NA	30,790	NA	15,985
Iodine, crude, thousand pounds	6,201	18,454	6,234	28,848
Lime:				
Hydrated, short tons	85,169	3,450	62,423	3,129
Other, do	554,332	19,165	417,792	16,044
Lithium:				
Ore, do	4,390	r416	5,784	528
Compounds, do	28	r2,018	62	1,848
Magnesium compounds:				
Crude magnesite, do	109	5	46	20
Lump, ground, caustic-calcined magnesia, do	6,485	1,169	12,406	2,122
Refractory magnesia, dead-burned, fused magnesite, dead-burned dolomite, do	92,927	18,580	72,719	16,830
Compounds, do	36,439	5,619	36,124	5,907
Mica:				
Uncut sheet and punch, thousand pounds	10,587	3,147	11,877	3,305
Scrap, do	176	9	73	7
Manufactures, do	776	2,929	831	3,487
Mineral-earth pigments, iron oxide pigments:				
Ocher, crude and refined, short tons	3	2	1	1
Siennas, crude and refined, do	465	210	244	116
Umber, crude and refined, do	7,567	857	4,434	686
Vandyke brown, do	798	259	687	260
Other natural and refined, do	1,424	470	817	298
Synthetic, do	45,121	22,543	33,262	18,674
Nepheline syenite:				
Crude, do	2,260	28	6,760	71
Ground, crushed, etc, do	533,700	10,818	497,580	11,193
Nitrogen compounds (major), including urea, thousand short tons	4,737	467,766	5,110	583,808
Peat:				
Fertilizer-grade, short tons	372,530	38,807	344,363	41,134
Poultry- and stable-grade, do	8,033	1,176	57,204	6,528
Phosphate, crude, metric tons	886	21,595	486	12,856
Phosphatic materials:				
Fertilizer and fertilizer materials, thousand metric tons	21	3,014	32	5,737
Ammonium phosphates used as fertilizers, do	313	42,356	294	53,053
Elemental phosphorus, do	(1)	1,264	(1)	928
Other phosphatic materials, do	142	16,395	77	16,630
Pigments and salts:				
Lead pigments and compounds, metric tons	19,718	24,377	12,934	15,225
Zinc pigments and compounds, do	r37,071	50,617	38,628	30,062
Potash, do	8,505,000	r520,800	8,193,000	648,000

See footnotes at end of table.

Table 10.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels —Continued

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
NONMETALS —Continued				
Pumice:				
Crude or unmanufactured ---------- short tons	3,568	$163	4,618	$133
Wholly or partly manufactured ---------- do	869	83	323	37
Manufactured, n.s.p.f ----------	NA	123	NA	92
Quartz crystal (Brazilian pebble) -- thousand pounds	428	216	816	402
Salt ---------- thousand short tons	5,275	40,860	5,263	44,071
Sand and gravel:				
Industrial sand ---------- do	71	r1,600	39	1,575
Other sand and gravel ---------- do	352	r721	502	1,143
Sodium compounds:				
Sodium bicarbonate ---------- do	3	616	2	425
Sodium carbonate ---------- do	40	r4,292	18	2,389
Sodium sulfate ---------- do	r188	r9,511	230	13,242
Stone:				
Crushed ---------- do	3,835	9,954	3,529	9,767
Dimension ---------- do	NA	65,803	NA	88,948
Whiting ---------- do	4,339	15,981	3,823	13,015
Strontium:				
Mineral ---------- short tons	43,956	2,335	38,646	2,147
Compounds ---------- do	5,861	2,928	2,932	1,888
Sulfur and compounds, sulfur ore and other forms, n.e.s. ---------- thousand metric tons	2,494	94,147	2,523	138,852
Talc, unmanufactured ---------- thousand short tons	22	3	21	4
Total ----------	XX	r22,306,471	XX	26,194,286

r Revised. NA Not available. XX Not applicable.
[1]Less than 1/2 unit.
[2]Includes titanium slag averaging about 70% TiO_2. For detail see Titanium chapter.

Table 11.—Comparison of world and U.S. production of selected nonfuel mineral commodities

(Thousand short tons unless otherwise specified)

Mineral	1979			1980[p]		
	World production[1]	U.S. production	U.S. percent of world production	World production[1]	U.S. production	U.S. percent of world production
METALS, MINE BASIS						
Antimony (content of ore and concentrate) short tons	71,933	722	1	74,065	343	[2]
Arsenic, white[3] do	33,834	W	NA	31,620	W	NA
Bauxite thousand metric tons	87,676	[4]1,821	2	89,933	[4]1,559	2
Beryl[5] short tons	2,974	W	NA	3,098	W	NA
Bismuth thousand pounds	7,880	W	NA	7,321	W	NA
Chromite	10,511	--	--	10,725	--	--
Cobalt (content of ore and concentrate) short tons	31,628	--	--	32,965	--	--
Columbium-tantalum concentrate thousand pounds	77,482	--	--	78,509	--	--
Copper (content of ore and concentrate) thousand metric tons	7,675	1,444	19	7,617	1,168	15
Gold (content of ore and concentrate) thousand troy ounces	38,802	970	2	38,882	951	2
Iron ore (gross weight) thousand long tons	897,099	85,716	10	873,633	69,613	8
Lead (content of ore and concentrate) thousand metric tons	3,523	526	15	3,518	550	16
Manganese ore (35% or more Mn, gross weight)	28,880	--	--	29,429	--	--
Mercury thousand 76-pound flasks	190	30	16	191	31	16
Molybdenum (content of ore and concentrate) thousand pounds	229,384	143,967	63	238,101	150,686	63
Nickel (content of ore and concentrate)	753	15	2	850	15	2
Platinum-group metals[5] thousand troy ounces	6,486	7	[2]	6,830	3	[2]
Silver (content of ore and concentrate) do	345,958	38,087	11	341,370	31,327	9
Tin (content of ore and concentrate) metric tons	245,319	W	NA	246,247	W	NA
Titanium concentrates (gross weight):						
Ilmenite[5]	3,872	639	17	4,019	549	14
Rutile[5]	397	W	NA	467	W	NA
Tungsten concentrate (contained tungsten) thousand pounds	103,706	6,643	6	117,549	6,072	5
Vanadium (content of ore and concentrate) short tons	38,301	5,520	14	39,556	4,806	12
Zinc (content of ore and concentrate) thousand metric tons	5,917	267	5	5,761	335	6
METALS, SMELTER BASIS						
Aluminum (primary only)	16,053	5,023	31	16,940	5,130	30
Cadmium metric tons	18,592	1,823	10	17,716	1,578	9
Cobalt short tons	31,115	464	1	32,491	500	2
Copper smelter (primary and secondary)[6] thousand metric tons	8,060	1,396	17	7,953	1,053	13
Iron, pig	583,357	86,975	15	559,685	68,699	12
Lead, smelter (primary and secondary)[7] thousand metric tons	5,389	1,377	26	5,131	1,223	24
Magnesium (primary only)	341	162	48	351	170	48
Nickel[8]	756	44	6	832	44	5
Selenium[3] thousand pounds	3,528	587	17	2,936	311	11
Steel, raw	816,283	[9]136,341	17	779,973	[9]111,835	14
Tellurium[3] thousand pounds	471	W	NA	450	W	NA
Tin metric tons	246,602	[10]4,600	2	248,104	[10]3,000	1
Zinc (primary and secondary) thousand metric tons	6,255	526	8	6,036	370	6
NONMETALS						
Asbestos do	4,890	93	2	4,818	80	2
Barite	7,855	[11]2,112	27	8,326	[11]2,245	27
Boron minerals	3,082	1,590	52	2,997	1,545	52
Bromine thousand pounds	766,097	497,000	65	653,836	381,600	58
Cement, hydraulic	963,198	[12]85,904	9	977,626	[12]76,709	8
Clays:						
Bentonite[3]	6,776	[11]4,422	65	6,625	[11]4,185	63
Fuller's earth[3]	2,018	[11]1,568	78	1,953	[11]1,534	79
Kaolin[5]	23,189	[11]7,761	33	22,971	[11]7,879	34
Corundum	29	--	--	18	--	--
Diamond thousand carats	39,013	--	--	40,058	--	--
Diatomite	1,663	[11]717	43	1,654	[11]689	42
Feldspar[5]	3,782	740	20	3,782	710	19
Fluorspar	5,058	109	2	5,124	93	2
Graphite	591	W	NA	597	W	NA
Gypsum	83,455	14,630	18	78,290	12,296	16
Iodine, crude thousand pounds	25,169	W	NA	25,255	W	NA
Lime (sold or used)	132,654 [11]	[12]20,983	16	131,623 [11]	[12]19,037	14

See footnotes at end of table.

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

(Thousand short tons unless otherwise specified)

Mineral	1979			1980[p]		
	World production[1]	U.S. production	U.S. percent of world production	World production[1]	U.S. production	U.S. percent of world production
NONMETALS —Continued						
Magnesite	11,886	W	NA	11,933	W	NA
Mica (including scrap) thousand pounds	[13]544,287	[13]268,000	49	[13]508,990	[13]234,000	46
Nitrogen, N content of ammonia	76,908	14,932	19	78,086	15,733	20
Peat	223,186	825	([2])	223,066	785	([2])
Perlite	1,602	[11]660	41	1,592	[11]638	40
Phosphate rock thousand metric tons	130,171	51,611	40	134,888	54,415	40
Potash (K_2O equivalent) do	25,933	2,225	9	27,871	2,239	8
Pumice[3]	18,004	[14]4,413	25	17,712	[14]3,758	21
Salt	189,436	[11] [12]45,820	24	181,608	[11] [12]40,379	22
Sodium compounds, natural and manufactured:						
Sodium carbonate	31,639	8,253	26	32,091	8,275	26
Sodium sulfate	4,919	1,180	24	4,963	1,259	25
Strontium[3] metric tons	93,678	--	--	82,179	--	--
Sulfur, minerals all forms thousand metric tons	55,207	12,101	22	56,077	11,839	21
Talc, pyrophyllite, soapstone	7,109	[10]1,453	20	7,595	[11]1,473	19
Vermiculite[3]	595	[10]346	58	583	337	58

[p]Preliminary. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1]For those commodities for which U.S. data are withheld to avoid disclosing company proprietary data, the world total excludes U.S. output and the U.S. percent of world production cannot be reported.

[2]Less that 0.5%.

[3]World total does not include estimates for output in the U.S.S.R. or mainland China.

[4]U.S. figures represent dried bauxite equivalent of crude ore; to the extent possible, individual country figures that are included in the world total are also on the dried bauxite equivalent basis, but for some countries, available data is insufficient to permit this adjustment.

[5]World total does not include an estimate for output in mainland China.

[6]Primary and secondary blister and anode copper, including electrowon refined copper that is not included as blister or anode.

[7]Includes bullion.

[8]Refined nickel plus nickel content of ferronickel, and nickel oxide.

[9]Data from American Iron and Steel Institute. Excludes production of castings by companies that do not report steel ingot.

[10]Includes tin content of alloys made directly from ore.

[11]Quantity sold or used by producers.

[12]Includes Puerto Rico.

[13]Excludes sericite mica.

[14]Includes American Samoa.

The Mineral Industry of Alabama

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

By James R. Boyle[1] and Richard Raymond[2]

The value of Alabama's nonfuel mineral production in 1980 was $328.6 million, a decrease of $7.8 million from 1979. Cement, crushed stone, lime, clays, and sand and gravel continued as the major commodities produced.

Alabama led the Nation in the production of crushed marble; was second in bauxite; third in native asphalt, ferroalloys, kaolin, and oyster shell; fourth in dimension marble, masonry cement, and bentonite; and fifth in fire clay and lime. Alabama ranked in the top 20 States in total value of nonmetallic minerals produced.

Adverse economic conditions in the construction and metals industries impacted on the minerals industry in Alabama. Mineral producers supplying raw or finished materials to these industries experienced periodic reductions in sales during the year. Unit price increases did not keep up with inflation.

The inflationary trend of the seventies is evident by comparison of the 1980 mineral production with that of 1970. During these 10 years, clay production decreased nearly one-third, while total value increased over 300%; sand and gravel production doubled, while total value increased over 500%. In general, total production increased about one-third, while total value in 1980 was 190% of that in 1970.

Table 1.—Nonfuel mineral production in Alabama[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry thousand short tons	303	$13,930	242	$13,012
Portland do.	2,578	103,187	2,491	108,438
Clays[2] do.	2,571	33,824	2,022	29,832
Gem stones	NA	2	NA	1
Lime thousand short tons	1,273	54,182	1,128	53,685
Sand and gravel do.	13,747	31,319	11,165	25,763
Stone:				
Crushed do.	26,443	83,566	23,433	82,270
Dimension do.	12	2,071	11	2,259
Combined value of asphalt (native), bauxite, clays (bentonite), mica (crude), phosphate rock, and salt	XX	14,286	XX	13,373
Total	XX	336,367	XX	328,633

NA Not available. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes bentonite; value included with "Combined value" figure.

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

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Autauga	W	W	Sand and gravel.
Baldwin	W	W	Clays.
Barbour	W	W	Clays, bauxite.
Bibb	W	W	Stone, clays, sand and gravel.
Blount	W	W	Cement, stone.
Calhoun	W	W	Stone, clays, sand and gravel.
Cherokee	W	$175	Sand and gravel.
Chilton	W	W	Sand and gravel, clays.
Clarke	W	942	Sand and gravel.
Clay	$4	16	Do.
Coffee	107	135	Do.
Colbert	W	W	Stone, native asphalt, sand and gravel.
Conecuh	W	W	Sand and gravel.
Crenshaw	W	W	Do.
Dale	W	W	Do.
Dallas	W	2,288	Sand and gravel, clays.
De Kalb	W	862	Stone.
Elmore	W	1,994	Sand and gravel, clays.
Escambia	857	W	Do.
Etowah	W	W	Stone, sand and gravel.
Fayette	184	W	Sand and gravel, stone.
Franklin	W	W	Stone, sand and gravel.
Geneva	W	417	Sand and gravel.
Greene	W	W	Do.
Hale	233	233	Do.
Henry	W	W	Clays, bauxite.
Houston	W	W	Sand and gravel.
Jackson	W	W	Stone.
Jefferson	W	W	Cement, stone, clays.
Lamar	W	W	Sand and gravel.
Lawrence	--	638	Stone.
Lee	W	W	Sand and gravel.
Limestone	W	W	Phosphate rock.
Lowndes	W	W	Clays, sand and gravel.
Macon	3,682	2,287	Sand and gravel.
Madison	W	W	Stone, sand and gravel, clays.
Marengo	W	W	Cement, stone.
Marion	275	361	Sand and gravel, clays.
Marshall	W	W	Stone, clays.
Mobile	W	W	Cement, stone, sand and gravel, clays.
Monroe	323	164	Sand and gravel.
Montgomery	W	W	Sand and gravel, clays.
Morgan	W	2,082	Stone.
Randolph	W	W	Stone, mica.
Russell	W	W	Sand and gravel, clays.
St. Clair	W	W	Cement, clays, stone, sand and gravel.
Shelby	W	W	Lime, cement, stone, clays.
Sumter	2,122	W	Clays, sand and gravel.
Talladega	W	W	Stone.
Tuscaloosa	913	1,137	Sand and gravel.
Walker	878	--	
Washington	W	W	Salt, stone, sand and gravel.
Wilcox	--	64	Stone.
Undistributed[2]	321,663	322,573	
Total	331,241	[3]336,367	

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

[1]The following counties are not listed because no nonfuel mineral production was reported: Bullock, Butler, Chambers, Choctaw, Cleburne, Coosa, Covington, Cullman, Lauderdale, Perry, Pickens, Pike, Tallapoosa, and Winston.

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

[3]Data do not add to total shown because of independent rounding.

Trends and Developments.—Although economic conditions in 1980 were unfavorable for many of the State's mineral producers, a significant number of companies continued plans to construct new or expand existing facilities. The Alabama Development Office, in its 1980 report on new and expanding mineral-related industries, announced 164 expansions totaling $181.4 million as follows: Mining and Quarrying of Nonmetallic Minerals, 19 expansions, with a total investment of $14.3 million; Stone, Clay, Glass, and Concrete Products, 70 expansions, with a total investment of $57.1 million; and Primary Metals, 75 expansions, with a total investment of $110.0 million. These expansions were expected to create nearly 900 jobs.

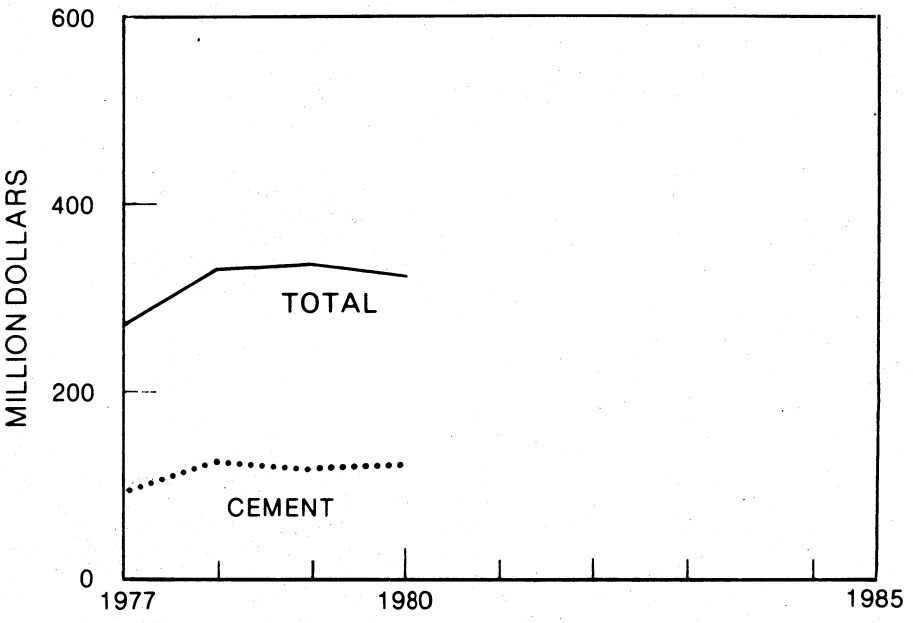

Figure 1.–Value of cement and total value of nonfuel mineral production in Alabama.

The Alabama State Docks at the Port of Mobile handled nearly 25 million tons of material during fiscal year 1980. Bulk materials comprise the major activity at the facility, with iron ore and bauxite being two of the major materials handled. The movement of these ores is vital to the operation of many heavy industries in the State.

Major imports through the State Dock facilities included iron ore (1,855,824 tons), bauxite (1,350,945 tons), manganese (89,600 tons), and rutile (26,780 tons). In addition to direct handling of raw materials, the general port tonnage through private facilities included 2,431,239 tons, mostly iron ore.

The bulk materials handling plant has been under a major renovation program for more than 3 years. A second 1,500-ton-per-hour ship unloader was received and scheduled for installation early in 1981. Total cost of all phases of the program will be $22 million.

The steel industry in the State suffered major shutdowns during the year, but ended on a relatively optimistic note. A sharp decline in orders forced United States Steel Corp. to temporarily shut down its Fairfield works near Birmingham for the first time in the plant's history. Of 8,500 employees, 5,500 were unemployed. By yearend, because of depleted stocks and an increase in steel rail orders, one blast furnace was back online, and employment rose to 5,400. Republic Steel Corp. experienced a similar shutdown at their Gadsden operation. During the year, one blast furnace was shut down, and the hot strip mill operated intermittently. Late in the year, the company announced plans to return the blast furnace to operation. Because of increased oil exploration activity, United States Steel Corp. announced the possibility of building a $400 million steel tube plant. By yearend the location of the proposed plant had not been selected, but the Fairfield works was considered a strong possibility as the site.

American Cast Iron Pipe Co. (Acipco) in Birmingham installed a $3 million system to capture and burn waste gases from the furnaces. The system, a recuperative heater, reduces plantwide demand for natural gas by 15%. Heat from burning the waste gases is captured and channeled to the blast furnace, one of the largest iron-melting facilities in the world. Alabama Gas Corp. estimates that 1,200° of heat generated by these waste gases represents enough energy saved to heat 2,600 Birmingham homes. The new system will also reduce the level of stack emissions from the blast furnace. Acipco, one of the largest producers of cast iron pipe in the world, makes various prod-

ucts ranging from fire hydrants to 54-inch-diameter pipes.

Legislation and Government Programs.—The Alabama Water Improvement Commission further amended their Surface Mining Regulations to prevent, reduce, and control new or existing water pollution associated with surface mining operations. In addition, guidelines were developed for minimizing the effects of surface mining and surface effects of underground mining on water quality.

In fiscal year 1980, the Federal Bureau of Mines contracted with Wyle Laboratories, Huntsville, to investigate noise control. The studies included noise control associated with auger cutting heads, screens for mineral preparation, longwall mining systems, and proposed machine redesign concepts. A separate contract involved evaluation of machine cabs for control of dust and other health and safety factors. Since fiscal year 1977, about $2.4 million has been committed to contractor research in Alabama. These activities are part of the Bureau's continuing work in the health and safety area.

The University of Alabama College of Engineering appointed Dr. Howard L. Hartman to the Endowed Chair of Mining Engineering, Department of Mineral Engineering. The Chair is supported by contributions from member companies of the mining industry of Alabama.

The Mineral Resources Institute of the University of Alabama conducted research in five areas; exploration, mining, processing, utilization, and conservation. Specific research sponsored by industry and government was carried out not only on coal and lignite, but also on clays, iron ore, and solid waste. The institute also conducted short courses on mineral waste handling, mining, mineral processing, and mine reclamation techniques.

The Alabama Development Office (ADO), through its State Planning Div., continued to be active in several areas related to the minerals industry. ADO administered geologic and minerals investigations conducted by the Geological Survey of Alabama to assist potential industrial developers.

The Geological Survey of Alabama conducted investigations and published 27 various reports and maps in cooperation with local, State, and Federal agencies. Although emphasis was mainly on energy development, significant activity was conducted in the nonfuel minerals area. The Geologic Div. completed mapping efforts on the Geologic Map of Quaternary and Surficial Units

Table 3.—Indicators of Alabama business activity

	1979	1980[p]	Change, percent
Employment and labor force, annual average:			
Total civilian labor force ---- thousands	1,624.0	1,642.0	+1.1
Unemployment ---- do	116.0	144.0	+24.1
Employment (nonagricultural):			
Mining[1] ---- do	16.7	16.9	+1.2
Manufacturing ---- do	374.9	362.0	-3.4
Contract construction ---- do	75.4	72.1	-4.4
Transportation and public utilities ---- do	71.7	71.5	-.3
Wholesale and retail trade ---- do	275.6	273.3	-.8
Finance, insurance, real estate ---- do	58.3	58.6	+.5
Services ---- do	197.8	204.4	+3.3
Government ---- do	291.6	299.5	+2.7
Total nonagricultural employment[1] ---- do	1,362.0	1,358.3	-.3
Personal income:			
Total ---- millions	$26,275	$28,964	+10.2
Per capita	$6,971	$7,484	+7.4
Construction activity:			
Number of private and public residential units authorized	17,610	16,469	-6.5
Value of nonresidential construction ---- millions	$454.0	$414.6	-8.7
Value of State road contract awards ---- do	$311.1	$230.0	-26.1
Shipments of portland and masonry cement to and within the State, thousand short tons	1,386	1,226	-11.5
Nonfuel mineral production value:			
Total crude mineral value ---- millions	$336.4	$328.6	-2.3
Value per capita, resident population	$89	$84	-5.6
Value per square mile	$6,518	$6,368	-2.3

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.

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

of Alabama and on a geologic map of the Alabama portion of the Atlanta 2° Quadrangle. The Mineral Resources Div. assisted industrial mineral producers in the State, and inventoried potential small-scale hydropower sites in the State. The Water Resources Div. initiated a study of seven major aquifers in the gulf coastal plain to provide baseline information for underground waste injection control. The Environmental Div. conducted several major ecological studies in coordination with other programs.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Nonmetals accounted for the bulk of the value of Alabama's total mineral production.

Asphalt (Native).—Alabama ranked third in the Nation in production of native asphalt. Southern Stone Co. produced asphaltic limestone at the Margerum quarry in Colbert County.

Cement.—Cement accounted for more than one-third of the value of nonmetallic mineral production. Nationally, Alabama ranked fourth in the production of masonry cement and eighth in portland cement. Production of both cements decreased; total value of portland cement increased, while masonry cement's value decreased slightly.

Portland cement was produced at seven plants in the State; three in Jefferson County, and one each in Marengo, Mobile, St. Clair, and Shelby Counties. Output was approximately 67% of capacity. Major end uses for portland cement were ready-mix concrete, concrete products, building materials, and highway construction.

Raw materials used in making cement totaled nearly 4.5 million tons of cement rock, limestone, chalk, clay, sand, shale, iron ore, oyster shell, and other materials.

Table 4.—Alabama: Portland cement salient statistics

(Short tons)

	1979	1980
Number of active plants	7	7
Production	2,681,824	2,520,029
Shipments from mills:		
Quantity	2,577,793	2,491,306
Value	$103,186,956	$108,437,688
Stocks at mills, Dec. 31	273,053	278,888

Table 5.—Alabama: Masonry cement salient statistics

(Short tons)

	1979	1980
Number of active plants	6	6
Production	307,802	246,216
Shipments from mills:		
Quantity	302,624	241,573
Value	$13,929,963	$13,011,656
Stocks at mills, Dec. 31	29,100	34,990

United States Steel Corp. announced that a final agreement was reached for the sale of its Universal Atlas Cement Div. to Lehigh Portland Cement Co., a subsidiary of Heidelberger Zement A. G. of Heidelberg, Federal Republic of Germany. Universal Atlas operates a plant in Leeds, Jefferson County.

Construction continued at Ideal Basic Industries, Inc.'s new dry process plant at Theodore, which is scheduled to be onstream in 1981. The 1.5 million-ton-per-year plant, estimated to cost $267 million, will eventually replace the present Mobile plant. Two reverse air fabric dust collector systems will be installed in the Theodore plant. The system will collect fumes and fugitive dust from raw materials from the two cement kiln-material dryer systems. In the plant, a reinforced suspension preheater system will lower capital costs, reduce maintenance costs, provide process stability, and lower NOx emissions. Approximately 3 million tons per year of limestone, sand, and clay from the company's mining operation in Monroe County on the Alabama River will be barged to the new plant.

Citadel Cement Corp., a subsidiary of Canada Cement Lafarge Ltd., closed its Birmingham plant because of high operating costs and the decline in construction activity. The plant, built in 1922, had an annual production capacity of 270,000 metric tons of cement. The company will continue to use the plant's storage capacity. Citadel's modern cement plant in Demopolis annually produces 680,000 metric tons; production was slightly curtailed because of weak demand.

Three other cement facility expansions, totaling $750,000, were announced through the Alabama Development Office. These expansions involved Alpha Portland Industries, Inc., Birmingham; Citadel Cement Corp., Demopolis; and Martin Marietta Corp., Calera.

Clays.—In 1980, Alabama's clay industry produced common clay, fire clay, kaolin, and bentonite. The State ranked third nationally in the prodution of kaolin, fourth in

bentonite, fifth in fire clay, and eighth in common clay. Athough unit values for all clays increased, all experienced a decrease in production. During the year, 28 companies mined clay at 37 pits in 20 counties. Ninety percent of all clay production came from the top 20 producing pits.

Common clay was mined by 17 companies at 25 pits in 16 counties; leading counties were Jefferson, Sumter, and Shelby. Major uses were construction related: Brick, cement, and concrete block.

Fire clay was mined by four companies at five pits in Calhoun, St. Clair, and Shelby Counties. Major use was in the foundry industry. Fire clay was also shipped to South Carolina and mixed with local clay for the manufacture of brick.

Kaolin was mined by six companies at six pits in Barbour, Henry, and Marion Counties in the southeastern part of the State. Major uses were in refractories and chemical manufacture.

One company mined bentonite at one pit in Lowndes County for use in the foundry industry and in drilling muds.

American Olean Tile started operation in its new $14 million tile plant at Fayette, 80 miles west of Birmingham. Olean, a subsidiary of National Gypsum Co., is expected to produce in excess of 10 million square feet of ceramic floor tile per year. The Tennessee-Tombigbee Waterway, a few miles west of Fayette, will reduce transportation costs. Preliminary work on the clays utilized was conducted by the Bureau of Mines Tuscaloosa Research Center under a cooperative agreement for the Geological Survey of Alabama.

Donoho Clay Co. announced a $39,000 expansion program at its Anniston operation.

Lime.—Alabama ranked fifth nationally in the production of lime. Production, from five plants in Shelby County, decreased 11%. Major uses were in steelmaking, paper manufacture, and water purification. The Alabama Development Office reported a capital expansion expenditure of $1.5 million by S.I. Lime Co., Saginaw.

Table 6.—Alabama: Lime sold or used by producers, by use

Use	1979		1980	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Paper and pulp	351,042	$14,946	327,353	$15,539
Water purification	154,322	6,571	169,365	8,284
Steel, open-hearth	W	W	47,073	2,354
Aluminum and bauxite	2	2	36,601	1,791
Mason's lime	19,506	788	16,075	795
Soil stabilization	14,836	632	W	W
Sugar refining	4,401	187	5,675	274
Other uses[1]	728,443	31,058	525,958	24,648
Total[2]	1,272,550	54,182	1,128,100	53,685

W Withheld to avoid disclosing company proprietary data; included with "Other uses."
[1]Includes acid mine water; agriculture alkalies (1979); calcium carbide; fertilizer (1979); food products; insecticides (1980); oil and grease (1980); oil well drilling; other chemical uses; other construction lime; other metallurgy; other ore concentration; road stabilization (1980); sewage treatment; steel, basic oxygen furnace; steel, electric; steel, open-hearth (1979); tanning; wire drawing (1980); and uses indicated by symbol W.
[2]Data may not add to totals shown because of independent rounding.

Mica.—Alabama ranked seventh in the Nation in the production of scrap mica, down from fourth in 1979. The drop resulted from the cessation of mining early in the year by Western Mica Co. in Randolph County. Their facility at Heflin continued to grind ore from Connecticut and North Carolina. The fine-ground mica was used primarily as an additive in paints.

Perlite.—Two plants, W.R. Grace & Co., Birmingham, and National Gypsum Co., Mobile, produced expanded perlite from ores shipped in from out of State; production and value increased over 1979. The material was used for horticultural purposes, concrete aggregate, and formed products.

Phosphate Rock.—Monsanto Co. produced phosphate rock from the Gilbert pit in Limestone County in the northern part of the State. The phosphate rock was shipped to Tennessee for further processing. Production increased 33%; value increased 31%.

Salt.—Alabama ranked 10th nationally in the production of salt. Olin Corp., in Washington County, produced salt from brine wells by solution mining a near surface salt dome for use in chemical manufacture. Production increased slightly, while value increased 20%.

Sand and Gravel.—Sand and gravel ranked third in terms of mineral value in Alabama in 1980. Sand and gravel was produced at 36 operations in 35 counties. The majority was used for construction purposes, with minor amounts for industrial uses. The decrease in production occurred in the construction sector; industrial sand and gravel production increased 22%, while value increased 32%. The major portion of sand and gravel was shipped by truck, with lesser amounts transported by railroad and waterway. Leading counties were Montgomery, Mobile, Elmore, and Franklin. The top 25 producing companies, with 37 operations, produced 80% of the total sand and gravel; no individual pit produced over 750,000 tons.

Table 7.—Alabama: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	7,281	$18,234	$2.50	5,267	$12,732	$2.42
Plaster and gunite sands	W	W	W	--	--	--
Concrete products	398	1,155	2.91	1,084	2,896	2.67
Asphaltic concrete	1,949	4,906	2.52	1,613	4,062	2.52
Roadbase and coverings	2,304	3,742	1.62	1,891	2,968	1.57
Fill	1,387	1,614	1.16	860	1,008	1.17
Snow and ice control	W	W	W	W	W	1.00
Other uses	62	194	3.12	W	W	3.41
Total or average	13,451	29,944	2.23	10,803	23,942	2.22

W Withheld to avoid disclosing company proprietary data; included in "Total."

Table 8.—Alabama: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	7,419	$13,115	$1.77	5,609	$10,170	$1.81
Gravel	6,031	16,828	2.79	5,194	13,772	2.65
Total[1] or average	13,451	29,944	2.23	10,803	23,942	2.22
Industrial:						
Sand	W	W	W	W	W	W
Gravel	W	W	W	W	W	W
Total or average	297	1,375	4.63	361	1,821	5.04
Grand total[1] or average	13,747	31,319	2.28	11,165	25,763	2.31

W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Data may not add to totals shown because of independent rounding.

Stone.—Stone ranked second in terms of mineral value in Alabama in 1980. Although production of both crushed and dimension stone decreased, unit values increased. Nationally, Alabama led in output of crushed marble, ranked third in production of oyster shell, and fourth in dimension marble. Crushed stone was produced at 52 operations in 23 counties. Material mined included limestone, marble, granite, sandstone, and oyster shell. The stone was used in cement manufacture, in concrete, and as roadbase. Principal production was from Shelby and Jefferson Counties in the central part of the State. Six quarries each produced in excess of 900,000 tons per year and accounted for nearly 30% of all crushed stone. Two companies quarried dimension stone for cut stone, rough block, sawed stone, and other uses. Shipments were mainly by truck, with a minor portion of total shipments by rail or waterway.

Although stone production decreased, some producers in northwestern Ala-

bama benefitted from construction of the Tennessee-Tombigbee Waterway. Operators not supplying the waterway directly were filling the demand left by producers supplying rock to the waterway.

The annual report of the Alabama Development Office reported expansion plans for 13 stone producers, totaling over $14.5 million. Major expansion programs involved Radcliff Materials, Vulcan Materials Co., Hodges & Co., and Southern Stone Co., Inc. During the year, Southern Stone Co., Inc., reopened United States Steel Corp.'s Dolonah quarry in Bessemer. Dolcito Quarry Co., Birmingham, completed a $5.5 million modernization program which included new crushers, mills, and bagging facilities.

Table 9.—Alabama: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	1,873	5,942	991	3,993
Concrete aggregate	3,646	9,247	3,137	9,891
Bituminous aggregate	2,618	7,855	2,061	6,903
Dense-graded roadbase stone	1,934	4,432	1,392	4,041
Surface treatment aggregate	181	273	80	226
Other construction aggregate and roadstone	3,495	9,938	5,169	14,446
Riprap and jetty stone	924	2,855	584	1,914
Railroad ballast	189	517	200	574
Filter stone	W	W	317	1,041
Manufactured fine aggregate (stone sand)	243	706	307	962
Terrazzo and exposed aggregate	W	W	20	692
Cement	5,140	11,502	4,311	10,832
Lime	2,848	10,415	2,606	10,293
Dead-burned dolomite	r143	W	164	W
Flux stone	1,943	5,462	468	1,248
Whiting or whiting substitute	276	2,567	W	W
Other fillers or extenders	W	W	455	9,353
Sulfur removal from stack gases	W	W	1	W
Other uses[2]	987	11,855	1,171	5,859
Total[3]	26,443	83,566	23,433	82,270

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1]Includes limestone, granite (1980), marble, sandstone,and shell.

[2]Includes stone used for agricultural marl and other soil conditioners, poultry grit and mineral food (1979), macadam aggregates, abrasives (1979), mine dusting, bedding materials (1980), porcelain (1979), roofing granules, and other uses.

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

Sulfur.—Alabama ranked fourth nationally in output of recovered sulfur. Four companies recovered sulfur from five high sulfur crude oil processing plants in Escambia, Mobile, Tuscaloosa, and Washington Counties: Exxon Co., Hunt Oil Co., Phillips Petroleum, and Union Oil Co. sold 374,000 metric tons valued at $32.0 million; a slight increase in production, and a 58% increase in value over 1979.

Talc.—Cyprus Industrial Minerals Co. ground talc from Western States at its plant in Talladega County near Alpine. The product was used primarily in toilet preparations.

METALS

Primary metal production was among the most important industries in the State. The four leading counties were Colbert, Jefferson, Madison, and Etowah.

Aluminum.—Alabama ranked sixth nationally in the production of primary aluminum; output and sales decreased because of the recession nationally. Primary aluminum was produced by Revere Copper and Brass, Inc., and Reynolds Metals Co. from alumina shipped in from Jamaica, Texas, Louisiana, and Arkansas.

Aluminum Company of America (Alcoa), Mobile, continued to produce alumina from imported bauxite. The company announced plans for an $18 million modification at its Mobile alumina facilities to increase production and for installation of an alumina grinding facility. The project will increase metal-grade alumina production capacity and provide the capability for adding to the local plant's growing line of chemical products. The expansion will include grinding, packaging, warehousing, and loading facilities. This capital program is in addition to the 4-year $60 million modernization and expansion project that was begun in early 1979. In another major project, three of the existing four digester units were replaced with two of the latest designs with equivalent capacity.

During the year, Reynolds Metals Co.,

Inc., Sheffield, cut back 35% of its capacity because of reduced demand. The decline in auto production was a major cause of the temporary shutdown of four potlines, representing 70,000 tons of annual capacity.

Expansion plans were announced by Reynolds and Revere Copper and Brass, Inc., Scottsboro. Reynolds planned expansion of its aluminum, sheet, wire, and secondary aluminum plants totaling $24.5 million. Revere's expansion, scheduled for its aluminum and coiled sheet plants, is expected to total $9.5 million. Revere achieved record primary aluminum production by gradually increasing its amperage to the potlines. Contributing were improved carbon anode quality and a 33% improvement in pot life. Revere also installed equipment to mantle carbon anodes and improve the cooling of baked anodes, which improved carbon quality and conserved energy.

The operations of both Revere and Reynolds, being energy intensive, face the problem of increased electrical rates from their supplier, the Tennessee Valley Authority. The companies have instituted various energy conservation programs, but the increases in the rates are expected to cause continued problems for the aluminum industry in north Alabama.

Bauxite.—Alabama ranked second in the Nation in bauxite production. Four companies mined bauxite in Barbour and Henry Counties for use in refractories and chemical manufacture. Refractory-grade bauxite producers were adversely affected by the reduction in steelmaking. Production of bauxite in the Eufaula area in the southeastern part of the State continued at a reduced level, mainly building up inventories.

Harbison-Walker Refractories Co., Inc., announced a $230,000 expansion program at its Baker Hill calcining operation.

Ferroalloys.—Alabama ranked third in the Nation in the production of ferroalloys. Production and value decreased 19% and 14%, respectively. The State's industry is centered in the Birmingham area.

Iron and Steel.—Alabama ranked seventh in the Nation in the production of pig iron. United States Steel Corp., Fairfield, and Republic Steel Corp., Gadsden, were the major producers. Iron and steel production and sales were down because of adverse market conditions.

Rutile (Synthetic).—Kerr-McGee Corp. reopened its 100,000-ton-per-year synthetic rutile plant in Mobile after a 2-year shutdown. The facility opened in mid-1977 and closed in March 1978 because of poor market conditions and the need for better product and environmental control. Ilmenite, imported from Australia, was processed into synthetic rutile and shipped to the company's Hamilton, Miss., plant for use as a paint pigment.

[1]State mineral specialist, Bureau of Mines, Tuscaloosa, Ala.
[2]Acting State geologist, Geological Survey of Alabama, Tuscaloosa, Ala.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Alumina:			
Aluminum Co. of America	1501 Alcoa Bldg. Pittsburgh, PA 15219	Plant	Mobile.
Aluminum smelters:			
Revere Copper & Brass Inc	Box 191 Rome, NY 13440	do	Jackson.
Reynolds Metals Co	Reynolds Metals Bldg. Richmond, VA 23218	do	Colbert.
Bauxite:			
Didier-Taylor Refractories Corp	Box 568 Eufaula, AL 36027	Mine and plant	Barbour and Henry.
Eufaula Minerals Co	Box 556 Eufaula, AL 36027	do	Barbour.
A. P. Green Refractories Co., a subsidiary of United States Gypsum Co.	Mexico, MO 65265	do	Do.
Harbison-Walker Refractories Co., Inc., a division of Dresser Industries, Inc.	Dale Rd. Route 1, Box 58 Eufaula, AL 36027	do	Do.
Cement:			
Alpha Portland Industries, Inc	15 South 3d St. Easton, PA 18042	Plant	Jefferson.
Citadel Cement Corp	2625 Cumberland Pkwy., NW. Atlanta, GA 30339	do	Jefferson and Marengo.
Ideal Basic Industries, Inc.[1]	821 17th St. Denver, CO 80202	do	Mobile.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Cement --Continued			
Lehigh Portland Cement Co	800 2d Ave., South Leeds, AL 35094	Plant	Jefferson.
Martin Marietta Corp.[2]	6901 Rockledge Dr. Bethesda, MD 20034	do	Shelby.
National Cement Co. Inc	Drawer A Ragland, AL 35131	do	St. Clair.
Clays:			
Bickerstaff Clay Products Co., Inc	Box 517 Bessemer, AL 35020	Mine	Jefferson and Russell.
Cordova Clay Co., Inc	Cordova, AL 35550	do	Walker.
Martin Marietta Corp	6901 Rockledge Dr. Bethesda, MD 20034	do	Shelby.
Tombigbee Lightweight Aggregate Corp., a division of Breeko Industries, Inc.	Box V Livingston, AL 35470	do	Sumter.
Ferroalloys:			
Alabama Alloy Co., Inc	Box 31195 Birmingham, AL 35222	Electric furnace	Jefferson.
Autlan Manganese Corp	Box 2703 Mobile, AL 36601	do	Mobile.
Interlake Inc., Globe Metallurgical Div.	Box 348 Selma, AL 36701	do	Dallas.
International Minerals & Chemical Corp., TAC Alloys Div.	Garner Rd. Bridgeport, AL 35740	do	Jackson.
Ohio Ferro-Alloys Corp	Box 68 Montgomery, AL 36057	do	Montgomery.
Reynolds Metals Co	Box 191 Sheffield, AL 35660	do	Colbert.
Union Carbide Corp	Box 391 Sheffield, AL 35660	do	Do.
Lime:			
Allied Products Co	Drawer 1 Montevallo, AL 35115	Plant	Shelby.
Cheney Lime & Cement Co.[3]	Allgood, AL 35013	do	Do.
Martin Marietta Corp.[4]	6901 Rockledge Dr. Bethesda, MD 20034	do	Do.
S. I. Lime Co	500 Southland Dr. Birmingham, AL 35226	do	Do.
Phosphate:			
Monsanto Co	Columbia, TN 38401	Pit	Limestone.
Pig iron:			
Republic Steel Corp	1629 Republic Bldg. Cleveland, OH 44115	Furnaces and mills.	Etowah and Jefferson.
U.S. Pipe and Foundry Co	3300 1st Ave., North Birmingham, AL 35202	Furnaces	Jefferson.
United States Steel Corp	Box 599 Fairfield, AL 35064	Furnaces and mills.	Do.
Salt:			
Olin Corp	120 Long Ridge Rd. Stamford, CT 06904	Brine wells	Washington.
Sand and gravel:			
Holland and Woodward Co., Inc	Box 1947 Decatur, AL 35601	Surface mine and plant.	Franklin.
R & S Materials, Inc	Box 3547 Montgomery, AL 36109	do	Autauga, Elmore, Macon, Montgomery.
Southern Industries, Radcliff Materials.	Drawer 2068 Mobile, AL 36601	do	Mobile and Montgomery.
South Ready Mix, Inc	Route 11, Box 120 Birmingham, AL 35210	do	Elmore.
Thackston, C.T	Box 3211 Montgomery, AL 36109	do	Montgomery.
Stone:			
Allied Products Co	Box 628 Alabaster, AL 35007	Quarries	Shelby.
Southern Stone Co., Inc.[5]	2111 8th Ave., South Birmingham, AL 35233	do	Bibb, Colbert, Lee, Shelby.
Trinity Stone Co., Inc	Drawer E Decatur, AL 35601	Quarry	Morgan.
Vulcan Materials Co.[6]	Box 7324-A Birmingham, AL 35223	Quarries	Calhoun, Colbert, Etowah, Franklin, Jackson, Madison, Shelby.
Wade Sand and Gravel Co., Inc	Box 39048 Birmingham, AL 35208	Quarry	Jefferson.
Talc:			
American Talc Co., Inc	Alpine, AL 35014	Plant	Talladega.

[1]Also clays.
[2]Also lime, stone, clays.
[3]Also cement.
[4]Also cement, clays, and stone.
[5]Also sand and gravel.
[6]Also clays and sand and gravel.

The Mineral Industry of Alaska

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

By Tom L. Pittman[1]

The value of nonfuel mineral production reported in Alaska in 1980 was $113.4 million. In 1979, the reported value was $123.9 million. The decrease in the 1980 value was mostly due to a substantial drop in the reported value of sand and gravel. There was also a small drop in the value of gem stones, consisting of soapstone and jade. Reported values and quantities of gold, silver, platinum-group metals, tin, and barite increased. Tungsten production decreased from the 1979 level. There was no reported production of antimony.

Exploration expenditures were estimated at $50 to $70 million by various industry sources, an increase over those of 1979. There were major exploration projects for molybdenum, gold and silver, lead and zinc, copper, tungsten, and chromium. Tin, nickel, cobalt, and platinum-group metals were actively sought in several areas. A total of 19,359 new mining claims were recorded in the year ending October 31, 1980, or about double the number of claims recorded in the year ending October 31, 1979.

Table 1.—Nonfuel mineral production in Alaska[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Gem stones	NA	$60	NA	$50
Gold (recoverable content of ores, etc.) troy ounces	6,675	2,053	9,826	6,019
Lead metric tons	--	--	31	29
Sand and gravel thousand short tons	50,900	104,905	44,911	85,214
Silver (recoverable content of ores, etc.) troy ounces	W	W	8	172
Stone, crushed thousand short tons	3,656	15,458	3,990	19,978
Combined value of barite, platinum-group metals (1980), tin, tungsten and values indicated by symbol W	XX	r1,389	XX	1,983
Total	XX	r123,865	XX	113,445

rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; included with "Combined value" figure. XX Not applicable.

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

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

(Thousands)

Region	1978	1979	Minerals produced in 1979 in order of value
Cook Inlet-Susitna	$10,486	$5,466	Sand and gravel, stone, gold.
Copper River	237	600	Sand and gravel, stone.
Kenai Peninsula	323	1,206	Do.
Kodiak	W	W	Tin, sand and gravel, stone.
Kuskokwim	W	--	
Northern Alaska	13	13	Sand and gravel.
Seward Peninsula	W	W	Gold, sand and gravel, stone, tin, silver.
Southeastern Alaska	W	W	Stone, sand and gravel, tungsten.
Yukon River	1,392	2,175	Gold, sand and gravel, stone, silver.
Undistributed[2]	151,204	114,406	
Total[3]	163,661	123,865	

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

[1]No nonfuel mineral production was reported in Alaska Peninsula, Aleutian Islands, Bering Sea, Bristol Bay, and Northwestern Alaska Regions.

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

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

Table 3.—Indicators of Alaska business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	180.0	187.0	+3.9
Unemployment	do	17.0	18.0	+5.9
Employment (nonagricultural):				
Mining[1]	do	5.8	6.5	+12.1
Manufacturing	do	12.7	13.4	+5.5
Contract construction	do	10.1	10.3	+2.0
Transportation and public utilities	do	16.7	17.0	+1.8
Wholesale and retail trade	do	29.4	29.1	-1.0
Finance, insurance, real estate	do	8.6	8.2	-4.6
Services	do	29.4	30.0	+2.0
Government	do	54.4	55.0	+1.1
Total nonagricultural employment[1 2]	do	166.9	169.4	+1.5
Personal income:				
Total	millions	$4,532	$4,966	+9.6
Per capita		$11,152	$12,406	+11.2
Construction activity:				
Number of private and public residential units authorized		2,706	2,227	-17.7
Value of nonresidential construction	millions	$78.3	$52.9	-32.4
Value of State road contract awards	do	$90.0	$85.0	-5.6
Shipments of portland cement to and within the State	thousand short tons	90	94	+4.4
Nonfuel mineral production value:				
Total crude mineral value	millions	$123.9	$113.4	-8.5
Value per capita, resident population		$305	$284	-6.9
Value per square mile		$211	$193	-8.5

[p]Preliminary.

[1]Includes bituminous coal and oil and gas extraction.

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

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

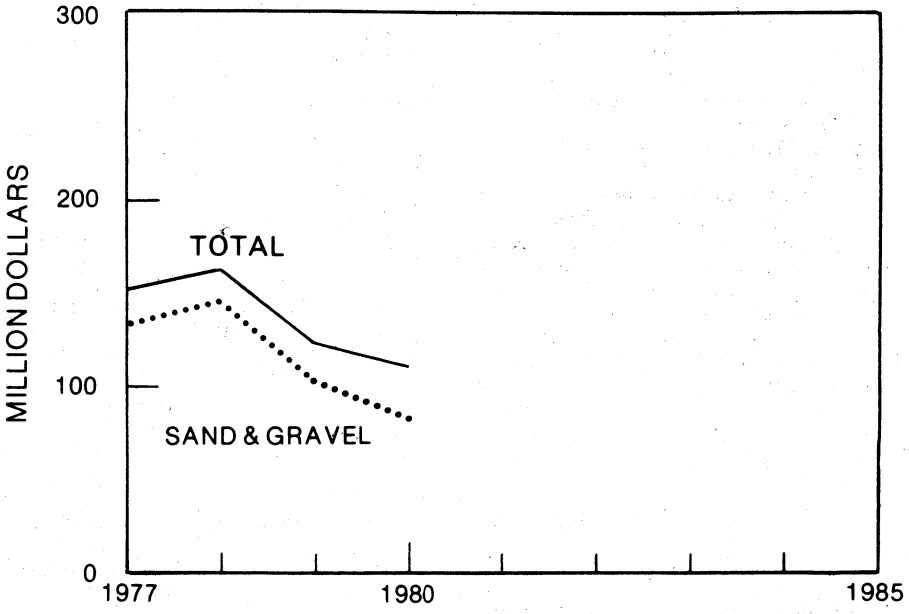

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Alaska.

There was a trend by several exploration companies to locate very large blocks of claims to protect regional operations. Many older small-scale prospects and exploration units have become virtual inholdings within some of these large groups of claims. Many problems in exploration and development depend on ownership and administrative status of large areas of Federal lands. The Alaska National Interest Lands Conservation Act, passed in December, should resolve some of these problems. Land tenure, access, the economic effects of permitting requirements, and the regulations of resource management and environmental protection agencies are still unresolved. Water rights and in-stream flow determinations and regulations are still not clarified by legislation. Mineral access, mining, processing, and transportation facilities within the coastal zone will be influenced or limited by the rather diverse district management programs being established. Most of the 12 Native Regional Corporations within the State are increasing their mineral-related activities. Several corporations have retained consultants to advise on procedures to evaluate their mineral resources. Some have entered leasing agreements, joint ventures, and stock acquisitions with various exploration and development companies both within and outside their own lands.

Legislation and Government Programs.—The Alaska National Interest Lands Conservation Act (ANILCA) was signed by President Carter on December 2, 1980 (Public Law No. 96-487). The act provides for the designation and conservation of certain Federal public lands, including designation of units of the National Park, National Wildlife Refuge, National Forest, National Wild and Scenic Rivers, and National Wilderness Preservation Systems, and for other purposes. This act and the Federal Land Policy and Management Act (Public Law 94-579) (FLPMA) and the ensuing land management agency regulations will determine and control the political aspects of access to most of the Federal public lands in Alaska for mineral exploration, development, and mining. ANILCA canceled the withdrawal from development of 110 million acres of public land (in November 1978) that were not included in the 56 million acres of national monuments proclaimed by President Carter in December 1978. These lands are now mostly under jurisdiction of the above acts. ANILCA specifies the status of valid existing rights

to mining claims and access to inholdings in the various systems.

On August 16, 1980, the U.S. Department of the Interior announced that the Mining and Mineral Research Institute at the University of Alaska had received a research grant of $53,541.

An opinion from the State Attorney General may require the State to lease minerals on State lands instead of using the present claim location procedures. The Department of Natural Resources requested the opinion to clarify a provision in the Alaska Statehood Act of 1959. Bills will be introduced in the 1981 session of the legislature to correct this problem existing on State-selected lands. A new mining loan law was passed and funded for $10 million. Loans are available to Alaskan operators who can meet the strict qualifications. The interest rates are below those charged by most other sources of mineral investment money. The district programs that will constitute the Alaska Coastal Management Program are in various stages of preparation. Programs for the City of Haines, Municipality of Anchorage, and the Annette Island Indian Reserve will be the first to be approved. Work is progressing on about 14 additional district programs. These and other district programs will bring the State into compliance with Federal Coastal Zone Management requirements when they are completed and accepted. These individual district programs will have various effects on mineral-related activities within the coastal zones of each of the districts.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Chromium.—Two companies explored chromite deposits at Claim Point and in the Red Mountain area near the south end of the Kenai Peninsula. One of the companies plans a more intensive investigation of the Red Mountain area in 1981. Both areas have produced and shipped sorted ore and mill concentrates. The mineral resources are owned by the Chugach Native Association, a regional Native corporation.

Copper.—The copper-zinc district in the Brooks Range, from the Ambler area to the Picnic Creek area, was relatively dormant, with most of the mining companies doing little more than assessment work on their claims. The identification of possibly significant amounts of cobalt and reference to the Ruby Creek deposit as copper-cobalt-zinc mineralization were disclosed in a professional paper presented at the annual meeting of the Alaska Miners Association in Anchorage. In the interior, exploration continued at Orange Hill, Bond Creek, Taurus, Gold Hill, and other copper and copper-molybdenum properties. In southeastern Alaska, exploratory work was done on the Alyu base metals and barite deposits northwest of Haines and on the Sumdum Chief southeast of Juneau. Active drilling took place on the Tracy-Magi claims north of the Sumdum Chief, on claims near Niblack, Anchorage, and at other locations on Prince of Wales Island.

Gold.—Production of gold has been estimated by several professional and industrial sources to range from 50,000 to 100,000 troy ounces, with a median figure of 70,000 to 75,000 troy ounces considered most likely. Between 300 and 400 producers contributed to this production. Less than 10% of the estimated number of operations reported about 15% of the estimated production to the Bureau of Mines. The reported average unit price was $613 per troy ounce of gold. Individual producers recovered from 1 troy ounce to several thousand troy ounces of gold. All but a very few were placer operations. They mined from less than a cubic yard to possibly 8,000 cubic yards per operating day. Methods of mining observed or reported included hand and small-scale mechanical methods, suction dredging, hydraulicking, bulldozers, draglines, front-end loaders, backhoes, and bucket-line dredges. Recovery methods ranged from a gold pan through simple to sophisticated sluice boxes, and combination systems using trommels, wobblers, sluices, jigs, and amalgamation.

On the Seward Peninsula, near Nome, the Alaska Gold Co. started up Dredge No. 5 on the Third Beach in August. Dredge No. 6 on the Submarine Beach did not operate. The company operated large thaw fields at both dredge sites. Alaska Gold had 30 permanent employees and 130 seasonal workers. Greatland Exploration mined on the Second Beach about 2 miles east of Nome. The company used a dragline, a bulldozer,

and Ross sluice boxes. Five relatively small dredges, which were reported operating in the Seward Peninsula area, are on Basin Creek, American Creek, Kougarok River, Niukluk River, and Ungalik River. Twenty-three other placer mines were reported operating, and an unknown number of small operators worked the beaches and creeks with pans, rockers, sluices, and suction dredges. The airstrip at Candle was lengthened to 5,500 feet and is being used by Hercules aircraft. This will facilitate the transport of fuel, supplies, and equipment to the Candle, Deering, and Buckland areas and the north side of the peninsula. Lee Dredging Co. is reported to be preparing to resume mining on the Solomon River next season. A group was exploring placer deposits on Coffee Creek. Lode exploration continued on the peninsula. The Anaconda Co. optioned, explored, and drilled the Big Hurrah property, drilled on Indian Creek, and worked on other hardrock prospects in the Death Valley and Indian Creek areas. Noranda Exploration, Inc., Inspiration Development Co., and several other companies scouted for promising prospects.

Tuluksak Dredging Ltd. has been operating two dredges on the Tuluksak River in the Kuskokwim Basin south of Aniak. Tuluksak and Noranda Mining, Inc., formed a joint venture called Northland Gold that put in a new camp and shop facilities. A 6-cubic-foot dredge is being rebuilt to operate in 1981 in the area near Nyac formerly worked by the New York Alaska Co. This dredge is expected to mine and wash about 4,500 cubic yards of ground per day.

Flat Creek Placers and others mined in the Iditarod area, outside of Flat. Ten operations were reported in the Eureka area, 15 near Manley, and 4 large operations and several smaller ones in the Rampart area. There were 15 mechanized mines reported working in the Fortymile, Chicken, Eagle, and Seventymile districts, as well as a large number of smaller operations. The Circle Hot Springs-Central-Miller Creek area reported 57 significant operations and several smaller ones on about 20 creeks. In the Fairbanks area, there were 27 mechanized mines and several smaller ones.

Six placer mines were reported active in the Tolovana area. The Livengood placer, operated by Asamera Oil (U.S.), Inc., used front-end loaders and a Ross sluice box on one section. The plant is rated at 200 cubic yards per hour. Asamera operated three churn drills on sampling and evaluation work and stripped some ground. The company is planning a new, large, highly mechanized nonfloat washing plant, an efficient tailings ponding and water-recovery system, and an innovative procedure for stripping frozen overburden. It will try ripping overburden in the winter and hauling it to waste dumps before it thaws. The Yentna-Cache Creek area, west of Talkeetna, had several operating placers. The most productive of these was operated by Bill Hall on lower Cache Creek, near Petersville. He uses two Hall Dredge floating washing plants side by side in the same pond, and they are fed by a backhoe. A duplicate backhoe and a bulldozer handle tailings and stripping and provide a standby feed unit. The slopes of the sluices are adjustable, and hydraulic lifters raise the riffles for fast cleanup. Hall has designed the plant to permit cleanup during the half-hour downtime required to service the on-board powerplant and the mining equipment. Sluice concentrates are discharged to a sump on the washing plant and are pumped to a tank truck that delivers them to a shore-based gold recovery unit. The plant has a rated capacity of about 5,000 cubic yards per day. In the upper Chistochina River area, Ranchers Exploration and Development Corp. ran its placer mine on a production basis this season and recovered slightly more than 3,000 troy ounces of gold in a 4-month season that ended in September.

The Hope-Sunrise placer area on the Kenai Peninsula was active, with four mechanized mines, a hydraulic operation, and numerous suction dredges and hand miners. A dozer-backhoe-sluice operation on Hope Mining Co. ground on Resurrection Creek has a rated capacity of 1,000 to 1,500 cubic yards per day.

Cusac Industries, Ltd., optioned a large group of claims at Yakataga Beach, on the Gulf of Alaska. The company completed a drilling program to evaluate the gold and heavy-minerals content, but results have not been announced. One mechanized placer operated in the Porcupine Creek area northwest of Haines, in southeastern Alaska. Several small operations were also active in this district.

Table 4.—Alaska: Placer production of gold

Year	Mines producing	Material[1] treated (thousand cubic yards)	Gold recovered		
			Troy ounces	Value (thousands)	Average value per cubic yard
1976	26	1,699	22,605	$2,833	$1.667
1977	22	1,800	18,924	2,807	1.559
1978	21	1,455	18,599	3,600	2.474
1979	14	778	6,675	2,053	2.639
1980	20	723	8,331	5,103	7.058

[1]Excludes material treated primarily for the recovery of platinum.

Four lode gold mines produced in Alaska in 1980. An increasing number of companies are actively exploring old and new prospects and old mines. Little Squaw Gold Mining Co. reported a productive season at its Mikado lode mine and at its placers in the Chandalar district, about 250 miles north of Fairbanks. Chandalar Development Associates operated the lode mine and the 100-ton mill one shift per day during a short season. Mill heads were reported to average about 2 troy ounces of gold per ton. Jan Drew Holdings, Ltd., leased Little Squaw's placer claims and sluiced about 20,000 cubic yards of gravel after stripping ground on Tobin Creek. The company started a 2-year drilling program on four other partially mined creeks. The Grant lode gold mine, on Ester Dome, just west of Fairbanks, was equipped with a small mill to handle relatively high-grade development ore. The mine development and exploration of adjacent property are handled by Tri-Con Mining for the owner, Silverado Mines. If developments continue to be favorable, Silverado plans to equip the property with a much larger mill and mining plant. The present mill produces a gravity concentrate that is shipped to a custom refinery for recovery of gold and silver values. St. Joe American Corp. is diamond-drilling the Ryan Lode deposit on Ester Dome. They also drilled the Mohawk deposit that is situated in the same area. Placid Oil Co., which has been exploring deposits near Cleary Summit, northeast of Fairbanks, may do underground work on the Vetter lode.

Catalina Energy and Resources Ltd. is reopening and evaluating the old Apollo Mine on Unga Island, south of Port Moller and the Alaska Peninsula. The property is owned by Alaska Apollo Mines, Ltd. The Apollo and the nearby Sitka Mine produced about $2.5 million in gold prior to 1908.

Starkey Wilson, of Dallas, Tex., acquired the Independence Mine, in the Willow Creek district, west of Palmer. Coronado Mining Co. is reopening and sampling the old workings and exploring for new ore reserves. Wilson gave the old mill and campsite to the State of Alaska for a historic monument or park. If the mine develops as indicated, the lower haulage and drain tunnel will be extended and connected with a decline driven from the Willow Creek drainage. Future access and operations will be based on that side of the mountains. The Silver Star Mine, in the Wrangell Mountains, shipped a small tonnage of gold-silver ore.

The Bedrock Mine produced a few tons of high-grade gold ore. In southeastern Alaska, Occidental Minerals Corp. has been examining accessible parts of the old Treadwell property on Douglas Island, just south of Douglas; several shallow core holes have been drilled. Mapco, Inc., did additional diamond drilling and exploration work on its Sweetheart Ridge gold-copper-zinc property southeast of Juneau and east of Gilbert Bay. Mapco also continued work on its gold prospects on Prince of Wales Island. Whelans Mining and Exploration, Inc., has relocated the old Eagle River Mine and a large block of claims to the northwest along the strike of the lode zone to and beyond the E Pluribus Unum Mine. Placid Oil Co. did preliminary examination work on the Kensington and Comet Mines and adjacent claim groups north of Juneau and east of Lynn Canal. The Stensland family is building a small mill at its Gold Standard Mine west of Helm Bay, north of Ketchikan. Howard Hayes and Associates continued cleanup of gold-bearing materials at the Old Alaska Juneau mill at Juneau.

Delta Smelting and Refining, Ltd., of Richmond, British Columbia, opened a gold

buying and melting plant in Fairbanks. If demand warrants, Delta will install a refinery and black-sand smelting equipment. The company announced that it handled about 40,000 troy ounces of gold in its first season. This new plant should benefit many of the placer and lode gold producers in Alaska.

Lead and Zinc.—Active exploration continued in the Red Dog-Wulik River area north of Kotzebue. Companies reported working were WGM Inc., General Crude Oil Co., Houston Oil and Minerals Corp., and Cominco American, Inc. Several other companies were showing an interest in the district. Cominco American opened an exploration office in Anchorage to serve its increasing Alaskan projects. Massive sulfide mineralization including zinc, lead, copper, silver, and gold was discovered in the Delta district of the east-central Alaska Range in 1976. More than 30 deposits have been identified in a 400-square-mile area, which Research Associates and Anaconda were drilling. Patino N.V. reported that it has outlined zinc mineralization by diamond drilling on one of its properties. WGM Inc., and companies active in the Pybus Bay area on Admiralty Island filed notices to hold their prospects pending the outcome of Alaska lands legislation and the regulations that will follow. These prospects are now within the Admiralty Island National Monument Wilderness, created by ANILCA. Mapco and Cominco did annual work on their Kuiu Island claims. Amoco Minerals Co. and others were active on Kupreanof Island near the north end of Duncan Canal. Amoco filed a work plan with the Forest Service anticipating diamond drilling from an adit scheduled to be driven in 1981.

Molybdenum.—The Quartz Hill molybdenum deposit is now ranked as one of the most important reserves known. About 44,000 feet of core hole were diamond drilled to as deep as 2,000 feet during the 1980 season by U.S. Borax & Chemical Corp. Extensive environmental, oceanographic, and engineering studies were continued on various phases of a proposed open pit mining, milling, tailings disposal, and concentrate marketing operation. The proposed scale of operation is 60,000 tons of ore milled per day. Expenditures in 1980 were reported to be about $5 million, bringing the total outlay to about $20 million. Helicopter transport is still the only access to and on the deposit area for crew, supplies, and equipment. The deposit is about 45 miles east of Ketchikan and 5 air miles from saltwater at the head of Wilson Arm of Smeaton Bay and from the head of the fjord Boca de Quadra. Road routes would each be about 10 miles long. By a 1978 Presidential Proclamation, the Quartz Hill project is within Misty Fjords National Monument. About 149,000 acres of the monument were excluded from wilderness classification by ANILCA. The mineral deposit and all developments and planned facilities will be within this nonwilderness portion of the monument. The act specified that the Forest Service would prepare and make available an analysis of a Mining Concepts Document prepared by U.S. Borax by early September 1981. A draft environmental impact statement covering an access road for the bulk sampling phase proposed by U.S. Borax must be completed within 12 months after December 2, 1980. No decision on which of two alternate routes will be used for access, and no road permit can be granted until this and other provisions of Section 503 of the act are satisfied.

AMAX Exploration, Inc., continued diamond drilling and geologic work at its Groundhog Basin deposit east of Wrangell. AMAX and Duval, Inc., held their Grant Creek-Burroughs Bay deposit by diamond drilling and geologic work done in the 1981 assessment year. This deposit is now in the Misty Fjords National Monument Wilderness.

Nickel and Cobalt.—Inspiration Development Co. continued annual drilling and geological detailing at its nickel-copper-cobalt claims covering the Bohemia Basin and Takanis deposits on Yakobi Island west of Pelican. The company did similar work on its Mirror Harbor area claims on Chichagof Island and adjacent coastal islands, about 15 miles south of its Yakobi Island claims. The Mirror Harbor area is within the West Chichagof-Yakobi Wilderness designated by ANILCA.

Platinum-Group Metals.—The Goodnews Bay Mining Co.'s placer platinum mine, dredge, and all facilities have been acquired by Hanson Properties, Inc., of Spokane, Wash. This operation has been inactive for several years. Hanson has put the dredge, powerplant, and other equipment in shape for a full season of operation in 1981. The company ran the dredge for several weeks and produced small amounts of platinum and platinum-group metals.

Fox Consultants of Vancouver, British Columbia, relocated the Salt Chuck Mine, west of Kasaan on Prince of Wales Island, in southeastern Alaska. The organization did preliminary exploration work and geologic mapping and will be diamond drilling in 1981. The mine produced direct-shipping copper-palladium ore and mill concentrates that also contained platinum. The mine was active from about 1907 through 1941.

Silver.—Noranda Exploration, Inc., completed an underground diamond-drilling program at the Greens Creek property owned by Pan Sound Joint Venture. It is continuing environmental base-line studies and engineering work on proposed tailings disposal sites, mill and surface plant sites, and various other projects. The company's operating area is within the north end of Admiralty Island National Monument but not in the Monument Wilderness.

The silver potential of several old prospects is being explored in Alaska, but there is little public information on developments. The El Dorado Mine shipped some silver-gold ores, and the Silver Star Mine sent out a small tonnage of gold-silver ore.

Anaconda Copper Co. did diamond drilling and exploratory work on its Pyrola silver-zinc-lead-barite prospect on Admiralty Island. Silver production for Alaska should be several thousand troy ounces higher than the quantity reported to the Bureau of Mines because of the amount naturally alloyed with the large quantity of unreported placer gold.

Tin.—Lost River Mining produced tin concentrates at its placer operation on Cape Creek, east of Wales on the Seward peninsula. The operation accounted for the only reported tin production in 1980. There is usually some production of tin concentrates as a coproduct at a few of the gold placers. Patino N.V. reported sampling at one of its properties resulted in the discovery of encouraging tin mineralization. Several companies are known to have been actively exploring for tin in Alaska.

Tungsten.—The Yellow Pup Mine produced tungsten concentrates at its small gravity mill on Gilmore Dome, east of Fairbanks. An area farther northeast of Fairbanks is being explored for tungsten potential and considerable claim location activity has resulted.

NONMETALS

Asbestos.—Alaska Asbestos Co. announced it has drilled 98 holes on the Slate Creek asbestos deposit and has an indicated reserve of about 55 million tons averaging 6.35% asbestos fiber. The deposit, which is operated by WGM Inc., is not drilled out, and additional holes should add to the reserves. The deposit, located north of Tok near the Forty Mile district, is on land belonging to Doyon Ltd., a Native regional corporation. Owners of Alaska Asbestos are reported to be Doyon Ltd., MacIntyre Mines Ltd., and General Crude Oil Co. They have other asbestos prospects in the area.

Barite.—Chromalloy American Corp. produced crude barite from its offshore mine at Castle Island, west of Petersburg. The barite was shipped to the Gulf Coast for processing and marketing.

Gem Stones.—Jade was produced in the Jade Mountain area east of Kotzebue. It is used in Native handicrafts and in domestic and foreign arts, crafts, and jewelry work. Soapstone is mined in Grubstake Gulch in the Talkeetna Mountains and marketed by the Hill family in Palmer. Most of it is used as carving material for arts and crafts and for the curio and tourist trade. Small amounts of specialty clays are obtained at various places for use in local hobby and merchant ceramic activities. A variety of coral is recovered offshore along the Alaska Peninsula and at other places. Coral is a popular item in the Alaskan jewelry trade, and is used to make unique and attractive rings, pendants, necklaces, bracelets, and similar items.

Gypsum.—Interest in gypsum exploration waned as the general demand declined. A scheduled project in the Iyoukeen Cove area on Chichagof Island, southwest of Juneau, did not materialize. Feasibility studies for a wallboard plant at Haines were dropped. Gypsum was to be supplied from a mine near Haines Junction, Yukon Territory.

Sand and Gravel.—Reported sand and gravel production in 1980 was 44.9 million short tons, which was about 12% less than 1979 production, and valued at $85.2 million. Production was all classified as construction sand and gravel. Principal uses reported in 1980 were fill 92%, concrete aggregate 4%, asphaltic concrete 2%, and roadbase and coverings 2%. Minor amounts were used for plaster and gunite sands, concrete products, snow and ice control, and other uses. In 1980, about 40.1 million short tons of sand were valued at $75.8 million. The gravel, about 4.8 million short tons, was valued at $9.4 million.

Table 5.—Alaska: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	4,161	$20,457	$4.92	1,903	$9,408	$4.94
Plaster and gunite sands	W	W	W	W	W	5.35
Concrete products	W	W	W	W	W	5.00
Asphaltic concrete	392	1,676	4.28	850	1,799	2.12
Roadbase and coverings	1,422	3,701	2.60	848	1,957	2.31
Fill	44,596	78,004	1.75	41,243	71,811	1.74
Snow and ice control	W	W	W	16	69	4.28
Other uses	82	267	3.24	42	124	2.99
Total or average	50,900	104,905	2.06	44,911	85,214	1.90

W Withheld to avoid disclosing company proprietary data; included in "Total."

Table 6.—Alaska: Construction sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	45,551	$91,845	$2.02	40,062	$75,778	$1.89
Gravel	5,349	13,060	2.44	4,849	9,436	1.95
Total or average	50,900	104,905	2.06	44,911	85,214	1.90

Table 7.—Alaska: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Dense-graded roadbase stone	379	1,456	344	1,808
Surface treatment aggregate	32	121	39	165
Other construction aggregate and roadstone	r3,191	r13,621	3,581	17,744
Riprap and jetty stone	23	50	1	2
Railroad ballast	--	--	2	14
Fill	17	68	--	--
Other uses[2]	13	142	22	247
Total[3]	3,656	15,458	3,990	19,978

rRevised.
[1]Includes limestone, granite, traprock, and miscellaneous stone.
[2]Includes stone used for concrete aggregate, bituminous aggregate, and terrazzo and exposed aggregate (1979).
[3]Data may not add to totals shown because of independent rounding.

Stone.—The 4 million tons of crushed stone produced in 1980 was valued at $20 million. The quantity of crushed stone was about 9.1% above the 1979 production. Principal uses in 1980 were other construction aggregate and roadstone 90%, dense-graded roadbase stone 9%, and surface treatment 1%. Small amounts were used for railroad ballast, riprap and jetty stone, concrete aggregate, and bituminous aggregate. No production of dimension stone was reported.

[1]State mineral specialist, Bureau of Mines, Juneau, Alaska.

Table 8.— Principal producers

Commodity and company	Address	Type of activity	Region
Barite:			
Chromalloy American Corp	Box 650 Petersburg, AK 99833	Open pit	Southeastern Alaska.
Gold:			
Alaska Gold Co	437 Madison Ave. New York, NY 10022	Placer-dredge	Seward Peninsula.
Asamera Oil (U.S.), Inc	Box 118 Denver, CO 80201	Placer	Yukon River.
Bliss and Sons	129 East 11th Ave. Anchorage, AK 99501	Placer-dredge	Northwestern Alaska.
Candle Creek Placers	Candle Creek, AK 99728	Placer	Yukon River.
Engstrom and Son Dredging Co	Box 536 Nome, AK 99762	Placer-dredge	Seward Peninsula.
Flat Creek Placers	Flat Creek, AK 99584	Placer	Yukon River.
G. A. Hanks and Sons	Chicken, AK 99732	do	Do.
Heflinger Mining and Equipment Co	409 Clara St. Fairbanks, AK 99701	do	Do.
Little Squaw Gold Mining Co	Box 184 Spokane, WA 99210	Lode placer	Do.
Marvel Creek Mining Co	Nyak, AK 99642	Placer-dredge	Kuskokwim River.
Miscovich Mining Co	Box 23 McGrath, AK 99627	Hydraulic	Do.
Peters Creek Mines	700 Ash Pl. Anchorage, AK 99501	Placer	Cook Inlet-Susitna.
Ruby Mining Co	Box 1 Ruby, AK 99768	do	Yukon River.
Sand and gravel:			
Alaska Aggregate Corp	7800 Lake Otis Parkway Anchorage, AK 99507	Pit	Cook Inlet-Susitna.
Alaska Brick Co	7800 Lake Otis Parkway Anchorage, AK 99507	Pit	Seward Peninsula.
Alaska Sand and Gravel, Inc	University Ave. Fairbanks, AK 99707	Pit	Yukon River.
Anchorage Sand and Gravel	1813 East 1st Ave. Anchorage, AK 99501	Pit	Cook Inlet-Susitna.
Castle Construction Co	8121 Sand Lake Rd. Anchorage, AK 99502	Pit	Do.
Central Construction Co., Inc	428-117 2d Ave. Seattle, WA 98101	Pit	Northwestern Alaska.
Energy Co. of Alaska	do	Pit	Cook Inlet-Susitna.
Fairbanks Sand and Gravel Inc	2 1/2 Mile Richardson Highway Fairbanks, AK 99707	Pit	Yukon River.
Green Associated	Pouch 85 Fairbanks, AK 99707	Pit	Southeastern Alaska.
Rogers and Babler Inc	4607 East Tudor Rd. Anchorage, AK 99507	Pit	Cook Inlet-Susitna.
Stone:			
Burgess Construction Co	394 Hamilton Fairbanks, AK 99707	Quarry	Yukon River and Southeastern Alaska.
Ketchikan Pulp Co	Box 11619 Ketchikan, AK 99901	do	Southeastern Alaska.
Moore Construction Co. Inc	Box 8100 Ketchikan, AK 99901	do	Do.
Olsen and Sons Logging Ltd	Box 950 Petersburg, AK 99833	do	Do.
Soderberg Logging and Construction Co	Box 400 Kake, AK 99830	do	Do.
Welborn Construction, Inc	Box 634 Kodiak, AK 99615	do	Kodiak.
Yutan Construction Co	Box 1775 Fairbanks, AK 99707	do	Yukon River.
Tin:			
Lost River Mining	Box 411 Nome, AK 99762	Placer	Seward Peninsula.

The Mineral Industry of Arizona

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Arizona Bureau of Geology and Mineral Technology, for collecting information on all nonfuel minerals.

By Lorraine B. Burgin[1]

The value of Arizona nonfuel mineral production decreased from $2.5 billion in 1979 to $2.4 billion in 1980. Despite a copper strike, Arizona again ranked first in national production of nonfuel minerals. Based upon the total value of all metal produced in the Nation in 1980, copper was first, and Arizona's copper production was 64.8% of the national total. The State ranked second in molybdenum produced, with 24% of the national total coming from its mines, second in silver, with 18% of domestic production, and fourth in gold, with 7.6% of that production. All of these metals were principally recovered as byproducts or coproducts of copper production.

Table 1.—Nonfuel mineral production in Arizona[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	138	$642	151	$1,151
Copper (recoverable content of ores, etc.) metric tons	946,002	1,940,211	757,314	1,709,997
Gem stones	NA	4,000	NA	3,100
Gold (recoverable content of ores, etc.) troy ounces	101,840	31,316	72,773	44,578
Gypsum thousand short tons	231	1,245	209	2,017
Lead (recoverable content of ores, etc.) metric tons	354	411	401	375
Lime thousand short tons	673	27,186	514	23,904
Molybdenum (content of concentrate) thousand pounds	35,101	213,065	35,668	341,965
Pumice thousand short tons	940	2,367	990	3,228
Sand and gravel do	[2]30,520	[2]74,716	24,399	73,773
Silver (recoverable content of ores, etc.) thousand troy ounces	7,479	82,941	5,668	116,984
Stone:				
Crushed thousand short tons	5,769	21,401	5,224	21,565
Dimension do	5	110	W	45
Combined value of asbestos, cement, fluorspar (1979), perlite, pyrites, salt, sand and gravel (industrial, 1979), tungsten, and zinc	XX	90,870	XX	83,032
Total	XX	2,490,481	XX	2,425,714

NA Not available. W Withheld to avoid disclosing company proprietary data. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes industrial sand; value included in "Combined value" figure.

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

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Apache	$2,315	$1,900	Pumice, sand and gravel, clays, stone.
Cochise	20,932	29,479	Copper, lime, stone, sand and gravel, silver, gold, lead.
Coconino	W	2,521	Pumice, sand and gravel, stone.
Gila	175,340	253,024	Copper, molybdenum, silver, sand and gravel, gold, lime, asbestos, fluorspar, stone, clays.
Graham	W	496	Sand and gravel, pumice.
Greenlee	264,204	385,755	Copper, silver, gold, lime, stone, sand and gravel, lead.
Maricopa	W	W	Sand and gravel, salt, lime, stone, clays, gold, copper, silver, lead.
Mohave	46,515	52,813	Copper, molybdenum, stone, silver, sand and gravel, zinc, gold, lead.
Navajo	3,294	2,942	Sand and gravel.
Pima	595,005	914,846	Copper, molybdenum, cement, silver, sand and gravel, stone, gold, lead, clays, zinc, tungsten.
Pinal	393,127	589,683	Copper, molybdenum, silver, gold, stone, sand and gravel, lime, gypsum, perlite, lead, pyrites, zinc.
Santa Cruz	1,457	W	Sand and gravel, tungsten.
Yavapai	148,293	199,699	Copper, cement, molybdenum, lime, stone, silver, sand and gravel, gold, gypsum, clays, lead.
Yuma	W	W	Sand and gravel, stone, lead, silver, copper, gold, zinc.
Undistributed[1]	54,144	57,323	
Total	[2]1,704,628	2,490,481	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes value of nonfuel mineral production that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.
[2]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Arizona business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,052.0	1,126.0	+7.0
Unemployment	do	53.0	75.0	+41.5
Employment (nonagricultural):				
Mining[1]	do	21.8	20.4	-6.4
Manufacturing	do	144.1	152.6	+5.9
Contract construction	do	86.5	75.2	-13.1
Transportation and public utilities	do	48.8	50.2	+2.9
Wholesale and retail trade	do	233.4	240.6	+3.1
Finance, insurance, real estate	do	55.6	57.4	+3.2
Services	do	193.5	205.1	+6.0
Government	do	196.2	201.6	+2.8
Total nonagricultural employment[1]	do	979.9	[2]1,003.3	+2.4
Personal income:				
Total	millions	$20,674	$23,521.0	+13.8
Per capita		$8,438	$8,649.0	+2.5
Construction activity:				
Number of private and public residential units authorized		53,752	36,619	-31.9
Value of nonresidential construction	millions	$718.9	$733.6	+2.0
Value of State road contract awards	do	$130.0	$117.0	-10.0
Shipments of portland cement to and within the State	thousand short tons	1,808	1,457	-19.4
Nonfuel mineral production value:				
Total crude mineral value	millions	$2,490.5	$2,425.7	-2.6
Value per capita, resident population		$1,017	$892	-12.3
Value per square mile		$21,864	$21,295	-2.6

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.
[2]Data do not add to total shown because of independent rounding.

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

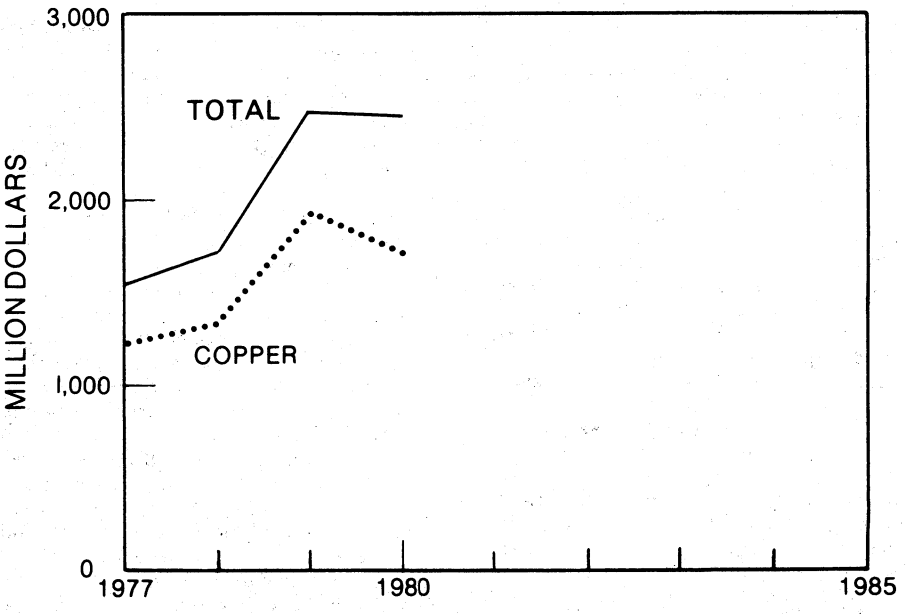

Figure 1.—Value of mine production of copper and total value of nonfuel mineral production in Arizona.

Metal production declined to about $2.2 billion in 1980, about 91.3% of the total value of nonfuel mineral production in the State. Although the value of copper production in the State dropped because of the copper strike, the dramatic increase in the prices of molybdenum, silver, and gold, and to a lesser extent copper, kept the total value of nonfuel mineral production high.

According to value of production, portland cement, sand and gravel, lime, and crushed stone were the leading commodities in the nonmetals group in 1980. Lime and asbestos declined in value of output.

Trends and Developments.—Speculation in the commodities markets significantly affected the rise in copper and precious metals prices to record levels in the first quarter of 1980. However, prices of these metals dropped severely by the second quarter, recovered somewhat in the third quarter during the copper strike, then weakened again in the last quarter. The copper strike, the depressed automobile and housing markets, and reduced demand for the high-priced metals in jewelry, electronic, and photographic industries contributed to the decline in copper, gold, and silver production even though the overall prices were higher than those of 1979.

The steady increase in the demand for molybdenum, leading to rising prices from 1974 to 1979, prompted large investments in exploration as well as the reevaluation of older properties with potential for molybdenum production. During 1980, the demand for molybdenum declined, allowing producers time to rebuild inventories. In 1980, a number of Arizona copper operations installed new molybdenum flotation circuits or reactivated existing circuits in their concentrators, thus accounting for the increased production of molybdenum in the State.

Improvements to increase productivity were noted at copper operations. To achieve higher recovery and more fuel and maintenance efficiency, at least four companies substituted 1,000-cubic-foot cells for smaller cells in concentrator flotation circuits.

Exploration for new ore bodies and reopening of old properties, stimulated by the high prices of metals at the beginning of the year, were not immediately diminished by weakened prices at yearend. Ranchers Exploration and Development Corp. drilled claims leased from Albert C. Harding and

Leith Pike near Pleasant in the Hieroglyphic Mountains 30 miles north of Phoenix. Of the 39 holes drilled from mid-June 1980 to yearend, 34 reportedly showed evidence of mineralization. The property is held by Ranchers Gold and Exploration-1980, a limited partnership in which Ranchers as general partner and manager owns 60% of the operation. Activities stimulated by the higher metal prices included leaching operations at old gold properties such as the Silver Cross Mine north of Cave Creek in Maricopa County and the Harquahala Mine in Yuma County. Higher prices also encouraged exploration and prospecting at the Black Diamond Mine on the east slope of the Dragoon Mountains in Cochise County, in the Oatman area in Mohave County, in the Trigo Mountains near Yuma, where New Jersey Zinc Exploration Co., a subsidiary of Gulf + Western Industries, Inc., investigated silver deposits in the Silver-Eureka mining district, and at Bisbee, where Phelps Dodge Corp. explored abandoned mines. In the Martinez mining district in Yavapai County, the old Congress Mine was reopened by Congress Consolidated Gold Mining Co. Renamed the Gunslinger, the old McCracken Mine near Kingman in Mohave County was reopened by Canadian Natural Resources, Ltd., and by the Fisher-Watt Mining Co. In the Tombstone area, activity included exploration drilling by Occidental Minerals Co., exploration in the Gambasino Dream Mine and the Nicholas Mine by Silver Ridge Mining Co., a subsidiary of Houston Mining and Resources, Inc., and heap leaching for silver near the old underground Contention Mine owned by the Escapule family.[2]

Legislation and Government Programs.—An important piece of legislation relevant to every facet of life in Arizona, including the mining industry, was passed at a special legislative session on June 4, 1980. Over 2 years in preparation, the Ground Water Management Act established a Department of Water Resources and designated water basins, subbasins, and irrigation nonexpansion areas. Agriculture, which uses 90% of the water, was expected to be most affected by the new act, which provided for planned withdrawal and recharging of the water basins in Arizona. Arizona's mining industries use less than 3% of the State's water.

In 1980, the Arizona Legislature passed the controversial "Sagebrush Rebellion" Bill which would allow the State to claim most of the public domain managed by the U.S. Department of the Interior's Bureau of Land Management (BLM) in the State. Proponents of the bill felt implementing the multiple-use concept in land management by Federal agencies had slowed to unacceptable levels. The BLM administers 12.5 million acres in Arizona. Military and Indian Reservations, national parks, monuments, wildlife, and other sanctuaries would not be included in the proposed transfer of lands to the State. Governor Bruce Babbit's veto of the bill on April 8 was overriden on April 18. Arizona was the fifth State to pass "Sagebrush Rebellion" legislation. The legislature also appropriated $60,000 to join Nevada in a lawsuit challenging the Federal Government's right to control the land.

Some recent activities of BLM are based on a 1976 Federal Land Policy and Management Act which required the agency to make recommendations to Congress for lands to be designated as wilderness areas. The "initial inventory" took place between October 1978 and September 1979, and 54% of the Arizona land inventoried was identified as nonwilderness. The "intensive inventory," which included examining the areas identified as wilderness, occurred between September 1979 and November 1980. The inventory decision report was published in November 1980.[3] In this intensive inventory phase, the lands were examined to determine whether they would have the wilderness qualities the Congress required. In a third phase, from November 1980 to October 1991, lands established as Wilderness Study Areas were to be studied to determine the effect of a wilderness designation; the U.S. Geological Survey and the Bureau of Mines were to assess the mineral resources in the proposed wilderness areas. Lands designated primitive or natural areas before November 1975 were called instant-study areas, and BLM made recommendations to the President as to their suitability in 1980. Instant-study areas in Arizona were Aravaipa Canyon Primitive Area (Safford District), Paiute Primitive Area, Paria Canyon Primitive Area, Vermilion Cliffs Natural Area, Big Sage Natural Area, and the Turbinella-Gambel Oak Natural Area (Arizona Strip District).

In 1980, the BLM Wilderness Study Areas under investigation by the Bureau of Mines included Crossman Peak, Lime Hills, Narrows, Pigeon Canyon, Sand Cove, and Snap Point—a total of 212,700 acres in Mohave County; and the Gila-San Francisco Area—

a total of 46,000 acres in Graham and Greenlee Counties.

The Forest Service Wilderness Areas under study by the Bureau of Mines in 1980 included Mazatzal (205,346 acres) in Gila, Maricopa, and Yavapai Counties; Pusch Ridge (56,430 acres) in Pima County; Superstition (124,140 acres) and Superstition Wilderness addition (20,500 acres) in Gila, Maricopa, and Pinal Counties.

In 1980, the second Forest Service Roadless Area Review and Evaluation (RARE II) Further Planning Areas under study by the Bureau of Mines included the following: Bunk Robinson Peak (15,850 acres) and Whitmire Canyon (12,740 acres) in Cochise County, Ariz., both with additional acreage in Hidalgo County, N. Mex.; the Dragoon Mountains (32,820 acres), North End (23,550 acres) area, and Winchester (14,100 acres) area in Cochise County; Whetstone (36,610 acres) in Cochise and Pima Counties; Kanab Creek (9,008 acres) in Coconino and Mohave Counties; Fossil Springs (14,090 acres) in Coconino, Gila, and Yavapai Counties; Rattlesnake (32,870 acres), West Clear Creek (31,850 acres), and Wet Beaver (9,890 acres) in Coconino and Yavapai Counties; Strawberry Crater North (1,790 acres) and South (8,050 acres) in Coconino Counties; Mazatzal Wilderness Contiguous (83,700 acres) in Gila, Maricopa, and Yavapai Counties; Arnold Mesa (28,320 acres) in Yavapai County; Hell's Gate (30,400 acres) in Gila County; and Hell's Hole (34,330 acres) in Greenlee County, Ariz., and additional acreage in Catron County, N. Mex. A total of 419,968 acres is included in the Arizona RARE II study further planning areas.

In 1980, four Government publications became available on the following:[4] The mineral resource potential of the Paiute Instant (Primitive) Study Area; a map of mines and prospects of the Paiute Primitive Area, Mohave County, Ariz.; a report on the Turbinella-Gambel Oak Instant Study Area; and a preliminary report on the mineral resource potential of the Vermilion Cliffs-Paria Canyon Instant Study Area, Coconino County, Ariz., and Kane County, Utah.

From January 1 to December 31, 1980, the Bureau of Mines awarded $1,624,953 in new research contracts and grants and modified existing contracts to the State of Arizona, the Univeristy of Arizona, and seven private companies. The projects covered such subjects as underground rescue and emergency programs, maintenance service, impact rock breakers, inventory of mine waste embankments, surface and underground openings, planning for optimized mining land use, utilizing water harvesting, a borehole mining tool, impact of mining on ground water, and in situ leaching of metallic ores.

Under the Surface Mining Control and Reclamation Act of 1977, the Arizona Mining and Mineral Resources and Research Institute received a $302,492 research grant in 1980 from the Office of Surface Mining.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Beryllium.—Brush Wellman, Inc., opened a new plant in Tucson to manufacture high-quality beryllia ceramic from beryllium oxide powder supplied by its Elmore, Ohio, facility for use as a substrate by the electronics industry.

Copper.—Because of the copper strike, which lasted as long as 5 months at some operations, tons of copper produced in the State dropped almost 20%. Value of production declined 11.8% owing to the higher prices paid for copper during the year; the 1979 average price was $0.92 per pound versus $1.01 per pound in 1980. Riding on speculation in gold and silver, the price of copper ranged from $1.43 per pound in mid-February 1980 to $0.85 in December. Although the copper strike effected a decline in production, the depressed auto and construction industries also contributed to the slower-than-expected recovery of the copper market after the strike.

Table 4.—Arizona: Production and value of copper in Arizona and the United States

Year	Arizona copper production		U.S. copper production		Arizona
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Percent of U.S. copper production
1976	929,339	$1,425,994	1,456,561	$2,234,975	63.8
1977	838,038	1,234,168	1,364,374	2,009,297	61.4
1978	891,405	1,306,866	1,357,586	1,990,323	65.7
1979	946,002	1,940,211	r1,443,556	2,960,676	65.5
1980	757,314	1,709,997	1,168,311	2,638,020	64.8

rRevised.

Table 5.—Arizona: Fifteen leading copper-producing mines in 1980, in order of output

Rank in 1980	Rank in 1979	Mine	County	Operator	Source of copper in 1980
1	r1	Morenci	Greenlee	Phelps Dodge Corp	Copper ore and precipitates.
2	4	Sierrita	Pima	Duval Corp	Copper ore.
3	2	Twin Buttes	do	Anamax Mining Co	Do.
4	r5	Ray Pit	Pinal	Kennecott Copper Corp	Copper ore and precipitates.
5	r3	San Manuel	do	Magma Copper Co	Copper ore and tailings.
6	r7	Bagdad	Yavapai	Cyprus Bagdad Copper Co	Copper ore.
7	r6	Pinto Valley	Gila	Cities Service Co	Copper ore and precipitates.
8	r10	Inspiration	do	Inspiration Consolidated Copper Co.	Do.
9		Eisenhower	Pima	Eisenhower Mining Co	Copper ore.
10		Pima	do	Cyprus Pima Mining Co	Do.
11	r9	New Cornelia	do	Phelps Dodge Corp	Do.
12	15	Esperanza	do	Duval Corp	Copper ore and precipitates.
13	r11	Magma	Pinal	Magma Copper Co	Copper ore.
14	8	Metcalf	Greenlee	Phelps Dodge Corp	Copper ore and precipitates.
15	r14	Sacaton Unit	Pinal	ASARCO Incorporated	Copper ore.
	r12	Mission	Pima	do	Do.
	r13	Silver Bell	do	do	Copper ore and precipitates.

rRevised.

Table 6.—Arizona: Material handled and copper produced at 15 leading copper open pit and underground mines

Mine	Ore mined (thousand metric tons)		Waste material removed (excluding material placed in leach dumps) (thousand metric tons)		Material placed in leach dumps (thousand metric tons)		Total copper produced[1] (metric tons)	
	1979	1980	1979	1980	1979	1980	1979	1980
OPEN PIT								
Morenci	19,690	16,051	17,551	11,832	8,885	14,983	101,091	120,659
Sierrita	30,312	32,086	33,384	35,612	--	--	91,657	93,666
Twin Buttes	12,620	10,006	35,347	29,209	1,739	2,020	101,930	84,283
Ray	12,883	10,142	--	--	35,107	29,946	93,160	76,360
Bagdad	13,239	13,771	21,972	19,712	1,253	863	52,960	58,024
Pinto Valley	15,634	10,037	--	--	27,470	16,299	64,348	42,416
Inspiration	5,498	3,795	9,677	NA	8,782	NA	r36,991	32,779
Eisenhower	NA	6,602	NA	17,109	NA	--	NA	30,867
Pima	W	6,630	NA	47,343	NA	--	W	26,821
New Cornelia	9,230	6,388	9,481	8,126	--	--	39,615	26,224
Esperanza	4,445	5,504	--	1,470	--	2,715	11,373	21,782
Metcalf	8,369	2,193	12,222	3,622	7,066	3,284	40,300	15,914
Sacaton Unit	3,634	3,465	11,215	7,668	--	--	19,384	14,603
Mission	4,370	W	3,329	W	--	--	25,422	W
UNDERGROUND								
San Manuel	19,803	12,522	135	20	--	--	111,307	72,696
Superior (Magma)	883	505	82	93	--	--	37,334	21,886

rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Gross metal content.

Table 7.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Lode mines producing[1]	Material sold or treated (metric tons)	Gold		Silver	
			Troy ounces	Value	Troy ounces	Value
1978, total	30	163,198,046	92,989	$17,998,020	6,637,838	$35,844,325
1979, total	42	185,485,876	101,840	31,315,805	7,478,942	82,941,467
1980:						
Gila	8	18,927,386	(2)	(2)	(2)	(2)
Pima	10	69,408,261	(2)	(2)	3,183,033	65,697,801
Pinal	5	26,875,415	30,947	18,956,894	1,093,799	22,576,012
Undistributed[3]	11	39,084,245	41,826	25,620,936	1,390,983	28,709,889
Total	34	154,295,307	72,773	44,577,830	5,667,815	116,983,702

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1978, total	891,404	$1,306,865,541	416	$309,129	W	W	$1,282,294,796
1979, total	946,002	1,940,211,347	354	410,996	W	W	W
1980:							
Gila	91,501	206,606,856	--	--	--	--	210,803,215
Pima	282,748	638,438,427	(2)	(2)	W	W	W
Pinal	177,470	400,723,422	--	--	W	W	W
Undistributed[3]	205,595	464,227,857	401	375,180	W	W	W
Total	757,314	1,709,996,562	401	375,180	W	W	W

W Withheld to avoid disclosing company proprietary data.
[1]Operations at miscellaneous cleanups not counted as mines.
[2]Included in "Undistributed."
[3]Includes Cochise, Greenlee, Maricopa, Mohave, Yavapai, and Yuma Counties and items indicated by footnote 2 combined to avoid disclosing company proprietary data.

Table 8.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1980, by class of ore or other source material

Source	Number of mines	Material sold or treated (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:							
Gold	1	45,359	1,000	500	--	--	--
Silver	3	3,217	97	20,980	--	--	--
Copper	27	153,905,834	71,533	5,640,703	690,307	325	W
Lead	3	1,764	--	1,485	--	35	--
Total	34	153,956,174	72,630	5,663,668	690,307	360	W
Other lode material:							
Gold-silver tailings and copper tailings[1]	2	[2]226,525	143	4,147	1,741	40	--
Copper precipitates	8	112,608	--	--	65,266	--	--
Total	10	339,133	143	4,147	67,007	40	--
Grand total	44	154,295,307	72,773	5,667,815	757,314	[3]401	W

W Withheld to avoid disclosing company proprietary data.
[1]Combined to avoid disclosing company confidential data.
[2]Excludes newly generated tailings.
[3]Data do not add to total shown because of independent rounding.

Table 9.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1980, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode:					
Cyanidation	1,000	500	--	--	--
Acid leaching (vat, tank, heap)[1]	--	--	85,101	--	--
Smelting of concentrates	71,447	5,636,733	604,823	349	W
Direct smelting of:					
Ore	183	26,435	383	11	--
Precipitates	--	--	65,266	--	--
Tailings	143	4,147	1,741	40	--
Total[2]	326	30,582	67,389	52	
Grand total[2]	72,773	5,667,815	757,314	401	W

W Withheld to avoid disclosing company proprietary data.
[1]Includes copper recovered by electrowinning process.
[2]Data may not add to totals shown because of independent rounding.

The Anamax Mining Co., under an equal partnership between AMAX Inc., and The Anaconda Company (a subsidiary of the Atlantic Richfield Co.), operated the Twin Buttes mine-mill and hydrometallurgical complex about 25 miles south of Tucson, Pima County. Twin Buttes has an annual design capacity of 90,000 tons of copper contained in concentrates from sulfide ore and approximately 36,000 tons of cathode copper from the oxide ore. The Anamax partnership includes mining and milling copper sulfide ore. Each company then purchases its share of the copper concentrate thus produced and arranges for smelting, refining, and sales. At the copper oxide operation, the partnership has responsibility through the production of electrowon cathode copper, at which point each partner purchases its share of copper and is responsible for its own sales. In 1980, most of the AMAX copper concentrates were sold to Nippon Mining Co., Ltd., of Japan.

The AMAX 1980 annual report noted that the Twin Buttes Mine (including the AMAX share of the adjacent Eisenhower Mining property) has estimated reserves of 211 million tons of sulfide ore with an average grade of 0.65% copper and 20 million tons of oxide ore with an average grade of 0.96% copper. In 1980, AMAX reported copper production declined, partly because of the strike, which lasted from July 31 to October 24, and partly because of a lower grade of sulfide ore from the Eisenhower Mining Co. The sulfide ore grade dropped from 0.94% to 0.82% in 1980.

On November 3, 1980, pursuant to a consent order between the Federal Trade Commission and the Atlantic Richfield Co., The Anaconda Copper Co. offered for sale its 50% interest in the Anamax Mining Co. Anaconda has until 1984 to complete the transaction.

Anamax completed the new tailings dam and water reclamation system in 1980 and began reclaiming a significant amount of the sulfide-mill water requirements. The company was also actively seeking new sources of water. Ground water management legislation passed in the State in 1980, the company reported, would allow the firm

sufficient water to meet future requirements; however, the constitutionality of that legislation was challenged. The Papago Indian Tribe and the U.S. Government, in 1975, brought action in the courts against Anamax Mining Co. and others for withdrawing surface and underground water from the Santa Cruz River Basin. In 1980, an amended complaint added 1,750 defendants. The Tribe claims the prior right to such water as necessary for use on the San Xavier Indian Reservation.

ASARCO Incorporated owns and operates the Mission and San Xavier open pit mines near Sahuarita, Pima County, about 15 miles south of Tucson; the Silver Bell open pit mine at Silver Bell, Pima County, 38 miles northwest of Tucson; and the Sacaton open pit mine, some 5 miles northwest of Casa Grande, Pinal County. The company also owns and operates the Hayden smelter at Hayden, Pinal County. Ores are processed through concentrators at each of the mines.

The 1980 Asarco annual report listed reserves at its properties as of December 31, 1980, as follows: San Xavier, 165,805,000 short tons of ore with an average of 0.52% copper per ton and 0.06 ounce of silver; Mission, 94,003,000 short tons with an average of 0.76% copper and 0.14 ounce of silver; and Sacaton, 26,055,000 short tons with an average of 1% copper.

Asarco's Mission, San Xavier, Silver Bell, and Hayden operations were closed by the copper strike, which lasted from July 1 to November 24. The company had about 1,500 employees at the involved Arizona properties. The Sacaton property, which was not unionized, continued to operate.

During the year, Asarco replaced the Mission Mine truck fleet with new 170-ton ore-haulage trucks, which were expected to consume 12 1/2% less fuel per ton of ore. Maintenance shops were expanded to accommodate these large vehicles. In addition, the larger flotation cells installed in the concentrator were expected to achieve a 25% savings in power costs, reduce maintenance and labor costs, and to increase copper recovery.

According to the Asarco 1980 annual report, work at the Sacaton property proceeded in sinking two shafts for development of an underground ore body near the present open pit mine. By yearend, the 20-foot-diameter production shaft had advanced to a depth of 1,500 feet, and the 14-foot-diameter ventilation shaft was sunk to a depth of 130 feet. Completion of the shafts and the start of underground development work were expected in 1981, and production would begin about 1984 when the present 11,000-ton-per-day open pit operation will be phased down. Planned for production at 7,000 short tons per day, the new underground mine is expected to have 1.25% copper ore.

At the Hayden copper smelter, the secondary exhaust hoods installed on the converter furnaces greatly improved operations and reduced the emission of sulfur dioxide to lower levels. The installation also improved working conditions and air-quality controls and effected higher operating rates. Begun in November 1978, the project was completed by mid-1980 at a cost of $4 million.

During the year, Asarco negotiated with the Environmental Protection Agency (EPA) on a proposal to modernize the Hayden smelter with the installation of a flash smelter. EPA, copper producers, and the State of Arizona disagreed as to methods of emission control for Arizona smelters. EPA favored a constant emission rate, whereas copper producers and the State favored multipoint roll-back systems which allow fluctuations in the emission rate based on weather conditions, variances among smelters, and the concentrates they produce. Completion of the negotiations was expected in 1981.

Retention of water rights and compliance with air pollution standards continued to be problems during the year. The new Ground Water Code was expected to allow Asarco operations to continue in the Santa Cruz Valley, subject only to any accrued claims for damages to various concerns such as farm organizations and the City of Tucson that have instituted suits against mining companies in the area. Asarco also uses the San Pedro River Watershed to supply its water needs at its Hayden smelter. Mining companies and other water users have had their rights to those waters challenged by the Gila River Indian Community. In 1980, the matter was ordered to the State courts.

Under a general partnership known as the Eisenhower Mining Co., Anamax Mining Co. and Asarco, are developing, mining, and concentrating the ores of the Palo Verde copper deposit about 15 miles south of Tucson, Pima County. The Palo Verde Mine is north of the Twin Buttes Mine, between Asarco's Mission and San Xavier Mines. Although Asarco operates the mine,

ores from each partner's interest in the Eisenhower property are processed into concentrates either at Asarco's Mission mill or at the Anamax Twin Buttes mill. Anamax has crushing facilities near the Palo Verde property and a 6.5-mile conveyor system to transport its ore to its Twin Buttes mill.

According to the 1980 AMAX Securities and Exchange Commission (SEC) Form 10K annual report (10K Report), Anamax processed 4 million tons of ore from the Eisenhower Mining Co. and recovered 22,382 tons of copper in concentrate. Asarco, in its 1980 annual report, recorded the recovery of 11,600 tons of copper as its share from the Eisenhower property, down from the 12,100 tons recovered in 1979. (Particulars of the company arrangements in the partnership are detailed in the 1978-79 Minerals Yearbook.[5] Production in 1980 declined when the Eisenhower Mine was shut down from July 1 to November 24 because of the copper industry strike.

According to the Asarco 1980 annual report, the total reserves of the partnership as of December 31, 1980, were an estimated 147,002,900 tons containing 0.12 ounce per ton of silver and 0.64% copper. Asarco ascertained its portion to be 38,148,000 tons of ore containing an average of 0.72% copper and 0.14 ounce per ton of silver.

The Cities Service Co. Miami Copper Operations in Gila County consist of the Pinto Valley open pit mine and a 50,000-short-ton-per-day concentrator located 6 miles west of Miami, plus a solvent extraction-electrowinning plant that processes leach waters from the old Miami copper mine at Miami. The latter plant recovers 11 million pounds of copper per year.

During the year, Cities Service was constructing a solvent extraction-electrowinning plant at the Pinto Valley site, scheduled for completion in July 1981. Site preparation began in May, and in July construction commenced on the $26 million facility. Three waste dumps with a surface of about 71 acres will be leached by the distribution of 6,600 gallons per minute of leach solution. The collection and distribution system will include three pump stations, 4.25 miles of pipeline to the dumps, about 16 miles of spray lines over the area, and three 3,000-gallon-per-minute pumps to return the solution 1 mile to the solvent extraction-electrowinning plant. Designed to treat up to 6,000 pounds of solution per minute, the new plant is expected to recover 10 to 11 million pounds of electrolytic-grade copper per year.

Cities Service also continued work on the Miami East project revived in 1979. A drilling program in the late 1960's discovered a deep-lying ore body; to determine the size and grade of the ore body, the old Miami Copper No. 5 shaft was deepened to 3,500 feet, and extensive drifting was carried out laterally on the 2,900- and 3,300-foot levels into the ore zones. In 1974, the No. 11 ventilation shaft was put down to 2,900 feet, and by October 1975 a connection was made to the No. 5 shaft. A second shaft was down 2,010 feet when development was terminated on the entire Miami East project in October 1975, because of a severe drop in copper prices. With higher metal prices, work was resumed in 1979, and the mine is scheduled to come onstream in 1982.

According to the Cities Service 1980 annual report, reserves in the Pinto Valley open pit mine and the underground mine were estimated to be 419.4 million tons with an average grade of 0.449% copper. Byproducts of copper production included molybdenum, gold, silver, and turquoise.

Cyprus Mines Corp., acquired by Standard Oil Co. (Indiana) in 1979, became an operating subsidiary of Amoco Minerals Co. (also a subsidiary of Standard) in 1980. During the year, Cyprus operated the Cyprus Bagdad, Cyprus Pima, and Cyprus Johnson open pit mines and the Cyprus metallurgical process demonstration plant. Although many copper operations in the State were closed during the copper strike, the nonunionized Cyprus mines maintained a normal production schedule.

The Cyprus Bagdad complex, 120 miles northwest of Phoenix in Yavapai County, consists of the open pit Cyprus Bagdad Mine, a 40,000-ton-per-day sulfide concentrator, and a dump-leaching, solvent extraction-electrowinning operation. In 1980, the company employed 817 people including 390 at the mine, 186 at the mill, and 30 at the solvent-extraction plant.

According to Niemi,[6] the $220 million expansion completed in 1977 included an in-pit primary crusher and a 6,400-foot-long conveyor system for transporting the crushed ore over a 1,020-foot rise to a 55,000-short-ton, live-ore stockpile above the concentrator. The three 32-foot-diameter primary autogenous grinding mills that were installed in the concentrator were the largest in use in the Southwest. Tailings flow through a 5,000-foot-long pipeline to a 240-

acre pond where water is reclaimed for mill use. Fresh water is obtained 30 miles northwest of Bagdad in the Big Sandy Valley near Wikieup. The solvent-extraction operation recovers 40,000 pounds per day of pure copper cathode from solutions pumped over the approximately 100 million short tons of oxide ore stockpile.

Cyprus Bagdad initiated an expansion program during the year to increase copper production about 30%, to approximately 85,000 short tons per year by 1982.

Niemi also reported that reserves, as of 1980, were over 300 million short tons of sulfide ore averaging 0.49% copper, 0.014% molybdenum, and trace silver, plus approximately 38 million short tons of overlying oxide ore with an acid-soluble copper content of about 0.35%. An additional 100 million short tons of oxide ore with an acid-soluble content of about 0.19% have been stockpiled from previous mining operations.

In response to EPA charges of contamination of tributaries of Burro Creek in 1980, Cyprus Bagdad hired hydrologic consultants to study the discharge problem.

The Cyprus Pima Mine of Cyprus Pima Mining Co.—owned 50.01% by Cyprus Mines Corp., 24.99% by Utah International (a division of General Electric), and 25% by Union Oil—is about 16 miles south of Tucson. Late in 1980, the company rehabilitated some of its shutdown mill facilities to increase the concentrator capacity from 18,000 to 32,500 tons of ore per day.

Duval Corp., a subsidiary of Pennzoil, Co., operated the Sierrita and Esperanza open pit copper-molybdenum mines 32 miles south of Tucson, Pima County. The company's Mineral Park open pit copper-molybdenum mine in Mohave County is 15 miles northwest of Kingman. At each mine, the ores are processed through concentrators for producing copper and molybdenum concentrates. The design capacity of the Sierrita concentrator is 82,500 short tons per day; the Esperanza concentrator has a daily capacity of 15,000 short tons; and the Mineral Park concentrator has a capacity of 19,000 short tons per day. At Esperanza and Mineral Park, copper is also recovered at leach-precipitation facilities. Products are sold as copper concentrates and precipitates, processed at Duval's Copper Leach Electrolysis and Regeneration (CLEAR) process hydrometallurgical plant, or toll smelted and refined by others for redelivery to and marketing by Duval.

According to the 1980 Pennzoil 10K Report, as of December 30, 1980, reserves were estimated to be 398,752,000 short tons of ore with an average grade of 0.3% copper and 0.035% molybdenum at Sierrita; 54,959,000 short tons of ore with an average grade of 0.27% copper and 0.033% molybdenum at Esperanza; and 43,832,000 short tons of ore with an average grade of 0.19% copper and 0.051% molybdenum at Mineral Park.

Factors stemming from the copper strikes at other companies may have contributed to the 9% increase in the total copper production from all Duval copper properties in Arizona and Nevada. The strike at Duval, begun September 30, lasted only 5 days, compared with the nearly 3-month shutdown other companies in the State sustained.

Located near the Sierrita property, Duval's pollution-free CLEAR process hydrometallurgical plant treated approximately one-fourth of Duval's copper production. Designed to produce 40,000 short tons of copper crystals per year, the plant, still being fine-tuned, was operated at about 91% capacity in 1980. With the CLEAR process, copper crystals (equivalent to high-grade blister copper) were electrolytically recovered from concentrates produced at the Esperanza and Sierrita properties and from precipitates produced at the Esperanza and Mineral Park properties. The 99.4% pure product is sold as such or processed by conventional toll-electrolytic copper refineries for redelivery and marketing by Duval. Recovered as a byproduct of copper purification, iron and sulfur are prepared at the plant for a fertilizer.

Late in the year, Duval purchased, for $1,000 an acre, approximately 6,284 acres of State land adjacent to its Sierrita-Esperanza properties in Pima County, and another 586 acres at its Mineral Park properties in Mohave County. The company had leased the properties since the mid-1960's for tailings ponds and waste dumps. Duval made a $1.3 million downpayment, 20% of the total purchase price; the rest would be paid over 25 years at 10.5% annual interest. The State retained oil and mineral rights to the land, and no water rights were attached to the land.

Water litigation continued in the Duval area of Pima County. Duval, as well as other mining companies and agricultural, municipal, and industrial interests, makes substantial water withdrawals from an underground aquifer in the upper Santa Cruz Basin in the county. In 1979, Duval, three

other copper mining companies, and agricultural interests reached settlement of a suit regarding the rights of the mining companies to withdraw water from the aquifer. Present claims to the water come from an earlier action (1975) in which the Papago Indian Tribe asserted prior rights to water. In 1980, Duval was added as a defendant.

An integrated natural resource company, Inspiration Consolidated Copper Co., operated the Thornton, Live Oak, Red Hill, and Joe Bush open pit copper mines at Inspiration. The company also operated the upper and lower Ox Hide open pit mine about 3 miles west of Inspiration in the Globe-Miami mining district, Gila County, and the Christmas open pit copper mine and mill about 35 miles south of Globe in the Banner mining district, Pinal County. At Inspiration, the complex includes three-stage crushing facilities, a vat leaching plant, a concentrator, a precipitation and solvent-extraction plant, electrowinning and electrorefining plants, a smelter, a sulfuric acid plant, and a continuous rod-fabricating plant. The smelter and electrorefining plant also treated outside ores on a toll basis.

Reduced production and deliveries of copper from the Inspiration area mines were due in part to the 115-day strike, which shut down the metallurgical treatment route through the smelter, and to various commissioning and startup delays after the strike. The strike idled about 1,600 workers.

Production at the Christmas open pit mine increased. At the Sanchez mine near Safford, Graham County, development remained suspended.

According to the Inspiration 1980 annual report, as of December 31, 1980, estimated reserves at the Inspiration area mines (including the Ox Hide) were 265,333,000 dry short tons at a grade of 0.55% copper; at the Christmas open pit mine, 11,613,000 dry short tons at a grade of 0.62% copper; at the inactive Christmas underground mine, 20,131,000 dry short tons at a grade of 1.78% copper; and at the Sanchez Mine, 79,362,000 dry short tons at a grade of 0.36% copper.

In late June, less than 5 months after start of construction, the company installed a $16 million patented ferric-cure leach system designed to produce leach solutions quickly and to provide high recovery rates from ores containing copper oxide minerals and chalcocite. The process is integrated with Inspiration's new $14 million solvent-extraction plant completed in October 1979. The third phase of a seven-stage $15 million modernization of the concentrator was completed. Expected results were improved recovery of copper and molybdenum in the concentrates, a reduction in energy consumption, and fewer personnel. Engineering continued on a project to bring the smelter into full compliance with the ambient air quality and sulfur dioxide emission regulations at designed plant capacity. Crushing, screening, and handling of secondary material, modernization of process control instrumentation, and modifications to one Hoboken converter are in an accelerated phase of the project. For the most part, the strike did not interrupt work by outside contractors.

Inspiration leased land on a tailings dam to a nearby town for constructing a sewage-treatment plant. The effluent was to be used for irrigating vegetation on tailings. The company is also developing a subdivision to supply quality housing for its employees and others in the area. Development costs will be recovered through land sales to builders.

Inspiration proposed a $7 million water-management system that would treat contaminated water on the site at a rate of 3,000 gallons per minute to obtain a goal of zero discharge of contaminants.

The company arranged a financing program totaling $150 million to further the modernization, expansion, and environmental control programs of its operations in Arizona. Funding will include an offering of $90 million in tax-exempt pollution-control bonds.

Ray Mines Division of Kennecott Minerals Co., a subsidiary of Kennecott Corp., operated an open pit mine, a silicate vat-leach and electrowinning plant near the mine at Ray, Pinal County, and a concentrator and smelter at Hayden, Gila County. Sulfide ore is crushed at the mine and then shipped 22 miles to the concentrator at Hayden. Copper concentrates are treated at Kennecott's Hayden smelter; the copper anodes are then shipped to the company's east coast electrolytic refinery in Maryland.

According to the Kennecott 1980 annual report, the Ray Mines Division mined, milled, and treated 11,180,000 net tons of ore in 1980 compared with 14,202,000 net tons in 1979. Copper recovered was 84,269 net tons in 1980 compared with 117,233 net tons in 1979; the average grade of ore, however, was 0.916% in 1980 compared with 0.876%

in 1979. The decreased production was attributed to the copper strike.

On March 1, 1980, Ray Mines brought onstream its new copper solvent-extraction plant. Constructed within the confines of an 11-year-old silicate-ore-leaching plant in the mine area, the plant cost an estimated $10 million. Designed to treat a maximum of 108 short tons per day by upgrading the quality of the pregnant leach solutions at the silicate ore leach plant, the solvent-extraction addition was to produce a more concentrated and purified copper electrolyte for the tankhouse than the vat leach liquors formerly presented. Previously, cathode copper from the silicate plant had to be reprocessed at the Hayden smelter. This new procedure is expected to increase the company's overall production by releasing additional smelting and refining capacity for sulfide concentrates. A brief description of the plant and its construction within the highly confined area appeared in two articles.[7]

In addition to the solvent-extraction plant in 1980, a new $750,000 acid-plant drying tower was constructed to replace the existing drying tower built in 1968 and rebricked in 1973.

The San Manuel Division of Magma Copper Co., a wholly owned subsidiary of Newmont Mining Corp., operates the largest underground copper mine in the United States. The mine and plant are 43 miles north of Tucson in Pinal County. The surface plant includes a concentrator, a smelter, a refinery capable of producing 200,000 tons of copper annually, and a 120,000-ton-annual-capacity continuous-cast copper rod-mill. American Metal Market, June 7, 1980, reported that Magma produced 125,000 tons of rod in 1979, three-quarters of its total copper production. At present production levels, reserves at San Manuel are expected to last well into the next century. As of December 31, 1980, the company reported Magma's ore reserves at San Manuel totaled 325,943,000 short tons with an average grade of 0.713% copper. The Kalamazoo ore body, the downfaulted segment of the San Manuel ore body, is scheduled for production in 1983. At Kalamazoo, reserves totaled 327,410,000 short tons with an average grade of 0.719% copper.

Production at San Manuel dropped from 21,970,000 tons of ore and smelter slag milled in 1979 to 13,887,000 tons in 1980. Average grade of ore improved from 0.63% copper in 1979 to 0.65% copper in 1980. The decrease in production resulted mainly from the strike and a fire in the San Manuel Mine.

During the year, throughput at the San Manuel smelter was curtailed 9.5% to comply with air-pollution regulations. Magma employed a converter-gas collection and cooling system and a sulfuric acid plant to reduce emissions of sulfur dioxide, as well as additional supplementary control systems involving air-quality monitoring and intermittent curtailments of operations. Enforcement of 1978 EPA and 1979 Arizona sulfur dioxide emission regulations, designed to achieve compliance solely by positive engineering controls with ambient-air-quality standards, had been stayed. Up to late 1980, Magma had expended $47 million for environmentally related capital additions; 1980 costs, including loss of production during curtailments, were estimated to be between $0.10 and $0.15 per pound of refined copper produced.

Among several hundred property owners, Magma is defendant in a legal action brought by the Gila River Indian Community for adjudication of its rights to the waters of the San Pedro watershed. The tribe claims prior rights to the surface and subsurface flow of the San Pedro River and its tributaries, and to ground waters of the San Pedro River and ground waters under the Gila River Reservation. At San Manuel, Magma obtains its industrial and potable water from dewatering its underground mine and from deep wells.

The high cost of energy prompted the company to study new means to reduce energy consumption at the San Manuel concentrator. In 1980, the development and installation of an angular spiraling system in the ball mill circuit contributed to a 16.7% decrease in ball mill energy consumption from 7.02 to 5.85 kilowatt-hours per dry ton, accounting for a $900,000-per-year reduction in operating cost to the concentrator division.[8]

The Bureau of Mines described batch-scale tests on a sample of porphyry copper mill tailings as part of a study to determine the feasibility of rutile recovery from this source. San Manuel samples contain 0.75% titania.[9] Another item appeared that briefly discussed the possibility of using such U.S. porphyry copper deposits as Bagdad, Bingham, and San Manuel as sources of rutile.[10]

The Superior Division of Magma Copper Co. operates an underground mine and a concentrator at Superior, Pinal County, 60

miles east of Phoenix. Ore concentrates are treated at the San Manuel smelter and refinery. According to the Newmont 1980 annual report, the Superior Division milled 569,800 tons of ore at an average grade of 4.32% copper in 1980, compared with 964,000 tons at 4.41% copper in 1979. The copper strike, which lasted 4 months, and a fire in December, which shut down operations for a week, resulted in a 41% decrease in production at the Magma Superior Mine. Ore reserves at Superior were an estimated 6,019,000 tons of 5.5% copper at the end of 1980.

The Lakeshore Mine, on the Papago Indian Reservation 28 miles southwest of Casa Grande, Pinal County, was operated by Noranda Exploration Co., Inc., a wholly owned subsidiary of Noranda Mines, Ltd., of Toronto, Canada. On October 31, 1978, Hecla Mining Co. and El Paso Natural Gas terminated their lease agreement and turned the Lakeshore back to the Papagos. In 1979, Noranda acquired the property from the Papago Indian Tribe and commenced a program of mine and plant rehabilitation.

Production from the oxide portion of the mine was resumed the fourth quarter of 1980. The ore was block-caved at 4,000 short tons per day, then vat-leached for the electrowinning plant at 2,000 short tons per day; the remainder was stockpiled.[11] Only partial production of the expected 6,000 short tons per day was achieved because of the 3 1/2-month copper strike which reduced the supply of sulfuric acid from the smelters. About 300 tons per day of sulfuric acid was required for the full operation of the vat-leach plant, and low-cost acid from in-State smelters was not available.[12] Copper cathode produced at the existing facilities was low grade; however, to improve the quality, Noranda was constructing a $7 million solvent-extraction plant with completion scheduled for mid-1981. The new solvent-extraction plant will be placed in the circuit between the vat-leaching and electrowinning facilities.

Mining the sulfide ore body and rehabilitating the concentrator will be reassessed in 1981. Production from this ore body would depend on improved economic conditions and higher copper prices.

Phelps Dodge Corp. ranked second in the State in total production of copper. The company owns and operates the Morenci and Metcalf open pit mines in Greenlee County, 169 miles northeast of Tucson, and the New Cornelia open pit mine at Ajo, Pima County, 130 miles west of Tucson. At each mine site, the copper ores are processed through concentrators. In addition, at the Morenci, Metcalf, and the closed Bisbee mines, certain low-grade copper materials are leached and copper recovered at precipitate plants. The concentrates and precipitate copper are then treated at one of the Phelps Dodge smelters at Douglas, Ajo, or Morenci. On a contract basis, these smelters also treated concentrates for others, including Cyprus Bagdad and Cyprus Pima.

In 1980, according to the company annual report, 176,500 short tons of copper in ores, concentrates, and precipitates was recovered from the Morenci, Metcalf, New Cornelia, and Bisbee properties, compared with 242,300 short tons in 1979.

The decrease in copper production at the Phelps Dodge Arizona properties was primarily attributed to the 100-day strike, and to the reduction in operating schedules at the Morenci and Metcalf mines and concentrators. Beginning in May and continuing through the year, Morenci and Metcalf operated on a 5-day workweek instead of the normal 6-day schedule. The company reported that settlement of the strike would increase hourly costs by almost 3-1/2% a year for the next 3 years in addition to quarterly wage adjustments tied to changes in the Consumer Price Index.

Because of weakened copper demand, lower copper prices, and higher operating costs, plans were being implemented late in December to place the Metcalf Mine on standby and to supply the Morenci and Metcalf concentrators with ore from the Morenci Mine. The procedure was expected to lower unit costs by lowering the overall waste ratio and by delivering a slightly higher grade of ore to the concentrators. In a program to improve recovery at the Morenci concentrator, the company replaced about half of the older 66-cubic-foot primary flotation cells with 1,000-cubic-foot cells; the remainder will be replaced in 1981.

At Ajo, preparations were made to expand the pit to extend the life of the New Cornelia Mine. In 1980, the company purchased employee-owned homes on Phelps Dodge property in the affected area, and arrangements were made for resettlement of the occupants. By yearend, site preparation was underway for relocating the mining engineering office and the locomotive-maintenance shop and for constructing a new office, change-room building, and mine garage. In early February

1980, construction commenced on a new $3 million byproduct molybdenum concentrator with a design capacity of 600 tons per day of copper concentrate; completed in early November, the plant was operated initially at 450 tons per day.

The company continued developing its low-grade sulfide copper deposit at Safford, Graham County. About $73 million (exclusive of $11.7 million of related capitalized interest) had been invested in the property since 1969, including $7.7 million during 1980; $6.1 million was spent in 1979. No date has been set for bringing this property into production. Although the Copper Basin property southwest of Prescott remained inactive, land-exchange preparations were underway.

During the year, Phelps Dodge developed a program to invest over $100 million in additional pollution controls at its Morenci and Ajo smelters. The equipment would be installed to meet current Federal and State environmental standards. The company, however, predicted that unless present Federal environmental laws were eased or the economics of such installations improved, the Douglas smelter would be closed in 1987. EPA proposed that a sulfuric acid plant should be constructed at the Douglas smelter. Concerning Ajo, the company said that before deciding to close that smelter rather than carry out further air-quality-control measures, various alternatives would be evaluated to determine an economically preferable way of handling production (such as the sale or toll smelting of concentrates). No major expenditures for bringing the Ajo smelter into compliance with Clean Air Standards are required before 1983.

In October 1980, Phelps Dodge entered into an agreement with Dravo Corp. to retrofit existing reverberatory furnaces to oxygen flash smelting units. The company planned pilot tests of the new oxygen-sprinkle process at its Morenci facility.

According to the 1979 Phelps Dodge annual report, the company had, since 1970, made total capital expenditures of $204.6 million at the three Arizona smelters to enable the plants to meet acceptable air-quality requirements. The smelters have operated under State permits that require sulfur dioxide emissions to be curtailed when abnormal weather conditions might cause these emissions to exceed ambient-air standards around the smelter. These requirements have resulted in lower production and higher costs at the smelters, particularly Morenci. Local meteorological conditions allow the Ajo smelter to operate almost continually. In December 1980, the Pima County Industrial Authority approved Phelps Dodge's request to refinance the $28 million in bonds originally issued to provide capital for installing pollution controls at the Ajo smelter; the 7-year bonds were issued in 1973. The reissue of the new 15-year, tax-free bonds was prompted by the anticipated expense of additional pollution controls at the Morenci and Ajo smelters.

Other matters of environmental importance were being studied such as the impact of floodwaters on the Chase Canyon waste dumps at Morenci and exposure of workers to arsenic, heat, lead, noise, and sulfur dioxide at the various smelters.

During the year, legislative, judicial, and administrative branches of government and industry studied water availability. The Morenci operation, which uses about 18,500-acre-feet of water, was involved in such a judicial study. Various Indian tribes are claiming prior and paramount rights to water being used by many. Phelps Dodge contends rights to certain waters were established many years ago by agreements and judicial decrees. State proceedings that relate to the Gila River, Little Colorado River, Verde River, and Salt River watersheds could affect virtually all water usage of the Morenci property.

According to the Continental Materials Corp. 1980 annual report, Continental Catalina, Inc., a partner in the Oracle Ridge mining partners (which includes Union Miniere, S.A., of Brussels) continued phase 1 of a new program to evaluate the Oracle Ridge Mine. The mine is on the north slope of the Santa Catalina Mountains north of Tucson. From April to December 1980, approximately 6,000 feet of underground drilling, 6,000 feet of surface drilling, and underground drifting into several ore blocks were completed. The company reported that assays tended to confirm earlier reserve estimates in certain rock formations. American Metal Market, April 17, 1980, reported that ore reserves, originally estimated at 11 million tons, were in 1980 estimated to be between 4 and 7.5 million tons with about 2.25% copper.

Getty Oil Co. and Hanna Mining Co., in an equally owned joint venture operated by Casa Grande Copper Co. (a Hanna subsidiary), reported as of December 31, 1980, an estimate of approximately 350 million tons

at 1.05% copper ores in place at their Casa Grande copper deposit. In 1980, engineering studies and metallurgical tests continued at the oxide and sulfide copper deposit discovered in 1976 near Casa Grande, Pinal County. Construction of a pilot mining shaft, bulk sampling, and drilling from underground workings will be necessary to determine whether a commercial deposit exists.

Occidental Minerals Corp., a subsidiary of Occidental Petroleum Corp., terminated its exploration and testing project on the Van Dyke Copper Co. and Sho-Me Copper Co. copper deposit in the Miami mining district, Gila County. Early in the century, Cleve Van Dyke, who patented the original property, made available the top 40 feet of the area for the Miami townsite and retained the remaining subsurface mineral rights. The two mining companies were organized later, and the properties were operated sporadically from the early twenties into the forties. In 1968, Occidental leased the Van Dyke and Sho-Me and began an exploration and testing program on the deposit, which underlies the town of Miami. Eventually, an estimated 100 million tons of oxide ore with an average grade of 0.5% copper was blocked out. The deposit lies east of the Miami fault and dips 15° from a depth of about 1,100 feet to 2,000 feet.

Occidental planned to leach the copper by injecting a solution of 2% to 4% sulfuric acid and return the solution through a solvent-extraction and electrowinning plant to recover the copper. The company proposed sinking a shaft outside the town, then driving drifts from which solution wells would be drilled. The use of hydraulic fracturing would eliminate underground detonations at all of the operations. Three injection wells and 12 recovery wells were proposed for the test project. In January 1980, fearing possible contamination of ground water, the town council rejected the testing permit, and Occidental referred the matter to the courts. Although the company was upheld in the lower court, Occidental decided to drop its option to purchase the subsurface rights and direct its exploration efforts elsewhere. Over $11 million was reportedly spent on exploration and tests, and the company was prepared to spend another $16 million to test the in situ method.

Throughout the year, Ranchers Exploration and Development Corp. continued to recover copper at its Bluebird operation near Miami, Gila County. Employees at the Bluebird did not participate in the copper strike. Ore was open-pit-mined, heap-leached, and processed through a solvent extraction-electrowinning plant on the property. Constructed in 1968, the facility was the first commercial plant to recover copper by solvent extraction-electrowinning, resulting in recovery of a 99.95% pure copper cathode.

Ranchers also leached copper at the Old Reliable Mine near Mammoth, Pinal County, in 1980. The Old Reliable was the first copper deposit to be blasted on a large scale and leached entirely in place.

Gold.—Gold is recovered in the State principally as a byproduct of copper production. The 28.5% decline in the amount of gold produced during 1980 was the result of the copper strike. The 42.3% increase in the total value of gold produced reflected the increase in the price of gold from an average unit price of $307.50 per troy ounce in 1979 to $612.56 per troy ounce in 1980. Fifteen large-scale operations recovered byproduct gold in 1980, and eight small precious and base-metal operations (under 100,000 tons of material sold or treated) recovered gold in 1980. Gold production was obtained from the following large-scale operations listed in descending order of the value of production: Morenci, San Manuel, New Cornelia, Superior, Sacaton, Christmas, Metcalf, Bagdad, Twin Buttes, Pima, Eisenhower, Inspiration, Ray, Sierrita, and Pinto Valley.

Lead.—Although lead output increased 13% in amount, the value of lead production decreased over 8% because of the drop in the price of lead, from $0.5264 per pound in 1979 to $0.4245 per pound in 1980. Three large copper operations recovered byproduct lead in 1980, and five small mines recovered lead in their base metal operations. The mines producing lead were Mission, Sierrita, Tiger Tailings Dump, Contract, Gold Hill, Sacaton, Phillips, and McCulley.

Molybdenum.—As in 1979, Arizona was ranked second in amount of molybdenum shipped during 1980. Molybdenum is recovered as a coproduct or byproduct at the following mines, listed according to value of production: Sierrita, Mineral Park, Twin Buttes, San Manuel, Esperanza, Eisenhower, Cyprus Bagdad, Pima, Ray, Pinto Valley, Morenci, Silver Bell, Inspiration, Mission, and Ajo. The new producers were Ajo and Morenci. The increases in production by eight of the mines reported were partly

attributed to the new output and to the short duration of the copper strike at those mines.

Output increased only 1.6%, whereas the value of production increased about 60%, principally because of the rise in price during most of the year. The average price increased from $6.07 to $8.93 per pound of molybdenum contained in technical-grade molybdic oxide. The Arizona Bureau of Geology and Mineral Technology published a description of molybdenum in Arizona and an analysis of the geologic implications of its occurrence. Over one-half of the total Arizona production has come from the Pima mining district.[13] The Arizona Department of Mineral Resources, in 1979, described molybdenum occurrences in Arizona, including the small mines.[14]

Silver.—The State ranked second in the U.S. output of silver, and the metal was recovered principally as a byproduct of copper production. The 24% decline in the amount of silver produced during 1980 was the result of the copper strike, which continued until early November before all companies had settled. Value of silver production, however, increased 41% because of the rise in the price of silver, from an average unit price of $11.09 per troy ounce in 1979 to $20.63 per troy ounce in 1980. Leading producers of silver listed by value of production include the Sierrita, Twin Buttes, Morenci, Bagdad, Superior, San Manuel, Eisenhower, Pima, Ray, New Cornelia, Mineral Park, Sacaton, Christmas, Mission, Silver Bell, Metcalf, Inspiration, San Xavier, and Campbell. Nine small operations recovered silver from precious and base metal mines.

Tungsten.—Production of tungsten declined in 1980; only one company mined scheelite during the year. Leigh Garnsey mined a small amount of tungsten from a property in Pima County. Roberto Hernandes, S & S Systems, and James E. Thornton recorded no production.

The Boriana Mining Co. abandoned efforts to recover tungsten from the tailings and mine dumps of the old Boriana Mine near Yuma, Mohave County. The Boriana was once one of the largest tungsten producers in the United States, and between 1938 and 1943 ore was treated in a 150-ton gravity mill. In 1979, a 500-short-ton-per-day mill was constructed to process the material with a new steam-flotation process similar to another operation in Siberia. Operated for 7 months, the mill failed to produce a marketable product; and before operators could perfect the process, financial difficulties forced the company to offer the mill for sale early in 1980. The mill was constructed following a 1976 federally financed study that sought to locate sufficient ore reserves to justify a mill for recycling tailings. The Arizona Bureau of Geology and Mineral Technology was under a 12-month Federal contract to continue exploration in the area in 1980.

Zinc.—Zinc production in Arizona dropped severely in 1980, with only two large copper operations recovering a minor amount of the metal as a byproduct. No small base metal operations recovered zinc. Contributing factors were the copper strike, low prices, and declines in the principal market (the construction and automobile industries). The average price of the metal increased from $0.373 per pound in 1979 to $0.374 per pound in 1980.

NONMETALS

Asbestos.—Following a nationwide trend, asbestos production in Arizona continued to decline. As in 1979, California, Vermont, and Arizona shipped asbestos. Jaquays Mining Corp. mined a low-iron chrysotile 33 miles northeast of Globe and processed the ore at its mill at Globe. The product was marketed for use in the filter industry. Early in the year, officials ordered abandoned asbestos mills in the area dismantled, tailings covered with 6 inches of new topsoil, and trailer park residents of a subdivision on old tailings temporarily relocated away from the area being decontaminated. State health officials granted Jaquays an operating permit requiring compliance with air-pollution-control measures in the mine, mill, tailings, and other phases of the operation. Asbestos has been mined and milled in the area for over 50 years.

Cement.—Two firms produced cement in the State. The Phoenix Cement Co., a division of Gifford-Hill & Co., Inc., has offices in Phoenix and a quarry and plant 2 miles northwest of Clarkdale in Yavapai County; the Arizona Portland Cement Co., a division of California Portland Cement Co., has offices in Phoenix and a quarry 5 miles from the plant at Rillito, Pima County, which is approximately 17 miles west of Tucson. Production of portland and masonry cement in the State decreased in amount of value, partly because of the decline in construction.

The 1980 California Portland Cement Co.

annual report noted its plant at Rillito has an annual capacity of 1,150,000 short tons. The company also reported importing clinker used in cement manufacture from Japan and Canada to supplement its own production in 1980.

In response to citizen complaints, the State Air Quality Control Bureau sampled air quality near the cement plants at Clarkdale and Rillito during the year. Particulates in the air were reported to come from unpaved roads in the area, as well as from the cement plants.

Clays.—In 1980, total clay production increased in value and amount over that of 1979. Nonswelling bentonite was mined in Apache County at the Cheto pit 6 miles southeast of Sanders by Filtrol Corp. and at the Cheto 1 by United Catalysts, Inc., of Louisville, Ky. In Yavapai County, Superior Co. also mined a nonswelling bentonite at the Verde Mine near Clarkdale. Common clay shale was mined by the Phoenix Brick Yard at the Tolleson clay pit in Maricopa County and at the Pantano pit in Pima County, by Magma Copper Co. at the Magma property in Pinal County, and by Phoenix Cement Co. at the Lakebed Mine in Yavapai County. McKusick Mosaic Co. obtained ball clay from the Weary Lode Mine in Gila County.

Bentonite, used in the filter industry and in agriculture, was shipped to Mississippi, Utah, and overseas. A low-swelling montmorillonite clay has been used in making beauty preparations, in refining and decolorizing mineral and edible oils, in making catalysts for refining petroleum, and in desiccants.[15] Ball clay for tile and wind chimes, cosmetic additives, sealants, and slip-glazing material was mined at The Weary Lode property 5 miles west of Globe. Common clay was used principally for face brick and for portland cement.

Gem Stones.—Preliminary estimates showed a decline in the value of gem stones in Arizona. Two excellent issues of the Mineralogical Record, May-June 1980 and July-August 1980, described mineral specimens and famous mineral localities in southern Arizona.[16]

Gypsum.—Production of crude gypsum decreased in amount in 1980. The major producer of crude and calcined gypsum for wallboard was the National Gypsum Co. with its quarry and crusher at Feldman near Winkelman, Pinal County, and its calcining and wallboard plant in Phoenix, Maricopa County. Another producer of crude gypsum was Superior Companies with a quarry and crushing and screening plant at Camp Verde near Clarkdale in Yavapai County, and another quarry and plant near Winkelman. Superior mined gypsum for cement additives at both sites. Pinal Mammoth Gypsum Co. mined gypsum for agriculture 6 miles north of Mammoth in Pinal County.

Lime.—Because the copper industry is a leading consumer of lime in Arizona, the 5-month copper strike effected a decline in the amount and value of lime produced in 1980. The following companies produced lime during the year: Paul Lime Division of Can-Am Corp. at Douglas in Cochise County; Flintkote Co. of Genstar, Ltd. (Canada), at Nelson in Yavapai County; Magma Copper Co. near San Manuel in Pinal County; Ray Mines Division of Kennecott Minerals Corp. near Ray in Gila County; Phelps Dodge Corp. near Morenci in Greenlee County; and Amstar Corp. near Chandler in Maricopa County.

In August 1979, Paul Lime Division completed the 400-metric-ton-per-day two-shafted vertical kiln announced in September 1978. Designed in Switzerland, the new kiln was expected to have low fuel consumption, to permit midproduction changes in feed sizes without disrupting the process, and to allow the production rate of the kiln to be cut back from normal without affecting the fuel efficiency or the quality of lime produced.[17] Although major consumers of the chemical lime manufactured by Paul Lime are the copper concentrating mills, the product is also used for pollution control and water purification.

Perlite.—Two companies, Filters International, Inc., and Harborlite Corp., produced crude perlite near Superior in Pinal County. Production in 1980 increased in amount and value over that of 1979. The Guzman Construction Co. mine remained inactive during 1980. Perlite serves as a filtering agent for beverages, chemicals, pharmaceuticals, and sugar, as well as an agricultural fertilizer carrier. Concrete aggregate, plaster board, and insulation board also contain perlite. Principal markets for the perlite were in Louisiana, Illinois, Texas, California, and Michigan.

Pumice and Volcanic Cinder.—Nine producers mined pumice or volcanic cinders from 34 operations at various locations in Apache, Coconino, and Graham Counties. Government agencies obtained volcanic cinder from pits in Apache and Coconino Counties for use in road construction. The

private companies that mined volcanic cinder for roads were Flagstaff Cinder Sales at its Black Pit and Red Hill operations near Flagstaff, and P. Zanzucchi at the Zanzucchi property, also near Flagstaff. Superlite Builders Supply removed scoria from the Darling Pit near Flagstaff for use in cinder blocks; Gila Valley Block Co. processed volcanic cinder at the P-B-T Pit near Safford in Graham County for the same purpose, as well as for landscaping and as an insulating medium. Pumice was mined by Apple Masonry, Inc., at the Apple Mine near Flagstaff, and Gila Valley Block Co. at the P-B-T Pit. Most private contractors prepared the pumice or cinder before marketing. Material used for road construction increased in amount but decreased in total value of production, whereas that used in building construction declined in amount and increased in value. The average value of pumice and volcanic cinder increased from $2.52 per ton in 1979 to $3.26 per ton in 1980.

Pyrites.—Magma Copper Co., Superior Division sold pyrite from its Magma Mine in 1980.

Salt.—Southwest Salt Co. uses solar evaporation to recover salt from brine wells drilled into a massive salt deposit 880 feet below the surface west of Phoenix, Maricopa County. Salt continues to be marketed for use as a water softener, as a tanning agent, and as cattle feed. In 1980, production declined in amount, but the value increased. Adjacent to the saltworks, propane and butane are stored in a solution cavity in washed-out salt.

Sand and Gravel.—The fifth most valuable commodity in the State was sand and gravel, ranked after copper, molybdenum, silver, and cement. Construction and industrial sand was obtained from 106 producers at 152 operations located in Maricopa, Pima, Yuma, Yavapai, Pinal, Gila, Coconino, Cochise, Mohave, Navajo, Apache, Graham, Santa Cruz, and Greenlee Counties. Maricopa, Pima, and Yuma Counties used by far the most sand and gravel. Leading producers of construction sand and gravel included Tanner Co.-United Metro Division, with deposits in Maricopa, Yuma, Pima, and Pinal Counties; the Arizona Sand and Rock Co., Union Rock and Material Corp., Nesbitt Construction Co., Allied Concrete and Materials Co., and Phoenix Sand and Rock Co., all with deposits in Maricopa County; and Columbia Building Materials, Inc., and Granite Construction Co., in Pima County. Producers of industrial sand included A. J. Gilbert Construction Co. in Cochise County; Arizona Silica Sand Co. in Apache County; Don Kelland Materials in Yuma County; and Little Hills Mines, Inc., in Pinal County.

Table 10.—Arizona: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	8,065	$25,985	$3.22	6,710	$24,416	$3.64
Plaster and gunite sands	770	1,966	2.55	638	1,911	3.00
Concrete products	720	2,669	3.71	507	1,879	3.70
Asphaltic concrete	5,270	13,901	2.64	3,853	12,061	3.13
Road base and coverings	10,667	21,337	2.00	9,459	24,799	2.62
Fill	4,625	7,746	1.67	2,804	5,925	2.11
Snow and ice control	82	82	1.00	29	33	1.17
Railroad ballast	4	14	3.14	W	W	3.12
Other	318	1,017	3.20	W	W	3.53
Total[1] or average	30,520	74,716	2.45	24,229	71,838	2.96

W Withheld to avoid disclosng company proprietary data; included in "Total."
[1]Data may not add to totals shown because of independent rounding.

Table 11.—Arizona: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	9,640	$23,516	$2.44	6,712	$20,781	$3.10
Gravel	20,880	51,200	2.45	17,517	51,057	2.91
Total or average	30,520	74,716	2.45	24,229	71,838	2.96
Industrial:						
Sand	W	W	W	W	W	11.41
Gravel	W	W	W	W	W	8.67
Total or average	W	W	W	170	1,936	11.37
Grand total or average	W	W	W	24,399	[1]73,773	3.02

W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Data do not add to total shown because of independent rounding.

Stone.—Although stone production declined in amount in 1980, value increased over that of 1979. Crushed stone comprised more than 99% of the total stone output.

Two companies produced limestone for cement: Phoenix Cement Co., a division of Gifford-Hill & Co., Inc., in Yavapai County, and Arizona Portland Cement Co., a division of California Portland Cement Co., in Pima County.

Lime used in copper operations was manufactured from limestone by the Flintkote Lime Co. a Genstar, Ltd., (Canada) company in Yavapai County; by the Paul Lime Division of Can-Am Corp. in Cochise County; by the Ray Mines Division of Kennecott Minerals Co. and by the San Manuel Mine of Magma Copper Co. in Pinal County. Phelps Dodge Corp. in Greenlee County, McFarland-Hullinger, Ray Mines, and Magma Copper mined limestone in Pinal County for use as a flux in copper smelters. Magma Copper and Little Hill Mines, Inc., in Pinal County and Charlie Nichols in Gila County mined sandstone or siliceous ores also used as a flux.

In other applications, Robert E. McKee, Inc., in Mohave County, mined and crushed dolomite for use as railroad ballast; J & A Mining Corp. in Pinal County mined limestone for filler; J. D. Dutton, Inc., in Coconino County and Granite Construction Co. in Pima County produced limestone for road construction; and Superior Co. in Apache County crushed limestone for treating sulfur dioxide stack gases. Paul Lime also crushed limestone for lime manufacture, for use in sugar refining, for treatment of stack gases, and for such uses as terrazzo and exposed aggregates.

Crushed granite was produced by Sanner Contracting Co., Madison Granite Co., Tall Stone & Supply Co., Inc., and Choctaw Materials, Inc., in Maricopa County; and by A & A Materials, Inc., in Pinal County. Some of the material was used for terrazzo and exposed aggregate. O. B. Willis Construction Co. prepared refractory sandstone in Greenlee County.

Crushed marble was produced for such uses as poultry grit, terrazzo and exposed aggregate, roofing granules, and fine aggregate by Andrada Marble Co. and Catalina Marble Co. in Pima County; and Sun Landscaping & Supply Co. quarried and crushed marble in Yuma County for terrazzo and exposed aggregate.

Catalina Marble Co. quarried dimension marble in Pima County, and J. Bowman cut dimension sandstone for flagging in Coconino County.

Table 12.—Arizona: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Poultry grit and mineral food	W	W	14	142
Bituminous aggregate	4	6	W	W
Dense-graded roadbase stone	--	--	53	W
Other construction aggregate and roadstone	204	544	209	365
Railroad ballast	W	W	W	2,813
Manufactured fine aggregate	W	W	80	762
Terrazzo and exposed aggregate	31	289	151	718
Lime manufacture	1,265	5,935	950	4,851
Flux stone	702	2,867	465	2,052
Other fillers or extenders	--	--	36	W
Roofing granules	14	199	7	93
Sulfur removal from stack gases	33	242	W	W
Other[2]	3,516	11,319	3,259	9,769
Total	5,769	21,401	5,224	21,565

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

[1]Includes limestone, granite, marble, and sandstone.

[2]Includes stone used for concrete aggregate (1979), surface treatment aggregate (1979), riprap and jetty stone, filter stone, cement manufacture, refractory stone, sugar refinery, and unspecified uses.

Vermiculite.—W. R. Grace & Co. continued to ship crude vermiculite into the State for processing and marketing. Production of the exfoliated vermiculite, which increased in amount and value, was used for construction and agriculture.

Zeolites.—The 1980 production of chabazite from the Bowie, Ariz., deposit reportedly declined sharply from 1979 levels. Shipping, however, was resumed by The Anaconda Copper Mining Co. and Union Carbide Corp. in December 1980. Anaconda trucked the chabazite to its new processing facility at Yerington, Nev., and Union Carbide shipped its chabazite by rail to a custom milling plant operated by TAKO at Hackleburg, Ala. The product was then bagged and trucked to the Linde Div. molecular sieve manufacturing plant at Chickasaw near Mobile, Ala.

Occidental Minerals staked claims covering mordenite occurrences near McHeffy Butte, almost 10 miles south of Oatman, and in the Black Mountains about 18 miles north of Union Pass in Mohave County. With Great Western Sugar Co., the company is reportedly studying the feasibility of using clinoptilolite as a soil conditioner to increase the yield from sugar beets.[18]

[1]State mineral specialist, Bureau of Mines, Denver, Colo.

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[11]Engineering Mining Journal. Lakeshore Copper Returned to Life by Noranda. V. 181, No. 10, October 1980, p. 43.

[12]Pay Dirt (Ariz. edition). Full Production for Lakeshore As Soon As Strike Ends 1980. No. 494, August 1980, pp. 1, 12.

[13]Wilt, J. C., and Stanley B. Keith. Molybdenum in Arizona. Arizona Bureau of Geology & Mineral Technology, Fieldnotes, v. 10, No. 3, September 1980, pp. 1-3, 6-9, 12.

[14]Hicks, C. J. Molybdenum Occurrences in Arizona. Arizona Department of Mineral Resources, Mineral Report No. 3, September 1979, p. 37.

[15]Pierce, H. W. Industrial Rocks and Minerals of Arizona. Arizona Bureau of Geology & Mineral Technology, Fieldnotes, v. 10, No. 2, June 1980, pp. 1-3, 10-11.

[16]The Mineralogical Record. Arizona-I. V. 11, No. 3, May-June 1980, pp. 135-191. (Various authors and articles); Arizona-II. V. 11, No. 4, July-August 1980, pp. 203-265. (Various authors and articles).

[17]Pit and Quarry. Shaft Kiln Addition Boosts Paul Lime Capacity. V. 72, No. 11, May 1980, pp. 57-59, 90.

[18]Eyde, T. H. Zeolites. Min. Eng., v. 33, No. 5, May 1981, p. 592.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos:			
Jaquays Mining Corp	1219 South 19th Ave. Phoenix, AZ 85009	Underground mine crushing, screening, air-separation plant.	Gila.
Cement:			
Arizona Portland Cement Co.[1] Div. of California Portland Cement Co.	Box 338 Rillito, AZ 85246	Quarry and dry-process, 3-rotary-kiln plant.	Pima.
Phoenix Cement Co.[2] Div. of Gifford-Hill, Inc.	2505 West Beryl Box 35395 Phoenix, AZ 85069	____do_____	Yavapai.
Cinder:			
Flagstaff Cinder Sales, Inc	Old Highway 66 Box 2796 Flagstaff, AZ 86003	Quarry	Coconino.
Superlite Builders Supply	4150 West Turney Box 23163 Phoenix, AZ 85063	Open pit mine	Do.
Clays:			
Filtrol Corp	Box 155 Sanders, AZ 86512	____do_____	Apache.
Phoenix Brick Yard	1814 South 7th Ave. Phoenix, AZ 85007	____do_____	Maricopa.
Copper:			
Anamax Mining Co.,[3 4 5] a subsidiary of Atlantic Richfield Co., Twin Buttes Mine.	Box 127 Sahuarita, AZ 85629	Open pit and underground mines and plant.	Pima.
ASARCO Incorporated:			
Hayden Unit	Box 98 Hayden, AZ 85235	Smelter	Gila.
Mission Unit.[3 4 6]	Box 111 Sahuarita, AZ 85629	Open pit mine and mill	Pima.
Sacaton.[4 5 6 7]	Box V Casa Grande, AZ 85222	____do_____	Pinal.
San Xavier Unit.[4]	Box 111 Sahuarita, AZ 85629	Open pit mine	Pima.
Silver Bell Unit.[3 4]	Silver Bell, AZ 85270	Open pit mine, mill, leach dumps, precipitation plant.	Do.
Southwestern Mining Dept. Western Operations headquarters.	1150 North 7th Ave. Box 5747 Tucson, AZ 85703	Office and research	Do.
The Anaconda Co., Mineral Resources Group.	Box 27007 Tucson, AZ 85726	____do_____	Do.
Cities Service Co., Miami Operations: Pinto Valley Mine.[3]	Box 100 Miami, AZ 85539	Open pit mine, mill, leach dumps, in-place leaching precipitation plants.	Gila.
Cyprus Mines Corp., a subsidiary of Amoco Minerals Co. Standard Oil Co. (Indiana):			
Cyprus Bagdad Copper Co.[3 4 5]	Box 245 Bagdad, AZ 86321	Open pit mine and mill	Yavapai.
Cyprus Johnson Copper Co	Drawer R Benson, AZ 85602	Open pit mine, heap leach, solvent extraction-electrowinning plant.	Cochise.
Cyprus Pima Mining Co.[3 4 5]	Box 7187 Tucson, AZ 85725	Open pit mine and mill	Pima.
Duval Corp., a subsidiary of Pennzoil Co.:			
Esperanza and Sierrita properties.[3 4 5 6 7]	Box 125 Sahuarita, AZ 85629	Open pit mines, mills, leach dumps, precipitation plant.	Do.
Mineral Park property.[3 4]	Box 1271 Kingman, AZ 86401	____do_____	Mohave.
Eisenhower Mining Co., Palo Verde Mine.[4 5]	Box 39 Sahuarita, AZ 85629	Open pit mine	Pima.
Inspiration Consolidated Copper Co.:[3 4 5]	Box 4444 Claypool, AZ 85532	Open pit mine, mill, vat leaching plant, electrowinning plant, in-place leaching, heap leaching, precipitation plant, rod plant rolling mill, custom smelter, electrolytic refinery.	Gila.
Christmas Mine.[4 5]	Box 4444 Claypool, AZ 85532	Open pit mine and concentrator.	Do.
Ox Hide Mine	Box 4444 Claypool, AZ 85532	Open pit mine	Do.
Kennecott Corp., Ray Mines Div.[3 4 5]	Hayden, AZ 85235	Open pit mine, precipitation, vat leaching, electrowinning plants, smelter.	Gila and Pinal.
Magma Copper Co.:			
San Manuel Div.[1 3 4 5]	Box M San Manuel, AZ 85631	Underground mine, mill, smelter, refinery.	Pinal.
Superior Div.[4 5]	Box 37 Superior AZ 85273	Underground mine and mill	Do.

See footnotes at end of table.

Table 13.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Copper —Continued			
Phelps Dodge Corp.: Copper Queen Branch	Bisbee, AZ 85603	Underground mine, leach dumps, in-place leaching, precipitation plant.	Cochise.
Douglas Reduction Works	Drawer E Douglas, AZ 85607	Smelter	Do.
Morenci and Metcalf Branch.[3 4 5]	Morenci, AZ 85540	Open pit mines, mills, leach dumps, precipitation plant, smelter.	Greenlee.
New Cornelia Branch.[3 4 5]	Drawer 9 Ajo, AZ 85321	Open pit mine, mill and smelter.	Pima.
Ranchers Exploration and Development Co., Bluebird Mine.	Box 880 Miami, AZ 85539	Open pit mine, dump leach, solvent extraction plant, electrowinning plant.	Gila.
Dolomite: Robert E. McKee Inc	Box 107 Peach Springs, AZ 86434	Quarry	Mohave.
Gold: Magma Copper Co.: San Manuel Div	Box M San Manuel, AZ 85631	*See* Copper	Pinal.
Superior Div	Box 37 Superior, AZ 85273	——do	Do.
Phelps Dodge Corp.: Morenci and Metcalf Branch	Morenci, AZ 85540	——do	Greenlee.
New Cornelia Branch	Drawer 9 Ajo, AZ 85321	——do	Pima.
Gypsum: National Gypsum Co	Star Route, Box 90 Winkelman, AZ 85292	Open pit mine and plant	Pinal.
Pinal-Mammoth Gypsum	2020 South 9th St. Coolidge, AZ 85228	Mine	Do.
Superior Companies.[8]	2402 South 19th Ave. Phoenix, AZ 85009	Quarries and plant	Pinal and Yavapai.
Lime: Paul Lime Div. of Can-Am Corp	Drawer T Douglas, AZ 85607	3 lime kilns	Cochise.
Kennecott Corp., Ray Mines Div	Hayden, AZ 85235	Kiln	Gila.
Phelps Dodge Corp., Morenci Branch.	Morenci, AZ 85540	Rotary kiln, fluidized-bed-kiln plant.	Greenlee.
Amstar Corp	11800 East Riggs Rd. Chandler, AZ 85224	Kiln	Maricopa.
The Flintkote Co., Div. of Genstar, Ltd.	Box 197 Peach Springs, AZ 86434	Quarries and plant	Yavapai.
Perlite: Filters International, Inc	Box Z Superior, AZ 85273	Open pit mine and plant	Pinal.
Harborlite Corp	Box 960 Superior, AZ 85273	——do	Do.
Salt: Southwest Salt Co	Box 1237 Litchfield Park, AZ 85340	Solar evaporation of brine from wells.	Maricopa.
Sand and gravel: Arizona Sand and Rock Co., Div. of California Portland Cement Co.	1801 East University Box 20067 Phoenix, AZ 85036	Plants	Do.
Tanner Co., United Metro Div	3640 South 19th Ave. Box 20128 Phoenix, AZ 85036	Open pits and plant	Maricopa and Pima.
Union Rock and Materials Corp	2800 South Central Ave. Box 8007 Phoenix, AZ 85066	Plant	Do.
Silica flux: Little Hill Mines, Inc	Box 332 Oracle, AZ 85603	Open pit mine	Pinal.
McFarland-Hullinger	Box 811 Tucson, AZ 85702	Plant and quarry	Gila.
O. Brice Willis	Box 1325 Clifton, AZ 85533	Open pit mine	Greenlee.
Stone: Andrada Marble Co	4901 East Drexel Tucson, AZ 85706	Quarry	Pima.
Vermiculite (exfoliated): W. R. Grace & Co	2925 Lyndon B. Johnson Freeway Dallas, TX 75234	Plants	Maricopa and Yuma.

[1]Also lime.
[2]Also clays.
[3]Also molybdenum.
[4]Also silver.
[5]Also gold.
[6]Also lead.
[7]Also zinc.
[8]Also clays and limestone.

The Mineral Industry of Arkansas

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Arkansas Geological Commission for collecting information on all nonfuel minerals.

By Jane P. Ohl[1]

The value of nonfuel mineral production in Arkansas for 1980 was $286.6 million, a decrease of 6.1% from the total 1979 value. This small decrease resulted from wide swings of the value pendulum for individual minerals. Some decreases in value were as great as 92.2%, and some increases were as great as 87%: Commodities that had significant (larger than 10%) downswings were barite, bromine, masonry cement, sand and gravel, dimension stone, tripoli, and vanadium; commodities that had significant upswings were clays, gypsum, lime, and crushed stone.

Almost 9 out of every 10 dollars of the State's total 1980 nonfuel mineral value was derived from 12 commodities of the nonmetallic sector. Leading the nonmetallics in value was bromine, followed by, in descending order, stone, cement, sand and gravel, and others of lesser value. Bauxite was the leading metallic mineral mined, in value, followed by vanadium, the only other metallic mineral produced in Arkansas during the year. Arkansas ranked 25th in the Nation as a producer of nonfuel minerals.

An effective measure of economic growth is the gross state product (GSP), an aggregation of the market value of all goods and services produced for final demand in the economy for any given year. Mining and quarrying industries of Arkansas accounted for $0.3 billion or 1.7% of the GSP of $17.4 billion in 1979, according to the Industrial Research and Extension Center, University of Arkansas.

Table 1.—Nonfuel mineral production in Arkansas[1]

Mineral		1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
Abrasives	short tons	273	$1,520	280	$1,686
Bauxite	thousand metric tons	1,430	20,555	1,299	19,252
Clays	thousand short tons	1,044	7,686	1,150	14,402
Gem stones		NA	150	NA	140
Lime	thousand short tons	160	6,287	175	7,785
Sand and gravel	do.	16,465	35,200	13,017	31,651
Stone:					
Crushed	do.	19,978	53,723	20,666	61,399
Dimension	do.	14	528	8	355
Combined value of barite, bromine, cement, gypsum, talc (soapstone), tripoli, and vanadium		XX	r179,447	XX	149,961
Total		XX	r305,096	XX	286,631

rRevised. 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 nonfuel mineral production in Arkansas, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Arkansas	W	--	
Ashley	$297	$176	Sand and gravel.
Baxter	W	1,269	Stone, sand and gravel.
Benton	W	3,991	Do.
Boone	869	W	Do.
Bradley	20	172	Sand and gravel.
Calhoun	2,452	2,848	Do.
Carroll	W	208	Stone, sand and gravel.
Chicot	W	W	Sand and gravel.
Clark	W	W	Stone, sand and gravel, clays.
Clay	122	166	Sand and gravel.
Cleburne	W	473	Stone.
Cleveland	W	W	Sand and gravel.
Columbia	W	W	Bromine.
Conway	541	W	Stone.
Craighead	2,216	W	Sand and gravel, clays.
Crawford	W	3,615	Stone, sand and gravel.
Crittenden	W	W	Clays.
Cross	448	529	Sand and gravel.
Dallas	10	10	Do.
Desha	W	--	
Drew	145	123	Sand and gravel.
Faulkner	1,343	W	Stone, sand and gravel.
Franklin	W	W	Sand and gravel.
Fulton	W	197	Do.
Garland	W	W	Vanadium, abrasives, tripoli, sand and gravel, stone.
Grant	323	278	Sand and gravel.
Greene	330	260	Do.
Hempstead	W	W	Sand and gravel, clays.
Hot Spring	W	W	Stone, sand and gravel, clays, abrasives.
Howard	W	24,742	Cement, gypsum, stone, sand and gravel.
Independence	8,362	8,407	Stone, lime, sand and gravel.
Izard	4,474	4,427	Sand and gravel, stone.
Jackson	W	W	Sand and gravel.
Jefferson	740	W	Do.
Johnson	W	W	Sand and gravel, clays.
Lafayette	611	291	Sand and gravel.
Lawrence	3,016	W	Stone, sand and gravel.
Lincoln	410	298	Sand and gravel.
Little River	W	44,411	Cement, stone, sand and gravel.
Logan	W	W	Stone, sand and gravel.
Lonoke	W	W	Stone, clays.
Madison	W	W	Sand and gravel.
Marion	764	610	Do.
Miller	W	2,202	Sand and gravel, clays.
Mississippi	19	19	Sand and gravel.
Monroe	W	W	Do.
Montgomery	W	W	Barite, stone, sand and gravel.
Nevada	115	366	Sand and gravel.
Newton	W	--	
Ouachita	2,330	W	Sand and gravel, clays.
Perry	W	1,269	Stone.
Phillips	W	--	
Pike	W	W	Sand and gravel, stone, gypsum.
Poinsett	601	666	Sand and gravel.
Polk	519	707	Do.
Pope	W	W	Sand and gravel, stone.
Pulaski	W	W	Stone, clays, sand and gravel, bauxite.
Randolph	57	57	Sand and gravel.
St. Francis	1,063	1,072	Do.
Saline	W	W	Bauxite, lime, sand and gravel, stone, soapstone.
Scott	8	8	Sand and gravel.
Searcy	W	W	Stone, sand and gravel.
Sebastian	W	2,037	Stone, sand and gravel, clays.
Sevier	271	W	Stone, sand and gravel.
Sharp	38	W	Sand and gravel, stone.
Stone	W	W	Sand and gravel.
Union	W	W	Bromine.
Van Buren	W	--	
Washington	W	751	Stone, sand and gravel.
White	W	W	Do.
Woodruff	W	W	Sand and gravel.
Yell	W	W	Do.
Undistributed[2]	232,553	198,442	
Total[3]	265,065	305,096	

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

[1]No nonfuel mineral production was reported for Lee and Prairie Counties.

[2]Includes gem stones and values indicated by symbol W.

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

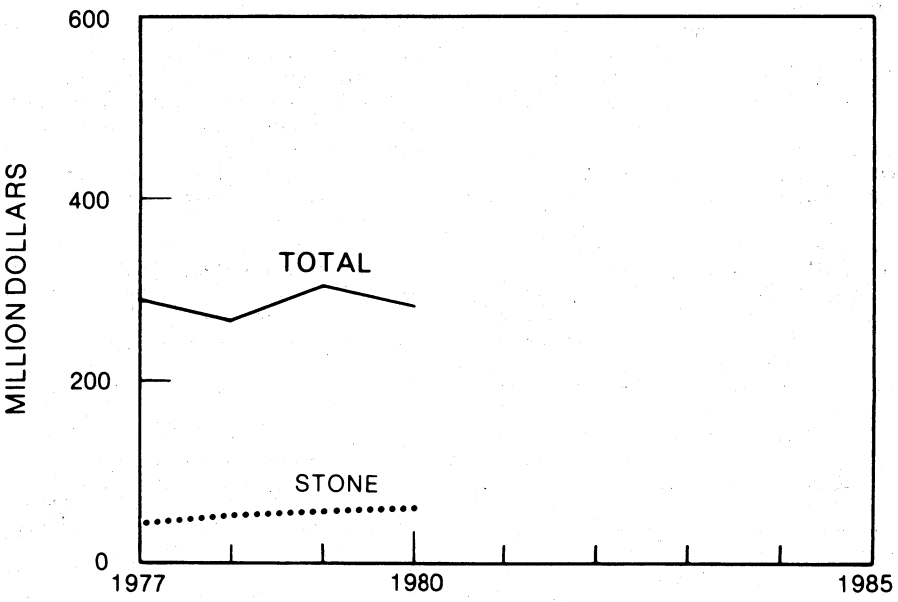

Figure 1.—Value of stone and total value of nonfuel mineral production in Arkansas.

Trends and Developments.—Within a 30-mile radius, Reynolds Metals Co.'s mined bauxite, refined it to alumina, reduced the alumina to molten aluminum, and continuously cast the aluminum into foil feedstock. In its 1980 annual report, Reynolds described the technological changes totaling $100 million that have been made at its reduction plant at Arkadelphia and at its rolling plant north of Malvern on State Highway 51.

Through improved bath chemistry, precise monitoring of alumina input, and computerized regulation of cell operation—without any change in basic reduction-cell design—sizable energy savings are being realized at the company's Patterson plant in Arkadelphia. Three newly installed developmental cells were being evaluated. On the basis of a 1971 Reynolds design, these cells incorporate technological improvements developed during the past decade. The cells offer the potential for operating at about 6 kilowatt-hours or less per pound of aluminum produced, compared with today's industry average of 7.5 to 8 kilowatt-hours per pound.

The continuous casting process at Malvern eliminates the high energy cost associated with ingot casting, transportation of ingots to sheet plants, reheating, and hot rolling. The new rolling plant uses eight continuous horizontal casting units. These eight units and a cold rolling mill will save 35% of the energy that would be required to produce aluminum feedstock by conventional methods and will free a substantial amount of existing sheet capacity for markets other than those served by Reynold's Flexible Packaging Div.

Tabular-alumina capacity at Aluminum Co. of America's (Alcoa) Arkansas Operations plant was increased 25% during the year.

Small rice farms in Bangladesh benefited from a shipment of zinc sulfate fertilizer and micronutrients that were packaged and shipped from Arkansas. Frit Industries, Inc., in Walnut Ridge, produced 1,000 metric tons of zinc sulfate and 500 tons of zinc-oxy-sulfate for shipment to Bangladesh in time for application to the fields in November 1980. Rice, the country's only food crop, has been produced from soils that are two-thirds less efficient than Arkansas soils. Technical and financial assistance for this activity was provided by the United States Agency for International Development. Frit Industries imported the crude zinc from domestic sources outside Arkansas.

Reclamation activities are underway continually at many open pit mining operations. Weyerhaeuser Co., for example, is said to be investing $5,000 per acre to reclaim land at its gypsum operation in Howard County; Reynolds Metals, in Saline County, is spending $2,000 per acre to recover spent lands at its bauxite mines. The costs borne by the mining companies are, of course, passed on to the ultimate consumer.

Employment.—Arkansas' mining industry (including fuels) employed an average of 5,193 workers, with a payroll of $94.4 million in 1980. During the year, 1,329 workers in nonmetallic minerals (except fuels) production averaged $271 weekly; workers in other mining averaged $402 on a weekly basis. According to the Employment Security Div., Arkansas Labor Department, mining ranked third in the State in average weekly wages paid to all classes of workers in 1980.

Reynolds Metals Co.'s capital investment of $36 million tripled the capacity of its new continuous rolling plant and added 50 jobs to the community. Acme Brick Co. completed expanding its plant at Malvern in the fourth quarter of 1980, investing $9 million and employing 50 additional people. Strong-Lite Products Corp. made a capital investment of $230,000 in its Pine Bluff vermiculite plant, bringing four new jobs into that area. In the southern part of the State, Great Lakes Chemical Corp. provided about 20 new jobs when it expanded its bromine-based flame-retardant plant capacity at El Dorado.

Table 3.—Indicators of Arkansas business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	955.0	972.0	+1.8
Unemployment	do	59.0	74.0	+25.4
Employment (nonagricultural):				
Mining[1]	do	4.8	5.2	+8.3
Manufacturing	do	217.8	210.4	-3.4
Contract construction	do	41.9	37.7	-10.0
Transportation and public utilities	do	43.6	43.3	-.7
Wholesale and retail trade	do	162.1	160.5	-1.0
Finance, insurance, real estate	do	31.0	31.2	+.6
Services	do	109.1	115.2	+5.6
Government	do	139.1	141.4	+1.7
Total nonagricultural employment[1]	do	749.4	744.9	-.6
Personal income:				
Total	millions	$15,159	$16,401	+8.2
Per capita		$6,953	$7,180	+3.3
Construction activity:				
Number of private and public residential units authorized		8,464	8,240	-2.6
Value of nonresidential construction	millions	$188.6	$132.8	-29.6
Value of State road contract awards	do	$192.8	$80.7	-58.1
Shipments of portland and masonry cement to and within the State	thousand short tons	954	807	-15.4
Nonfuel mineral production value:				
Total crude mineral value	millions	$305.1	$286.6	-6.1
Value per capita, resident population		$140	$125	-10.7
Value per square mile		$5,745	$5,398	-6.0

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.

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

Legislation and Government Programs.—During 1980, Arkansas Tech University's Mining and Mineral Resources Research Institute received a $55,234 grant from the Federal Government and $36,230 in matching funds from the State to develop a curriculum on mining and minerals technology. In July 1981, the Institute expected to receive an additional $155,000. Students who complete the course of study will receive an associate of science degree and qualify as mining and minerals technicians. If the program develops successfully, it may be expanded into a 4-year baccalaureate program.

U.S. Bureau of Land Management paid more than $1.6 million in lieu of taxes to local governments in Arkansas during fiscal 1980 to offset the loss of tax revenues from tax-exempt Federal properties. Such pay-

ments are in addition to payments of local shares of revenue from leasing public land, timber cutting, mining, and grazing. Arkansas received more than any of the 26 States east of the Mississippi River except Florida, which received $2 million.

During the year, the U.S. Bureau of Mines and the U.S. Geological Survey jointly released reports on three potential Arkansas wilderness areas. Under the Roadless Area Review and Evaluation (RARE) program, the U.S. Forest Service determined in 1973 that some National Forest lands were worthy of study for possible inclusion in the National Wilderness Preservation System. The Forest Service requested the Bureau of Mines and the Geological Survey to do a mineral survey that would provide decision-makers with some information necessary to make the choice. The three joint reports are U.S. Geological Survey Open-File Report 80-354, Richland Creek; 80-355, Dry Creek; and 80-356, Belle Starr Caves. In January 1979, the Forest Service identified two sites, Belle Starr East in Scott County and Belle Starr West in Sebastian County, covering 6,000 acres and 5,000 acres, respectively, in its RARE II program as Further Planning Areas. The Bureau of Mines completed the fieldwork in these two areas, and reports on them were started in 1980.

The Mining and Reclamation Div. of the Arkansas Department of Pollution Control and Ecology held a meeting on September 22, 1980, the subject of which was the Permanent Program Regulations contained in Open Cut Reclamation Act 336 of 1977. This Arkansas statute requires that land disturbed by opencut mining or by the spoiling of overburden from open pit mining be restored to productive use. Mine operators are required to determine the effect of their operations on the ground water formations and to state the results of test borings or corings.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives.—During the year, only the Hot Springs Mine of the Malvern Minerals Co., Inc., in Garland County, west-central Arkansas, produced tripoli. According to Norman F. Williams, State Geologist, the Arkansas Whetstone Co., Hall's Arkansas Oilstones, Inc., Norton-Pike Co., and Hiram A. Smith Whetstone Co. produced novaculite, an exceedingly fine grained cryptocrystalline quartzose rock, from deposits in Garland County in 1980. After Illinois and Oklahoma, Arkansas ranked third in the United States as a producer of these and other abrasive materials.

Barite.—Arkansas produced a 25% smaller share of the Nation's total primary barite output during 1980, when compared with that of 1979. Nevertheless, Arkansas ranked third out of nine producing States. From 1944 through 1970, the State produced more than 8 million short tons of crude barite; precise annual data are unpublished for earlier years (1940-43). For some later years (1971-76), production data are given in "Directory of Arkansas Mineral Producers and Production, 1979," by W. V. Bush and R. B. Stroud: 1971, 160,210 tons; 1972, 161,801; 1973, 120,303; 1974, 37,226; 1975, 70,140; and 1976, 94,173 tons. A reasonable estimate brings total barite production from Arkansas mines (1940-80) to about 9 million short tons.

Although barite has many uses, its fortunes are closely linked with the oil and gas well drilling industry because barite is an indispensable ingredient in drilling muds. NL Industries, Inc., operated a flotation mill and grinding plant at Magnet Cove in Hot Spring County and the McKnight open pit mine in Montgomery County during 1980. Milwhite Co., Inc., operated a grinding plant at Bryant, Saline County. Milchem Inc., a wholly owned subsidiary of Baker International Corp., a Delaware corporation, received permits in 1980 from the U.S. Environmental Protection Agency to develop three open pit mines and a processing facility at Fancy Hill, Montgomery County; the estimated capital investment is $30 million. The ore, a bedded type deposit in the Stanley Shale of Mississippian age, is to be removed from three discontinuous areas along the 9,000-foot strike of the deposit. The company estimated that it will recover 200,000 short tons of ore annually. In the fall of 1980, waste-removal operations and plant construction were begun; the mine and plant should become operational in August 1982.

Bromine.—Arkansas, again the largest domestic producer of bromine, accounted for about one-half of the world's production during the year; however, both quantity and value of the State's output decreased from 1979 by about 24% and 20%, respec-

tively. Nevertheless, bromine and brominated compounds dominated the State's industrial mineral sector in terms of value of production, accounting for more than one-fourth of the value of all nonmetallic mineral commodities produced during the year. The bromine was extracted from salt brines associated with oilfields in the south-central part of Arkansas. Elemental bromine and brominated compounds came from six plants operated by five companies in Columbia and Union Counties. The Dow Chemical Co. and Ethyl Corp. operated plants at Magnolia in Columbia County. Arkansas Chemicals, Inc., Great Lakes Chemical Corp., and Velsicol Chemical Corp. operated plants in Union County near El Dorado and Marysville. Velsicol's El Dorado facility has an annual bromine production capacity of 40 million pounds; some of the bromine and bromine compounds were used in Velsicol's line of flame retardants. Great Lakes operated a 105-million-pound-per-year bromine plant adjacent to Velsicol's at El Dorado, as well as an 80-million-pound-per-year plant at Marysville.

Robert Aaron, ARCO Oil and Gas Co., a Division of Atlantic Richfield Co., in Dallas, Tex., stated that ARCO has been selling its salt brines from Columbia County oil and gas production since 1970 to local bromine producers in Magnolia. In 1980, the current local producer was thought to have extracted bromine at the rate of 2 pounds per barrel of brine; brine production from ARCO oil wells in 1980 amounted to about 5.6 million barrels.

Cement.—Shipments of portland cement by the State's two producers decreased slightly (less than 5%) from 1979; shipments of masonry cement also decreased, but moderately (between 10% and 20%). Portland cement output, which accounted for more than nine-tenths of the total cement produced in the State, consisted primarily of Type I—general use and Type II—general use and moderate heat of hydration and/or moderate sulfate resistance. Only small amounts of Type III—high early strength and Type V—high sulfate resistance were produced. Ready-mix companies used two-thirds of the portland cement; other users were general contractors, concrete-product manufacturers, building-material dealers, and highway contractors. Nearly 90% of the portland cement shipped to consumers was handled by truck in bulk form.

Clays.—Common clays and kaolin were produced from 18 mines in Clark, Craighead, Crittenden, Hempstead, Hot Spring, Johnson, Lonoke, Miller, Ouachita, Pulaski, and Sebastian Counties during 1980. Production increased 10% over that of 1979 to 1,149,967 short tons. Total and unit values nearly doubled to $14.4 million and $12.52, respectively. The leading companies, in decreasing order of tonnage mined, were Acme Brick, a subsidiary of Justin Industries, Inc.; Arkansas Lightweight Aggregate Corp.; Eureka Brick & Tile Co.; and Stauffer Chemical Co. The common clays were used, in decreasing order of amounts, for common and face brick, concrete block and structural concrete, sewer pipe, and highway surfacing. The kaolin clays, mined only in Pulaski County, were used for clay-based refractories, pesticides and related products, and refractory mortar and cement and were calcined, leached, and precipitated as alum salt. Acme Brick produced common clay from Hot Spring and Sebastian Counties and shale from Sebastian for a total value of $791,082. The unit value for the 400,032 short tons produced by Acme Brick ranged from $1.62 to $2.31. The average unit value for the combined common clays produced during the year rose 9% above the average unit value for the combined common clays in 1979.

According to the State, fewer than 100 persons were employed in clay mining; however, in the processing plants, where the product is prepared for use or sale, 767 were employed, or approximately eight times the personnel in the mines. Acme Brick provided 50 new jobs at its structural brick facility in Malvern during 1980. Among the factors contributing to the rise of raw-clay prices were costs related to zoning, such as companies having to find quality clays at greater distances from users than in former years; costs related to land acquisition and, after mining, to reclamation; and costs related to other environmental and energy factors. If unchecked, rising prices will have an adverse effect on the clay industry and on employment within the industry by making competing materials more socially and economically attractive.

Gem Stones.—The value of gem minerals collected in Arkansas during 1980 was estimated at $140,000, about 6.6% less than in 1979. The increasingly popular, nearly 900-acre Crater of Diamonds State Park, south-southeast of Murfreesboro, attracted more

than 188,000 visitors. For a $3 fee, visitors are permitted to search the 78-acre volcanic breccia (kimberlite) pipe for gems; the diamond-containing soil is plowed frequently to aid the searchers. In October 1980, a man found a 5.15-carat white diamond worth between $6,000 and $8,000. Many other semiprecious stones also are found in the park: Agate, amethyst, jasper, opal, and quartz.

Gypsum.—Arkansas Gypsum Co., Inc., at Murfreesboro, Pike County, and Dierks Div. of Weyerhaeuser Co. at its open pit mine near Briar, Howard County, mined crude gypsum. Output declined about 8%; however, total value rose more than 25%. Weyerhaeuser also calcined the gypsum and produced wallboard at its plant near Briar, 10 miles north of Nashville. Temple-Eastex, Inc., at West Memphis, manufactured gypsum board from calcined gypsum.

Perlite.—Crude ore, mined outside the State, was expanded by Strong-Lite Products Corp. at its Pine Bluff plant in Jefferson County. All of the 700 short tons of expanded perlite, valued at $123,000, was used in horticultural aggregates.

Sand and Gravel.—Total quantity of construction and industrial sand and gravel decreased about 21% from 1979 production to 13 million short tons. Owing to inflation, the value decreased only 10% to $31.7 million. Throughout the State in 1980, 187 operations were worked in 59 counties. A majority of operations, 124, were small—producing 50,000 short tons or less. Calhoun County led the State in quantity produced, about 1.2 million short tons from nine operations, but Ouachita County led the State in value sold, $3.2 million from eight operations. The Arkansas State Highway Department produced sand and gravel from sites in at least 33 counties; the various county road departments quarried sand and gravel in 18 other counties; in addition, more than 100 private companies produced sand and gravel during the year. Producers sold or used construction sand and gravel, in decreasing order of value, as concrete aggregate, roadbases and covering, asphaltic concrete, fill, concrete products, and other uses. Some industrial sand and gravel also was produced and used as filtration aids, for traction, in hydraulic fracturing, and for miscellaneous uses. Construction sand and gravel had an average value of about $2.40 per ton; industrial sand for filtration was sold for $16.40 per ton; the next highest prices were for blasting sand, $12.69, and hydraulic fracturing sand, $12.52. Shipments of sand and gravel amounted to 89% of total production; of that 89%, 91% was trucked and 9% was sent by rail.

Table 4.—Arkansas: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	7,020	$16,435	$2.34	5,662	$16,447	$2.90
Plaster and gunite sands	223	463	2.08	176	440	2.49
Concrete products	157	407	2.59	471	1,150	2.44
Asphaltic concrete	2,469	5,393	2.18	1,467	3,810	2.60
Roadbase and coverings	4,836	8,145	1.68	4,102	6,910	1.68
Fill	1,171	1,505	1.28	727	1,255	1.73
Snow and ice control	W	W	W	W	W	5.54
Railroad ballast	1	2	4.50			
Other	87	244	2.80	338	1,012	2.86
Total or average	15,964	32,594	2.04	12,943	31,024	2.40

W Withheld to avoid disclosing company proprietary data; included in "Other."

Table 5.—Arkansas: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	6,737	$12,712	$1.89	5,229	$11,215	$2.14
Gravel	9,227	19,883	2.15	7,714	19,809	2.57
Total or average	15,964	[1]32,594	2.04	12,943	31,024	2.40
Industrial:						
Sand	501	2,605	5.20	W	W	8.57
Gravel	--	--	--	W	W	7.21
Total or average	501	2,605	5.20	74	627	8.42
Grand total or average	16,465	[1]35,200	2.14	13,017	31,651	2.43

W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Data do not add to total shown because of independent rounding.

Table 6.—Arkansas: Sand and gravel sold or used by producers, by county[1]

County	1979			1980		
	Number of mines	Quantity (thousand short tons)	Value (thousands)	Number of mines	Quantity (thousand short tons)	Value (thousands)
Ashley	3	109	$176	3	68	$134
Baxter	3	185	341	2	W	W
Boone	1	22	83	1	30	148
Bradley	3	91	172	3	82	167
Calhoun	10	1,345	2,848	9	1,152	2,799
Clark	4	178	409	4	119	354
Clay	6	123	166	6	77	145
Cleveland	2	W	W	3	188	325
Craighead	7	547	1,149	6	435	1,084
Cross	7	369	529	5	157	286
Dallas	1	6	10	1	24	24
Drew	3	81	123	2	12	12
Faulkner	2	479	W	1	141	W
Fulton	4	100	197	4	90	196
Garland	5	409	698	5	368	693
Grant	5	216	278	5	284	351
Greene	5	120	260	4	70	170
Hempstead	3	54	124	4	131	199
Hot Spring	4	494	1,148	3	262	700
Howard	4	57	102	6	37	66
Independence	6	393	928	5	285	835
Izard	7	490	2,525	5	447	455
Johnson	1	108	378	1	75	207
Lafayette	6	244	291	5	192	210
Lincoln	4	193	298	4	175	279
Marion	4	296	610	5	277	1,075
Miller	6	797	2,160	7	811	3,085
Mississippi	1	11	19	1	10	10
Montgomery	4	148	199	3	147	191
Nevada	4	214	366	3	20	29
Ouachita	8	999	2,519	8	1,079	3,202
Pike	5	973	2,029	6	755	1,486
Poinsett	5	334	666	4	266	737
Polk	7	418	707	7	462	860
Pope	5	587	1,177	4	436	978
Randolph	1	35	57	1	4	4
St. Francis	3	580	1,072	3	448	1,218
Saline	5	438	1,063	4	354	1,016
Scott	1	4	8	1	4	7
Searcy	1	25	38	--	--	--
Sevier	3	101	349	4	125	377
Sharp	1	25	38	--	--	--
White	3	116	219	1	W	W
Yell	2	W	W	1	W	174
Undistributed[2]	30	3,951	8,674	27	2,917	7,358
Total[3]	205	16,465	35,200	187	13,017	31,651

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Arkansas, Columbia, Conway, Crittenden, Desha, Lee, Lonoke, Newton, Perry, Phillips, Prairie, Union, and Van Buren Counties are not listed because no production was reported.
[2]Includes Benton, Carroll, Chicot, Cleburne (1980), Crawford, Franklin, Jackson (1979), Jefferson, Lawrence, Little River, Logan, Madison, Monroe (1979), Pulaski, Sebastian, Stone, Washington, and Woodruff Counties, and data indicated by symbol W.
[3]Data may not add to totals shown because of independent rounding.

Stone.—Limestone, granite (syenite, nepheline syenite), sandstone, slate, and other miscellaneous stone were produced in the State during 1980. Crushed and dimension stone ranked third in value of all nonfuel minerals produced in Arkansas, an increase in value nearly 14% over that of 1979, quantity increased about 3.4%. In 1980, production was recorded from 72 quarries: 66 provided crushed stone, 5 provided dimension stone, and 1 produced both types. The quarries, all in the northwestern part of the State, in 1980 were operated by 39 firms in 32 counties.

Pulaski County led in stone production during the year, followed by Benton, Independence, Lawrence, and Little River Counties. These five counties, which produced more than 1 million short tons each, collectively accounted for nearly two-thirds of the total output. More than half of the State's total stone production and total stone value came from the operations of 4 firms at 16 quarries.

Production from individual quarry operations throughout the State ranged widely. During the year, approximately 25% of the quarries yielded less than 25,000 tons, 25% between 25,000 and 100,000 tons, 33% between 100,000 and 500,000 tons, 10% between 500,000 and 900,000 tons, and 7% from quarries yielding more than 900,000 tons. More than 85% of all crushed stone shipped was hauled by truck in 1980.

Four companies at five quarries in Pulaski County, central Arkansas, crushed granite: Cabot Quarry of Freshour Construction Co., Inc.; Cook Granite Quarry of Missouri City Stone Co., Markham & Brown, Inc.; Granite Mountain Quarries 1 and 2 of McGeorge Contracting Co., Inc.; and Little Rock Granite Operation of Minnesota Mining & Manufacturing Co. The crushed granite was sold primarily for dense-graded roadbase material, other unspecified construction aggregate, railroad ballast, roofing granules, concrete aggregate, and riprap and jetty stone. The selling price for all uses, ranging from $1.75 per ton to $8.14, averaged $2.88.

Limestone, the leading rock type produced in the State during 1980 in quantity and value, was produced at 27 quarries in 13 counties. Benton, Independence, Lawrence, and Little River Counties, each with production greater than 1 million tons, accounted for nearly 70% of the crushed limestone output. Except for Howard and Little River Counties, in the southwest corner of Arkansas, all the producing counties were in the northern half of the State. Cement manufacture, dense-graded roadbase material, and bituminous aggregate were the principal uses or products, each representing more than 1 million short tons. The average selling price for all crushed limestone products was $2.77 per ton. In an early 1980 decision, the Arkansas Supreme Court upheld a circuit court decision that limestone is not a mineral. The court

Table 7.—Arkansas: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	400	1,267	470	1,651
Poultry grit and mineral food	W	W	12	100
Concrete aggregate	2,599	6,675	1,604	4,850
Bituminous aggregate	2,259	6,588	2,595	7,736
Dense-graded roadbase stone	4,965	12,085	5,670	15,426
Surface treatment aggregate	220	742	755	2,723
Other construction aggregate and roadstone	2,821	7,364	1,851	5,229
Riprap and jetty stone	475	1,550	1,020	3,387
Railroad ballast	1,570	4,074	1,763	4,938
Filter stone	101	252	51	174
Manufacture fine aggregate (stone sand)	W	W	277	350
Abrasives	7	65	5	61
Asphalt filler	100	752	W	W
Other fillers or extenders	21	140	W	W
Roofing granules	1,284	5,244	1,284	5,551
Other uses[2]	3,156	r6,925	3,309	9,223
Total	19,978	53,723	20,666	61,399

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1]Includes granite, limestone, sandstone, slate, and other miscellaneous stone.

[2]Includes stone used for agricultural marl and soil conditioners, cement manufacture, lime manufacture, flux stone, refractory stone (1980), fill, flour (slate), glass manufacture, paper manufacture, and "Other uses."

stated that limestone cannot be included in a reservation of mineral rights and that rights to such a nonmineral cannot be transferred by deed.

Crushed sandstone was produced from 31 quarries in 14 counties in roughly the northwest half of the State. Clark, Crawford, Sebastian, and Sevier Counties each produced more than 500,000 tons, or 60%, of the crushed sandstone taken from the State's quarries during the year. Dense-graded roadbase material, bituminous aggregate, and riprap and jetty stone were the leading uses of crushed sandstone. The average selling price of the product, for all uses, was $3.01 per ton. Dimension sandstone from five quarries in Logan, Sebastian, and Independence Counties, 8,100 tons valued at $353,000, constituted more than 99% of the dimension stone output of Arkansas during 1980. Producers were Oran McBride Stone Masonry Co. at Batesville in Independence County, Logan County Building Stone Co. and Sunset Stone Co. at Paris in Logan County, Quality Stone Co. at Subiaco in Logan County, and Hackett Stone near Hackett in Sebastian County. The output was sold as rough block, cut stone, flagging, house stone veneer, and sawed stone.

Crushed slate was produced at two quarries operated by Bird & Son, Inc., and The Milwhite Co., Inc., in Montgomery and Saline Counties, respectively, in central Arkansas. The material was used in manufacturing roofing granules and slate flour.

In Polk County, 19 short tons of dimension slate valued at $1,710 was sold for flagging.

Sulfur (Recovered Elemental).—The Ethyl Corp. and Phillips Petroleum Co. were the only companies to report sulfur recovery in southern Arkansas. From operation of its sulfur recovery unit at Magnolia, Columbia County, Ethyl Corp. stripped sulfur from bromine-bearing brines. Phillips Petroleum Co. treated sour natural gas at its gas-cleaning plant in the McKamie-Patton Field, Lafayette County. Total recovered sulfur in Arkansas decreased nearly 25% from 1979, but value of the output rose more than 11%.

Talc.—The Milwhite Co., Inc., mined a small fraction of the Nation's talc from its Congo pit west of Benton. Mined in only 10 other States, talc is ground for use in ceramics, cosmetics, insecticides, paint, paper, plastics, refractories, roofing, rubber, and other products.

Vermiculite.—A hydrated mineral of the mica group, crude vermiculite was imported from out-of-State and exfoliated by W. R. Grace & Co. at its North Little Rock plant in Pulaski County and by Strong-Lite Products Corp. at its Pine Bluff plant in Jefferson County. Strong-Lite produced 3,815 short tons of exfoliated vermiculite, three-fourths of which was used in paint texture products. The remainder was used in horticultural and concrete aggregates and as block insulation. W. R. Grace & Co. exfoliated vermiculite that was used principally as concrete aggregate and block insulation, and also as fireproofing, horticultural aggregate, loose-fill insulation, and plaster aggregate. Values received by the producers for this mineral resource decreased about 9% in 1980, and production decreased more than 21% from that of 1979.

METALS

Bauxite.—Mine production of crude ore and shipments from mines and processing plants to consumers during 1980 declined from that of the previous year. Crude ore mined in 1980 was 9% less and value declined 6%. Shipments were down nearly 12%, owing partly to a sluggish automobile market; however, ore shipment values declined merely 5%, indicating that prices per metric ton were up.

Arkansas led among the three States in the Nation that produced bauxite or bauxitic clays, accounting for nearly 1.3 million metric tons (dry equivalent) or 83% of the total national production. Three companies produced ore from four open pit mines in Saline and Pulaski Counties: Alcoa operated a mine at Bauxite and a refinery from which alumina in various forms and gallium were extracted; American Cyanamid Co. operated the Quapaw Mine at Bryant and a plant at Benton, producing calcined bauxite; and Reynolds Metals Co. operated mines at Sweet Home and Bauxite and converted domestic and imported raw bauxite into cell-grade aluminum oxide and specialty alumina products at its Hurricane Creek alumina plant. The bauxite ore at Hurricane Creek is covered by 75 to 170 feet of overburden that thickens eastward, making future mining increasingly expensive. Porocel Corp., which processes Arkansas and foreign bauxite ores, operated a calcining plant at Berger.

The space shuttle "Columbia" carried a large aluminum fuel tank. Aluminum also has been used to form drill pipe capable of penetrating ultradeep (26,400 feet) oil and gas deposits in southwestern Texas.

Table 8.—Arkansas: Mine production of bauxite and shipments from mines and processing plants to consumers in the United States

(Thousand metric 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]
1976	2,045	1,694	24,481	2,068	1,756	27,580
1977	2,048	1,703	24,851	1,964	1,684	26,532
1978	1,778	1,446	21,103	1,734	1,483	24,230
1979	1,685	1,430	20,555	1,695	1,442	24,600
1980	1,533	1,299	19,252	1,499	1,309	23,388

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

Vanadium.—Output of crude vanadium ore from the Wilson Springs Mine in Garland County during 1980 was significantly less than output in 1979. About the first of August 1980, the operation was shut down for maintenance and continued shutdown for the remainder of 1980, owing to lack of demand for the metal. In both value and production of recoverable (contained) vanadium, Arkansas ranked fourth of the five producing States in the Nation, having slipped from third rank in 1979. The open pit mine at Wilson Springs, owned by Union Carbide Corp., was the only domestic deposit mined exclusively for its vanadium content. The deposit is associated with an intrusion of alkalic igneous rocks that penetrates Devonian and Mississippian sedimentary rocks composed principally of novaculite and shale. The company's nearby plant has an annual capacity of about 15 million pounds of V_2O_5 equivalent; the mine and plant employ about 250 when production is normal.

[1]State mineral specialist, Bureau of Mines, Denver, Colo.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives (tripoli):			
Malvern Minerals Co., Inc	Box 1246 Hot Springs, AR 71901	Mine	Garland.
Barite:			
NL Industries, Inc., Baroid Div.:	Box 1675 Houston, TX 77001		
McKnight Mine	----------	Open pit	Montgomery.
Magnet Cove plant	----------	Plant	Hot Spring.
Bauxite:			
Aluminum Co. of America	1501 Alcoa Bldg. Pittsburgh, PA 15219	Mine and plant	Saline.
American Cyanamid Co	Berdan Ave. Wayne, NJ 07470	----do----	Do.
Reynolds Metals Co	Box 97 Bauxite, AR 72011	Mines and plant	Pulaski and Saline.
Bromine:			
Arkansas Chemicals, Inc	Route 6, Box 98 El Dorado, AR 71730	Brine wells and plant.	Union.
The Dow Chemical Co., Magnolia plant	Midland, MI 48640	----do----	Columbia.
Ethyl Corp., Arkansas Div	451 Florida St. Baton Rouge, LA 70801	----do----	Do.
Great Lakes Chemical Corp	Box 2200 West Lafayette, IN 47906	----do----	Union.
Velsicol Chemical Corp	351 East Ohio St. Chicago, IL 60611	----do----	Do.
Cement:			
Arkansas Cement Corp., a subsidiary of Arkansas-Louisiana Gas Co.	Box 130 Foreman, AR 71836	Plant	Little River.
Ideal Cement Co., a subsidiary of Ideal Basic Industries, Inc.	Box 8789 Denver, CO 80201	----do----	Howard.
Clays:			
Acme Brick Co., Division of Justin Industries, Inc.	Box 425 Fort Worth, TX 76101	Pits and plants	Hot Spring and Sebastian.
Arkansas Lightweight Aggregate Corp	El Dorado, AR 71730	----do----	Crittenden and Lonoke.
Eureka Brick & Tile Co	Box 379 Clarksville, AR 72830	Pit and plant	Johnson.
Stauffer Chemical Co	Box 9509 Industrial Station Little Rock, AR 72209	----do----	Pulaski.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Gypsum:			
Arkansas Gypsum Co., Inc	275 Shady Grove Rd. Hot Springs, AR 71901	Mine	Pike.
Weyerhaeuser Co	Route 4, Box 78 Nashville, AR 71852	Mine and plant	Howard.
Lime:			
Aluminum Co. of America	1501 Alcoa Bldg. Pittsburgh, PA 15219	Plant	Saline.
Arkansas Lime Co., a subsidiary of Rangaire Corp.	Box 2356 Batesville, AR 72501	Quarry and plant	Independence.
Reynolds Metals Co	6603 West Broad St. Richmond, VA 23226	do	Saline.
Perlite (expanded):			
Strong-Lite Products Corp	Box 8029 Pine Bluff, AR 71611	do	Jefferson.
Sand and gravel:			
Arkhola Sand & Gravel Co., a subsidiary of Ashland Oil, Inc.	Box 1627 Fort Smith, AR 72901	Pit and plant	Crawford.
Gifford-Hill & Co., Inc	Box 47127 Dallas, TX 75247	Pits and plants	Lafayette, Miller, Ouachita.
Jeffrey Sand Co	Box 998 Fort Smith, AR 72901	do	Faulkner, Pulaski, Sebastian.
Jet Asphalt & Rock Co	Rt 3, Box 512 El Dorado, AR 71730	Pit	Calhoun and Ouachita.
St. Francis Material Co	Box 999 Forest City, AR 72335	Pit	Calhoun, Craighead, Poinsett, St. Francis.
Stone:			
Granite:			
Freshour Construction Co., Inc.[1]	Box 77 Sweet Home, AR 72164	Quarry	Pulaski.
McGeorge Contracting Co., Inc	Box 7008 Pine Bluff, AR 71611	Quarries	Do.
Minnesota Mining & Manufacturing Co	3M Center, 224 6SW St. Paul, MN 55101	Quarry	Do.
Limestone:			
Arkansas Cement Corp., a subsidiary of Arkansas-Louisiana Gas Co.	Box 130 Foreman, AR 71836	do	Little River.
Arkansas Lime Co., a subsidiary of Rangaire Corp.	Box 2356 Batesville, AR 72501	Quarries	Independence, Izard, Little River.
Ben M. Hogan Co., Inc	Box 2860 Little Rock, AR 72203	do	Fulton and Lawrence.
Ideal Cement Co., a subsidiary of Ideal Basic Industries, Inc.	Box 8789 Denver, CO 80201	Quarry	Howard.
McClinton-Anchor Co., subsidiary of Ashland Oil, Inc.	Box 756 Fayetteville, AR 72701	do	Benton and Washington.
Midwest Lime Co	Box 2608 Batesville, AR 72501	do	Independence.
Sandstone:			
Arkhola Sand & Gravel Co., subsidiary of Ashland Oil, Inc.	Box 1627 Fort Smith, AR 72901	Quarries	Crawford and Sebastian.
Ben M. Hogan Co., Inc	Box 2860 Little Rock, AR 72203	do	Fulton, Garland, Pike, White.
H M B Construction Co	Box 5606 Texarkana, TX 75501	Quarry	Sevier.
M & M Rock Co., Inc	Box 1190 Conway, AR 72032	Quarries	Faulkner and Perry.
Slate:			
Bird & Son, Inc	Box C Glenwood, AR 71943	Quarry	Montgomery.
Sulfur (recovered elemental):			
Ethyl Corp., Arkansas Div	Box 729 Magnolia, AR 71753	Sulfur recovered in bromine extraction.	Columbia.
Phillips Petroleum Co	724 Adams Bldg. Bartlesville, OK 74004	Sulfur recovered as a byproduct of petroleum refining.	Lafayette.
Talc:			
The Milwhite Co., Inc	Box 15038 Houston, TX 77020	Mine and plant	Saline.
Vanadium:			
Union Carbide Corp., Metals Div	Route 6, Box 943 Hot Springs, AR 71901	Mine and mill	Garland.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	Pulaski.
Strong-Lite Products Corp	Box 8029 Pine Bluff, AR 71611	do	Jefferson.

[1]Also produced sandstone in Lonoke and Pulaski Counties and limestone in Independence, Randolph, Searcy, and Sharp Counties.

The Mineral Industry of California

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the California Division of Mines and Geology, Department of Conservation, for collecting information on all nonfuel minerals.

By D. W. Lockard,[1] J. F. Davis,[2] and P. K. Morton[3]

Production value of California's nonfuel mineral output in 1980 was $1.9 billion, an increase of nearly 7% over that reported in 1979. This can be attributed largely to increased production of industrial minerals and to rising unit prices.

Nonmetallics, led by cement, sand and gravel, and boron minerals, accounted for over 90% of the State's mineral production value. California again led the Nation in the production of boron minerals, sand and gravel, and tungsten.

Table 1.—Nonfuel mineral production in California[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Asbestos	short tons	76,332	$20,434	W	W
Boron minerals	thousand short tons	1,590	310,211	1,545	$366,760
Cement:					
Masonry	do	W	W	--	--
Portland	do	9,724	541,815	8,797	542,487
Clays	do	2,531	18,621	2,558	17,766
Diatomite	do	422	60,989	W	W
Gem stones		NA	240	NA	200
Gold (recoverable content of ores, etc.)	troy ounces	3,195	982	3,651	2,236
Gypsum	thousand short tons	1,624	10,354	1,644	12,763
Lead (recoverable content of ores, etc.)	metric tons	2	2	W	W
Lime	thousand short tons	564	25,545	554	29,444
Mercury	76-pound flasks	151	43	226	88
Pumice	thousand short tons	r794	r3,478	568	3,159
Sand and gravel	do	129,348	347,385	116,426	381,005
Silver (recoverable content of ores, etc.)	thousand troy ounces	64	712	49	1,017
Stone:					
Crushed	thousand short tons	r38,593	r103,342	37,250	116,321
Dimension	do	41	2,258	36	1,967
Talc	do	176	6,960	100	1,863
Zinc (recoverable content of ores, etc.)	metric tons	W	W	--	--
Combined value of calcium chloride, carbon dioxide, copper, feldspar, iron ore, magnesium compounds, molybdenum, peat, perlite, potassium salts, rare-earth concentrates, salt, sodium carbonate, sodium sulfate, tungsten, and values indicated by symbol W		XX	r312,925	XX	408,619
Total		XX	r1,766,296	XX	1,885,695

rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

Table 2.—Value of nonfuel mineral production in California, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Alameda	W	W	Sand and gravel, salt, stone, clays.
Alpine	$161	$262	Silver, gold, lead, copper.
Amador	W	11,007	Sand and gravel, stone, clays.
Butte	W	4,688	Sand and gravel.
Calaveras	48,789	56,305	Cement, asbestos, stone, gold, sand and gravel, clays, silver, copper, zinc, lead.
Colusa	W	W	Sand and gravel, stone.
Contra Costa	W	14,455	Stone, sand and gravel, lime, clays.
Del Norte	W	W	Sand and gravel, stone.
El Dorado	W	W	Stone, sand and gravel, talc.
Fresno	11,788	17,410	Sand and gravel, asbestos, stone, clays, tungsten.
Glenn	W	W	Sand and gravel, lime.
Humboldt	2,498	2,874	Sand and gravel, stone.
Imperial	W	W	Gypsum, sand and gravel, lime.
Inyo	44,504	45,322	Tungsten, talc, boron, molybdenum, stone, perlite, copper, sand and gravel, silver, pumice, clays, gold.
Kern	341,783	389,730	Boron, cement, stone, sand and gravel, clays, gypsum, carbon dioxide, tungsten, salt, silver, gold, copper, lead.
Lake	1,745	W	Sand and gravel, pumice, stone, mercury.
Lassen	605	1,065	Sand and gravel, pumice, stone.
Los Angeles	W	58,320	Sand and gravel, lime, stone, clays, tungsten.
Madera	4,292	6,357	Tungsten, sand and gravel, stone, pumice.
Marin	W	W	Stone, clays, sand and gravel.
Mariposa	W	262	Sand and gravel, stone.
Mendocino	1,434	1,547	Sand and gravel.
Merced	W	1,913	Do.
Modoc	W	W	Peat, sand and gravel, pumice, stone.
Mono	2,242	1,104	Pumice, clays, gold, silver, tungsten, sand and gravel, pyrophyllite, copper, lead.
Monterey	W	44,325	Magnesium, lime, sand and gravel, stone.
Napa	W	W	Salt, sand and gravel, stone.
Nevada	W	W	Sand and gravel, clays, stone.
Orange	W	W	Sand and gravel, feldspar, stone, clays.
Placer	W	W	Sand and gravel, clays, stone.
Plumas	W	1,190	Stone, sand and gravel, pumice.
Riverside	W	W	Iron ore, cement, sand and gravel, stone, clays.
Sacramento	W	22,917	Sand and gravel, gold, stone, silver.
San Benito	W	W	Asbestos, stone, sand and gravel, clays.
San Bernardino	350,439	421,613	Cement, boron, sodium carbonate, rare-earth minerals, stone, potash, sodium sulfate, sand and gravel, lime, clays, salt, pumice, calcium chloride, talc, feldspar, iron ore, tungsten.
San Diego	39,133	44,880	Sand and gravel, stone, salt, magnesium, tungsten, clays.
San Joaquin	W	12,662	Sand and gravel, lime, peat.
San Luis Obispo	3,725	4,724	Stone, sand and gravel, clays.
San Mateo	W	W	Magnesium, stone, salt, sand and gravel.
Santa Barbara	W	64,409	Diatomite, sand and gravel, stone, lime.
Santa Clara	W	W	Cement, stone, sand and gravel.
Santa Cruz	W	W	Cement, sand and gravel, stone, clays.
Shasta	23,229	28,796	Cement, sand and gravel, stone, clays, pumice.
Sierra	W	W	Gold, silver.
Siskiyou	2,290	W	Sand and gravel, pumice, stone.
Solano	3,929	W	Stone.
Sonoma	W	11,831	Sand and gravel, stone.
Stanislaus	W	W	Sand and gravel, clays.
Sutter	W	696	Sand and gravel, clays, stone.
Tehama	906	818	Sand and gravel, stone, pumice.
Trinity	W	W	Sand and gravel, stone.
Tulare	W	3,938	Sand and gravel, tungsten, stone.
Tuolumne	W	W	Lime, stone, gold.
Ventura	12,969	15,881	Sand and gravel, clays, stone.
Yolo	W	W	Sand and gravel, lime.
Yuba	W	W	Sand and gravel, stone, clays.
Undistributed	615,223	475,002	
Total[2]	1,511,690	1,766,296	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]No nonfuel mineral production was reported for Kings and San Francisco Counties.
[2]Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of California business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	10,968.0	11,203.0	+2.1
Unemployment	do	684.0	760.0	+11.1
Employment (nonagricultural):				
Mining[1]	do	39.3	42.9	+9.2
Manufacturing	do	2,002.7	2,001.1	-.1
Contract construction	do	463.3	431.3	-6.9
Transportation and public utilities	do	534.7	542.5	+1.5
Wholesale and retail trade	do	2,223.8	2,267.5	+2.0
Finance, insurance, real estate	do	595.9	620.9	+4.2
Services	do	2,070.0	2,164.6	+4.6
Government	do	1,735.0	1,766.9	+1.8
Total nonagricultural employment[1 2]	do	9,664.6	9,837.6	+1.8
Personal income:				
Total	millions	$227,793	$255,647	+12.2
Per capita		$10,037	$10,856	+8.2
Construction activity:				
Number of private and public residential units authorized		211,696	143,812	-32.1
Value of nonresidential construction	millions	$6,221.8	$6,309.6	+1.4
Value of State road contract awards	do	$490.0	$518.0	+5.7
Shipments of portland and masonry cement to and within the State	thousand short tons	9,561	8,238	-13.8
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,766.3	$1,885.7	+6.8
Value per capita, resident population		$78	$80	+2.6
Value per square mile		$11,130	$11,883	+6.8

[p]Preliminary.
[1]Includes oil and gas extraction.
[2]Data may not add to totals shown because of independent rounding.

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

Portland cement was the leading mineral commodity in terms of revenue, followed by sand and gravel, boron compounds, and crushed stone. A significant decrease in iron ore production was recorded for the year.

Employment.—Direct metal and nonmetal mining employment showed little increase from 1979, averaging slightly under 11,000 for 1980. Average weekly earnings in State mineral industries exceeded $450.

Legislation and Government Programs.—The State legislature voted into law Senate Bill (SB) 1300, which strengthens the State's Mining and Reclamation Act and provides additional funding of approximately $1.1 million. Source of the additional funds will be monies the State derives from Federal mineral leases. They are earmarked to be spent on land classification-designation activities, on activities in reclamation compliance, and on related support for local government.

During 1980, the California Division of Mines and Geology (CDMG) operated on a $7.75 million budget for its geological programs, data acquisition, advisory services, and information dissemination. Also during the year, CDMG celebrated its 100th anniversary of continuous operations. The first map (Sacramento) of the new Regional Geologic Series (1:250,000) was completed; several other quadrangles are in preparation. Mineral land classification studies under the Surface Mining and Reclamation Act (SMARA) continued; a draft environmental impact report on the designation in the San Fernando Valley region was prepared.

In order to extend mining permits in the Santa Clara River area, a preliminary draft report to classify sand and gravel deposits in the Simi and western Ventura County regions was prepared at the request of Ventura County and local aggregate producers. Most of the California Desert Conservation Area (CDCA) programs continued to emphasize identification of geological hazards through the Active Fault Evaluation and Strong Motion Instrumentation Programs. CDCA also provided technical assistance to local agencies for the review of mine reclamation plans as required under SMARA.

The State Mining and Geology Board acted on numerous requests pertaining to its functions under SMARA. The Board received its first petition allowed under SMARA, for a mineral classification study of Pfizer, Inc.'s limestone deposits in the Lucerne Valley area, San Bernardino County; a draft classification report was submitted for review in October. Letters of intent, which are used to begin the petition

process and establish priority, were received by the Board in 1980. These were from the Gladding McBean Co., Pacific Clay Co., and Riverside Cement Co., and pointed to urbanization problems near clay deposits in the Santa Ana Mountains in Orange and Riverside Counties. Another, Granite Rock Co., alerted the Board to possible effects on the company's Pico Blanco limestone deposit in the Big Sur area due to Monterey County's coastal zone program. The Board reviewed and commented on Sonoma County's Aggregate Resource Management Study, which was developed to assure adequate construction material supplies on the Dry Creek floodplain as well as quarry sites along the Russian River. Federal mining regulations were reviewed to assure State standards were at least equivalent; uniform regulations are to be used.

The Board began to implement new guidelines for strengthening SMARA, as addressed in SB 1300. In its final recommendations, it urged that more consideration be given to CDMG for mineral resource conservation, continuing the regional geologic map series (State Geologic Atlas), and improving expertise in the mineral economic area.

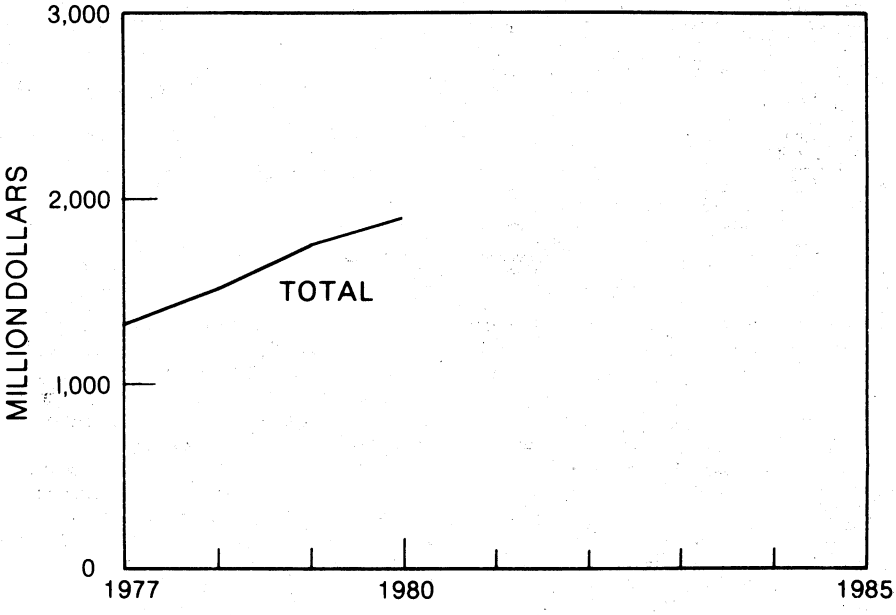

Figure 1.—Total value of nonfuel mineral production in California.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Asbestos.—Two operators reported asbestos production in 1980: Union Carbide Corp. and Calaveras Asbestos Ltd. Output decreased slightly for the year, while value received increased when compared with figures reported in 1979. Calaveras was the State's largest producer from its Copperopolis Mine in Calaveras County.

Most production was short fiber chrysotile asbestos (grades 4 through 7) and was used in molded products, paper insulation, and brake linings.

California was the leading State in asbestos production, accounting for over 70% of the Nation's output.

Boron Minerals.—Operators in California were the Nation's only producers of boron minerals in 1980. Production came from Kern, Inyo, and San Bernardino Counties; U.S. Borax and Chemical Corp. accounted for the bulk.

American Borate Co., a wholly owned subsidiary of Owens Corning Fiberglas, Inc., continued underground development work at the Billie Mine, Inyo County.

NL Industries Inc. and Duval Corp. continued to explore a borate deposit in San Bernardino County.

Calcium Chloride.—All reported production came from three producers in San Bernardino County: Leslie Salt Co., National Chloride Co. of America, and Hill Brothers Chemical Co. Leslie accounted for over 50% of total State output.

Production and value increased by 14% and 30%, respectively, when compared with data reported in 1979.

Cement.—Output declined slightly in 1980; this placed California in second place, behind Texas, in national cement production. Twelve plants reported production. The State's largest producer was the Kaiser Cement Corp., followed by California Portland Cement Co.; Kaiser's Permanente plant had the largest single plant production for the year.

Kaiser Cement announced plans to increase, by 50%, the capacity of its Cushenbury plant. Target date is 1983.

Construction of a 114-foot-high circular preblending dome and storage silo highlighted the 1980 progress in Flintkote Cement Co.'s $42 million expansion of its Calaveras Div. plant at Redding. When completed, annual plant capacity is expected to be 600,000 short tons.

In a major corporate change, Genstar Ltd. of Vancouver, British Columbia, Canada, planned to acquire The Flintkote Co. in 1981.

The Port of Long Beach committed $17 million from its cash reserve to build the first west coast harbor cement terminal. The facility will handle 600,000 short tons annually from Asian and European sources. A new Los Angeles firm, Pacific Coast Cement Co., signed a $2 million yearly lease for the facility.

Table 4.—California: Portland cement salient statistics

(Short tons)

	Northern California		Southern California		California total	
	1979	1980	1979	1980	1979	1980
Number of active plants	4	4	8	8	12	12
Production	2,941,268	2,608,472	6,920,513	6,241,246	9,861,781	8,849,718
Shipments from mills:						
Quantity	2,893,971	2,556,225	6,829,718	6,241,051	9,723,689	8,797,276
Value	$161,338,023	$151,156,310	$380,477,273	$391,331,064	$541,815,296	$542,487,374
Stocks at mills, Dec. 31	218,983	277,609	237,099	207,927	456,082	485,536

Clays.—Clays were produced by 37 companies operating 61 quarries in 24 separate counties. More than 90% of total clay produced was common clay; kaolin and bentonite clay made up the bulk of the remainder.

Lightweight Processing Co. was the State's leading producer from two quarries in Ventura County, followed by Amcord, Inc. and The Flintkote Co.; these three companies accounted for 34% of total State production. Southern Clay of California was the leading producer of nonswelling bentonite.

Diatomite.—All reported production in 1980 came from four producers in Santa Barbara County. Production decreased, while value increased, when compared with 1979 data. Johns-Manville Products Corp., Lompoc, continued to be the State's largest producer. California was the leading State in diatomite produced.

The proposed sale of Airox Earth Resources' inactive Santa Maria Mine to Gulf Mineral Resources Co., Denver, Colo., was expected to become final in early 1981.

Plans by Grefco, Inc., for a diatomite mining and processing operation on its Lake Britton property near Burney, Shasta County, were stalled by environmental and operational constraints; once operational, the property has an expected 50-year life.

Feldspar.—Production of a feldspar-silica mixture from three operations accounted for the State's entire output. Both production and value were up when compared with that reported in 1979. Owens-Illinois, Inc.'s, Mission Viejo Mine in Orange County was the largest producer. Crystal Silica Co.'s Oceanside Mine in San Diego County was a new producer in 1980.

Graphite (Synthetic).—Great Lakes Carbon Corp. was the leading producer of synthetic graphite in 1980. Most of the output was used in the manufacture of electrodes.

Gypsum.—Eight companies reported gypsum output in 1980. The bulk of the production was from two companies, United States Gypsum Co. (Imperial County) and H. M. Holloway, Inc., (Kern County). Total production and value increased in 1980 when compared with data reported in 1979.

United States Gypsum's plant was the leading State producer of calcined gypsum.

Peat.—Production rose slightly in 1980, although value received dropped 4% when compared with that of 1979. There were two producers in the State: Rodel, Inc., Modoc County, and Delta Humas Co., San Joaquin County. Most of the production was used by nurseries.

Perlite.—American Perlite Co.-Redco, Inc., was the State's only crude perlite producer in 1980. Both output and value increased above that reported in 1979. Expanded perlite sold by the State's nine processing plants reached nearly 54,000 short tons, with a value of just under $7 million; American Perlite Co.'s North Hollywood plant was the largest State producer of expanded perlite.

Phosphate Rock.—There was no production reported for the State in 1980. Some stockpiled material from the Cayama Mine, Santa Barbara County, was disposed of during the year.

United States Gypsum renewed its efforts to obtain approval from the Department of the Interior to begin mining its phosphate deposit in Ventura County; an Environmental Impact Statement was issued on the project in 1976.

Potassium Salts.—Kerr-McGee Chemical Corp. was the sole producer of potassium salts in 1980, from its plant in San Bernardino County. Output decreased when compared with that of 1979; value was up slightly over 30%. Most production was in the form of standard muriate (+60% K_2O).

Pumice and Volcanic Cinder.—Output and value both decreased in 1980 from that reported in 1979. This can be attributed to declining activity in the State's construction sector. For the year, 20 producers operated 106 quarries in 13 counties. Clearlake Lava Co. was the State's largest producer from its property in Lake County. The company's entire output went into concrete aggregate.

Rare-Earth Minerals.—California accounted for nearly all of the Nation's rare-earth mineral production. The sole producer was Molycorp, Inc.'s Mountain Pass operation in San Bernardino County; output and value were nearly constant with that reported in 1979.

Salt.—Total salt output and value received increased 28% and 42%, respectively, when compared with that reported in 1979. Cargil Inc.'s Leslie Salt Co. was the leading State producer from plants around the southern end of San Francisco Bay.

Sand and Gravel.—California remained the Nation's leading producer of construction sand and gravel, even though output declined slightly from that reported in 1979. Most of the decline can be attributed to reduced activity in the construction industry.

A total of 347 operations were reported as producing in 1980. Conrock Co. led the field, utilizing 17 operations in Los Angeles, San Diego, San Bernardino, Orange, and Ventura Counties; company output was more than 10% of the State's total. Other leading producers included Lone Star Industries, Inc. (10 operations), Kaiser Sand & Gravel Corp. (3 operations), Owl Rock Products Co. (6 operations), and Livingston-Graham Inc. (4 operations). Companies recording output exceeding 1 million short tons of construction sand and gravel each totaled 21. Production from operations in the following counties each exceeded 10 million tons: Alameda, Los Angeles, and San Diego.

Most industrial sand and gravel came from deposits in San Diego County (Ottawa Silica Co.), and Amador and Orange Counties (Owens-Illinois, Inc.). Industrial sand and gravel was produced by 8 companies from 10 separate operations.

Table 5.—California: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	57,639	$150,864	$2.62	49,603	$146,932	$2.96
Plaster and gunite sands	3,360	9,724	2.89	3,307	11,199	3.39
Concrete products	2,439	6,388	2.62	2,141	6,157	2.88
Asphaltic concrete	23,129	64,976	2.81	20,560	66,030	3.21
Roadbase and coverings	28,625	70,510	2.46	26,251	78,238	2.98
Fill	9,399	16,490	1.75	8,429	21,344	2.53
Snow and ice control	20	71	3.55	78	364	4.67
Railroad ballast	142	456	3.21	139	505	3.63
Other	2,472	6,629	2.68	2,286	6,048	2.65
Total[1] or average	127,226	326,109	2.56	112,795	336,817	2.99

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

Table 6.—California: Sand and gravel sold or used by producers, by use

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	52,602	$131,909	$2.51	47,120	$140,966	$2.99
Gravel	74,623	194,200	2.60	65,675	195,851	2.98
Total or average	[1]127,226	326,109	2.56	112,795	336,817	2.99
Industrial sand	2,122	21,276	10.03	3,631	44,189	12.17
Grand total or average	129,348	347,385	2.69	116,426	[1]381,005	3.27

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

Sodium Carbonate.—Total State production came from the Kerr-McGee Chemical's operation at Searles Lake in San Bernardino County. Output increased only slightly, but value increased 50% over that recorded in 1979.

Sodium Sulfate.—All output came from Kerr-McGee Chemical plants in San Bernardino County. Production and value increased 18% and 36%, respectively, when compared with that reported in 1979. California remained the Nation's largest sodium sulfate producer in 1980.

Stone.—Stone production was reported from 153 quarries in 43 counties in 1980. Kaiser Cement Corp. headed a list of 13 operators, each recording over 1 million tons of production; the top five operators accounted for 34% of State production. Limestone was the leading type of stone produced and was utilized in cement production.

Over 2 million short tons of stone were produced from each of five counties, led by San Bernardino County's 6.9 million tons.

Dimension stone was produced from 17 deposits in 12 counties. The leading producer was the V & M Quarry Co., from its deposit in Plumas County.

Table 7.—California: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	24	110	39	216
Poultry grit and mineral food	136	1,126	145	1,387
Concrete aggregate	1,743	3,750	2,044	5,405
Bituminous aggregate	2,385	6,927	1,732	5,708
Macadam aggregate	410	1,615	893	3,261
Dense-graded roadbase stone	r8,703	r20,049	8,491	22,110
Surface treatment aggregate	360	843	95	334
Other construction aggregate and roadstone	6,386	12,467	4,639	9,990
Riprap and jetty stone	1,799	5,472	2,035	6,796
Railroad ballast	158	432	205	616
Filter stone	218	631	297	935
Manufactured fine aggregate (stone sand)	W	W	116	1,089
Terrazzo and exposed aggregate	170	1,754	186	1,701
Cement manufacture	r12,160	r26,347	12,214	31,894
Lime manufacture	744	2,610	416	1,146
Flux stone	r111	561	150	705
Mine dusting	—	—	24	63
Other fillers or extenders	327	4,203	302	3,032
Bedding materials	32	W	W	W
Drain fields	W	W	67	131
Fill	332	579	1,005	1,917
Glass manufacture	413	3,925	413	4,889
Roofing granules	756	2,078	572	1,928
Sugar refining	325	2,180	638	3,504
Other uses[2]	r900	5,680	531	7,567
Total[3]	r38,593	r103,342	37,250	116,321

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1]Includes limestone, granite, marble (1979), sandstone, shell, traprock, miscellaneous stone, and slate.

[2]Includes stone used for dead-burned dolomite, ferrosilicon, asphalt filler (1979), whiting or whiting substitute, carbon dioxide (1980), floor (slate), unspecified uses, and uses indicated by symbol W.

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

Sulfur.—Byproduct sulfur recovered at 15 petroleum refineries increased to nearly 480,000 metric tons in 1980; it was valued at $17.6 million. Chevron USA Inc.'s refinery at El Segundo was the largest producer. California ranked third in the Nation in 1980 for recovered sulfur shipped.

Talc, Soapstone, and Pyrophyllite.—Reported production and value dropped significantly in 1980 when compared with 1979 data. Most output came from mines in Inyo and San Bernardino Counties; Continental Minerals Co., Pfizer, Inc., and Cyprus Industrial Minerals Co. were the State's leading producers. Cyprus' Panamit Mine in Death Valley experienced a major slope failure in December, which will hinder future production.

There was no recorded production of pyrophyllite in 1980.

Vermiculite (Exfoliated).—W. R. Grace & Co. was the State's only producer in 1980. Production came from two plants, one each in Alameda and Orange Counties. Both output and value increased in 1980 compared with 1979 data. Much of the production was used in fireproofing.

METALS

Antimony.—No antimony production was reported in the State for 1980. Ford Mining Co. did not ship any material from its stockpile at the Ford Mine, Kern County.

Chromium.—There was no reported chromium output for 1980, although exploration for the metal continued. U.S. Chrome Co. completed further drilling on its Seiad Valley property, Siskiyou County.

Del Norte Chrome Corp. announced it plans exploration of 15 zones in Del Norte County and in southwestern Oregon; targets are located in the ultramafic complexes known to exist in the area. The company is a subsidiary of Canarium Investment Corp. Ltd., of British Columbia, Canada.

Copper.—All production came as a byproduct from tungsten mining at Union Carbide's Pine Creek Mine. Both output and value dipped below the reported 1979 level.

During the year, CONOCO, Inc. reportedly drilled exploratory holes near the inactive Walker Mine, Plumas County.

Gold.—Output increased slightly in 1980 over that reported for 1979. Recorded placer output accounted for most of the increase. The State's leading producer was Troy Gold, Inc.'s Blazing Star Mine in Calaveras County, followed by Dickey Exploration Co.'s Oriental Mine in Sierra County. Reported

placer production from six counties totaled 1,161 ounces for the year.

Near yearend, Homestake Mining Co. announced a major gold discovery near Knoxville, Napa County. The company anticipates production could start in 1984.

Based on 63 drill holes, Homestake has outlined 6 million tons of rock grading 0.17 ounce gold per ton. The deposit contains micron-sized gold particles, perhaps explaining why it was overlooked in gold rush days. The company plans further testing in 1981 on what has been tabbed as California's most significant mineral discovery in many years.

Noranda Mining, Inc., was granted a permit by the Siskiyou County Planning Commission to open a 90-acre open pit gold-silver deposit at the Grey Eagle Mine near Happy Camp. Operations could commence in 1982. The company estimates a resource of 1 million tons grading 0.16 ounce gold and 0.48 ounce silver per ton; a 4- to 5-year mine life is expected. Additional resources of copper exist in the same area, which are to be evaluated following exhaustion of the surface gold-silver deposits. Capital cost of the initial open pit operation is estimated at $25 million.

In April, Yuba Goldfields, Inc., announced that in 1982, a subsidiary of St. Joe Minerals, Inc., will resume gold dredging operations on a 410-acre tract of Yuba's 10,000-acre property near Marysville, Yuba County. Placer Service Corp., a wholly owned subsidiary of St. Joe, plans to invest nearly $5.5 million in the venture. An existing Yuba dredge is being reconditioned to dig at least 150 feet deep to get at richer material. Reportedly, sufficient gold reserves have been confirmed on the tract to permit production of about 20,000 ounces of gold per year for more than 7 years. Yuba is reserving rights to the sand and gravel, and stone produced as byproducts of the dredging operations.

Two Canadian firms, Pegasus Exploration, Ltd., and Argo Gold Mining, Inc., secured an option on the inactive Cerro Gordo Mine in Inyo County. The companies state that previous work has established 5 million tons of reserves and that 300,000 tons of gold-silver mineralized dump material remain; the companies anticipate reworking the dump material in 1981.

Table 8.—California: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing[1]		Material sold or treated[2] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1978, total	12	2	15,480	7,480	$1,447,755	58,014	$313,275
1979, total	6	2	10,361	3,195	982,464	64,185	711,812
1980:							
Alpine	1	--	1,623	476	291,579	14,464	298,537
Calaveras	1	--	6,054	1,144	700,769	9,483	195,729
San Bernardino	1	--	7	43	26,340	9	186
Undistributed[3]	4	2	172	1,988	1,217,769	25,301	522,214
Total	7	2	7,856	3,651	2,236,457	49,257	1,016,666

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1978, total	W	W	W	W	W	W	$2,176,056
1979, total	W	W	2	$1,889	W	W	2,224,283
1980:							
Alpine	--	--	--	--	--	--	590,116
Calaveras	--	--	--	--	--	--	896,498
San Bernardino	--	--	--	--	--	--	26,526
Undistributed[3]	W	W	W	W	--	--	2,070,242
Total	W	W	W	W	--	--	3,583,382

W Withheld to avoid disclosing company proprietary data.

[1]Operations from which gold and silver are recovered as byproducts from sand and gravel operations are not counted as producing mines.

[2]Does not include gravel washed.

[3]Del Norte, Fresno, Inyo, Sacramento, San Joaquin, Sierra, Siskiyou, Stanislaus, and Tuolumne Counties combined to avoid disclosing company proprietary data.

Table 9.—California: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1980, by class of ore or other source material

Source	Number of mines[1]	Material sold or treated[2] (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:							
Dry gold	5	6,218	1,951	9,811	--	W	--
Gold-silver, lead, tungsten[3]	2	[4]1,638	539	39,353	W	W	--
Total	7	7,856	2,490	49,164	W	W	--
Placer	2	--	1,161	93	--	--	--
Grand total	9	7,856	3,651	49,257	W	W	--

W Withheld to avoid disclosing company proprietary data.
[1]Operations from which gold and silver are recovered as byproducts from sand and gravel operations, and copper that is recovered as a byproduct from tungsten operations, are not counted as producing mines.
[2]Does not include gravel washed.
[3]Combined to avoid disclosing company proprietary data.
[4]Excludes tungsten ore tonnage.

Table 10.—California: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1980, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode:					
Amalgamation and direct smelting of ore[1]	809	472	--	W	--
Smelting of concentrates[2]	1,681	48,692	W	--	--
Total lode material	2,490	49,164	W	W	--
Placer	1,161	93	--	--	--
Grand total	3,651	49,257	W	W	--

W Withheld to avoid disclosing company proprietary data.
[1]Combined to avoid disclosing company proprietary data.
[2]Includes byproduct recovery from tungsten ore.

Iron Ore.—California ranked third in the Nation for 1980 iron ore shipments. There was a substantial reduction of iron ore production in 1980 when compared with that of 1979; a corresponding reduction was also shown in reported value. Kaiser Steel Corp. was the largest producer, from its Eagle Mountain Mine in Riverside County. California Portland Cement Co. and Standard Slag Co. were the only other reported producers; output from these companies came from San Bernardino County.

Iron Oxide Pigments.—Pfizer, Inc., was the sole producer from its plant in Alameda County. Production and value dipped slightly in 1980 when compared with that reported in 1979.

Lead.—Two operations had reported lead production in 1980: The C & W Mine (Inyo County) and the Troublesome Claim (Tuolumne County). Output in 1980 remained essentially level with that recorded in 1979.

Mercury.—The bulk of State production came from one operation, the Knoxville Mine, in Lake County. Production was up slightly when compared with 1979 data.

Molybdenum.—Value of molybdenum output increased $1 million over that reported in 1979, while production decreased nearly 10%. All production came as a byproduct from Union Carbide's Pine Creek tungsten mine, Inyo County.

Placer Amex Inc. identified a new molybdenum-bearing porphyry deposit in the New York Mountains, San Bernardino County. A comprehensive drilling program was under way at yearend.

Nickel.—No nickel production was reported in the State for 1980. Cal-Nickel Corp. continued delineating nickel resources at its 8,000-acre Gasquet Mountain project, Del Norte County. The company has outlined about 37 million tons of lateritic ore containing an average of 0.87%

nickel, 0.09% cobalt, and about 2% chromium. Pilot plant testing is being conducted by UOP, Inc.

Silver.—Production was off slightly for the year, while value received increased nearly 50% when compared with that reported in 1979. The bulk of output came as a byproduct from tungsten ores at Union Carbide's Pine Creek Mine in Inyo County. Other notable silver producers include the Zaca and Blazing Star Mines. Less than 100 ounces were reported from placer operations.

The draft environmental impact report prepared for San Bernardino County, for ASARCO Incorporated's Waterloo silver mine, was released during the year. Complete evaluation of the project is expected in 1981. Ore reserves are estimated to be 30 million tons, averaging 2.9 ounces silver per ton. The mine is expected to produce 6,000 tons of ore per day; a 25-year mine life is predicted.

Also near Calico, another potential silver operation is being investigated by Dusty Mac Mines, Ltd. The company has identified 12.5 million tons of rock grading 1.2 ounces silver per ton. A 50-ton-per-day pilot plant has been constructed.

Tungsten.—California was the Nation's leading State in the production of tungsten concentrates, accounting for more than 50% of total production. Twelve mines reported production in 1980. Union Carbide's Pine Creek Mine (Inyo County) and Teledyne Tungsten's Strawberry Mine (Madera County) were the major producers. Smaller producers operated in Inyo, Kern, Los Angeles, San Diego, and Tulare Counties. Overall, State production was 14% less than was reported in 1979.

[1]State mineral specialist, Bureau of Mines, Spokane, Wash.
[2]State geologist and Director, California Division of Mines and Geology, Sacramento, Calif.
[3]Minerals officer, California Division of Mines and Geology, Santa Ana, Calif.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos:			
Calaveras Asbestos Corp	Box 127 Copperopolis, CA 95228	Open pit mine	Calaveras.
Union Carbide Corp	Box K King City, CA 93930	do	San Benito.
Boron compounds:			
Kerr-McGee Chemical Corp.[1]	Box 367 Trona, CA 93562	Evaporators	San Bernardino.
U.S. Borax and Chemical Corp	Box 75128 Stanford Station Los Angeles, CA 90005	Open pit mine	Kern.
Calcium chloride:			
Leslie Salt Co.[2]	Box 364 Newark, CA 94560	Solar evaporators.	San Bernardino.
National Chloride Co. of America[2]	Box 604 Norwalk, CA 90605	do	Do.
Cement:			
California Portland Cement Co.[3]	800 Wilshire Blvd. Los Angeles, CA 90017	Plants	Various.
Kaiser Cement Corp.[4]	300 Lakeside Dr. Oakland, CA 94612	do	Do.
Clays:			
Amcord, Inc.[5]	1500 Rubidoux Ave. Riverside, CA 92509	Pits	Do.
The Flintkote Co.[6]	San Francisco, CA 94104	do	Do.
Lightweight Processing Co	650 South Grand Ave. Los Angeles, CA 90017	do	Ventura.
Diatomite:			
Johns-Manville Products Corp	2500 Miguelita Rd. Lompoc, CA 93436	Open pit mine	Santa Barbara.
Feldspar:			
Owens-Illinois, Inc.[3 5]	Box 248 San Juan Capistrano, CA 92675	Pit	Orange.
Gold:			
Dickey Exploration Co.[7]	Box K Alleghany, CA 95910	Mine	Sierra.
Troy Gold, Inc.[7]	Box 5 West Point, CA 95255	do	Calaveras.
Gypsum:			
United States Gypsum Co	Plaster City, CA 92269	Quarry	Imperial.
Iron ore:			
Kaiser Steel Corp	Box 158 Eagle Mountain, CA 92241	Mine	Riverside.
Lime:			
Kaiser Aluminum & Chemical Corp	300 Lakeside Dr. Oakland, CA 94612	Plant	Monterey.

See footnotes at end of table.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Perlite:			
American Perlite Co.-Redco, Inc	Box 579 Big Pine, CA 93513	Open pit mine	Inyo.
Pumice:			
Cinder Products Co	Box 206 Clearlake Oaks, CA 95423	do	Lake.
Clearlake Lava Co	Star Route Clearlake Oaks, CA 95423	do	Do.
U.S. Forest Service, Region 5[3]	630 Sansome St. San Francisco, CA 94111	Pits	Various.
Sand and gravel:			
Conrock Co	Box 2950, Terminal Annex Los Angeles, CA 90051	do	Do.
Kaiser Sand & Gravel Corp.[3]	300 Lakeside Dr. Oakland, CA 94612	do	Do.
Livingston-Graham, Inc	13550 Live Oak Ave. Irwindale, CA 91706	do	Do.
Lone Star Industries, Inc.[3 8]	2800 Campus Dr. San Mateo, CA 94403	do	Do.
Owl Rock Products Co	Box 47 Irwindale, CA 91707	do	Do.
Teichert & Son Aggregates, Inc	3500 American River Dr. Sacramento, CA 95824	do	Do.
Silver:			
Claude B. Lovestedt[9]	Box 1496 Carson City, NV 89701	Mine	Alpine.
Stone:			
Basalt Rock Co., Inc.[5]	Box 2540 Napa, CA 94558	Quarries	Various.
Kopper Co., Inc.[5]	Box 580 Pleasanton, CA 94566	do	Do.
Talc:			
AMOCO Minerals (Cyprus)	7000 Yosemite St. Box 3299 Englewood, CO 80155	Open pit mines	Inyo, San Bernardino.
Continental Minerals Co	1700 East Desert Inn Rd. Las Vegas, NV 89114	Mine	Inyo.
Pfizer, Inc.[3]	17092 D-Street Victorville, CA 92392	Open pit mine	Do.
Tungsten:			
Teledyne Tungsten	4709 North El Capitan Ave. Fresno, CA 93703	do	Madera.
Union Carbide Corp.[10]	Old Ridge Bury Rd. Danbury, CT 06817	Underground mine and plant.	Inyo.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plants	Various.

[1]Also lime, potash, soda ash, and sodium sulfate.
[2]Also salt.
[3]Also stone.
[4]Also lime, sand and gravel, and stone.
[5]Also sand and gravel.
[6]Also cement, lime, sand and gravel, and stone.
[7]Also silver.
[8]Also cement.
[9]Also gold.
[10]Also copper, gold, molybdenum, and silver.

The Mineral Industry of Colorado

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Division of Mines of the State of Colorado, for collecting information on all nonfuel minerals.

By Karl E. Starch[1]

The value of nonfuel mineral production in Colorado was $1.3 billion in 1980, nearly 50% above that of 1979. Molybdenum continued to be the State's major nonfuel mineral product and was responsible for about three-fourths of its nonfuel mineral value. The State ranked first in the nation in molybdenum, vanadium, and carbon dioxide production; second in tungsten and tin (byproducts of molybdenum); third in silver and lead; and sixth in gold.

Employment in the mining sector of Colorado's economy increased 12.8% during 1980. This was a slower rate of increase than the 14% annual rate that prevailed during most of the preceding 6 years, but still a considerably larger rate of increase than occurred in any other sector of the State's labor force during the year.

Legislation and Government Programs.—The second, and final, regular session of Colorado's 52d General Assembly convened the first Tuesday of January 1980 and adjourned May 5, 1980, being a "short session." Little of significance in mining legislation was enacted. Of the two items that seemed to be of most interest, land reclamation and severance taxes, no mined land reclamation items were included on the Governor's "Call," and the legislature rejected the Governor's request for an increase in severance taxes. Several measures affecting nonfuel minerals were enacted:

S.B. 51 allows a credit against severance taxes due for approved contributions made to local governments to assist in solving impact problems arising from an increase in production by an established mining operation. Effective April 10, 1980.

S.B. 101 requires that proceeds of forfeited reclamation bonds be used for reclaiming the land for which the bonds were posted rather than going into the general fund. Effective April 1, 1980.

H.B. 1073 prohibits mineral-claim location on State-owned lands for mining coal or oil shale. Effective April 13, 1980.

H.B. 1195 sets forth specific requirements for abandoning holes drilled in prospecting for minerals. Effective July 1, 1980.

Present and future access to public lands for mineral exploration continued to be of major interest to the mining industry in Colorado. Under its mineral land assessment program, the U.S. Bureau of Mines carried out field investigations and prepared reports on the mineral potential of a number of areas in Colorado. Areas investigated included the following: Wilderness areas on U.S. Forest Service administered lands—Maroon Bells-Snowmass (220,000 acres), Hunter-Frying Pan and Spruce Creek (82,000 acres), Comanche-Big South (47,000 acres), Indian Peaks (85,000 acres), and Lost Creek (58,000 acres); Forest Service Roadless Area Review and Evaluation (RARE II) further planning areas—Cannibal Plateau (32,000 acres), Service Creek (40,000 acres), St. Louis Peak (13,000 acres), and Williams Fork (75,000 acres); and Bureau of Land Management wilderness study area projects—Powderhorn (51,000 acres).

Table 1.—Nonfuel mineral production in Colorado[1]

Mineral	1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
Clays[2] thousand short tons	[2]521	[2]$2,717	336	$2,223
Copper (recoverable content of ores, etc.) metric tons	362	742	461	1,041
Gem stones	NA	70	NA	70
Gold (recoverable content of ores, etc.) troy ounces	13,850	4,259	39,447	24,164
Gypsum thousand short tons	275	1,727	227	3,409
Lead (recoverable content of ores, etc.) metric tons	7,554	8,767	10,272	9,615
Molybdenum thousand pounds	W	W	102,498	915,304
Peat thousand short tons	33	299	29	327
Sand and gravel do.	25,680	[3]56,263	[3]27,433	[3]74,452
Silver (recoverable content of ores, etc.) thousand troy ounces	2,809	31,151	2,987	61,653
Stone:				
Crushed thousand short tons	6,835	19,435	6,277	20,068
Dimension do.	3	163	6	259
Zinc (recoverable content of ores, etc.) metric tons	9,910	8,149	13,823	11,406
Combined value of carbon dioxide, cement, clays (bentonite, 1979), iron ore, lime, perlite, pumice, pyrites, salt, sand and gravel (industrial), tin, tungsten concentrate, vanadium, and values indicated by symbol W	XX	692,356	XX	140,524
Total	XX	826,098	XX	1,264,515

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

[2]Excludes bentonite; value included in "Combined value" figure.

[3]Excludes industrial sand and gravel; value included in "Combined value" figure.

Cleanup of 39 old radium dump sites in Colorado was provided for in the Hazardous Waste Containment Act of 1980 passed by the U.S. House of Representatives September 22, 1980. The bill established a $1.2 billion trust fund to finance cleanup of dangerous waste sites including those in Colorado.

The Colorado Department of Natural Resource's Division of Mined Land Reclamation began a program to reduce hazards related to inactive mines in the State. The first phase of the program, undertaken in July and financed with a $600,000 grant from the Federal Office of Surface Mining, was to locate and inventory all abandoned mines in the State, a number estimated to be 40,000.

Colorado received a total of $21.5 million as its share of revenues collected by the Bureau of Land Management in its management of public lands in Colorado during fiscal year 1980. States receive 50% of such Federal revenues collected. The State Board of Land Commissioners reported revenues of $3 million for the fiscal year from leases on the 4 million acres on which the State owns mineral rights, an increase of 80% over that of the previous year.

The Colorado Mining Association and Western Small Miners Association were among the organizations attempting to reduce Federal regulations on miners in the State. Two major projects, Rio Blanco Oil Shale Co.'s proposed oil shale surface retort project and Multi Mineral Corp.'s proposed nahcolite mine agreed to participate in Colorado's Joint Review Process, a State program designed to expedite the review, regulation, and permitting process for mineral resource development projects in the State. Both were in the Piceance Basin area of western Colorado.

At a National Governor's Association meeting in August, Colorado joined other Western States in supporting the right of coal-producing States to impose severance taxes in opposing Federal legislation that would place a limit to the amount of severance tax a State could enact.

The Colorado Legislature reduced the Colorado Division of Mines budget for 1980-81 by 85% or $700,000, cutting the division's staff from 27 to 12 employees on July 1, 1980. Rationale for the cut was that the Federal Mine Safety and Health Administration had taken over mine inspection responsibilities in the State, leaving the State Division of Mines with primarily safety education and training responsibilities.

During 1980, the Colorado Geological Survey's mineral resource activities included the following: (1) Provided technical support to Front Range county governments and industry in defining commercial gravel deposits and advising them on problems related to rock quarrying; (2) reviewed 42 gravel pit and rock quarry applications for Front Range and west slope counties; (3) evaluated mineral locations and potential in the Rio Grande, Roosevelt, Arapahoe, San Isabel, and Gunnison National Forests and the proposed Oh-Be-Joyful Wilderness Area in cooperation with the U.S. Forest Service; (4) initiated a 3-year statewide inventory

Table 2.—Value of nonfuel mineral production in Colorado, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Adams	$6,616	$7,567	Sand and gravel, stone.
Alamosa	W	W	Peat.
Arapahoe	3,747	4,430	Sand and gravel.
Boulder	31,054	30,922	Cement, sand and gravel, stone, clays, silver, gold, zinc, lead, peat, copper.
Chaffee	W	W	Stone, sand and gravel, peat.
Clear Creek	W	W	Molybdenum, stone.
Costilla	W	W	Pumice, sand and gravel.
Crowley	34	W	Sand and gravel.
Custer	W	W	Perlite.
Delta	751	789	Sand and gravel, stone.
Denver	73	74	Do.
Dolores	72	26	Stone.
Douglas	W	W	Sand and gravel, clays, stone.
Eagle	2,551	W	Silver, sand and gravel, copper, gold, lead, pumice.
Elbert	262	W	Clays, sand and gravel.
El Paso	W	W	Sand and gravel, stone, clays.
Fremont	43,424	47,816	Cement, stone, gypsum, clays, sand and gravel.
Garfield	W	W	Sand and gravel, stone.
Gilpin	W	W	Gold.
Grand	373	339	Sand and gravel.
Gunnison	W	W	Sand and gravel, lead, silver, gold.
Huerfano	96	100	Sand and gravel.
Jackson	26	26	Sand and gravel, stone.
Jefferson	W	13,802	Sand and gravel, stone, clays.
Kit Carson	157	W	Sand and gravel.
Lake	273,075	344,998	Molybdenum, tungsten, silver, zinc, lead, gold, tin, pyrites, copper, sand and gravel.
La Plata	565	827	Sand and gravel.
Larimer	W	W	Cement, sand and gravel, stone, gypsum, lime.
Las Animas	98	W	Clays, sand and gravel.
Lincoln	W	W	Sand and gravel.
Logan	W	W	Lime, sand and gravel.
Mesa	W	W	Sand and gravel, vanadium, stone.
Mineral	W	W	Silver, lead, zinc, copper.
Moffat	W	W	Sand and gravel, vanadium.
Montezuma	W	W	Carbon dioxide, sand and gravel, stone.
Montrose	W	W	Vanadium, sand and gravel, salt, stone.
Morgan	W	W	Sand and gravel, lime.
Otero	429	203	Sand and gravel.
Ouray	1,686	W	Sand and gravel, zinc, silver, lead, copper.
Park	W	309	Peat, silver, gold, lead, stone, copper.
Phillips	22	34	Sand and gravel.
Pitkin	W	W	Iron ore, sand and gravel.
Prowers	W	131	Sand and gravel, stone.
Pueblo	W	W	Lime, sand and gravel, clays, gold, silver, stone, lead, copper.
Rio Blanco	357	537	Sand and gravel.
Rio Grande	W	W	Sand and gravel, stone.
Routt	422	591	Do.
San Juan	W	W	Gold, lead, silver, zinc, copper.
San Miguel	W	W	Vanadium, sand and gravel, zinc.
Sedgwick	W	W	Lime, sand and gravel.
Summit	1,011	1,214	Sand and gravel, stone, lead, silver.
Teller	W	W	Peat, sand and gravel, gold, silver, lead, copper.
Washington	23	42	Sand and gravel.
Weld	W	W	Sand and gravel, lime.
Yuma	373	375	Sand and gravel.
Undistributed[2]	274,526	370,948	
Total[3]	641,826	826,098	

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

[1]The following counties are not listed because no nonfuel mineral production was reported: Archuleta, Baca, Bent, Cheyenne, Conejos, Hinsdale, Kiowa, and Saguache.

[2]Includes gem stones and values indicated by symbol W.

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

of metallic mines and occurrences for inclusion in the U.S. Geological Survey's Computerized Resources Information Bank (CRIB); (5) completed a 2.5-year in-house statewide inventory of nonmetallic mining and processing operations and provided data on mineral resource management to the Governor's Front Range planning project; and (6) released the following publications: *Proceedings of the Fifteenth Forum on Geology of Industrial Minerals*, Resource Series 8; *Rare-Earth Pegmatites of the South Platte District, Colorado*, Resource Series 11; and *Industrial Minerals of Colorado*, Society of Mining Engineers of AIME (preprint and Transactions article).

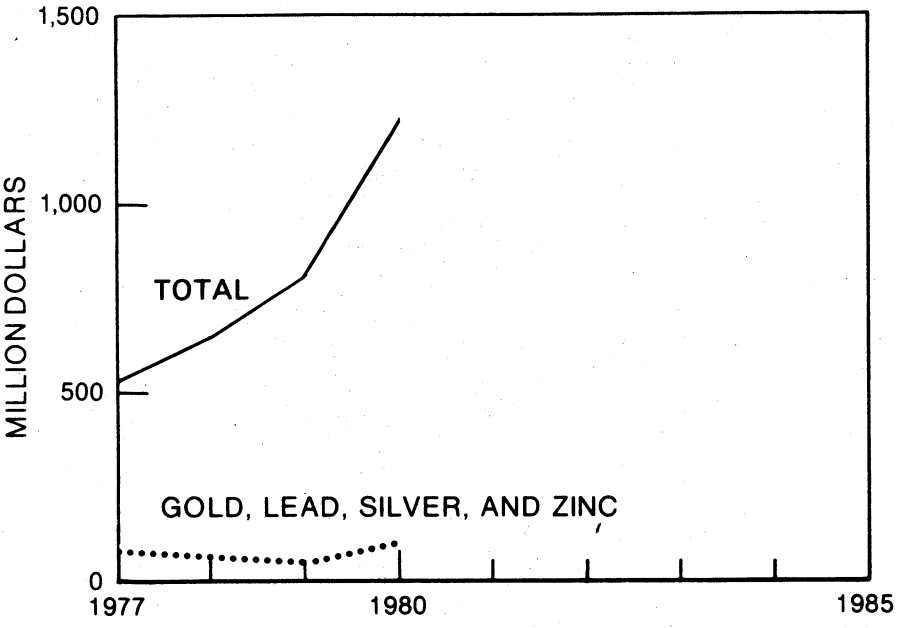

Figure 1.—Value of mine production of gold, lead, silver, and zinc, and total value of nonfuel mineral production in Colorado.

Table 3.—Indicators of Colorado business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,386.0	1,474.0	+6.4
Unemployment	do.	66.0	82.0	+24.2
Employment (nonagricultural):				
Mining[1]	do.	30.6	34.5	+12.8
Manufacturing	do.	180.7	181.4	+.4
Contract construction	do.	80.2	77.0	-4.0
Transportation and public utilities	do.	76.1	79.8	+4.9
Wholesale and retail trade	do.	297.7	305.0	+2.4
Finance, insurance, real estate	do.	74.0	76.7	+3.6
Services	do.	240.5	253.4	+5.4
Government	do.	238.6	243.3	+2.0
Total nonagricultural employment[1]	do.	1,218.4	1,251.1	+2.7
Personal income:				
Total	millions	$25,268	$28,718	+13.6
Per capita		$9,114	$9,964	+9.3
Construction activity:				
Number of private and public residential units authorized		42,833	26,746	-37.6
Value of nonresidential construction	millions	$667.2	$701.0	+5.1
Value of State road contract awards	do.	$122.9	$115.0	-6.4
Shipments of portland and masonry cement to and within the State	thousand short tons	1,555	1,432	-7.9
Nonfuel mineral production value:				
Total crude mineral value	millions	$826.1	$1,264.5	+53.1
Value per capita, resident population		$298	$438	+47.0
Value per square mile		$7,924	$12,130	+53.1

[p]Preliminary.
[1]Includes coal, natural gas, and petroleum.

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

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Cadmium, Indium, and Thallium.—ASARCO Incorporated (Asarco) recovered cadmium, indium, thallium metal, and thallous sulfate at its Globe smelter in Denver from flue dust, dross, and byproduct materials received from out-of-State smelters. The output was not included in the State mineral production because the origin of the processed materials could not be determined. Cadmium is contained in some zinc ores mined in Lake, Ouray, San Juan, and San Miguel Counties and recovered at out-of-State smelters.

Copper.—The production of copper remained at about the same alltime low level as in 1979, less than 15% of the level of copper production in the State in the early and mid-1970's. Produced as a coproduct from base metal ores in lode mines in Colorado, copper was the least important of the five metals extracted from these ores, less than 1% of the total value of these metals. Colorado's national position as a copper producer was insignificant. The Idarado Mine in Ouray and San Miguel Counties, historically Colorado's major copper producer, closed in mid-1978 and had not reopened by yearend 1980. Copper was produced in seven mines located in seven different counties in the State. Foremost among these was Standard Metals Corp.'s Sunnyside Mine in San Juan County, whose byproduct production of copper accounted for nearly one-half of the State's copper output. Other producers in order of importance were the Leadville unit of Asarco near Leadville, the New Jersey Zinc Co.'s Eagle Mine near Eagle, and Homestake Mining Co.'s Bulldog Mountain Mine at Creede. These four mines produced more than 98% of the total copper in Colorado in 1980. The Bulldog and the Eagle Mines produced substantially less copper than they had in 1979, the Leadville unit increased its production quite substantially, whereas the Sunnyside Mine increased production dramatically in its recovery from a 1978 flood. At Ouray, the Camp Bird Mine of Federal Resources Corp. reported copper production in 1980 for the first time since the mine was closed because of an unfavorable economic situation in 1977. The average price of copper rose from $0.93 per pound in 1979 to $1.0242 per pound in 1980.

Gold.—The threefold increase in gold production in Colorado in 1980, compared with that of 1979, was largely the result of return to normal production of the Sunnyside Mine, closed by a flood in mid-1978. Production remained at a lower level than existed in the State in the early and mid-1970's, yet represented a halt in the decline in gold production that had occurred over the past 7 years. The sixfold increase in value of gold yield reflected the large increase in output multiplied by the doubling of the average gold price from $307.50 in 1979 to $612.56 in 1980. Gold was reported mined in 12 counties in Colorado in 1980, from 20 lode mines and 1 placer mine.

Standard Metals Corp.'s Sunnyside Mine, near Silverton in San Juan County, was the State's leading gold producer in 1980 and, together with the second largest producer, Asarco's Leadville unit (Black Cloud Mine) near Leadville in Lake County, was the source of most of the State's total output of gold. Other important producers, in order of output, were the Cross Mountain Mine, owned and operated by Hendricks Mining Co. in Boulder County; the Eagle Mine of New Jersey Zinc Co. in Eagle County; the Globe Hill deposit of Gold Resources Joint Venture, near Cripple Creek, Teller County; and the Sherman Tunnel Mine, operated by Day Mines, under lease from Leadville Corp., Inc., near Leadville in Lake County.

As the price of gold rose to over $800 during the year, interest in reevaluating gold properties also rose; the State began experiencing its largest precious metal boom since the 1930's. Interest was concentrated in the San Juan Mountains area and the Boulder and Clear Creek Counties area. One aspect of the increase in interest in gold was a surge in penny mining stocks on the Denver over-the-counter stock exchange.

Mining of new ore began in mid-January at Standard Metals Corp.'s Sunnyside Mine near Silverton. The mine suffered more than $9 million in damage when water from a lake above the underground workings flooded through those workings in June 1978. Standard Metals sued its insurors for compensation and was awarded nearly $9 million in damages by the U.S. District Court in Denver in December 1979. Milling of stockpiled ore, begun in November 1979, reached 650 short tons per day in January 1980; the mill returned to full operation by the end of 1980.

Table 4.—Colorado: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing[1]		Material sold or treated[2] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1978, total	18	1	734,172	32,094	$6,211,796	4,217,181	$22,772,776
1979, total	15	1	411,473	13,850	4,258,879	2,808,934	31,151,078
1980:							
Boulder	4	--	7,433	W	W	23,472	484,462
Clear Creek	1	--	191	16	9,801	629	12,983
Eagle	1	--	8,261	596	365,086	212,961	4,395,515
Gilpin	3	--	804	56	34,304	1,147	23,675
Gunnison	1	--	13	--	--	653	13,478
La Plata	1	--	14	51	31,241	180	3,715
Park	1	1	5,443	W	W	18,915	390,405
Pueblo	1	--	1,775	261	159,878	454	9,371
Summit	2	--	5,093	51	31,241	13,281	274,120
Undistributed[3]	8	--	520,123	38,416	23,532,105	2,715,366	56,045,153
Total[4]	23	1	549,148	39,447	24,163,656	2,987,058	61,652,877

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1978, total	1,191	$1,746,791	15,151	$11,256,600	22,208	$15,177,907	$57,165,870
1979, total	362	742,120	7,554	8,766,654	9,910	8,149,288	53,068,019
1980:							
Boulder	1	2,883	18	16,896	--	--	[5]504,241
Clear Creek	--	--	1	540	--	--	23,324
Eagle	90	203,357	69	64,183	--	--	5,028,141
Gilpin	1	2,478	5	4,888	--	--	65,345
Gunnison	--	--	3	2,964	--	--	16,442
La Plata	--	--	1	635	--	--	35,591
Park	--	--	293	274,674	--	--	[5]665,079
Pueblo	--	--	1	918	--	--	170,167
Summit	--	--	8	7,402	--	--	312,763
Undistributed	368	831,813	9,873	9,242,089	13,822	11,406,279	101,057,439
Total[4]	461	1,040,531	10,272	9,615,189	13,823	11,406,279	107,878,532

W Withheld to avoid disclosing company proprietary data.
[1]Operations from which gold, silver, copper, lead, or zinc were recovered as byproducts from sand and gravel or cleanup are counted as mines.
[2]Does not include gravel washed.
[3]Includes Lake, Mineral, Ouray, San Juan, and Teller Counties and items indicated by symbol W combined to avoid disclosing company proprietary data.
[4]Data may not add to totals shown because of independent rounding.
[5]Excludes value of gold content; included in "Undistributed."

Asarco's Leadville unit (Black Cloud Mine) produced 11,399 ounces of gold in 1980 according to the company's annual Form 10K report to the Securities and Exchange Commission, which was a substantial increase over that of the preceding year. Asarco also explored other Leadville properties during the year.

Day Mines, Inc., which operates the Sherman Tunnel under agreement with Leadville Corp. in the Leadville area, began evaluating the Resurrection property, also held by the Leadville Corp., as a potential high-value development.

Among other gold resource developments during the year, Federal Resources Corp. began reactivating the Camp Bird Mine near Ouray, January 1, 1980. The Camp Bird Mine produced more than 1 million ounces of gold between 1902 and 1960 and continued to be a strong producer until 1977 when it was closed because of the unfavorable ratio between metal prices and mining costs. Work was done on a development and exploration basis and by midyear, the company had begun to stockpile mine-run ore. Federal Resources, in April 1980, leased the Bachelor and Syracuse Mines, 8 miles from the Camp Bird Mine, to begin evaluating and redeveloping those primarily silver-producing mines. Ore from all three mines was processed in Federal's 500-ton-per-day mill adjacent to the Camp Bird Mine, and concentrates were sent to the Bunker Hill smelter in Kellogg, Idaho.

Texasgulf, Inc., and Golden Cycle Corp., which had ended an earlier joint operating agreement in 1979, entered a new joint venture under the name Cripple Creek and Victor Mining Co. Texasgulf holds a 64% interest in the project and agreed to spend approximately $7 million in rehabilitating

Table 5.—Colorado: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1980, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode:					
Amalgamation, cyanidation and direct smelting of ore[1]	[2]8,819	396,055	90	210	--
Smelting of concentrates	30,628	2,591,003	371	10,061	13,823
Total	39,447	2,987,058	461	[3]10,272	13,823
Placer	W	--	--	--	--
Grand total	39,447	2,987,058	461	[3]10,272	13,823

W Withheld to avoid disclosing company proprietary data.
[1]Combined to avoid disclosing company proprietary data.
[2]Includes placer production.
[3]Data do not add to total shown because of independent rounding.

Table 6.—Colorado: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1980, by class of ore or other source material

Source	Number of mines[1]	Material sold or treated[2] (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:							
Dry gold	3	1,465	219	W	W	--	--
Gold-silver	1	18	2	199	--	--	--
Silver	4	205,059	W	2,440,142	W	1,321	W
Total	8	206,542	[3]221	[4]2,440,341	W	1,321	W
Lead	13	39,818	1,377	97,071	W	280	--
Lead-zinc[5]	2	297,876	37,481	431,623	461	8,533	13,823
Total[6]	15	337,694	38,858	528,694	461	8,812	13,823
Other lode material:							
Lead tailings and silver and lead cleanup	--	4,911	368	18,023	--	138	--
Total lode[6]	23	549,148	39,447	2,987,058	461	10,272	13,823
Placer	1	--	W	--	--	--	--
Grand total[6]	24	549,148	39,447	2,987,058	461	10,272	13,823

W Withheld to avoid disclosing proprietary data; included in recovery from lead-zinc ore.
[1]Detail will not necessarily add to totals shown because some mines produce more than one class of material. Operations from which gold and silver are recovered as byproducts from sand and gravel operations or cleanup are not counted as producing mines.
[2]Does not include gravel washed.
[3]Excludes gold content of silver ore.
[4]Excludes silver content of gold ore.
[5]Includes data indicated by symbol W.
[6]Data may not add to totals shown because of independent rounding.

the Ajax and Cresson Mines and the Carlton mill. Mining and milling were scheduled to begin within 2 years, and daily production was to reach 150 tons within 3 years. Texasgulf will receive 75% of the first $10 million in profits and 84% thereafter until payout of its investment. The production plan was based on inferred reserves of approximately 300,000 tons of ore averaging about 0.33 ounce of gold per ton.

Cripple Creek Gold Production Corp., Teller County, continued developing the Mary Nevin Mine and mill and acquired an interest in the Lexington group of claims and options to lease the Joe Dandy and Ophir properties. Yellow Gold of Cripple Creek, Inc., continued evaluating the company's Rittenhouse and Moffat Tunnel properties, finding mineralization that warranted further exploration. The company also purchased a mill in Pueblo for transfer to the Cripple Creek area.

Bakers Park Mining and Milling Co. in Ouray County, Leadville Gold and Silver Corp., and Norsigo Processing and Refining, Ltd., in Lake County, announced new mill construction or developments. Strategic Metals International acquired a property in Jefferson County for development of a chemical smelter.

Hendricks Mining Co. continued developing the Cross Mountain Mine and Hendricks mill in Boulder County, becoming the State's third largest producer of gold in 1980. Silver State Mining Corp. further developed its Moose, Hock Hocking, and Morning Star Mines, and Alma mill in Park County and leased the Iron Clad property in Teller County. Moritz Mining Co. continued developing its Smith Mine properties and others in Gilpin County. Alpha Energy and Gold of Ouray announced finding commercially recoverable gold in its Brooklyn Mine in Ouray County. Lake City Mines, Inc., continued exploration in the Golden Wonder Mine in Hinsdale County. Cobb Nuclear Corp. and Houston Natural Gas Fossil Fuels Co. agreed to spend $2.5 million to explore and develop the London Mine in Summit and Park Counties. Homestake Mining Co. initiated a 2-year exploration program at the Buffalo Boy Mine properties in San Juan County. Earth Sciences, Inc., proposed developing the El Plomo Mine in Costilla County. AZL Resources, Inc., and Asarco entered an agreement for exploration of gold on a property near Crestone. Hard Rock Mining Co. worked the Gold Crest Mine in Lake County. Norsigo Processing and Refining, Ltd., continued production at the Continental Chief, also in Lake County. Numerous other companies and individuals did exploration and development work on gold prospects in the State.

The Fairplay dredge, a 2,500-ton "desert boat" that had processed 140,000 yards per week of South Platte River bottom material for gold south of Fairplay in the 1940's and early 1950's, was dismantled and shipped to Bogota, Colombia.

Colorado rose to sixth among the States in gold production in 1980, from ninth in 1979; its proportion of the Nation's gold production rose to 4% from 1.4% in 1979.

Iron Ore.—Colorado produced an insignificant portion of the Nation's total iron ore. The single producer of iron ore in the State remained the Cooper Mine near Ashcroft and Aspen in Pitkin County. It was operated for the Pitkin Iron Co. by Morrison-Knudsen Co., Inc. The entire output, a magnetite ore containing about 65% iron, was shipped to the Pueblo steel mill of the CF&I Steel Corp., the Nation's 10th largest steel producer. Shipments in 1980 were about one-half those of 1979, largely because of a slowdown in the economy and its effect on the steelmaking industry. The Cooper Mine ceased shipping fines to CF&I following shutdown of the sintering plant at the Pueblo mill. CF&I laid off 800 of its 6,000 workers at one point during the year, but finished the year with a strong earnings increase as a result of expanded capacity and record production of rails and oil industry tubular goods.

Ore mined at the Cooper Mine was trucked to a railhead at Woody Creek, transshipped by rail down the Roaring Fork River Valley to the main line of the Denver and Rio Grande Western Railroad at Glenwood Springs, and thence to Pueblo.

Lead.—Although lead production in Colorado in 1980 increased substantially over that of 1979, it remained at about one-third of the production levels in the early 1970's. The relative importance of lead among the five metals produced from Colorado's base and precious metal ores (copper, gold, lead, silver, and zinc) also declined to little more than 10% of the total value of these materials. Average unit price declined from $0.526 per pound in 1979 to $0.425 per pound in 1980. Eighteen mines operating in 13 counties produced lead in the State in 1980. One mine, Asarco's Leadville unit in Lake County, however, dominated production. The next three mines in order of output—Standard Metals Corp.'s Sunnyside Mine in San Juan County, Homestake Mining Co.'s Bulldog Mountain Mine in Mineral County, and Day Mines, Inc.-Leadville Corp.'s, Sherman Tunnel—cumulatively produced a little more than one-third the output of the Leadville unit. The Camp Bird Mine, Federal Resources Corp., in Ouray County, again reported production of lead after a 3-year closure; the Eagle Mine of New Jersey Zinc Co. in Eagle County, a former major producer, continued to produce at a reduced level; and the Idarado Mine in Ouray and San Miguel Counties, once the State's largest producer of lead, remained closed as it has been since mid-1978.

Molybdenum.—Molybdenum was the most valuable nonfuel mineral produced in Colorado in 1980. All the primary molybdenum production in Colorado, more than one-half of the Nation's total molybdenum production, was from two mines, the Climax Mine near Leadville in Lake County and the Henderson Mine near Empire in Clear Creek County. Both mines were owned and operated by Climax Molybdenum Co., a division of AMAX Inc. The output of 102 million pounds of molybdenum reported in the company's annual report in 1980 compares with 92 million pounds reported in 1979. Most of this increased output resulted

from the Henderson Mine being brought to its design capacity of 50 million pounds of molybdenum annually during 1980.

Despite strikes in the copper industry that reduced the substantial amounts of byproduct molybdenum produced, worldwide markets for molybdenum generally softened during the year with market prices falling below producer price levels for molybdenum oxide. Although at yearend, the molybdenum market had a surplus supply condition in which the company could not sell all of its production, AMAX did not reduce production or personnel at its two Colorado mines, preferring instead to build up inventory.

Astride the Continental Divide 100 miles west of Denver at 11,318 feet above sea level, the Climax Mine has produced more than 400 million tons of crude ore in its 60 years of mining operations. As reported in the company's annual report and Form 10K report, ore production from the two underground levels and open pit in 1980 totaled over 17 million tons, an alltime record daily average of 47,821 tons. Average daily production was 19,922 tons from the Storke level, 8,614 tons from the 600 level, and 19,285 tons from the open pit. From this ore, 52.1 million pounds of molybdenum—as well as byproduct tungsten, tin, and pyrite—were produced. The company estimates proven and probable ore reserves at 433 million tons averaging 0.309% molybdenum disulfide (which has a molybdenum content of 60%) of which 152 million tons can be mined by open pit methods and 281 million tons by underground methods. The full extent of mineralization has yet to be defined. Capital expenditures at Climax during the year were nearly $90 million, including approximately $47 million for mine development. Work continued on schedule on the No. 6 crusher, which is expected to go into operation in late 1981, with a total cost estimated at $40 million. It will accommodate increased output from the open pit where larger blasthole drills were placed in operation during the year. Two new drills are drilling 8 3/4-inch-diameter holes and could handle drill bits as large as 10 1/2 inches. Initial ground breaking for the 900 level in the mine took place in July, and two declines to that level were collared in after the East Fork of the Arkansas River was relocated. The heavy-metals water-treatment plant, treating water for release in Ten Mile Creek on the north slope of Fremont Pass, continued to operate under extension of a 1978 Colorado Department of Health Cease and Desist Order while an application for a new permit was being processed by that department's Water Quality Control Division. In July 1980, AMAX filed a lawsuit in Colorado State District Court seeking a court order requiring reexamination of the water quality standards and rules applying to Climax. The suit should be resolved when the terms and conditions of the new National Pollutant Discharge Elimination System discharge permits are determined.

Plans were completed for constructing a Storke level water-collection system to clean water released into the Arkansas River. Total work force at Climax increased to over 3,000 with about 1,600 of these working underground and 450 in the open pit. Total payroll for the year was about $72.9 million. New 3-year contracts were negotiated between the company and two unions that represent most Climax workers: The Oil, Chemical, and Atomic Workers Union represents about 2,300 employees and the International Brotherhood of Electrical Workers represents about 150 workers. There has not been a strike at the Climax Mine since 1962 when workers were off the job for about 6 months.

The Henderson Mine, in Clear Creek County about 60 miles west of Denver, began production in mid-1976, based on an award-winning mining plan. In 1980, AMAX annual reports indicated 50 million pounds of molybdenum were produced from a daily mining rate of 30,000 tons of ore. Capital expenditures for the year were $66 million of which $34 million was for mining development. A fourth grinding mill was completed and placed in operation during the year. A contract was signed with Harrison Western Corp. to deepen the No. 1 shaft, a 23-foot-diameter ventilation shaft, to the 7,700-foot level, which will increase ventilation capacity in the mine. The first commercial application of a process developed by the Bureau of Mines to dewater mine drainage slimes was made at the Henderson Mine.

Approximately 1,560 were employed in the Henderson Mine in 1980, and 400 in the mill 14 miles west of the mine on the other side of the Continental Divide. Probable and proven reserves at the site are estimated at 239 million tons averaging 0.419% molybdenum disulfide.

Evaluation and feasibility studies continued at Mount Emmons in Gunnison County where preliminary analysis indicates an ore body containing approximately 155 million tons of mineralized material averaging

approximately 0.44% molybdenum disulfide. The ore body, about 2,500 feet in diameter and 300 feet thick, lies about 1,200 feet below the surface. In September 1980, AMAX purchased the entire remaining interest of the U.S. Energy Corp. and Crested Butte Mining Co. in the Mount Emmons claims, including reserved mineral interest in any lead, zinc, silver, or associated minerals. AMAX will make advance royalty payments of 700,000 pounds of molybdenum, pay 6% royalty on future production from the property, lend $7.5 million to each company, and purchase $10 million of restricted shares and warrants of each of the two companies. AMAX and the town of Crested Butte are in litigation over an ordinance the city adopted affecting the watershed in which the Mount Emmons prospect is located.

Reclamation of the 125 acres covered by two tailings disposal ponds at the Urad Mine, near the Henderson Mine and closed since 1974, was essentially completed in 1980. Reclamation involved the use of about 1.5 million tons of rock, 4,200 tons of sewage sludge, 24,000 cubic yards of wood chips, and 32,000 tree seedlings. A reservoir, originally constructed for industrial mill-water recycling, was converted into a lake and stocked with trout by the Colorado Division of Parks and Outdoor Recreation. The entire site is open to the public.

Noranda Exploration, Inc., explored for molybdenum on Porphyry Mountain near Jamestown in Boulder County. Activities were hampered by local opposition and sabotage of machinery and a drill hole.

Silver.—Although silver production in Colorado increased only slightly in 1980, a near doubling in average price from $11.09 per ounce to $20.63 per ounce resulted in total value also nearly doubled over the 1979 value. Twenty-three mines produced silver in 14 counties in 1980; 5 mines each produced 100,000 troy ounces or more. Silver strengthened its role as the most important of the base and/or precious metals complex—copper, gold, lead, silver, and zinc—which are generally produced as coproducts and/or byproducts in Colorado. The value of silver produced in 1980 was 50% greater than the value of the other four metals combined. The leading silver producer in the State, again the Bulldog Mountain Mine of Homestake Mining Co. at Creede, Mineral County, yielded more than the next five major producers combined. The second largest producer was the Sherman Tunnel Mine, operated by Day Mines under lease from Leadville Corp., near Leadville in Lake County, followed in order by Asarco's Leadville unit (Black Cloud Mine) at Leadville, New Jersey Zinc Co.'s Eagle Mine in Eagle County, and Standard Metals Corp.'s Sunnyside Mine near Silverton in San Juan County. Sixth in production was the historically important Camp Bird Mine, owned and operated by Federal Resources Corp., near Ouray, Ouray County, which was being brought back into production after being closed in 1977.

Homestake Mining Co. spent $1.5 million on capital improvements at its Bulldog Mountain Mine, plus another $750,000 for underground equipment in 1980. Shops, offices, mill, and equipment were updated. Ore production was opened up on the 9,000-foot level. A steel liner was placed in the 830-foot ventilation shaft to control a cave-in problem, and ventilation capacity was doubled by rearranging the airflow to provide air intake through both portals and exhaust through the shaft. Mine-power capacity was doubled, as was compressed-air capacity for operating drills. A new telephone system was installed. The carbon plant, used for secondary recovery of silver, was modernized. A new water treatment plant was opened October 1 at a cost of $1 million. The company claimed that treated mine water discharged into Willow Creek actually was more free of heavy metals than the creek itself. The 175-employee mine, which had an annual payroll of more than $4 million, was Creede's largest employer. The Bulldog Mine ranked seventh in silver mines in the United States in 1980.

Homestake began a 2-year exploration program on the Buffalo Boy properties in San Juan County, which will include drilling, bulk sampling, and more than 3,000 feet of drifting.

The Creede Silver Project, a joint venture between Chevron Resources Co. and Minerals Engineering Co., entered its second phase, with a contract to Harrison Western Corp. for underground evaluation of the property in Mineral County, including mine rehabilitation, drifting, crosscutting, diamond drilling, and the collection and preparation of bulk ore samples.

Ranchers Exploration and Development Corp. began development work at the Revenue-Virginius Mine near Ouray in Ouray County. Most silver production from the mine occurred around the turn of the century. Projected data suggest the presence of a minable deposit of 1 million tons containing approximately 10 million ounces

of silver.

Federal Resources Corp. leased and began developing the Bachelor and Syracuse silver mines near Ouray. Assays from development drifts in the mines indicated 9 to 12 ounces of silver per ton of ore. The Bachelor also was believed to contain about 250,000 tons of millable material in its dumps.

The Anaconda Company purchased mineral and surface rights to 4,500 acres of land near Rico, Dolores County. The Rico mining district was known for its rich silver ore mined early in the century.

Colorado was ranked third in the Nation in silver production in 1980, and fourth in 1979. Production was 9.5% of the Nation's total, a larger proportion than in 1979.

Tin.—Only Colorado of the 48 conterminous States produced tin in 1980, but Alaska produced more tin than Colorado. All tin produced was a byproduct of molybdenum production at AMAX's Climax Mine near Leadville in Lake County. Climax ore contains about 0.006% tin. Company news releases indicated production of 183,518 pounds of low-grade tin in 1980, which was shipped to a recovery plant in Boulder County.

Tungsten.—Colorado was second among the three States that produced significant amounts of tungsten in 1980. All reported production of tungsten was from AMAX's Climax Mine near Leadville where it was a byproduct of molybdenum output. Wolframite (WO_3), the tungsten mineral recovered, was concentrated from a feed grade of 0.03% WO_3 to a marketable product grade of 70% WO_3. The three-stage gravity circuit used to concentrate the tungsten consists of a rougher stage, Humphrey spirals and Reichert cones operating in parallel; a cleaner stage utilizing Reichert cones; and a third stage of Deister tables. Flotation removed the impurities, pyrite and phosphorus; magnetic separators removed iron. AMAX's Form 10K report for 1980 stated that the total amount of tungsten produced at its Climax operation was 2.26 million pounds of tungsten trioxide containing 1.79 million pounds of tungsten, up slightly from last year's output. The tungsten produced at Climax, sold primarily in the United States, was used in tungsten-carbide compounds for cutting tools, high-temperature alloy steel, lamp filaments, and electrical contacts.

Vanadium.—The production of vanadium in Colorado in 1980 declined slightly from the 1979 level. Vanadium is used largely as an alloying element in steel, and its demand reflects somewhat that for steel. Colorado retained its rank as first among the five States in the Nation that produce vanadium. Vanadium was produced in Colorado largely as a coproduct or byproduct of uranium, and the sagging market for uranium affected production of uranium and/or vanadium ore in the State, which has averaged about 5 pounds of vanadium oxide (V_2O_5) for each pound of uranium oxide (U_3O_8) contained. Montrose and San Miguel Counties were the major sources of vanadium ores in 1980; smaller amounts were produced in Mesa and Rio Blanco Counties.

Two companies processed vanadium. Union Carbide Corp. at its Uravan plant in Montrose County was the State's largest producer, and Cotter Corp.'s Canon City plant in Fremont County was the second. The Cotter Corp. produced vanadium solely from its own ore production, whereas the Union Carbide plant processed purchased ore as well as ore from its own mines.

Concerns about the stability of Union Carbide Corp.'s three tailings ponds led the Colorado Department of Health to order a brief shutdown of the Uravan mill in January. The mill has been operated since about 1950. Although the company spent about $12 million in buttressing the ponds to extend their usefulness, it still faced the problem of developing new tailings disposal sites to handle growing tailings needs. In December, Union Carbide announced plans to shut down its Uravan mill for 6 months because of the deteriorated market for uranium. Operations were reduced at a number of Union Carbide's mines in the Uravan mineral belt, including the King Solomon Mine, Sunday Mine, and Deremo Mine in western Colorado for the same reason. The operating license at the Uravan mill expired in 1975; uncertainty of renewal conditions and company plans for rebuilding the mill and tailings ponds delayed renewal of the license.

The Cotter Corp. experienced a number of problems with its Canon City facility during the year. The Colorado Bureau of Investigation released a report in September alleging a number of health and safety violations in the plant between 1968 and 1977. Later in the year, the Colorado Department of Health threatened to suspend the license of the plant if alleged contamination problems were not solved. Citizen and environmental groups made similar allegations. The company worked with these groups to resolve questions. The company contended that the new mill, completed in August 1979 at a cost of $60 million, solved most of the

problems that the old mill on the same site had experienced. Plagued by mechanical problems that kept the plant at about one-half its capacity, Cotter Corp. in November asked the builder of the new mill to oversee its operations in an effort to solve its mechanical problems and bring it up to its full 1,200-ton-per-day production level. The vanadium circuit was closed in February for repairs and returned to partial service. The first strike at the mill in the 10-year presence of the Oil, Chemical, and Atomic Workers, began February 29, and was settled April 9.

Although operations were cut back at some of its uranium operations because of the poor market, Cotter began developing a new open pit mine in the Paradox Valley, west of Naturita, in May. The mine was expected to contain about 2,500 tons of uranium and 12,500 tons of vanadium.

In other State developments, Amoco Minerals, Inc., received the Fremont County Planning Commission's approval and a Colorado Mined Land Reclamation Board permit to proceed with developing its Hansen Project on Tallahassee Creek; however, the company decided to delay the project until market conditions improved.

Homestake Mining Co. completed public hearings as the final step in the process of applying for a license to construct a mill and tailings pond adjacent to its open pit Pitch Mine near Marshall Pass in Gunnison County. Pioneer Uravan, Inc., a subsidiary of Pioneer Corp. of Texas, contracted with Davy-McKee Co. for design and construction of a uranium-vanadium project near Slick Rock in San Miguel County. Facilities would include an ore buying station, a 1,000-ton-per-day mill with uranium and vanadium circuits, and a tailings disposal system. Pioneer would own two-thirds of the project and Wisconsin Public Service's Mining Division, one-third. Delay in obtaining an operating license from the Colorado Department of Public Health forestalled beginning the project in 1980.

Zinc.—Colorado was ranked seventh in the Nation, with 4% of total zinc production.

Three mines in Colorado reported producing zinc in 1980, compared with 10 such mines in 1979. Nevertheless, the quantity of zinc output was about 40% greater in 1980 than that of 1979. In longer term perspective, production of zinc remained low, about 20% of the early 1970's level. Historically the most important of the base metals complex produced in Colorado, zinc trailed far behind silver and gold in value of production, but remained ahead of lead and copper at about 11% of the total five-metal value. Asarco's Leadville unit in Lake County produced close to two-thirds of the total; Standard Metals Corp.'s Sunnyside Mine in San Juan County and Homestake Mining Co.'s Bulldog Mountain Mine in Mineral County were the other two producers, in that order. Traditionally large zinc producers, the Idarado and Eagle Mines, were missing entirely from the list of 1980 zinc producers. The average price of zinc was about $0.37 per pound in 1980, about the same as in 1979.

NONMETALS

Carbon Dioxide.—Colorado was the Nation's major producer of carbon dioxide in 1980. Shell Oil Co. spent $9 million over 3 1/2 years in developing carbon dioxide (CO_2) fields near Cortez in Montezuma and Dolores Counties in southwestern Colorado. The CO_2 in the McElmo Dome and Doe Canyon areas of the two counties is of high quality. Shell, in cooperation with Mobil Oil Co., proposed building a 478-mile pipeline to Denver City, Tex., where the CO_2 would be injected into the Wasson Oilfield in a tertiary oil-recovery project that could yield an estimated 280 billion barrels of oil. The Bureau of Land Management completed a final environmental statement on the proposed project and approved the right-of-way across 109 miles of Federal lands. Shell has completed 16 wells in the Yellow Jacket Canyon area. If Shell and Mobil decide to go ahead with the project, a field of 140 wells would be drilled to remove about 580 million cubic feet of CO_2 per day from the McElmo Dome and about 80 million cubic feet per day from Doe Canyon. A startup date of 1984 was anticipated. An investment of about $1.6 billion would be required. Landowners in the Cortez area filed a suit to determine whether CO_2 is a gas or a mineral. The Federal Government retained the oil and gas rights under terms of many of the post-1914 homestead deeds to land in the area; hence the court's decision will determine whether or not landowners can claim royalties on CO_2 production.

Atlantic Richfield Oil Co. proposed a similar pipeline project to transport CO_2 from the Sheep Mountain area, west of Walsenburg in Huerfano County, 400 miles to the Midland, Tex., area.

Cement.—In terms of value of output, cement was the most important nonmetallic mineral produced in Colorado in 1980. Although continuing to be affected by a de-

pressed housing market, the level of cement output in 1980 was very similar to that in 1979. As in previous years, two companies produced cement in Colorado in 1980; Ideal Basic Industries, Inc., at two plants, the Boettcher plant in Larimer County and the Portland plant in Fremont County; and the Martin Marietta Corp., at its Lyons plant in Boulder County. All three plants produced portland cement; the Boettcher and Lyons plants also produced masonry cement. Most of the cement produced was of the type II, moderate-heat-resistant cement, with lesser amounts of type III high-early-strength cement, oilwell cement, and type-V high-sulfur-resistant cement also manufactured. Ready-mix companies were the major customers for the output of Colorado's three cement plants, followed in order by concrete-product manufacturers, other contractors, building-materials dealers, and highway contractors. The cement was typically shipped to the consumer in bulk, by truck.

The Martin Marietta Lyons plant was shut down February 15 for a $7 million conversion of its processing operation. The 490-foot-long dry kiln was cut to 245 feet in length, and a 188-foot tower containing a precalciner was added to accommodate the shorter length with greater energy efficiency. A kerogen roaster was eliminated from the system. The higher temperatures possible with the new system completely burn the small amount of kerogen in the limestone feed of the plant, thus eliminating a problem that had plagued the plant since its opening in 1969. The converted plant was brought back onstream March 30, with an unchanged capacity of about 430,000 tons per year.

The overall renovation and expansion of Ideal Basic's Boettcher plant near Fort Collins was essentially completed and a phased startup procedure begun; kiln firing is scheduled for April 1981. Total cost of the renovation project rose to about $72 million. The Boettcher plant, built in 1927 and previously modernized in 1957, increased in annual rated capacity from 325,000 tons to 460,000 tons as a result of this expansion. Ideal Basic's Portland plant near Florence was built in 1948 and expanded in 1974 to an annual rated capacity of 885,000 tons.

Clays.—Clays were produced in 8 counties in Colorado in 1980, by 15 companies operating 34 mines. Both quantity and value of output were down considerably from that of the preceding year. Producing counties continued to be mainly on the eastern slope. Three types of clay were reported: Bentonite (both swelling and nonswelling varieties), common clay, and fire clay. Common clay represented more than 80% of the total clay produced and bentonite represented about 10% of the total. Jefferson County was the leading county in production with nearly 43% of the total. Following, in order of output, were Fremont, Douglas, and Pueblo Counties, cumulatively contributing about 43% of the State total. Fremont County was the only county in which bentonite was produced. Nonswelling-type bentonite clay comprised less than 5% of the total bentonite output.

Average prices ranged from about $5.30 per ton for common clay, to $7.44 per ton for fire clay, and $16.00 for swelling-type bentonite.

The largest individual producer of clay in the State was Robinson Brick and Tile Co., producing mostly common clay. Second was Silver Rocker Bentonite Co., the State's only major producer of bentonite. These two

Table 7.—Colorado: Clays sold or used by producers, by county

(Short tons)

County	1979[1]		1980	
	Quantity	Value	Quantity	Value
Boulder	W	W	W	W
Douglas	96,129	$610,409	45,613	$365,106
Elbert	W	W	W	W
El Paso	W	W	W	W
Fremont	28,401	111,178	55,523	650,767
Jefferson	228,304	1,079,620	144,523	694,875
Las Animas	W	W	W	W
Pueblo	54,303	274,601	45,115	247,194
Other[2]	114,125	641,422	45,668	265,336
Total	521,262	2,717,230	336,442	2,223,278

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Bentonite is excluded from the data.
[2]Consists of data indicated by symbol W.

companies accounted for nearly one-half of the State's clay production. Other important producers, in order of their output, were Denver Brick and Pipe Co.; Wesley D. Conda, Inc.; and G. W. Parfet Estate, Inc. These companies contributed about 30% of total production. Uses to which Colorado clays were put included common brick, face brick, flue lining, animal feed, drilling mud, sealant, sewer pipe, and adobe brick.

Gypsum.—Six companies produced crude gypsum in Colorado in 1980, three in Fremont County and three in Larimer County. Although the quantity of output was little changed from that of 1979, the value of output nearly quadrupled. The Flintkote Co. Coaldale Mine in Fremont County was the largest crude-gypsum producer. Crude gypsum was marketed as a soil conditioner and cement retarder. Flintkote Co. also produced calcined gypsum, a product used mainly in producing wallboard. Reported output was considerably below that of 1979.

Lime.—The quantity and value of quicklime produced were both more than 50% greater than in 1979. Three companies produced lime in six counties. One company, Great Western Sugar Co., produced quicklime for use in processing sugar beets into sugar in five counties: Larimer, Logan, Morgan, Sedgwick, and Weld. These counties are all in the northeastern part of the State along the South Platte and Poudre Rivers where irrigated sugar beet production takes place. The CF&I Steel Corp., in Pueblo County, produced lime for use in its Pueblo steel plant. It was the largest producer of lime in the State in 1980.

Calco, Inc., brought a new quicklime plant onstream at Salida early in the year. Located in a former Denver and Rio Grande Railroad repair facility, the plant has a daily pebble-quicklime production capacity of 100 tons. The 6 1/2- by 120-foot Fuller Traylor kiln calciner is coal fired through a Herbert 11A Atritor. The high-calcium limestone used for the company's operations comes from the CF&I quarry at nearby Monarch Pass. The product of the plant is used primarily in waste-water treatment. Calco also produces pulverized limestone for agricultural and industrial uses.

Peat.—Peat was produced by six companies in Alamosa, Boulder, Chaffee, Park, and Teller Counties, counties with mountainous areas where peat occurs. Production in 1980 was moderately larger than in 1979. Two-thirds of the total output was humus-type peat, with smaller amounts of reed sedge and unidentified other types produced. Most of the peat produced was used as a fertilizer mix; peat was also used as a general soil conditioner, an ingredient in potting soil, nursery applications, and on golf courses. Most of the product was shipped in bulk, with smaller amounts packaged. Prices ranged widely from about $7.50 per ton to $29.90 per ton for bulk products and $40.00 to $74.50 for packaged products, depending on type of peat and use. The Universal Peat Co. in Park County was the largest producer, with more than one-half total output.

Perlite.—One company in Colorado, Persolite Products, Inc., again produced crude perlite in 1980 near Westcliffe in Custer County. Reported production was about one-third less than last year's output. Expanded perlite was produced at two plants; Persolite's plant at Florence in Fremont County, and at Grefco, Inc.'s plant at Antonito in Conejos County. The Antonito plant is considerably the larger of the two. New Mexico was the source of crude perlite for the Antonito plant. Almost 90% of the output from the Antonito plant was used as filter aid material; that from the Florence plant was used in insulation, construction aggregate, and horticultural aggregate.

Pumice.—Pumice in the form of scoria was produced by two companies in Colorado in 1980. The larger of the two, the Colorado Aggregate Co., at its Mesita Hill operation near Mesita, Costilla County, produced about the same quantity of processed scoria as in 1979. Its product was used mostly in landscaping, with a secondary use in roofing. The second company, the Dotsero Block, Co., Inc., at its Dotsero operation near Gypsum, Eagle County, produced both processed and unprocessed scoria for use in road construction and concrete aggregate. Its reported level of output in 1980 was lower than in 1979.

Pyrites.—Pyrite was produced as a by-product of molybdenum production by AMAX at its Climax Mine near Leadville. Three to five pounds of pyrite were removed in the processing of each ton of ore at the Climax mill. Coors Container Co. in Golden used pyrite in bottlemaking.

Sand and Gravel.—Sand and gravel was the most widely distributed mining activity in the State, occurring in 48 of 63 counties. One hundred thirty-eight companies extracted sand and gravel from 202 different sites. The quantity produced remained relatively constant with that of the 3 preceding years. The total value of production, howev-

er, which had also remained relatively constant in those same 3 years, increased very significantly in 1980.

Jefferson County, the State's largest producer of sand and gravel, together with Boulder County, cumulatively produced nearly 30% of the State total. They were followed in order of output by Adams,

Table 8.—Colorado: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	7,441	$21,700	$2.92	9,392	$34,032	$3.62
Plaster and gunite sands	55	223	4.05	97	560	5.76
Concrete products	276	563	2.04	243	586	2.41
Asphaltic concrete	3,888	7,394	1.90	3,660	8,137	2.22
Roadbase and coverings	10,554	20,459	1.94	11,067	24,954	2.25
Fill	2,237	3,525	1.58	1,705	3,061	1.80
Snow and ice control	406	783	1.93	538	1,161	2.16
Railroad ballast	32	103	3.25	75	156	2.09
Other	623	1,516	2.43	656	1,804	2.75
Total[1] or average	25,512	56,263	2.21	27,433	74,452	2.71

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

Table 9.—Colorado: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	8,179	$18,419	$2.25	8,989	$25,880	$2.88
Gravel	17,333	37,844	2.18	18,444	48,572	2.63
Total or average	25,512	56,263	2.21	27,433	74,452	2.71
Industrial:						
Sand	W	W	15.91	W	W	25.29
Gravel	W	W	6.45	--	--	--
Total or average	W	W	13.14	W	W	25.29
Grand total or average	25,680	[1]56,263	W	W	W	2.78

W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Excludes industrial sand and gravel.

Larimer, and El Paso Counties, each of which produced more than 2 million tons of sand and gravel in 1980. These top five counties accounted for nearly 60% of total output. Three other counties, Arapahoe, Mesa, and Weld, each produced more than 1 million tons of sand and gravel during the year. These eight major sand and gravel-producing counties were the source of three-fourths of the State's production of this important nonmetallic mineral; the remaining 40 counties contributed just 25% of the total output. As is generally the case with a construction mineral like sand and gravel which cannot economically be shipped very far, the eight major producing counties were associated with the major population centers of the State, four of them being part of metropolitan Denver.

Less than 1% of the sand and gravel produced in the State was of industrial quality; the remaining 99% was construction-quality material. Two-thirds of the construction sand and gravel output in the State was gravel; one-third, sand. About 40% of the total was used as roadbase, 34% concrete aggregate, and about 13% in asphalt aggregate. Fill, snow and ice control, concrete products, plaster and gunite, and railroad ballast were among the other uses. Hydraulic fracturing (of geologic structures containing oil) was the major use of the small amount of industrial sand produced. Trucks were the means of transporting 85% of the sand and gravel produced, 13% was used on site, and railroads transported most of the small remaining balance. The unit value of construction sand and gravel ranged from $1.88 per ton for fill material to $5.76 per ton for sand used in plaster; average value was about $2.71 per ton. Two companies producing industrial sand received an average $25.29 per ton for their product.

About 30% of the sand and gravel operations in the State produced less than 25,000 tons annually; another 30% produced 25,000 to 100,000 tons; and 27% produced 100,000 to 300,000 tons. Three operations were larger than 1 million tons.

The largest producers of sand and gravel in the State in order of size were as follows: Mobile Pre-Mix Sand and Gravel Co., operating in Adams, Jefferson, and Larimer Counties; Flatiron Sand and Gravel Co., operating in Boulder, Larimer, Summit, and Weld Counties; Schmidt-Tiago Construction Co., in El Paso, Moffat, and Rio Blanco Counties; and Cooley Gravel Co., in Adams and Arapahoe Counties. The 10 largest companies produced a little more than 40% of the total output from 33 deposits.

A number of proposals to extract sand and gravel from new sites generated heated public controversy. The sharpest conflict over land use decisions, apportioning land among urban use, sand and gravel recovery, and scenic preservation, was in the Denver metropolitan area.

Stone.—Stone was produced by 27 companies at 35 quarries in 9 of Colorado's 63 counties. The quantity and value of production changed very little between 1979 and 1980. Less than 1/10 of 1% of the total stone production was dimension stone; most of that was sandstone used as house siding veneer. Most of the crushed-stone output was produced from limestone. Granite (gneisses and schists) was the second most used type of stone, amounting to about one-half the total produced from limestone. Sandstone and traprock were the other sources of crushed rock. Unit prices were about $3.36 per ton for crushed limestone, $2.69 per ton for crushed granite, and $4.79 per ton for crushed sandstone. Dimension stone prices ranged from $32.26 per ton for sandstone to $178.57 per ton for granite, much of which was used in making monuments.

The major use of crushed stone in the State was in manufacturing of cement (mostly limestone), followed in order by concrete aggregate (two-thirds granite), dense roadbase (mostly granite), unspecified aggregate (mostly granite), and flux stone (almost entirely limestone). Prices ranged from $1.84 per ton for unspecified aggregate to $12.05 per ton for refractory stone.

Fremont and Jefferson Counties were the largest producers of stone, with more than one-half of the total output between them. Other major producing counties, in order of output, were El Paso, Boulder, Larimer, and Chaffee. All stone produced was transported by truck. Less than 25,000 tons annually was produced at one-half of the quarries worked during the year; more than 1 million tons was produced at each of two quarries that were the source of nearly one-half of the State's output for the year. Dimension stone was produced only in Boulder, Douglas, and Larimer Counties. The major companies producing stone were, in order of rank, Ideal Cement Co., a division of Ideal Basic Industries, Inc.; Cooley Gravel Co.; Castle Concrete Co.; Martin Marietta Corp.; Asphalt Paving Co.; and CF&I Steel Corp. The three largest companies produced nearly two-thirds of the total.

As with sand and gravel, efforts to develop new stone quarries drew public opposition. Proposals to quarry stone (generally

Table 10.—Colorado: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	2	5	3	8
Poultry grit and mineral food	84	253	37	155
Concrete aggregate	631	1,977	795	2,809
Bituminous aggregate	185	553	W	W
Macadam aggregate	6	13	9	23
Dense-graded roadbase stone	641	1,168	779	2,085
Surface treatment aggregate	26	62	41	106
Other construction aggregate and roadstone	599	1,036	717	1,318
Riprap and jetty stone	310	901	146	527
Terrazzo and exposed aggregate	100	608	W	233
Cement manufacture	3,105	8,866	2,710	9,033
Lime manufacture	23	69	39	126
Flux stone	648	2,322	433	W
Sugar refining	165	881	102	459
Waste materials	9	33	11	42
Other[2]	300	688	453	3,092
Total[3]	6,835	19,435	6,277	20,068

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

[1]Includes limestone, granite, sandstone, traprock, and miscellaneous stone.

[2]Includes stone used for railroad ballast (1979), manufactured fine aggregate (stone sand), refractory stone, and mine dusting.

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

reported in the press as sand and gravel) from both North and South Table Mountains, east of Golden, and the mouth of Clear Creek Canyon, west of Golden in Jefferson County, drew protracted public comment. At another controversial site, the Colorado Mined Land Reclamation Board granted approval to continue mining limestone aggregate at a 57-acre mountainside site northwest of Colorado Springs; approval was granted only after acceptance of a plan to reclaim the Queen's Canyon quarry, a site that has long been a center of controversy as "the scar on the mountain."

Sulfur.—Continental Oil Co. recovered elemental sulfur from acid gases at its petroleum refinery near Denver. Elemental sulfur was not included in table 1 because it is considered a secondary product.

[1]State mineral specialist, Bureau of Mines, Denver, Colo.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ideal Basic Industries, Inc.[1]	Box 8789 750 17th St. Denver, CO 80201	Plants	Fremont and Larimer.
Martin Marietta Corp.[1]	11300 Rockville Pike Rockville, MD 20852	Plant	Boulder.
Clays:			
Denver Brick and Pipe Co	Box 2329 Denver, CO 80201	Mines	Denver and Pueblo.
Robinson Brick & Tile Co	Box 5243 Denver, CO 80217	____do	Douglas, Elbert, El Paso, Jefferson.
Silver Rocker Bentonite Co	445 Scott St. Salida, CO 81201	____do	Fremont.
Gold:			
Standard Metals Corp.[2]	Box 247 Silverton, CO 81433	Mine and mill	San Juan.
Gypsum:			
The Flintkote Co	400 Westchester Ave. White Plains, NY 10604	Mine and plant	Fremont.
Ernest W. Munroe	101 East Vine Dr. Fort Collins, CO 80521	Mine	Larimer.
Quad-Honstein Joint Venture	1301 Arapahoe St. Golden, CO 80401	____do	Do.
U.S. Soil Conditioning Co	Box 336 Salida, CO 81201	____do	Do.

See footnotes at end of table.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Iron ore:			
Pitkin Iron Corp	105 West Adams St. Chicago, IL 60603	Strip mine	Pitkin.
Lead:			
ASARCO Incorporated[3]	Box 936 Leadville, CO 80461	Mine and mill	Lake.
Lime:			
CF&I Steel Corp.[1]	Box 316 Pueblo, CO 81002	Mine	Pueblo.
The Great Western Sugar Co	1530 16th St. Denver, CO 80217	Plants	Adams, Boulder, Larimer, Logan, Morgan, Sedgwick, Weld.
Molybdenum:			
AMAX Inc.[4]	13949 West Colfax Ave. Golden, CO 80401	Mine and mill	Clear Creek and Lake.
Peat:			
Universal Peat Co	1557 South Ingalls St. Lakewood, CO 80422	Bog	Park.
Perlite (crude and expanded):			
Grefco, Inc	Box 308 Antonito, CO 81120	Plant	Conejos.
Persolite Products, Inc	Box 105 Florence, CO 81226	Mine and plant	Custer and Fremont.
Pumice:			
Colorado Aggregate Co., Inc	Box 106 Mesita, CO 81142	Strip mine and plant.	Costilla.
Dotsero Block Co., Inc	Box 933 Glenwood Springs, CO 81601	do	Eagle.
Sand and gravel:			
Cooley Gravel Co.[1]	Box 5485 Denver, CO 81217	Pits and plants	Adams and Arapahoe.
Flatiron Sand and Gravel Co	Box 229 Boulder, CO 80302	do	Boulder, Larimer, Summit, Weld.
Mobile Pre-Mix Sand and Gravel Co	7620 Madison St. Denver, CO 80204	do	Adams, Jefferson, Larimer.
Schmidt-Tiago Construction Co	Box 487 8150 West 49th St. Arvada, CO 80002	do	El Paso, Moffat, Rio Blanco.
Silver:			
Day Mines, Inc.[5]	Box D Leadville, CO 80461	Mine and mill	Lake.
Homestake Mining Co.[6]	Box 98 Creede, CO 81130	do	Mineral.
The New Jersey Zinc Co.[7]	Gilman, CO 81634	Mine	Eagle.
Stone:			
Castle Concrete Co	Box 2379 Colorado Springs, CO 80901	Quarries	El Paso.
Vanadium:			
Cotter Corp	Box 352 Golden, CO 80401	Mine and mill	Fremont and Jefferson.
Union Carbide Corp	270 Park Ave. New York, NY 10017	Mine and mills	Garfield, Mesa, Montrose, San Miguel.

[1]Also stone.
[2]Also zinc, lead, silver, and copper.
[3]Also zinc, gold, silver, and copper.
[4]Also pyrites, tin, and tungsten.
[5]Also lead, gold, zinc, and copper.
[6]Also lead, zinc, and copper.
[7]Also copper, gold, and lead.

The Mineral Industry of Connecticut

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the State Geological and Natural History Survey of Connecticut, Department of Environmental Protection, for collecting information on all nonfuel minerals.

By L. J. Prosser, Jr.[1]

Connecticut's nonfuel mineral production was valued at $65.8 million in 1980, $3.5 million less than that of 1979. The decline in value was the first since 1975. Decreased output of clays, lime, sand and gravel, and crushed stone reflected weakened demand for construction-related commodities.

Stone remained the most valuable commodity produced, followed by sand and gravel and feldspar. In New England, Connecticut ranked first in output of crushed stone and second in clays and sand and gravel. Nationally, Connecticut was second in feldspar production and fourth in mica.

Table 1.—Nonfuel mineral production in Connecticut[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	112	$435	92	$482
Lime	do.	33	2,053	19	1,352
Sand and gravel[2]	do.	9,990	23,612	7,103	18,692
Stone:					
Crushed	do.	8,271	38,767	7,977	40,283
Dimension	do.	13	475	15	723
Combined value of feldspar, gem stones, mica and industrial sand		XX	3,894	XX	4,231
Total		XX	69,236	XX	65,763

XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes industrial sand; value included in "Combined value" figure.

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

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Fairfield	$1,994	$1,899	Sand and gravel.
Hartford	W	W	Stone, sand and gravel, clays.
Litchfield	9,080	10,968	Sand and gravel, stone, lime.
Middlesex	4,333	4,224	Feldspar, sand and gravel, stone, mica, clays.
New Haven	W	W	Stone, sand and gravel.
New London	W	4,025	Sand and gravel, stone.
Tolland	W	W	Do.
Windham	W	W	Stone, sand and gravel.
Undistributed[1]	38,203	48,120	
Total	[2]53,612	69,236	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes gem stones and values indicated by symbol W.
[2]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Connecticut business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,581.0	1,616.0	+2.2
Unemployment	do	81.0	95.0	+17.3
Employment (nonagricultural):				
Mining	do	([1])	([1])	--
Manufacturing	do	436.3	441.8	+1.3
Contract construction	do	[2]52.3	[2]49.0	-6.3
Transportation and public utilities	do	60.8	60.9	+.2
Wholesale and retail trade	do	294.8	299.2	+1.5
Finance, insurance, real estate	do	99.6	104.5	+4.9
Services	do	272.6	286.4	+5.1
Government	do	181.3	182.6	+.7
Total nonagricultural employment	do	1,397.7	1,424.4	+1.9
Personal income:				
Total	millions	$31,555	$35,442	+12.3
Per capita		$10,129	$11,445	+13.0
Construction activity:				
Number of private and public residential units authorized		14,830	9,659	-34.9
Value of nonresidential construction	millions	$483.8	$424.9	-12.2
Value of State road contract awards	do	$59.0	$29.6	-49.8
Shipments of portland and masonry cement to and within the State	thousand short tons	782	630	-19.4
Nonfuel mineral production value:				
Total crude mineral value	millions	$69.2	$65.8	-4.9
Value per capita, resident population		$22	$21	-4.6
Value per square mile		$13,822	$13,129	-5.0

[p]Preliminary.
[1]Included with "Contract construction."
[2]Includes mining.

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

Trends and Developments.—State-sponsored industrial development funding continued at an accelerated pace in 1980. Financing increased to about $400 million from $267 million in 1979.[2] Approved loans included those for metal-dependent manufacturers of aircraft parts, batteries, copper-laminated materials, industrial glass and machine products, metal fasteners, tools, and turbine blade castings.

The Connecticut Department of Transportation (ConnDOT), citing potential rising costs in quarrying, conducted a pavement-recycling project on Interstate 84 near Waterbury. The new road surface consisted of a 9-inch layer of recycled concrete mixed with additional aggregate. ConnDOT also tested a new cellulose-based paving material developed by York Research Corp. The patent-pending material cost 2 to 3 cents per pound less than asphalt.[3] Conventional methods and equipment were used for the resurfacing test.

Historically, Connecticut has been an in-

tegral part of the brass industry in the Eastern United States. However, depressed economic conditions in 1980 adversely affected many of the State's producers.

Foundry consumption of brass ingot in Connecticut declined significantly; mill closings, out-of-State relocations, production cutbacks, and reduction in work forces occurred throughout the year. Anaconda Industries, Div. of The Anaconda Company, Waterbury, relocated headquarters to Chicago, Ill., because of increasing demand from western markets. Bridgeport Brass Co., a subsidiary of National Distillers & Chemical Corp., closed at yearend because of service, supply, and utility costs in addition to antiquated mill facilities. Century Brass Products, Inc., Waterbury, curtailed production and laid off 500 workers because of dwindling demand from the housing industry and automakers.

The Bristol Brass Corp., acquired early in the year for $6.5 million by a group of private investors, initially announced plans to upgrade mill facilities and boost production by 20%. However, these plans were delayed by a lawsuit concerning the financial records submitted by the previous owner. A hearing to resolve the dispute is scheduled in 1981.

Legislation and Government Programs.—The 1980 General Assembly enacted several bills that affected manufacturers and mineral producers.

Public Act 80-356 defined previously enacted wetland development statutes. Developed to facilitate permit applications, the new regulations included procedures for sand and gravel dredging and building activity in tidally influenced areas.

Public Act 80-359 established a task force to study public health hazards of asbestos. The legislation also banned, until July 1981, installation of any vinyl-lined pipe containing tetrachloroethylene, a toxic substance used as a solvent in applying vinyl to the inside of asbestos-cement pipe. Nine towns in the State have discovered the toxic chemical in their water systems.

Public Act 80-464 involved the use, production, storage, and disposal of chemicals. The act required industrial and manufacturing firms to list all elements or compounds mixed or produced that generate a hazardous substance.

Public Act 80-472 regulated the siting of hazardous waste treatment and disposal facilities. The law included a revenue incentive for communities that house waste facilities. Operators of disposal sites would pay a town 5 cents per gallon of waste or a certain percentage based on gross receipts, whichever is greater.

The Connecticut Geological and Natural History Survey began a mine mapping project using aerial photographs to classify lands according to use. The inventory included acreage of mined land and was scheduled for completion in 1981. Limited funding delayed analysis programs on bedrock mining; unconsolidated materials excavation; and rock, mineral, and gem stone locations.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Connecticut relied entirely on out-of-State sources to meet 1980 demand. Independent Cement Corp. planned to construct a $4 million cement distribution center with a 13,000-short-ton storage capacity in Willington, about 25 miles northeast of Hartford. The firm, a subsidiary of St. Lawrence Cement, Inc., of Montreal, Canada, expected to begin construction in early 1981 pending approval of a zoning change.

Clays.—Mining of common clay continued in 1980 at two sites in the central part of the State. The clay was used in the manufacture of building brick and lightweight aggregate.

Feldspar.—Commercial mining of feldspar in the United States began in Connecticut around 1825. In 1980, the State ranked second nationally in feldspar production; North Carolina ranked first, and Georgia was third. Combined tonnage from the three States accounted for about 90% of the Nation's output.

The Feldspar Corp. operated two open pit mines in Middlesex County. The crude ore was processed by flotation methods and used as a flux in glassmaking and ceramics. Markets for Connecticut feldspar included the New England States, New Jersey, and New York. Shipment by truck has replaced rail delivery as the primary means of transport.

Gem Stones.—Individual collectors and mineral clubs recovered mineral specimens from quarries and mine dumps in the central part of the State.

Lime.—Pfizer, Inc., produced hydrated and quicklime at Canaan in the northwest corner of the State. For the first time since 1975, output declined mainly because of weakened demand from the construction industry. Lime was used primarily for mason's lime, sewage treatment, and glass manufacturing, with a minor amount used by the company for manufacturing calcium metal. In addition to Connecticut, the lime was marketed in Massachusetts, New Jersey, New York, and Rhode Island.

Mica.—The Feldspar Corp. produced crude mica as a coproduct from feldspar processing at Middletown in Middlesex County. Recovered by flotation, the mica was sold to the United States Gypsum Co.'s plant in Alabama for use as a filler in paint.

Sand and Gravel.—Production in 1980 was the lowest since 1976, reflecting decreased demand by the construction industry. In the past decade, 76 million short tons of sand and gravel was mined, contributing $156 million to the value of mineral production in Connecticut.

Sand and gravel was extracted from all eight counties of the State; Litchfield, Hartford, and New Haven were the principal producing counties. In New England, Connecticut ranked second in output of construction sand and gravel, and together with Massachusetts, accounted for all the industrial sand produced in the area.

The Connecticut Department of Environmental Protection authorized dredging permits valid until mid-1982 for extraction of up to 4 million short tons of sand and gravel. The dredging sites are located along the Housatonic River at Derby and Orange in New Haven County, and at Shelton in Fairfield County. The State received 15 cents per ton for the material removed from State waters.

Stone.—Connecticut's stone industry accounted for over three-fifths of the value of mineral production in the State in 1980. Traprock was the leading type of stone mined, followed by granite, limestone, and sandstone.

Table 4.—Connecticut: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,397	$9,409	$2.77	2,407	$7,534	$3.13
Plaster and gunite sands	23	77	3.40	12	60	4.91
Concrete products	280	684	2.44	183	499	2.72
Asphaltic concrete	1,804	4,599	2.55	825	2,113	2.56
Roadbase and coverings	r2,148	4,482	2.09	2,322	5,608	2.42
Fill	1,459	2,196	1.51	965	1,788	1.85
Snow and ice control	r569	1,276	2.24	250	545	2.18
Other uses	311	887	2.86	139	546	3.93
Total[1] or average	9,990	23,612	2.36	7,103	18,692	2.63

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

Table 5.—Connecticut: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	5,058	$11,780	$2.33	3,616	$9,281	$2.57
Gravel	4,932	11,832	2.40	3,487	9,411	2.70
Total or average	9,990	23,612	2.36	7,103	18,692	2.63
Industrial sand	W	W	20.31	W	W	23.34
Grand total or average	W	W	2.46	W	W	2.75

W Withheld to avoid disclosing company proprietary data.

Nationally, the State ranked fourth in traprock output. Approximately one-third of all the stone produced in New England came from Connecticut's 13 traprock quarries. The largest quantities of traprock were extracted from Hartford and New Haven Counties in the central part of the State.

Crushed limestone was produced at four quarries in Litchfield County in northwestern Connecticut. The stone was marketed mainly as filler, aglime, and whiting. Crushed granite, marketed primarily as riprap and jetty stone, was produced in Windham County in the northeastern part of the State.

Connecticut's dimension stone producers quarried granite and sandstone. Most of the dimension granite was extracted in New Haven County; lesser amounts were quarried in Windham and Tolland Counties. Dimension sandstone production was centered in Tolland and Windham Counties. The stone was marketed for veneer, flagging, and rubble.

[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.
[2]Connecticut Business Journal. Dec. 23-30, 1980, p. 5.
[3]Engineering News-Record. June 5, 1980, p. 29.

Table 6.—Connecticut: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	65	409	80	585
Concrete aggregate	1,216	5,621	1,172	5,817
Bituminous aggregate	2,322	12,152	2,170	12,205
Dense-graded roadbase stone	1,599	6,641	1,534	6,816
Surface treatment aggregate	W	W	42	145
Other construction aggregate and roadstone	1,558	5,833	1,506	6,140
Riprap and jetty stone	175	814	445	2,218
Filter stone	W	W	19	61
Manufactured fine aggregate	20	99	--	--
Terrazzo and exposed aggregate	r3	r41	--	--
Cement manufacture	14	24	11	20
Lime manufacture	20	35	8	15
Whiting	94	1,207	78	1,007
Other filler and extenders	106	1,108	83	1,094
Other uses[2]	1,080	4,783	827	4,159
Total[3]	8,271	38,767	7,977	40,283

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."
[1]Includes limestone, granite, sandstone(1979), traprock, and miscellaneous stone (1980).
[2]Includes stone used for macadam aggregate, railroad ballast, flux stone, and glass manufacture (1979).
[3]Data may not add to totals shown because of independent rounding.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
The Michael Kane Brick Co	654 Newfield St. Middletown, CT 06475	Pit and mill	Middlesex.
Kelsey-Ferguson Brick Co. (Div. of Susquehanna Corp.)	Route 5 East Windsor Hill, CT 06028	Mine and mill	Hartford.
Feldspar:			
The Feldspar Corp.[1]	Box 99 Spruce Pine, NC 28777	Mines and plant	Middlesex.
Lime: Pfizer, Inc.[2]	Daisy Hill Rd. Canaan, CT 06018	Pit and limekiln	Litchfield.
Sand and gravel:			
Beard Sand & Gravel Co	127 Boston Post Rd. Milford, CT 06460	Pit	New Haven.
Connecticut Sand & Stone Corp	7 West Main St. Plainville, CT 06062	Pit and plants	Hartford and Litchfield.
Finco Corp	Pent Highway Wallingford, CT 06492	Pit	New Haven.
Island Sand & Gravel Co	Box 71 Shelton, CT 06484	Plant	Do.
New London Sand & Gravel	47 Fog Plain Rd. Waterford, CT 06385	Pit	New London.
O'Connor Brothers	Greenwood Rd. East Norfolk, CT 06058	Pit	Litchfield.
Oneglia & Gervasini Building Materials, Inc.	P.O. Box 907 Torrington, CT 06790	Plant	Do.
Ottawa Silica Co	Box 577 Ottawa, IL 61350	Pit and plant	New London.
Roncari Industries, Inc.[3]	1776 South Main St. East Granby, CT 06026	do	Hartford.
Sega Sand and Gravel Co. Inc	271 Danbury Road New Milford, CT 06776	Pit	Litchfield.
Windham Sand & Stone, Inc	Box 346 Willimantic, CT 06226	Pit	Windham.
Stone (crushed and broken):			
Edward Balf Co[4]	Box 11190 Newington, CT 06111	Quarry	Hartford.
O & G Industries, Inc	Casson Ave. Torrington, CT 06790	do	Litchfield.
Tilcon Tomasso	Box 67, 909 Foxen Rd. N. Bradford, CT 06471	Quarries	Hartford, New Haven, and Windham.
York Hill Trap Rock Quarry Co	Westfield Rd. Meriden, CT 06450	Quarry	New Haven.

[1]Also crude mica.
[2]Also limestone.
[3]Also traprock.
[4]Also sand and gravel.

The Mineral Industry of Delaware

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Delaware Geological Survey for collecting information on all nonfuel minerals.

By William Kebblish[1] and Robert J. Tuchman[2]

The value of Delaware's nonfuel mineral production, excluding magnesium compounds, was $2.4 million in 1980, reflecting a drop of nearly $1 million from the 1979 figures. Sand and gravel remained the most important commodity produced, in terms of total value. Sulfur and slag were recovered as byproducts from manufacturing processes. Crude gypsum was calcined by one company, and iron and steel products were produced by two companies. Nationally, the State ranked 50th in value of mineral production. With housing starts and other construction activities restricted by high interest rates, the State's mineral production declined.

Legislation and Government Programs.—During 1980, the Delaware Geological Survey was involved in 29 projects—12 related to basic geology, 5 to geophysics, 3 to economic geology, and 9 to water resources. Individual project topics included preparation of a detailed Statewide geologic map, drilling for stratigraphic control in the coastal plain, geology of the Mid-Atlantic Outer Continental Shelf, operation of various seismological centers, and the uses of glauconite.

A report entitled "Review and Revision of Delaware Mineral Laws" was published by the State Survey and is to be used in conjunction with the State's Coastal Management Program to develop Delaware's onshore and offshore mineral resources. The report, prepared under contract with the Delaware Office of Management, Budget, and Planning, was funded by the Federal Coastal Energy Impact Program.

Table 1.—Nonfuel mineral production in Delaware[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	11	$9	--	--
Sand and gravel do	1,674	3,281	1,075	$2,398
Total	XX	[2]3,290	XX	[2]2,398

XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Partial total; excludes the value of magnesium compounds, which must be concealed to avoid disclosing company proprietary data.

Table 2.—Indicators of Delaware business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	275.0	280.0	+1.8
Unemployment	do	22.0	22.0	--
Employment (nonagricultural):				
Mining	do	(1)	(1)	--
Manufacturing	do	70.2	71.0	+1.1
Contract construction	do	15.6	14.6	-6.4
Transportation and public utilities	do	12.4	12.3	-.8
Wholesale and retail trade	do	56.5	56.0	-.9
Finance, insurance, real estate	do	11.8	11.9	+.8
Services	do	[2]45.8	[2]47.6	+3.9
Government	do	44.4	45.1	+1.6
Total nonagricultural employment	do	256.7	[3]258.4	+.7
Personal income:				
Total	millions	$5,402	$6,068	+12.3
Per capita		$9,280	$10,195	+9.9
Construction activity:				
Number of private and public residential units authorized		2,985	2,895	-3.0
Value of nonresidential construction	millions	$52.3	$136.5	+161.0
Value of State road contract awards	do	$26.0	$45.0	+73.1
Shipments of portland and masonry cement to and within the State	thousand short tons	163	139	-14.7
Nonfuel mineral production value:				
Total crude mineral value	millions	$3.3	$2.4	-27.3
Value per capita, resident population		$6	$4	-33.3
Value per square mile		$1,599	$1,166	-27.1

[p]Preliminary.
[1]Included with "Services."
[2]Includes mining.
[3]Data do not add to total shown because of independent rounding.

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

A Federal congressional study identified chemical waste sites in Delaware. Thirty-four sites were located—21 in New Castle County, 10 in Kent County, and 3 in Sussex County. A large portion of the industrial waste generated originates from mineral processing. Types of waste included cadmium, residues of pesticides, and various herbicides.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Clays.—Delaware Brick Co., the only clay producer in the State, ceased operations late in 1979 after clay was exhausted at its Red Clay Mine near Wilmington. The company had employed approximately 30 workers. Clay was used in the manufacture of common and face brick.

Gypsum.—Crude gypsum, imported from Nova Scotia, was calcined by Georgia-Pacific Corp., Wilmington, New Castle County. Calcined gypsum was used for wallboard manufacture.

Magnesium Compounds.—Barcroft Co., Delaware's sole producer of magnesium compounds, increased production from its plant at Lewes, Sussex County, by more than 83% in quantity and 78% in value, compared with 1979 levels. Magnesium compounds, extracted from seawater, were used to produce pharmaceuticals, including milk of magnesia.

Sand and Gravel.—Production of construction sand and gravel in 1980 totaled 1.1 million tons and comprised most of Delaware's nonfuel mineral output. This amount, a 36% decrease compared with that of 1979, was due to the decline in construction caused by high interest rates. To a lesser extent, local zoning ordinances also restricted new mineral development. Construction sand and gravel was produced by eight companies in two of the State's three counties. No production was reported from Sussex County.

Table 3.—Delaware: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	428	$1,087	$2.54	338	$914	$2.71
Plaster and gunite sands	W	W	W	W	W	W
Concrete products	W	W	W	W	W	W
Asphaltic concrete	W	W	W	W	W	W
Roadbase and coverings	870	1,519	1.75	398	786	1.98
Fill	W	W	W	186	242	1.30
Snow and ice control	W	W	W	--	--	--
Total or average	1,674	3,281	1.96	1,075	2,398	2.23

W Withheld to avoid disclosing company proprietary data; included in "Total or average."

Table 4.—Delaware: Construction sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	546	$1,265	$2.31	510	$1,193	$2.34
Gravel	1,127	2,017	1.79	565	1,205	2.13
Total[1] or average	1,674	3,281	1.96	1,075	2,398	2.23

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

Table 5.—Delaware: Construction sand and gravel sold or used, by county

(Thousand short tons and thousand dollars)

County	1979			1980		
	Quantity	Value	Number of companies	Quantity	Value	Number of companies
Kent	700	1,492	6	494	1,164	5
New Castle	973	1,789	3	581	1,234	3
Total	[1]1,674	3,281	9	1,075	2,398	8

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

In 1980, nearly one-half of the production was processed sand and the remainder was processed gravel; average unit value was $2.34 and $2.13, respectively. Sand and gravel was used mainly for roadbase and concrete aggregate. Other uses included fill, concrete products, and snow and ice control. Nearly 80% of the sand and gravel was moved to market by truck; the remaining 20% was used locally. There was no production of industrial sand and gravel.

During the year, a zoning permit for a proposed sand and gravel pit along U.S. Route 13 was requested by Parkway Gravel, Inc., and Van Demark & Lynch, Inc. The request was denied by the New Castle County Board of Adjustments because of concern over local water supplies.

Slag.—International Mill Service Co. processed and sold steel slag produced at Phoenix Steel Corp.'s facility in Claymont. Sales increased 19% in quantity and 32% in value from 1979 to 1980. The slag was used mainly for roadbase.

Sulfur.—Byproduct sulfur was recovered from refining crude petroleum by Getty Refining & Marketing Co. in New Castle County. Shipments decreased nearly 23% in quantity from 1979 to 1980, but value increased nearly 44%. Reduced demand for oil refinery products resulted in decreased production of sulfur. At yearend, Getty Refining announced plans for a $110 million methanol plant at its Delaware City complex.

METALS

Iron and Steel.—Two companies produced steel products within the State. Phoenix Steel Corp., Claymont, produced carbon, alloy, and clad plate; Taylor-Davis Corp., Wilmington, produced steel reinforcing bars. In the spring of 1980, Phoenix Steel was granted approval by the U.S. Navy to manufacture armor plate, becoming the fourth plate producer in the Nation to be thus certified.[3] The company also entered into an agreement with E. I. du Pont de Nemours & Co. to produce and market clad steels made with Du Pont's explosion bonding process.

[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.
[2]Program assistant, Bureau of Mines, Pittsburgh, Pa.
[3]Phoenix Steel Corp. 3d Quarter Report, 1980.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Gypsum, calcined:			
Georgia-Pacific Corp	900 SW. 5th Ave. Portland, OR 97204	Plant	New Castle.
Magnesium compounds:			
Barcroft Co	Box 474, Henlopen Dr. Lewes, DE 19958	do	Sussex.
Sand and gravel:			
Barber Sand and Gravel	R.F.D. 1 Harrington, DE 19952	do	Kent.
Contractor Sand & Gravel Co	Box 2630 Wilmington, DE 19805	Pit	New Castle.
Dover Equipment & Machine Co	113 West 6th St. Dover, DE 19901	Dredge	Kent.
Parkway Gravel, Inc	4048 New Castle Ave. New Castle, DE 19720	Pits	New Castle.
Staytons Select Borrow	R.D. 1, Box 305 Felton, DE 19943	Pit	Kent.
Whittington Sand & Gravel Co	U.S. Route 40 Bear, DE 19701	Pit	New Castle.
Slag:			
International Mill Service Co	1500 Walnut St. Philadelphia, PA 19102	Plant	Do.
Sulfur, elemental:			
Getty Refining & Marketing Co	Delaware City, DE 19706	Refinery	Do.

The Mineral Industry of Florida

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Florida Bureau of Geology for collecting information on all nonfuel minerals.

By James R. Boyle[1] and Charles W. Hendry, Jr.[2]

The value of nonfuel mineral production in 1980 in Florida was $1.5 billion, an increase of $239.2 million over that of 1979. Florida ranked first nationally in total value of nonmetallic minerals produced, and nonmetals accounted for over 95% of the State's total nonfuel mineral production value. The State ranked first in the production of phosphate rock and titanium concentrates, and was second in crushed stone, fuller's earth, and peat. Staurolite and zircon concentrates were produced only in Florida. Principal nonmetals, in order of value, were phosphate rock, stone, cement, sand and gravel, and clays.

Although mineral output in 1980 increased compared with the 1970 level, and in some cases doubled in the 10-year period, total value during this period increased nearly 500%.

Table 1.—Nonfuel mineral production in Florida[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	255	$13,098	285	$22,074
Portland	do	2,957	126,562	3,574	182,590
Clays	do	681	[2]31,308	614	[2]24,164
Gem stones		NA	4	NA	5
Lime	thousand short tons	210	11,440	195	12,434
Peat	do	153	2,190	154	2,398
Sand and gravel	do	21,708	39,520	[3]14,464	[3]28,831
Stone (crushed)	do	[r]63,787	[r]188,896	66,209	215,972
Combined value of clays (kaolin), magnesium compounds, phosphate rock, rare-earth concentrate, industrial sand (1980), staurolite, titanium concentrate (ilmenite and rutile), zircon concentrate		XX	[r]856,589	XX	1,020,286
Total		XX	[r]1,269,607	XX	1,508,754

[r]Revised. NA Not available. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes value of kaolin; value included in "Combined value" figure.
[3]Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Florida, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Alachua	$3,074	$2,789	Stone.
Bay	663	1,040	Sand and gravel.
Brevard	W	W	Clays, stone, sand and gravel.
Broward	12,408	20,607	Stone, sand and gravel.
Calhoun	75	52	Sand and gravel.
Charlotte	W		
Citrus	2,445	6,002	Stone, phosphate rock.
Clay	23,838	26,526	Titanium, zirconium, staurolite, sand and gravel, monazite, clays.
Collier	3,521	6,236	Stone.
Dade	W	W	Stone, cement, sand and gravel.
Dixie	W		
Escambia	680	605	Sand and gravel.
Gadsden	W	W	Clays, sand and gravel.
Glades	W	W	Sand and gravel.
Gulf	W	W	Magnesium, lime.
Hamilton	W	W	Phosphate rock.
Hardee	W	W	Do.
Hendry	W	W	Stone, sand and gravel.
Hernando	W	W	Stone, cement, lime, clays.
Highlands	W	W	Peat.
Hillsborough	W	W	Phosphate rock, cement, stone, peat.
Jackson	1,594	620	Stone, sand and gravel.
Lake	W	W	Sand and gravel, peat.
Lee	8,036	W	Stone.
Leon	W	W	Sand and gravel.
Levy	449	2,846	Stone.
Manatee	W	W	Cement, stone.
Marion	10,189	12,772	Stone, clays, sand and gravel, phosphate rock.
Monroe	W	2,447	Stone.
Nassau	W	W	Titanium, zirconium, monazite.
Okaloosa	33	36	Sand and gravel.
Orange	64	64	Do.
Palm Beach	90	W	Stone.
Pasco	W	W	Do.
Polk	640,981	676,298	Phosphate rock, sand and gravel, peat.
Putnam	W	W	Sand and gravel, clays, peat.
St. Lucie	307	W	Sand and gravel.
Santa Rosa	W		
Sarasota	W	W	Sand and gravel, stone.
Sumter	W	W	Lime, stone.
Suwannee	W	W	Stone.
Taylor	W	2,787	Do.
Walton	W	W	Sand and gravel.
Undistributed[2]	390,321	507,884	
Total[3]	1,098,772	1,269,607	

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

[1]The following counties are not listed because no nonfuel mineral production was reported: Baker, Bradford, Columbia, De Soto, Duval, Flagler, Franklin, Gilchrist, Holmes, Indian River, Jefferson, Lafayette, Liberty, Madison, Martin, Okeechobee, Osceola, Pinellas, St. Johns, Seminole, Union, Volusia, Wakulla, and Washington.

[2]Includes gem stones and values indicated by symbol W.

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

Of the 54.4 million metric tons of phosphate rock produced in the United States, Florida was the predominant producer, and for the 87th consecutive year supplied more than any other State. Florida and North Carolina supplied nearly 87% of the domestic phosphate rock output; Florida supplied most of the exports.

The nationwide recession did not affect the nonmetallic minerals industry in Florida as seriously as other Southeastern States. Although the housing market was stable, commercial and other nonresidential building increased. Road maintenance work decreased because of reduced Federal input.

Trends and Developments.—The Florida Phosphate Council reported that member companies plan to spend about $2 billion in the next 5 years in expansion programs. Of the $2 billion, an estimated 18% will be for environmental controls. Companies plan to develop six new mines, one chemical fertilizer complex, and expand two mines and eight chemical fertilizer plants. These operations will be in Hamilton County in north Florida, and in De Soto, Hardee, Hillsborough, Manatee, and Polk Counties in the southern part of the State. The council estimates construction and operating jobs will number about 11,600 as companies build and expand plants and mines to keep pace with increasing world demand for

fertilizer. Delays involving permits governing land use and air- and water-quality standards may extend the time period for startup of operations. Companies report that it can take 5 years and cost more than $6 million to obtain necessary permits to open a new mine.

Norsk Hydro Aluminum Inc. began production of cold-drawn aluminum tubing at Rockledge, approximately 60 miles southeast of Orlando. This is the first manufacturing plant owned entirely by Norway's Norsk Hydro to be located outside Europe. The $6.5 million plant is expected to produce 5 million pounds of extruded shapes and tubes annually when it reaches full production in mid-1981.

The Port of Tampa, which handled over 51 million tons of cargo, shipped the major portion of exported phosphate. Phosphate exports totalled nearly 16 million tons, which included nearly 12 million tons of bulk phosphate. Phosphate accounted for about 90% of all export cargo through the Port of Tampa. About 1.2 million tons of aragonite was imported from the Bahamas for use in the manufacture of cement.

Table 3.—Indicators of Florida business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	3,835.0	3,925.0	+2.4
Unemployment	do	230.0	234.0	+1.7
Employment (nonagricultural):				
Mining[1]	do	10.1	10.6	+5.0
Manufacturing	do	443.6	457.2	+3.1
Contract construction	do	241.4	267.0	+10.6
Transportation and public utilities	do	208.5	219.3	+5.2
Wholesale and retail trade	do	889.5	931.7	+4.7
Finance, insurance, real estate	do	235.0	252.6	+7.5
Services	do	752.6	815.8	+8.4
Government	do	600.5	616.3	+2.6
Total nonagricultural employment[1]	do	3,381.2	3,570.5	+5.6
Personal income:				
Total	millions	$75,631	$86,944	+15.0
Per capita		$8,521	$8,987	+5.5
Construction activity:				
Number of private and public residential units authorized		175,705	178,092	+1.4
Value of nonresidential construction	millions	$1,684.8	$2,132.5	+26.6
Value of State road contract awards	do	$383.6	$316.0	-17.6
Shipments of portland and masonry cement to and within the State	thousand short tons	4,998	5,820	+16.4
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,269.6	$1,508.8	+18.8
Value per capita, resident population		$143	$155	+8.4
Value per square mile		$21,680	$25,764	+18.8

[p]Preliminary.
[1]Includes oil and gas extraction.

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

Legislation and Government Programs.—The Federal Bureau of Mines and Agrico Chemical Co. conducted borehole mining research tests to recover deep phosphate ore in St. Johns County. The mining site used by Agrico and the Bureau for the borehole mining in the summer of 1980 has been completely restored. All borehole mining cavities were backfilled using a Bureau-developed technique to replace 1,800 tons of ore that was shipped to the Agrico Mill at Mulberry, Fla., and the original topography was restored. The U.S. Geological Survey, which monitored the impact on ground water hydrology of the borehole mining operations, issued a draft report stating that the mining had no significant, long-term effect on the ground water despite two episodes of roof collapse during the mining.

As a followup to the borehole mining tests, Agrico announced plans for a pilot borehole phosphate mining and processing program in St. Johns County. The first 9 months of 1981 will be used to obtain operating permits, construct and install mining and processing equipment, and field test the components. Mining and processing will start in the first quarter of 1982 and will continue for most of 1982. The mining rate planned is 30 tons per hour on a one-shift basis, and processing the matrix will be at a rate of 15 tons per hour on a two-shift basis.

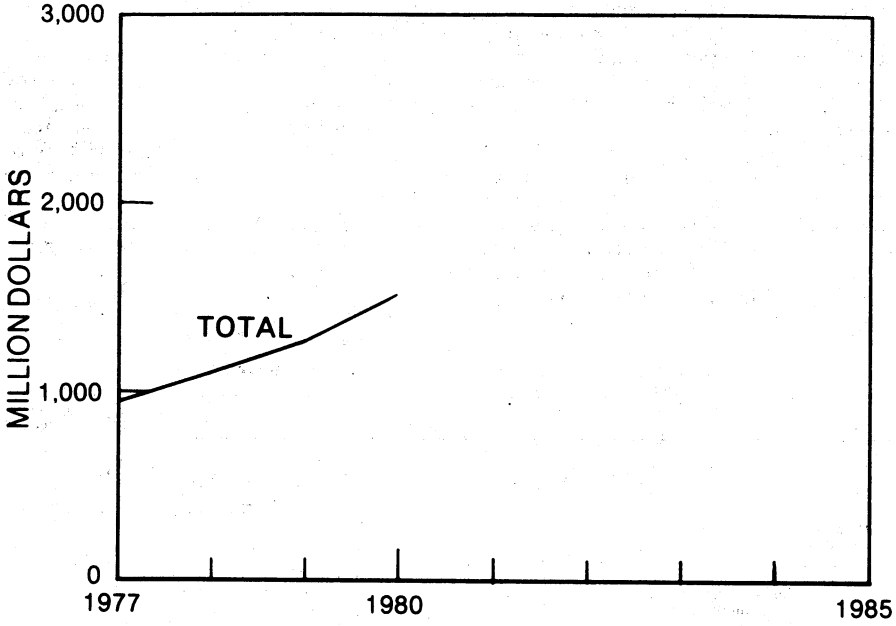

Figure 1.—Total value of nonfuel mineral production in Florida.

The Bureau approved a report, "Economic Impact of the Phosphate Rock Industry on Selected Florida Counties, Florida, and the United States," for open file status. The report was prepared by the Florida Resources and Environmental Analysis Center under Bureau contract.

The Bureau awarded a contract to Zellars-Williams, Inc., Lakeland, to obtain, estimate, and accumulate engineering and profile data from foreign phosphate mines and deposits.

The Florida Bureau of Geology had two contracts with the Bureau, one to inventory and classify reclaimed lands in the phosphate area, and the other to monitor phosphate activities in Florida using digital analyses of Landsat imagery.

Since 1972, the Bureau, at its Tuscaloosa Research Center, has been involved in a concerted research effort to develop methods that will either eliminate the retention areas of phosphate waste slimes or provide an improved waste storage system.

Inhouse Bureau project activity during 1980 included research on water recovery from phosphatic clay slimes, continuous flocculation dewatering and floc formation studies, and reuse and purification of low-quality waters for processing.

Research programs included beneficiation of dolomitic phosphate ores, beneficiation of phosphate-bearing Hawthorn Formation limestone, recovery of phosphate from beneficiation slimes, and direct acidulation of phosphate matrix to improve recovery of P_2O_5.

In a U.S. Environmental Protection Agency (EPA) mine waste study, EPA selected 20 copper, phosphate, uranium, gold and silver, lead and zinc, and molybdenum mine sites in 10 States for intense study. The analysis is designed to determine which mine wastes, if any, warrant specially tailored regulations in the future under EPA's hazardous waste law, Part C of the Resource Conservation & Recovery Act (RCRA). Mine and processing wastes are currently exempt from RCRA until results are presented to Congress and the law is amended. Sites being considered in Florida for study include two phosphate mine waste rock dumps and two tailings ponds. EPA will analyze solid waste, ground water, surface water, and emissions at each site. Monitoring will be completed by August 1982, with a report to Congress in October 1982.

Brownwell Engineering, Inc., was award-

ed a contract by the U.S. Geological Survey for exploratory drilling to determine the nature of the phosphatic sediments, clay, and peat of the Holocene, Bone Valley, and Hawthorn Formations in the Roadless Area Review and Evaluation (RARE) II and wilderness areas of the Ocala, Osceola, and Apalachicola National Forests.

The Geological Survey released Circular 824, "Thorium Resources of Selected Regions in the United States." The report covers thorium reserves and resources in beach placers in northern Florida. These deposits are principally mined for titanium, with thorium and other minerals recovered as byproducts.

The Florida Department of Environmental Regulations completed the publication, "Water Quality and Mining." Included in the report are the major regulations affecting mining and its environmental effects, and the report recommends the best management practices.

During the year, the Florida Bureau of Geology completed eight studies on environmental geology, stratigraphy, ground water, and clay resources in the State. Twelve other geologic and stratigraphic studies were continued. In addition to basic geologic studies, the Bureau of Geology handled reclamation and maintained a geologic well log library and a computerized list of mineral producers and statistics.

Twelve publications were issued during the year, including "Limestone, Dolomite, and Coquina Resources of Florida," and "Sand and Gravel Resources of Florida." The staff supported a major revision of Chapter 16C-16, Florida Administrative Code, Mine Reclamation Rules. Florida's Governor and Cabinet approved these reclamation rules, which would require restoration of a mining site to as near as possible its original state. The rules include (1) restoration of environmentally sensitive areas, (2) elimination of certain tax rebates, (3) approval of premining reclamation plans, (4) stricter standards for creation of lakes, (5) retroactive compliance of future Federal standards for radiation emissions, and (6) requirements for slime storage below natural grade to the greatest extent possible. Effective date of the rules was October 1, 1980.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Shipments of both portland and masonry cement increased in 1980. Production of masonry cement in Florida ranked third nationally, while portland ranked fifth. Five companies produced portland cement at six plants; masonry was produced at four plants. Most of the shipments of both portland and masonry cement were to users within the State.

Portland cement shipments, mainly in bulk form, were made by truck and rail. Principal consumers were ready-mix dealers, building material dealers, and concrete products manufacturers, with the remaining to other contractors and Government agencies.

Most raw materials used to manufacture cement were mined within the State, and included limestone, clay, sand, and staurolite. With higher value uses developing for staurolite, a substitute may be necessary in the near future. Oolitic aragonite imported from the Bahamas was used along with small amounts of gypsum, clinker, fly ash, clay, iron ore, and slag; most were obtained from out-of-State sources.

Eleven rotary kilns were operated at five plants. Of the 11, 10 were wet process, and 1 was dry process. About 440 million kilowatthours of electrical energy, in addition to natural gas, fuel oil, and coal, were consumed in the manufacture of cement.

Moore McCormack Resources, Inc., new owners of Florida Mining & Materials Corp., announced a $68 million expansion program for cement and concrete production at the company's Brooksville plant. The plan calls for adding a second coal-fired kiln and increasing grinding and storage capabilities. The plant is expected to be operational by the third quarter of 1982, and will double the production capacity of the plant to 1.2 million tons of cement per year. The company also plans to purchase additional trucks to increase deliveries of ready-mix and concrete block.

Clays.—Clays mined in Florida included common clay, fuller's earth, and kaolin. Total clay production and value decreased.

Common clay output and value increased. Common clay was produced by four companies at four pits in Clay, Gadsden, Hernando, and Lake Counties in the northern part of the State. The clays were used in the manufacture of cement and lightweight aggregate.

Florida continued to rank second in the Nation in fuller's earth production, although production decreased. Fuller's earth was mined by four producers from nine pits in Brevard, Gadsden, and Marion Counties. Main end uses were for fertilizer fillers, pet waste absorbents, pesticides, and drilling mud.

Kaolin was produced by one company at two pits in Putnam County; production remained at about the same level as in 1979. The deposit also includes silica, with the sand recovered for glass and other industrial uses. Principal uses for kaolin were in electrical porcelain, whiteware, and wall tile. Major kaolin markets were in the Southeast, although some was exported.

Fluorine.—Fluorine, in the form of fluosilicic acid, was recovered at six plants as a byproduct of wet-process phosphoric acid manufacture. Fluosilicic acid was used to produce cryolite, aluminum fluoride, sodium silica fluoride, and was also used in water fluoridation. The value of fluorine byproducts is not included in the State's mineral value.

Gypsum.—Imported gypsum was calcined at two plants in Duval County and one plant in Hillsborough County. United States Gypsum Co., Jim Walter Corp., and National Gypsum Co. calcined gypsum in kettles, a rotary kiln, and a holoflite unit, respectively. Production in 1980 decreased to 637,000 tons, a drop of 22,000 tons from the 1979 level.

United States Gypsum announced plans to expand its north Jacksonville plant, with completion scheduled for late 1981. The $25 million expansion will increase capacity to 600 million board feet per year, reportedly making it the largest in the world. The market area is south Georgia and Florida.

Lime.—Quicklime was produced by Basic Magnesia, Inc., Gulf County; Chemical Lime, Inc., Hernando County; and Dixie Lime & Stone Co., Sumter County. Hydrated lime was produced by Chemical Lime, Inc. Production decreased 7%, but value increased 9%. Lime was used for magnesia, water treatment, and sewage-disposal systems.

Magnesia.—Florida ranked second nationally in the recovery of magnesium compounds from seawater. Basic Magnesia, Inc., Port St. Joe, Gulf County, produced caustic calcined magnesia and refractory-grade magnesia from seawater; plant capacity is 100,000 tons of MgO equivalent. Shipments in 1980 decreased 9%; value increased 3%.

Peat.—Florida ranked second nationally in peat production in 1980. Production and value increased slightly. Ten plants produced moss, reed-sedge, and humus peat from five counties. Most of the peat, shipped in bulk, was used for general soil improvement and for potting soils.

Perlite.—Four companies produced expanded perlite from crude ore shipped into the State. Production increased to 31,700 tons; value increased to $3.7 million. Perlite was expanded at plants in Broward, Duval, Escambia, and Indian River Counties, and was used for horticultural purposes, insulation, and fillers.

Phosphate Rock.—Florida ranked first in the Nation in the production of phosphate rock. Marketable production of phosphate rock in 1980 increased 6% in quantity and 20% in value.

The phosphate industry continued to be the principal mineral industry in the State. Nearly all phosphate companies announced development or expansion plans. Development costs of mines have increased from $34 per ton of annual capacity in 1975 to approximately $100 per ton in 1980; construction costs of phosphoric acid plants have increased from $141 per ton of annual capacity in 1975 to $440 per ton in 1980. In 1980, companies spent $436 million for expansion, replacement, and new construction. Expansion plans announced in 1980 will be equivalent to an additional $2 billion investment by 1985 if permits are obtained. In line with local government concerns, the Governor and Cabinet approved revised reclamation rules for phosphate producers that would require restoration of a mining site as near as possible to its original state.

Soft-rock phosphate was produced by four companies in 1980, operating five mines in Citrus and Marion Counties. The soft-rock phosphate was used for direct application to the soil and, if low in fluorine, as an animal feed supplement.

Land-pebble phosphate was produced at 22 mines by 13 companies in Hamilton, Hardee, Hillsborough, and Polk Counties. In 1980, agricultural uses accounted for 71%; industrial, 1%; and exports, 28%. Normal superphosphate, triple superphosphate, wet-process phosphoric acid, and defluorinated phosphate rock were produced for agricultural uses. Industrial chemicals were produced from the production of elemental phosphorus.

Agrico Chemical Co., with a reported annual mining capacity of 7.5 million tons,

began an expansion program at its South Pierce phosphoric acid facility. The addition to the phosphoric acid plant will reportedly increase capacity by 120,000 tons per year by 1981.

AMAX, Inc., purchased the mining operations and phosphate reserves of Borden, Inc., for $200 million, and will spend $44 million more to expand and improve the operation. In addition to Borden's Big Four Mine, AMAX acquired a phosphoric acid complex at Piney Point and a defluorinated feed phosphate facility at Plant City. The Big Four Mine in Hillsborough County will expand capacity from 1.6 to 2.5 million tons per year. In addition to purchasing additional reserves, a dragline and processing equipment were acquired. AMAX continued development of its proposed $335 million, 4 million-ton-per-year mine in Manatee and De Soto Counties. A contract was awarded for the engineering, design, and construction of the facility. AMAX plans to spend a projected $625 million in the 1980's to develop their phosphate operations.

Beker Industries Corp. started developing its $100 million phosphate mine in eastern Manatee County. Present plans call for a 1-million-ton-per-year operation. A production level of 3 million tons per year, is scheduled by late 1982. Beker plans to build a $5 million facility at Port Manatee to ship rock to its fertilizer plant in Louisiana.

Estech, Inc., continued in its attempts to develop its 3-million-ton-per-year Duette Mine in Manatee County. Early in the year, the Manatee County Zoning Board denied Estech a permit to mine, but this was revised by the Governor and Cabinet. However, the Florida Department of Environmental Regulation then denied Estech a permit for waste water discharge. The permit is required in order to construct slime ponds. Mining plans are thus delayed indefinitely.

Farmland Industries, Inc., planned to develop a $200 million mine and chemical plant near Ora in Hardee County. However, the Hardee County Commission rejected Farmland's request to build the chemical plant, but gave approval to the 2-million-ton-per-year mine. Farmland did not appeal, but was considering either increasing production at its Green Bay plant or purchasing an existing plant.

Gardinier, Inc., received permission to expand its fertilizer plant adjoining Hillsborough Bay and the Alafia River. The $67 million expansion program will convert the plant to wet grinding, increase production capacity by 20%, and reduce emissions. The company purchased mineral rights to more than 7,000 acres in Hardee County for over $10 million.

W. R. Grace & Co. announced plans to spend $300 million from 1980 to 1984 for environmental controls; the 1980 budget was $52.7 million, compared with $38.9 million in 1979. W. R. Grace & Co. and International Minerals & Chemical Corp. (IMC) continued development of their Four Corners Mine in Hardee, Hillsborough, Manatee, and Polk Counties. The $500 million venture will have a design capacity of 5 million tons per year. Grace, which is planning to expand its Hooker Praire Mine, is participating in a joint venture with U.S.S. Agri-Chemicals, Inc. The companies plan a $200 million fertilizer plant at Fort Meade to include two sulfuric acid facilities.

IMC announced a planned $400 million expansion of its Florida phosphate operations. In addition to its venture with Grace, IMC plans to spend $58 million to expand its New Wales plant, increasing overall output by 500,000 tons per year. IMC purchased additional reserves, including a $4 million purchase of land from Bartow Minerals near IMC's Clear Springs operation. IMC also purchased a $13.5 million dragline capable of removing overburden in excess of 40 feet thick.

Mississippi Chemical Corp. filed a proposal to develop a 3-million-ton-per-year mine and beneficiation plant in Hardee County. Reserves are reportedly sufficient for over 30 years. A decision on when the mine will be developed has not been made by Mississippi Chemical Co.

Mobil Oil Corp. received permits from the South Florida Water Management District to develop a new mine in the Fort Meade area. The 3-million-ton-per-year mine, to be in operation by 1984, will replace Mobil's Fort Meade Mine scheduled to close in 1988. Mobil has been purchasing land east and southeast of the proposed site.

Occidental Petroleum Corp. (Oxy) continued construction of a $3.2 million animal feed supplement plant at White Springs. Although an embargo was placed on phosphate fertilizer shipments to the Soviet Union, Oxy's major customer, the company was able to develop other markets to sustain its operations. Oxy and South Africa's Triomf Fertilizer agreed in principle to a marketing program whereby Oxy would have an alternative source of phosphoric

acid to fulfill its contracts with the Soviet Union, while Triomf would utilize Oxy as a source of phosphate rock. Oxy also was negotiating with mainland China to construct production plants in China and receive phosphoric acid in return.

Bartow Minerals and T. A. Minerals Corp. closed their phosphate rock mining operations in Polk County in 1980.

Zellars-Williams, Inc., Lakeland, was awarded a $36,000 contract by the South Florida Water Management District to project the water needs and possible water sources for the phosphate industry over the next 20 years. The area to be studied includes land in the Alafia, Manasota, and the Peace River Basins.

Sand and Gravel.—Total sand and gravel output decreased in 1980. Lake, Polk, and Glades were the leading producing counties.

During 1980, 34 companies operated 46 mines in 19 counties. Transportation was primarily by truck, with the balance shipped by railroad and waterway. Sand and gravel was used mainly for construction purposes, which included concrete aggregate and fill, with the balance going into industrial uses. Four companies produced over 1 million tons each; the top 14 companies, with 25 pits, mined 90% of the total sand and gravel in the State. Florida Rock Industries, Inc., opened an industrial sand operation at Interlachen in Putnam County. The sand will be used by southeastern glass manufacturers and foundries. Glass sand is shipped to Anchor Hocking Corp. in Jacksonville, with foundry sands shipped to the Alabama markets. The company also obtained permits for a $2 million sand plant in Marion County. Construction started at the end of the year with financing through Industrial Development Revenue Bonds. The plant will serve the Daytona Beach market.

Table 4.—Florida: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	11,949	$19,200	$1.61	7,927	$16,713	$2.11
Plaster and gunite sands	239	584	2.44	W	W	2.99
Concrete products	869	1,765	2.03	2,424	4,998	2.06
Asphaltic concrete	868	2,195	2.53	619	1,855	3.00
Roadbase and coverings	2,214	2,845	1.28	680	1,907	2.80
Fill	4,503	4,556	1.01	2,432	2,310	.95
Other	--	--	--	383	1,049	2.74
Total[1] or average	20,642	31,145	1.51	14,464	28,831	1.99

W Withheld to avoid disclosing company proprietary data; included in "Other."
[1]Data may not add to totals shown because of independent rounding.

Table 5.—Florida: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	18,143	$26,843	$1.48	13,305	$26,238	$1.97
Gravel	2,500	4,302	1.72	1,159	2,592	2.24
Total[1] or average	20,642	31,145	1.51	14,464	28,831	1.99
Industrial sand	1,066	8,375	7.86	W	W	6.32
Grand total or average	21,708	39,520	1.82	W	W	2.12

W Withheld to avoid disclosing company proprietary data.
[1]Data may not add to totals shown because of independent rounding.

Staurolite.—Florida is the only State with a recorded production of staurolite. Staurolite was recovered as a byproduct of ilmenite production at the Highland and Trail Ridge plants of E. I. du Pont de Nemours & Co., Clay County, and by Associated Minerals Ltd., Inc. (United States), also in Clay County. Production decreased in 1980. Staurolite was mainly used in sandblasting, with minor amounts used in cement and as a foundry sand.

Stone.—Florida ranked second in the Nation in crushed stone production, which included limestone, marl, and oyster shell.

Stone was produced by 89 companies at 128 quarries in 24 counties. The three leading counties were Broward, Dade, and Hernando, which supplied 65% of the State's total production. Sixteen companies produced over 1 million tons each from 36 quarries, and accounted for 67% of the production and 71% of the value.

Crushed stone was transported mainly by truck and railroad, and was used for dense-graded roadbase, concrete and bituminous aggregate, and cement manufacture. Two companies processed oyster shell for roadbed material.

Sulfur.—Florida ranked fifth in the Nation in the production of recovered elemental sulfur. Recovered sulfur from Exxon's desulfurization plants in Escambia and Santa Rosa Counties decreased in 1980.

Table 6.—Florida: Crushed stone sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979[1]		1980[2]	
	Quantity	Value	Quantity	Value
Agricultural limestone	1,131	6,036	1,729	8,299
Agricultural marl and other soil conditioners	52	452	115	632
Poultry grit and mineral food	490	2,837	497	3,064
Concrete aggregate	14,085	53,980	14,583	57,691
Bituminous aggregate	3,498	12,490	4,604	17,010
Dense-graded roadbase stone	17,603	37,602	16,497	40,325
Surface treatment aggregate	2,885	12,804	3,708	14,716
Other construction aggregate and roadstone	13,409	30,858	12,164	32,946
Riprap and jetty stone	58	277	59	398
Filter stone	55	233	W	W
Manufactured fine aggregate (stone sand)	5,642	19,770	5,813	23,134
Cement manufacture	2,344	5,139	2,337	5,615
Lime manufacture	367	1,007	449	1,120
Asphalt filler	21	209	20	221
Other fillers	188	1,222	184	1,288
Fill	1,580	2,919	2,288	5,068
Glass manufacture	W	W	20	191
Other[3]	200	632	1,140	4,257
Total[4]	63,609	188,467	66,209	215,972

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Crushed limestone only.
[2]Includes limestone, shell, and marl.
[3]Includes stone used for macadam aggregate, railroad ballast, and filter stone (1979).
[4]Data may not add to totals shown because of independent rounding.

Vermiculite.—Exfoliated vermiculite was produced by two operators at four plants in Broward, Duval, and Hillsborough Counties from crude ore shipped into the State. Production increased 11% over that of 1979; principal uses were for lightweight aggregate, horticulture, and insulation.

METALS

Mineral Sands.—Du Pont and Associated Minerals produced concentrates from their heavy mineral operations in Clay County. In May 1980, Associated Minerals Consolidated Ltd. (AMC) of Sydney, New South Wales, Australia, acquired the properties of Titanium Enterprises at Green Cove Springs for $11.7 million. The properties were mined thereafter by Associated Minerals Ltd., Inc., a subsidiary of the Australian firm AMC. AMC plans to invest an additional $6 million for working capital and improvements to bring the operation up to optimum capacity. Reserves at Green Cove Springs are projected to last 16 years at an average annual production rate of 25,000 tons of rutile, 25,000 tons of zircon, and 50,000 tons of ilmenite, plus significant quantities of leucoxene, staurolite, and monazite.

Rare-Earth Minerals.—AMC produced monazite concentrates as a byproduct from its operations in Clay County. Florida was

the only domestic producer of rare earths from mineral sands mining.

Titanium.—Du Pont and AMC, Clay County, produced titanium concentrates for use in titanium dioxide pigment manufacture.

Zircon.—Production and value of zircon concentrates from Du Pont and AMC, both in Clay County, decreased in 1980. Florida was the only producer of zircon concentrates in the United States.

[1]State mineral specialist, Bureau of Mines, Tuscaloosa, Ala.

[2]State geologist, Florida Bureau of Geology, Tallahassee, Fla.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Florida Mining & Materials Corp	Box 23965 Tampa, FL 33622	Plant	Hernando.
General Portland, Inc	12700 Park Central Place Suite 2100 Dallas, TX 75251	Plants	Dade and Hillsborough.
Lonestar Florida, Inc	Box 2035 PVS Hialeah, FL 33012	Plant	Dade.
Rinker Portland Cement Corp	Box 650679 Miami, FL 33165	do	Do.
Clays:			
Florida Mining & Materials Corp	Box 6 Brooksville, FL 33512	Open pit mine	Hernando.
Mid-Florida Mining	Box 68-F Lowell, FL 32663	do	Marion.
Pennsylvania Glass Sand Corp	Berkeley Springs, WV 35411	do	Gadsden.
Gypsum (calcined):			
Jim Walter Corp	Box 135 Jacksonville, FL 32226	Plant	Duval.
National Gypsum Co	4100 First Intl. Bldg. Dallas, TX 75270	do	Hillsborough.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Duval.
Lime:			
Chemical Lime, Inc	Box 250 Ocala, FL 32670	do	Hernando.
Dixie Lime & Stone Co.[1]	Drawer 217 Sumterville, FL 33585	do	Sumter.
Magnesium compounds:			
Basic Magnesia, Inc.[2]	Box 160 Port St. Joe, FL 32456	do	Gulf.
Peat:			
F. E. Stearns Peat	Route 1, Box 542D Dover, FL 33527	Bog	Hillsborough.
Peace River Peat Co	Box 1192 Bartow, FL 33830	Bog	Polk.
Superior Peat & Soil	Box 2688 Sebring, FL 33870	Bog	Highlands.
Perlite (expanded):			
Airlite Processing Corp. of Florida.	Route 2, Box 740 Vero Beach, FL 32960	Plant	Indian River.
Armstrong Cork Co	Box 1991 Pensacola, FL 32589	do	Escambia.
Chemrock Corp	End of Osage Street Nashville, TN 37208	do	Duval.
W. R. Grace & Co.[3]	62 Whittemore Ave. Cambridge, MA 02140	do	Broward.
Phosphate rock:			
Agrico Chemical Co	Box 3166 Tulsa, OK 74101	Open pit mines and plants.	Polk.
Borden, Inc	Box 790 Plant City, FL 33566	Open pit mine and plant.	Hillsborough and Polk.
Brewster Phosphates	Bradley, FL 33835	do	Do.
C. F. Industries	Box 790 Plant City, FL 33566	do	Hardee.
Estech, Inc	Box 208 Bartow, FL 33830	Open pit mines	Polk.
Gardinier, Inc	Box 3269 Tampa, FL 33601	Open pit mine and plant.	Do.
International Minerals & Chemical Corp.	Box 867 Bartow, FL 38830	Open pit mines	Do.
Mobil Oil Corp.[4]	Box 311 Nichols, FL 33863	do	Do.
Occidental Petroleum Corp	White Springs, FL 32096	Open pit mine	Hamilton.
U.S.S. Agri-Chemicals, Inc	Box 867 Fort Meade, FL 33841	do	Polk.
W. R. Grace & Co	Box 471 Bartow, FL 33830	Open pit mine and plant.	Do.

See footnotes at end of table.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel:			
Florida Rock Industries, Inc., Shands & Baker.	744 Riverside Ave. Jacksonville, FL 32201	Pits	Clay, Lake, Lee, Putnam.
General Development Corp	1111 South Bayshore Dr. Miami, FL 33131	do	St. Lucie, and Sarasota.
E. R. Jahna Industries, Inc., Ortona Sand Co. Div.	First & East Tillman Lake Wales, Fl 33853	do	Glades, Lake, Polk.
Silver Sand Co. of Clermont Inc	Route 1, Box US 1 Clermont, FL 32711	Pit	Lake.
Staurolite:			
E. I. du Pont de Nemours & Co	DuPont Bldg. D-10084 Wilmington, DE 19898	Mines and plants	Clay.
Stone:			
Florida Crushed Stone Co	Box 317 Leesburg, FL 32748	Quarries	Hernando and Sumter.
Florida Rock Industries, Inc.[5]	Box 4467 Jacksonville, FL 32201	do	Collier, Lee, Sumter, Suwannee.
Lone Star Florida, Inc	Box 6097 Fort Lauderdale, FL 33310	Quarry	Dade.
Rinker Southeastern Materials, Inc.	Box 2634 Hialeah, FL 33012	Quarries	Do.
Vulcan Materials Co	Box 7324-A Birmingham, AL 35223	do	Broward and Dade.
Titanium concentrates:			
Associated Minerals Consolidated Ltd.	Green Cove Springs, FL 32043	Mine and plant	Clay.
E. I. du Pont de Nemours & Co.[6]	DuPont Bldg. D-10084 Wilmington, DE 19898	Mines and plants	Do.

[1]Also stone.
[2]Also lime.
[3]Also phosphate rock and exfoliated vermiculite.
[4]Also elemental phosphorus.
[5]Also sand and gravel.
[6]Also zircon concentrate and rare-earth oxides and thorium oxide in monazite concentrate.

The Mineral Industry of Georgia

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U. S. Department of the Interior, and the Georgia Geologic Survey, Environmental Protection Division, Georgia Department of Natural Resources, for collecting information on all nonfuel minerals.

By James R. Boyle[1] and Bruce J. O'Conner[2]

The value of Georgia's nonfuel mineral production in 1980 was $770.7 million, an increase of $71.1 million over that of 1979. Georgia ranked fifth nationally in value of nonmetallic minerals produced. Georgia led the Nation in the production of fuller's earth, kaolin, and dimension stone; was second in kyanite; third in bauxite, feldspar, and crude iron oxide pigments; and fourth in barite, byproduct gypsum, and mica.

The inflationary trend of the past decade is evident by comparison of 1980 mineral production with that of 1970. Tonnage of most commodities increased, some as much as 60%, while total value in 1980 was about 380% of that in 1970.

Of the more than $7 billion worth of minerals produced in Georgia since the inception of recordkeeping, the leading commodities were kaolin, crushed granite, portland cement, dimension marble, and dimension granite; kaolin alone accounted for over 35% of the total value.

Table 1.—Nonfuel mineral production in Georgia[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	102	$5,172	89	$5,464
Portland	do.	1,335	55,117	1,231	55,463
Clays	do.	8,322	437,671	8,283	500,555
Gem stones		NA	20	NA	20
Sand and gravel[2]	thousand short tons	5,014	10,792	4,858	11,898
Stone:					
Crushed	do.	40,902	154,021	40,884	162,642
Dimension	do.	244	17,908	231	17,466
Talc	do.	W	W	25	116
Combined value of barite, bauxite, feldspar, iron oxide pigments (crude), kyanite, mica, peat, sand and gravel (industrial), and value indicated by symbol W		XX	r18,870	XX	17,064
Total		XX	r699,571	XX	770,688

rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

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

[2]Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Georgia, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Baldwin	W	W	Sand and gravel.
Barrow	W	$60	Stone.
Bartow	W	W	Barite, crude iron oxide pigments, clays.
Bibb	W	W	Clays, sand and gravel.
Carroll	W	W	Stone.
Chatham	$536	W	Sand and gravel.
Cherokee	W	99	Do.
Clarke	2,194	W	Stone.
Clayton	3,675	W	Do.
Cobb	W	W	Stone, sand and gravel.
Coffee	W	W	Stone, clays.
Columbia	W	W	Do.
Columbus (city)	W	W	Do.
Cook	W	W	Sand and gravel.
Coweta	W	W	Stone.
Crawford	W	1,320	Sand and gravel.
Decatur	12,934	W	Clays, sand and gravel.
De Kalb	W	10,386	Stone.
Dougherty	W	399	Sand and gravel.
Douglas	W	W	Stone, clays, sand and gravel.
Effingham	W	W	Sand and gravel.
Elbert	W	W	Stone, sand and gravel.
Evans	132	179	Sand and gravel.
Fannin	--	W	Stone.
Fayette	2,070	W	Do.
Floyd	W	W	Stone, clays, sand and gravel.
Forsyth	2,623	4,107	Stone.
Fulton	W	W	Cement, stone, clays, sand and gravel.
Gilmer	W	W	Stone.
Glynn	72	50	Sand and gravel.
Gordon	1,663	2,126	Stone.
Greene	W	W	Sand and gravel, stone.
Gwinnett	W	W	Stone.
Habersham	W	W	Do.
Hall	W	4,889	Do.
Hart	W	W	Mica.
Henry	W	W	Stone.
Houston	W	W	Cement, clays, stone.
Jasper	W	W	Feldspar, stone.
Jefferson	W	W	Clays.
Jones	W	W	Stone.
Laurens	W	W	Sand and gravel.
Lee	W	W	Stone, sand and gravel.
Lincoln	W	W	Kyanite.
Long	320	244	Sand and gravel.
Lowndes	W	W	Do.
Lumpkin	W	788	Stone.
Madison	W	2,528	Do.
Marion	W	W	Sand and gravel.
Miller	6	W	Peat.
Monroe	W	W	Stone.
Montgomery	W	W	Sand and gravel.
Murray	W	W	Stone, talc.
Oglethorpe	2,220	2,858	Stone.
Paulding	W	W	Do.
Pickens	15,927	17,649	Do.
Pike	W	60	Sand and gravel.
Polk	W	13,497	Cement, stone, clays, sand and gravel.
Rabun	1,306	1,004	Stone.
Richmond	W	12,432	Clays, stone, sand and gravel.
Screven	W	W	Peat.
Seminole	W	W	Sand and gravel.
Spalding	W	W	Stone.
Stephens	W	W	Do.
Sumter	W	W	Clays, bauxite.
Talbot	W	W	Sand and gravel.
Taylor	W	W	Do.
Thomas	W	W	Clays, sand and gravel.
Troup	W	W	Stone.
Twiggs	63,239	W	Clays.
Union	W	2,434	Sand and gravel, stone.
Walker	W	W	Stone, clays.
Ware	204	204	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Georgia, by county[1] —Continued

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Warren	W	W	Clays, stone.
Washington	$121,234	$131,949	Clays.
Wheeler	W	W	Sand and gravel.
Whitfield	3,400	3,347	Stone.
Wilkinson	50,876	69,128	Clays.
Undistributed[2]	r304,327	417,831	
Total[3]	r588,960	699,571	

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1]The following counties are not listed because no nonfuel mineral production was reported: Appling, Atkinson, Bacon, Baker, Banks, Ben Hill, Berrien, Bleckley, Brantley, Brooks, Bryan, Bulloch, Burke, Butts, Calhoun, Camden, Candler, Catoosa, Charlton, Chattahoochee, Chattooga, Clay, Clinch, Colquitt, Crisp, Dade, Dawson, Dodge, Dooly, Early, Echols, Emanuel, Franklin, Glascock, Grady, Hancock, Haralson, Harris, Heard, Irwin, Jackson, Jeff Davis, Jenkins, Johnson, Lamar, Lanier, Liberty, McDuffie, McIntosh, Macon, Meriwether, Mitchell, Morgan, Muscogee, Newton, Oconee, Peach, Pierce, Pulaski, Putnam, Quitman, Randolph, Rockdale, Schley, Stewart, Taliaferro, Tattnall, Telfair, Terrell, Tift, Toombs, Towns, Treutlen, Turner, Upson, Walton, Wayne, Webster, White, Wilcox, Wilkes, and Worth.

[2]Includes gem stones and some clays 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 Georgia business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,334.0	2,385.0	+2.2
Unemployment	do	119.0	154.0	+29.4
Employment (nonagricultural):				
Mining[1]	do	7.7	7.7	--
Manufacturing	do	528.5	516.2	-2.3
Contract construction	do	103.6	103.1	-.5
Transportation and public utilities	do	136.0	138.1	+1.5
Wholesale and retail trade	do	495.0	495.0	--
Finance, insurance, real estate	do	108.6	111.6	+2.8
Services	do	329.3	343.8	+4.4
Government	do	418.7	430.9	+2.9
Total nonagricultural employment[1]	do	2,127.4	2,146.4	+.9
Personal income:				
Total	millions	$39,031	$43,241	+10.8
Per capita		$7,627	$8,000	+4.9
Construction activity:				
Number of private and public residential units authorized		40,650	35,549	-12.6
Value of nonresidential construction	millions	$812.4	$868.0	+6.8
Value of State road contract awards	do	$286.0	$230.5	-19.4
Shipments of portland and masonry cement to and within the State	thousand short tons	2,289	2,209	-3.5
Nonfuel mineral production value:				
Total crude mineral value	millions	$699.6	$770.7	+10.2
Value per capita, resident population		$137	$141	+2.9
Value per square mile		$11,882	$13,090	+10.2

[p]Preliminary.

[1]Includes bituminous coal extraction.

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

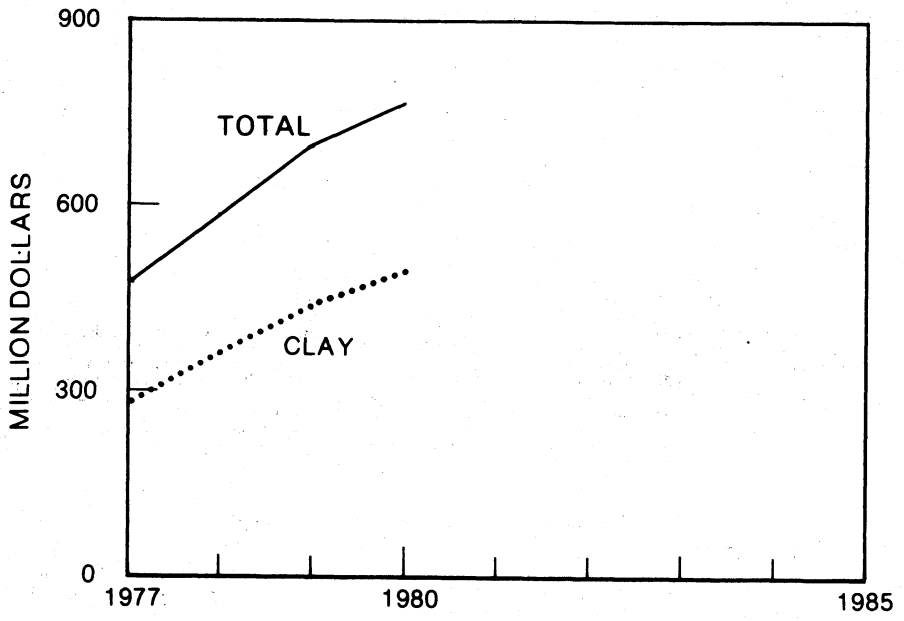

Figure 1.—Value of clays, and total value of nonfuel mineral production in Georgia.

The mineral industry was affected by economic conditions nationally. Most industries providing raw materials to the automotive, paper, and steel industries reduced production; export markets for kaolin held firm. Barite production decreased partially because of increased imports into the gulf area. The Georgia Department of Labor reported a drop of 500 in employment in the stone, clay, and glass manufacturing sector mainly because of a decrease in demand of structural clay products; construction employment decreased 900 during the year.

Trends and Developments.—Construction of the new bulk handling facility at the Georgia Port Authority's Brunswick Terminal was completed; the first commodity imported into the facility was potash. A contract was awarded for construction of a second storage building capable of accommodating 24,000 tons of cargo. Studies predict a doubling of annual tonnage through the facility within 15 years; present throughput capability is 125,000 tons. Exports of kaolin pass through the authority's Savannah facility, which also handles bauxite, kyanite, and zircon sand.

Atlantic Steel Co., Atlanta, completed a $25 million expansion program with the installation of a six-strand continuous caster and finishing mill. The company, with an annual capacity of 750,000 tons, produces merchant and special-quality bars and various wire products. The first heat of steel went through the caster in December. The company, traditionally active in southeastern markets, has expanded into the Midwest.

Legislation and Government Programs.—Work performed at the Federal Bureau of Mines Reno Research Center, which utilized kaolin from the Sandersville area, resulted in a Bureau publication, RI 8476, "Producing Alumina From Clay by the Hydrochloric Acid Process, A Bench-Scale Study."

During the year, the Bureau had contracts with several companies and institutions, as follows: Glasrock Products, Inc., Airborne Dust Monitoring System; Law Engineering Testing Co., Study of Surface Coal Mine Slope Stability Problems; Morehouse College, Feasibility Study of the Reclamation of the Common Precious Metals From Seawater; and Spelman College, Detoxica-

tion of Arsenic & Characterization of the Organic Compounds Produced by Roasting of Phosphates.

The State Department of Natural Resources, through the Surface Mining & Land Reclamation Program, continued to enforce the State Surface Mining Act of 1967, which requires surface mining operators to reclaim affected lands. During the year, 378 mining operations were active in 111 counties in the State. Major commodities mined were kaolin, granite, limestone, and sand.

The Georgia Geologic Survey continued basic mapping, ground water investigations, environmental atlas programs initiated in previous years, and expanded technical programs. Investigations during the year included a geology and management plan for Cumberland Island, subsurface geology of the Coastal Plain, a study of the Irwinton-Sandersville kaolin district, economic geology of the Villa Rica area, and preparation of a coastal atlas. The hydrology program included stream gaging, basic data collection, and an areal study of the Atlanta area. An accelerated ground water program was conducted in cooperation with the U.S. Geological Survey.

The Georgia Tax Reform Commission completed a report, "Mineral Resources Taxation in Georgia." The report included present taxation practices and arguments for and against severance taxes. The commission recommended three possible actions: (1) Train officials in mining counties as to proper methods of mineral evaluation, (2) require State level assessment of mineral property, or (3) enact a severance tax as a replacement for current ad valorem taxes.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Nonmetals accounted for nearly all of the State's total mineral production value in 1980. The principal nonmetals produced, in descending order of value, were clays, crushed stone, cement, dimension stone, and sand and gravel.

Barite.—Georgia ranked fourth nationally in the production of primary barite. Production in 1980 decreased significantly. Barite production was limited to the Cartersville district in Bartow County in the northwestern part of the State. New Riverside Ochre Co. and Paga Mining Co. were the only producers, with Paga Mining Co. working old tailings ponds. Although the companies jointly own reserves, the recent depressed market situation caused caution in developing the property. Imports of chemical-grade barite into the gulf region adversely impacted Georgia barite production. Approximately 500,000 tons of barite was imported through gulf ports compared with about 200,000 tons in 1979.

Georgia barite concentrates were used in the manufacture of chemicals and as fillers and extenders in paint and rubber products.

Cement.—Three companies, Medusa Cement Co., Marquette Cement Manufacturing Co., and Martin Marietta Cement Corp., produced portland and masonry cement from plants in Houston, Polk, and Fulton Counties, respectively. Masonry cement constituted a small portion of the total production.

Major sales of portland cement in 1980 were for ready-mix concrete (46%), to highway contractors (21%), and for concrete products (16%). The majority of shipments were by truck. Both portland and masonry cement production decreased in 1980, but value increased, reflecting inflation's impact on construction activities.

Raw materials used were mainly cement rock, limestone, and shale, with smaller amounts of clay, sand, iron ore, and gypsum. Of the five kilns in operation, four used the dry process.

Clays.—Georgia continued to lead the Nation in the production of clays. Although total clay production decreased slightly, total value increased 14%, reflecting the inflationary trend in the Nation. Clays mined in the State, in order of decreasing value, were kaolin, fuller's earth, and common clay.

Georgia led the Nation in production of kaolin, the leading commodity in the State in terms of value. Since records have been kept, kaolin has provided over 35% of the value of minerals produced in the State. The State's industry in 1980 was composed of 20 companies operating along the Fall Line Kaolin Belt in east-central Georgia. Production in 1980 totaled 6.3 million tons valued at $463.7 million, up from 6.1 million tons and $404.2 million in 1979. Major uses for premium-grade kaolin were paper coating and filler applications.

Table 4.—Georgia: Kaolin sold or used by producers, by kind and use

(Short tons)

Use	1979				1980			
	Airfloat	Unprocessed[1]	Washed[2]	Total	Airfloat	Unprocessed[1]	Washed[2]	Total
Domestic:								
Adhesives	r29,285	--	r15,459	44,744	40,663	--	16,835	57,498
Alum (aluminum sulfate) and other chemicals	200	245,004	8,181	253,385	9,511	219,520	9,252	238,283
Animal feed	W	--	--	W	10,220	--	--	10,220
Asphalt tile and linoleum	38,871	4,670	--	43,541	5,744	6,000	--	11,744
Catalysts (oil refining)	W	W	W	62,171	--	--	67,082	67,082
China and dinnerware; crockery and earthenware	15,707	3,398	18,830	37,935	25,827	2,096	8,547	36,470
Electrical porcelain	16,894	--	--	16,894	22,741	--	--	22,741
Face brick	267	18,500	55	18,822	289	32,083	--	32,372
Fiberglass and mineral wool	109,807	--	2,393	112,200	69,611	--	56	69,667
Firebrick, block, shapes	536	11,112	--	11,648	352	2,658	--	3,010
Floor and wall tile, ceramic	W	--	W	13,248	W	--	--	W
Flue linings and high-alumina brick	r41,373	r12,865	--	54,238	40,176	4,492	--	44,668
Foundry sand	770	--	--	770	671	--	510	1,181
Glass: glass, enamels, hobby ceramics	W	--	--	W	W	--	--	W
Grogs and crudes, refractory	18,533	400,270	17	418,820	W	444,748	--	444,748
Ink	W	--	--	W	W	--	--	W
Kiln furniture, mortar, cement	--	W	W	34,681	W	W	--	33,132
Medical, pharmaceutical, cosmetic	W	--	W	2,036	W	--	W	1,990
Paint	r10,702	--	r109,222	119,924	33,262	--	103,426	136,688
Paper coating	r313,884	--	r1,959,999	r2,273,883	65,887	--	2,217,027	2,282,914
Paper filling	r119,593	--	r738,712	858,305	448,736	--	734,193	1,182,929
Plastics	r2,465	--	r53,458	55,923	5,277	--	42,557	47,834
Pottery	7,988	r14,365	--	r22,353	14,203	6,607	--	20,810
Roofing granules	W	--	W	12,646	17,361	--	--	17,361
Roofing and structural tile	r4,995	(3)	--	4,995	434	--	--	434
Rubber	r73,363	--	r16,474	r89,837	66,849	--	10,657	77,506
Sanitary ware	r117,401	W	W	r128,727	111,054	--	69	111,123

Miscellaneous airfloat:								
Animal oil (1980), fertilizer, gypsum products (1980), oil and grease absorbents, pesticides and related products, pet waste absorbents (1979), textiles (1980), waterproofing and sealing (1980), other, unknown	r31,422	--	--	r31,422	40,280	--	--	40,280
Miscellaneous, unprocessed:								
Common brick (1979), drain tile (1980), flower pots, gypsum products, portland cement (1979), quarry tile (1979), sewer pipe (1979)	--	r23,747	--	r23,747	--	6,263	--	6,263
Miscellaneous, waterwashed:								
Gypsum products, pesticides and related products, waterproofing and sealing, other, unknown	--	--	r66,110	r66,110	--	--	42,569	42,569
Undistributed	r47,378	r26,214	r124,592	r462,076	24,934	18,935	890	49,637
Total	r1,001,434	r760,145	r3,113,502	4,875,081	1,054,082	743,402	3,253,670	5,051,154
Exports:								
Paint	r654	--	r29,496	30,150	--	--	25,494	25,494
Paper coating	--	--	580,435	580,435	--	--	691,446	691,446
Paper filling	1,082	--	52,859	53,941	30	--	72,399	72,429
Plastics	--	--	23,324	23,324	--	--	21,997	21,997
Refractories	--	276,037	--	276,037	--	260,040	--	260,040
Rubber	78	--	843	921	78	--	498	576
Undistributed	r19,126	(3)	r200,094	219,220	12,894	--	175,377	188,271
Total	r20,940	r276,037	r887,051	1,184,028	13,002	260,040	987,211	1,260,253
Grand total	r1,022,374	r1,036,182	r4,000,553	6,059,109	1,067,084	1,003,442	4,240,881	6,311,407

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes high-temperature calcined.
[2]Includes low-temperature calcined and delaminated.
[3]Revised to zero.
[4]Incomplete total; difference included in totals for specific uses.

Table 5.—Georgia: Kaolin sold or used by producers, by kind

Kind	1979		1980	
	Short tons	Value	Short tons	Value
Airfloat	r1,022,374	r$29,710,085	1,067,084	$38,748,311
Calcined[1]	920,961	91,925,829	984,465	109,048,491
Delaminated	358,293	31,891,253	438,310	40,600,948
Unprocessed	359,875	2,483,198	295,996	1,925,839
Waterwashed	r3,397,606	r248,175,256	3,525,552	273,376,731
Total	6,059,109	404,185,621	6,311,407	463,700,320

rRevised.
[1]Includes both low-temperature filler and high-temperature refractory grades.

Table 6.—Georgia: Kaolin sold or used by producers, by use

(Short tons)

Use	1979	1980
Domestic:		
Adhesives	44,744	57,498
Chemicals	253,385	238,283
Fiberglass and mineral wool	112,200	69,667
Firebrick, block, shapes	11,648	3,010
Floor and wall tile, ceramic	13,248	8,244
Paint	119,924	136,688
Paper coating	r2,273,883	2,282,914
Paper filling	858,305	1,182,929
Plastics	55,923	47,834
Rubber	r89,837	77,506
Sanitary ware	r128,727	111,123
Whiteware	37,935	36,470
Other	r875,322	798,988
Exports	1,184,028	1,260,253
Total	6,059,109	6,311,407

rRevised.

Table 7.—Georgia: Kaolin sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1979			1980		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Sumter	W	W	W	W	W	W
Twiggs	6	1,193	77,218	6	1,345	96,465
Warren	3	697	38,916	3	824	47,828
Washington	6	1,902	131,949	6	1,974	149,809
Wilkinson	6	924	69,128	5	854	68,794
Other[1]	7	1,343	86,974	5	1,314	100,804
Total	28	6,059	[2]404,186	25	6,311	463,700

W Withheld to avoid disclosing company proprietary data; included in "Other."
[1]Includes Columbia, Houston, and Richmond Counties and data indicated by symbol W.
[2]Data do not add to total shown because of independent rounding.

In October, Combustion Engineering, Inc., owner of 42% of Yara Engineering Corp., purchased the remaining 58% for $66.5 million. Yara, which includes Georgia Kaolin Co. and American Industrial Clay Co., has a production capacity of 1.6 million tons per year of kaolin. Funding was authorized for a $25.3 million plant in Wrens and a major expansion of the Dry Branch plant. The Wrens plant produces filler clay for use in paper, and the Dry Branch plant produces speciality clay for industrial use and paper-grade coating clay.

Many of the kaolin producers have announced expansion plans over the past few years to meet the needs of the expanding paper industry. Engelhard Minerals & Chemicals Corp., Freeport Kaolin Corp.,

Anglo-American Clays Corp., Nord Kaolin Co., Thiele Kaolin Co., and J. M. Huber Co. were either undergoing or considering expansion of their operations. Many kaolin operations export through facilities in Savannah, which also handled kaolin from South Carolina operations.

Georgia ranked first in the Nation in the production of fuller's earth. In 1980, eight companies in Decatur, Houston, Jefferson, and Thomas Counties produced a total of 649,000 tons valued at $32.7 million compared with 621,000 tons valued at $28.8 million for 1979. Fuller's earth was used in liquid fertilizers, paints, and oil well drilling muds.

Common clay and shale, used in brick, cement, and tile, was produced by 10 companies operating 15 pits in 9 counties. Production in 1980 was 1.3 million tons valued at $4.2 million compared with 1.6 million tons valued at $4.7 million in 1979.

Production of brick decreased nearly 40% for some companies. Merry Companies, Inc., with six brick plants in Augusta, closed one plant during the year because of the decrease in housing construction. The remaining five plants operated at a reduced workweek. At full capacity, the six plants can produce 450 million bricks per year. The company and Boral Ltd., an Australian building materials firm, were planning a merger. If the $41.4 million merger is completed, Merry Companies would continue operating under its name as a subsidiary of Boral.

Feldspar.—Georgia ranked third nationally in the production of feldspar. Production decreased 7%, while value increased 23%. High-potash feldspar was mined from weathered pegmatite at the Monticello Mine in Jasper County by The Feldspar Corp. The firm also opened a new mine near Siloam in Greene County. Approximately $400,000 was invested in ore pretreatment facilities. After concentration and deliming, the ore was shipped to Monticello for further processing.

Gypsum.—Calcined gypsum and gypsum board products were produced by three companies from raw materials mined in other States. National Gypsum Co. and The Flintkote Co. in Chatham County, and the Gypsum Div. of Georgia Pacific Corp. in Glynn County produced wallboard, plasters, fillers, and agricultural sand additives. American Cyanamid Co. recovered gypsum as a byproduct in their titanium dioxide plant in Savannah. Some of the byproduct gypsum was converted into briquettes by Lemo, Inc., for use by the cement industry. Production of both calcined and byproduct gypsum decreased.

Kyanite-Mullite.—Georgia was one of two States producing kyanite. C-E Minerals, Inc., a division of Combustion Engineering, operated a surface mining operation and a flotation plant at Graves Mountain in Lincoln County.

Synthetic mullite, a product of sintering a mixture of aluminous and siliceous materials, was produced by the Mulcoa Div. of C-E Minerals in Sumter County. C-E Minerals initiated a $10 million expansion at their aluminum-silicate operation, including two new rotary kilns expected to be operational by early 1981. Capacity would be increased 40% to over 500,000 tons per year.

Mica.—Georgia ranked fourth nationally in the production of crude mica. Franklin Mineral Products Co., Inc., mined mica from an open pit mine in Hart County. Production remained at about the same level as in 1979, with value increasing 10%. Georgia mica was shipped to Franklin, N.C., for grinding. Ground mica was used as an extender and filler in various products including paint, wallpaper, and rubber products.

Peat.—Production of peat declined during the year. Two companies in Miller and Screven Counties produced peat for use as a potting medium and general soil conditioner.

Perlite.—Armstrong Cork Co. expanded perlite at a plant near Macon in Bibb County; production and value increased. The product was used in acoustical tile, pipe insulation, and other lightweight insulating material. Raw material was obtained from mines in the Western United States.

Sand and Gravel.—Sand and gravel was produced in 1980 by 50 companies, operating 54 mines in 33 counties. Leading counties were Crawford, Talbot, and Taylor. Total sand and gravel output decreased, but total value increased. Operations were relatively small, with none producing over 600,000 tons per year; 90% of the total production came from only 27 pits. Only one company produced industrial sand and gravel, with output increasing.

Table 8.—Georgia: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,348	$6,670	$1.99	3,047	$7,038	$2.31
Plaster and gunite sands	230	418	1.81	235	490	2.08
Concrete products	256	660	2.58	599	1,492	2.49
Asphaltic concrete	360	1,249	3.47	236	956	4.05
Road base and coverings	393	1,165	2.93	299	1,205	4.02
Fill	353	454	1.29	W	W	1.46
Snow and ice control	W	W	W	W	W	2.70
Other	70	178	2.54	--	--	--
Total[1] or average	5,014	10,792	2.15	4,858	11,898	2.45

W Withheld to avoid disclosing company proprietary data; included in "Other" and/or "Total."
[1]Data may not add to totals shown because of independent rounding.

Table 9.—Georgia: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	4,110	$7,736	$1.88	4,094	$9,198	$2.25
Gravel	904	3,057	3.38	764	2,700	3.54
Total or average	5,014	[1]10,792	2.15	4,858	11,898	2.45
Industrial sand	W	W	W	W	W	8.56
Grand total or average	W	W	W	W	W	2.91

W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.

Stone.—Crushed stone production decreased slightly, while value increased. Georgia ranked eighth in the Nation in crushed stone output. Crushed stone produced included limestone, granite, marble, sandstone, and slate. Leading producing counties for crushed stone were Gwinnett, De Kalb, and Jones. Georgia led the Nation in the production of dimension stone which included granite, marble, and sandstone.

In 1980, 65 companies produced crushed and/or dimension stone at 114 quarries compared with 64 companies producing from 112 quarries in 1979. Although most dimension stone quarries produced relatively small tonnage, 15 crushed stone quarries each produced in excess of 1 million tons of stone per year. Of the total stone tonnage, nearly 90% was produced by seven companies.

Crushed stone was produced at 66 quarries in 1980 compared with 67 quarries in 1979. Leading producers were Vulcan Materials Co.; Florida Rock Industries, Inc.; and Martin Marietta Aggregates. Shipments were mainly by truck, followed by railroad and waterway. Crushed stone was used mainly for dense-graded roadbase, concrete and bituminous aggregate, railroad ballast, and cement manufacture. Construction activity remained high in certain areas of the State. Expansion of the Atlanta airport and interstate highway work kept crushed stone production at high levels through most of the year.

Table 10.—Georgia: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	453	2,219	242	1,316
Concrete aggregate	6,992	25,530	6,940	27,829
Bituminous aggregate	7,328	25,601	7,724	30,055
Dense-graded roadbase stone	8,158	26,289	8,045	28,023
Surface treatment aggregate	1,857	5,986	2,160	7,263
Other construction aggregate and roadstone	9,051	30,428	7,461	27,018
Riprap and jetty stone	120	471	152	659
Railroad ballast	2,823	8,080	3,054	9,660
Filter stone	W	W	930	3,605
Manufactured fine aggregate (stone sand)	345	1,163	671	2,543
Cement manufacture	1,518	3,343	1,758	4,227
Other[2]	2,257	24,911	1,746	20,445
Total[3]	40,902	154,021	40,884	162,642

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes limestone, granite, marble, sandstone, and slate.
[2]Includes stone used for terrazzo and exposed aggregate, abrasives (1979), asphalt filler, whiting or whiting substitute, other fillers or extenders, flour slate (1979), lightweight aggregate, unspecified uses, and uses indicated by symbol W.
[3]Data may not add to totals shown because of independent rounding.

Table 11.—Georgia: Dimension stone[1] sold or used by producers, by use

Use	1979			1980		
	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)
Rough stone:						
Rough blocks	53,551	511	$1,545	37,368	393	$1,207
Irregular-shaped stone	37,961	428	1,727	23,732	281	868
Rubble	11,938	136	181	36,556	366	692
Monumental	111,846	1,146	5,606	110,863	1,084	5,722
Dressed stone:						
Monumental	7,688	75	1,673	13,918	152	5,835
Other[2]	21,406	240	7,176	9,059	99	3,141
Total[3]	244,390	r2,536	17,908	231,496	2,374	17,466

rRevised.
[1]Includes limestone, granite, marble, sandstone, and slate.
[2]Includes stone used for rough flagging, cut stone, sawed stone, house stone veneer (1980), curbing, and dressed flagging (1979).
[3]Data may not add to totals shown because of independent rounding.

Martin Marietta Aggregates completed an $8.5 million expansion program at its Macon Ruby Quarry in Jones County. Capacity will be increased from 1,000 tons per hour to more than 1,500 tons per hour of crushed granite. A gyratory crusher, electric shovel, and improvements to loading facilities were included in the expansion program.

Dimension stone was produced at 49 quarries in 1980 compared with 46 quarries in 1979. Dimension stone was used for rough monumental stone, dressed monumental stone, and rough blocks. The State's dimension granite industry was centered in Elbert County, northeast of Atlanta, while the dimension marble and sandstone industries were located in Pickens County, north of Atlanta. The Elberton Granite Association announced that volume of orders for dimension granite had increased 5% to 10% during the year.

Members of the Elberton Granite Association authorized a $170,000 project to build a workable prototype water jet machine to quarry Elberton granite with the use of high-pressure streams of water. A National Science Foundation grant in 1977 made possible a $70,000 study of various methods of cutting granite, and it was determined that the water jet offered the best possibilities for further development.

Talc.—The Southern Talc Co. produced talc from two mines in the Fort Mountain area of Murray County in the northern part of the State; production and value decreas-

ed. The crude talc was trucked to the company's Chatsworth mill where it was ground for use in ceramics, insecticides, roofing, rubber, and various other products.

METALS

Bauxite.—Georgia was one of three bauxite-producing States in the Nation. Bauxite was used in refractories and aluminum-based chemicals. Production decreased because of reduced demand for refractory uses. Mullite Co. of America mined and dried calcined bauxite near Andersonville.

Gold.—With the price of gold remaining at a relatively high level, panning of stream gravels increased. Exploration programs were carried out by several companies; no development plans were announced.

Iron Oxide Pigments.—Georgia was one of four States with crude iron oxide pigment production, and ranked third nationally. Ochre and umber was produced by New Riverside Ochre from surface mined material in Bartow County. Production and value both decreased by 19%.

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[1]State mineral specialist, Bureau of Mines, Tuscaloosa, Ala.

[2]Senior economic geologist, Georgia Geologic Survey, Environmental Protection Div., Georgia Department of Natural Resources.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Barite, primary:			
New Riverside Ochre Co.[1]	Box 387 Cartersville, GA 30120	Open pit mine	Bartow.
Paga Mining Co	Box 130 Cartersville, GA 30120	____do ___	Do.
Bauxite:			
Mullite Co. of America	Box 37 Andersonville, GA 31711	Open pit mine and plant.	Sumter.
Cement:			
Marquette Cement Manufacturing Co	20 North Wacker Dr. Chicago, IL 60606	Plant	Polk.
Martin Marietta Cement Corp	6901 Rockledge Dr. Bethesda, MD 20034	____do ___	Fulton.
Medusa Cement Co	Box 5668 Cleveland, OH 44101	____do ___	Houston.
Clays:			
American Industrial Clay Co	433 North Broad St. Elizabeth, NJ 07207	Open pit mines.	Warren and Washington.
Engelhard Minerals & Chemicals Corp	Menlo Park Edison, NJ 08817	____do ___	Decatur, Washington, Wilkinson.
J. M. Huber Co	Thornall St. Edison, NJ 08817	____do ___	Twiggs and Warren.
Thiele Kaolin Co	Box 1056 Sandersville, GA 31082	____do ___	Warren and Washington.
Feldspar:			
The Feldspar Corp	Box 99 Spruce Pine, NC 28777	Open pit mines and plant.	Greene and Jasper.
Gypsum:			
The Flintkote Co	400 Westchester Ave. White Plains, NY 10604	Plant	Chatham.
Georgia Pacific Corp	Box 311 Portland, OR 97207	____do ___	Glynn.
National Gypsum Co	4100 First International Bldg. Dallas, TX 75270	____do ___	Chatham.
Kyanite:			
C-E Minerals, Inc	901 East Eighth Ave. King of Prussia, PA 19406	Open pit mine and plant.	Lincoln.
Mica:			
Franklin Mineral Products Co., Inc	Box O Wilmington, MA 01887	Open pit mine	Hart.
Peat:			
Colonial Peat Co	Box 161 Newington, GA 30446	Bog	Screven.
Shep Peat Co	Box 307 Colquitt, GA 31737	Bog	Miller.
Perlite, expanded:			
Armstrong Cork Co	1010 Concord Lancaster, PA 17604	Plant	Bibb.

See footnotes at end of table.

Table 12.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel:			
Atlanta Sand & Supply Co	Route 1 Roberta, GA 31078	Open pit mine	Crawford.
Brown Bros. Sand Co	Howard, GA 31039	Open pit mines.	Talbot.
Butler Sand Co	Box 296 Butler, GA 31006	Open pit mine	Taylor.
Colwell Construction Co	Box 6 Blairsville, GA 30512	____do ___	Union.
Howard Sand Co	Box 118 Butler, GA 31006	Open pit mines.	Talbot and Taylor.
Stone:			
Florida Rock Industries, Inc	Box 4667 Jacksonville, FL 32201	Quarries ___	Fayette, Floyd, Spalding.
Georgia Marble Co	3460 Cumberland Pkwy., NW. Atlanta, GA 30303	____do ___	De Kalb, Douglas, Gilmer, Pickens.
Martin Marietta Aggregates	6801 Rockledge Dr. Bethesda, MD 20034	____do ___	Jones, Lee, Richmond, Warren.
North Georgia Crushed Stone Co., a division of Koppers Co.	Box 458 Lithonia, GA 30058	____do ___	Clarke, De Kalb, Fayette, Fulton, Habersham, Hall, Stephens, Walker.
Vulcan Materials Co	Box 7324-A, 1 Office Park Birmingham, AL 35223	____do ___	Carroll, Cobb, Coweta, Douglas, Fulton, Greene, Gwinnett, Henry, Troup.
Talc:			
Southern Talc Co	Box F Chatsworth, GA 30705	Mines and mill.	Murray.

[1]Also produced iron oxide pigments.

The Mineral Industry of Hawaii

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Department of Land and Natural Resources of the State of Hawaii for collecting information on all nonfuel minerals.

By George T. Krempasky[1]

Hawaii's nonfuel mineral production totaled $60 million in 1980, 6.6% less than the record year, 1979. Nonmetals— cement, gem stones, lime, pumice, salt, sand and gravel, and stone— accounted for the total value. Use of mineral commodities— cement, stone, sand and gravel, and pumice— was directly related to the construction industry.

Cement was manufactured at two plants in Honolulu County—Cyprus Hawaiian Cement Corp. and Kaiser Cement Corp. Each plant operated at about two-thirds of its capacity and both plants switched from oil to Australian coal during the year. Pumice, volcanic cinder, and sand and gravel were mined in Hawaii, Kauai, and Maui Counties. Crushed stone was produced from quarries in Hawaii, Honolulu, Kauai, and Maui Counties. Vermiculite imported from Montana was exfoliated in Honolulu County. Gem stone material was harvested from the waters surrounding the Hawaiian Islands.

The ocean mining industry, consisting of multinational consortia which have invested many millions of dollars in developing ocean mining technology, was buoyed by actions of the U.S. Congress and the President. On June 26, 1980, President Carter signed into law the Deep Seabed Hard Minerals Act. The law is expected to promote orderly development of deep seabed mining until an international agreement can be reached by the United Nations' Law of the Sea Conference.

Table 1.—Nonfuel mineral production in Hawaii[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland thousand short tons	469	$29,346	358	$23,722
Masonry do.	12	1,077	13	960
Pumice do.	359	1,240	314	1,200
Sand and gravel do.	1,081	3,063	1,035	2,855
Stone:				
Crushed do.	6,868	28,969	6,341	30,634
Dimension do.	1	W	W	11
Combined value of other nonmetals and value indicated by W	XX	209	XX	294
Total	XX	63,904	XX	59,676

W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

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

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Hawaii	$3,780	$5,672	Stone, pumice, sand and gravel.
Honolulu	W	W	Cement, stone, sand and gravel, salt.
Kauai	W	W	Stone, sand and gravel, pumice.
Maui	W	3,974	Sand and gravel, stone, pumice, lime, gem stones.
Total	52,748	63,904	

W Withheld to avoid disclosing company proprietary data; included in "Total."

Table 3.—Indicators of Hawaii business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	399.0	400.0	+0.2
Unemployment	do	25.0	20.0	-20.0
Employment (nonagricultural):				
Mining	do	(1)	(1)	--
Manufacturing	do	24.0	23.5	-2.1
Contract construction	do	23.4	23.9	+2.1
Transportation and public utilities	do	30.5	30.9	+1.3
Wholesale and retail trade	do	102.9	104.5	+1.6
Finance, insurance, real estate	do	31.5	33.5	+6.4
Services	do	[2]95.3	[2]98.9	+3.8
Government	do	86.5	89.0	+2.9
Total nonagricultural employment	do	394.1	404.2	+2.6
Personal income:				
Total	millions	$8,371	$9,371	+12.0
Per capita		$9,248	$9,787	+5.8
Construction activity:				
Number of private and public residential units authorized		11,035	9,880	-10.5
Value of nonresidential construction	millions	$253.3	$311.4	+22.9
Value of State road contract awards	do	$41.4	$38.9	-6.0
Shipments of portland and masonry cement to and within the State	thousand short tons	434	378	-12.9
Nonfuel mineral production value:				
Total crude mineral value	millions	$63.9	$59.7	-6.6
Value per capita, resident population		$70	$62	-11.4
Value per square mile		$9,908	$9,252	-6.6

[p]Preliminary.
[1]Included with "Services."
[2]Includes mining.

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

Hawaii is actively encouraging a manganese nodule industry for the State. Its Department of Planning and Economic Development (DPED), in a booklet entitled "State of Hawaii, Manganese Nodule Program, 1980-1985," discusses goals and objectives, history, 5-year plan, funding and program expenses, and program personnel. DPED has initiated studies related to potential impacts of tailings disposal. In addition, studies to determine the social and economic impacts and legal and economic questions are underway. The National Oceanic and Atmospheric Administration and DPED are working on a report that discusses a hypothetical plant at Kawaihoe, Big Island (Hawaii), with land disposal of tailings.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Cyprus Hawaiian Cement Corp. and Kaiser Cement Corp. operated cement plants in Honolulu County, Oahu Island. Production in 1980 decreased 23% compared with that of 1979; value of production decreased 19%. Cyprus' plant was closed approximately 2 weeks for equipment repair, and Kaiser's plant was down for 6 weeks because of a labor-management dispute. Both plants switched from oil to coal—Kaiser in June, and Cyprus in October. Coal was obtained from Newcastle, Australia.

Portland cement was used by building material dealers, concrete product manufacturers, ready-mix companies, and government agencies. The principal users were ready-mix consumers.

Lime.—The Hawaiian Commercial & Sugar Co., Ltd., produced hydrated lime at Paia, Maui County. Quantity produced remained constant; however, value increased considerably.

Pumice and Volcanic Cinder.—Pumice and volcanic cinder were extracted in Hawaii, Kauai, and Maui Counties. Fourteen operators recovered material from 15 pits for use as concrete aggregate, in road construction, and as landfill. During 1980, 80% of the total production was used in road construction, 19% was used as concrete aggregate, and 1% was used for landfill. Production declined 13% in 1980 when compared with 1979 statistics, but value declined only 3%.

Sand and Gravel.—Five companies produced sand and gravel from five pits in Hawaii, Honolulu, Kauai, and Maui Counties. Production declined about 4% when compared with the production level of 1979. Approximately 64% of the material produced was from Maui County. Main uses for the product are shown in table 4. The total production was transported by truck.

Table 4.—Hawaii: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	W	W	W	39	$168	$4.27
Asphaltic concrete	334	$1,395	$4.18	324	1,329	4.10
Roadbase and coverings	362	903	2.49	352	877	2.49
Fill	W	W	W	320	482	1.51
Total[1] or average	1,081	3,063	2.83	1,035	2,855	2.76

W Withheld to avoid disclosing company proprietary data; included in "Total or average."
[1]Data may not add to totals shown because of independent rounding.

Table 5.—Hawaii: Construction sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	540	$1,515	$2.81	519	$1,411	$2.72
Gravel	542	1,548	2.86	516	1,444	2.80
Total or average	[1]1,081	3,063	2.83	1,035	2,855	2.76

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

Stone.—Crushed and dimension stone were produced from 28 quarries in Hawaii, Honolulu, Kauai, and Maui Counties. More than 70% of the crushed stone came from Honolulu County. All material was transported to users by truck. Quarry production ranged from less than 25,000 tons per year to more than 1 million tons annually. More than 50% of the total production came from quarries producing 900,000 tons per year

or more. Eighteen companies were engaged in mining stone for various uses (table 6). Principal producers, with more than 300,000 tons per year, are listed in table 7.

[1]State mineral specialist, Bureau of Mines, Spokane, Wash.

Table 6.—Hawaii: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	16	85	W	W
Poultry grit and mineral food	2	W	W	14
Concrete aggregate	1,642	8,448	1,259	6,830
Bituminous aggregate	480	2,107	419	2,257
Macadam aggregate	W	W	W	240
Dense-graded roadbase stone	1,329	3,920	1,260	4,331
Surface treatment aggregate	146	597	130	549
Other construction aggregate and roadstone	1,454	5,082	1,417	5,618
Riprap and jetty stone	43	W	W	W
Railroad ballast	2	W	W	W
Filter stone	--	--	1	W
Manufactured fine aggregate (stone sand)	783	5,755	949	7,955
Cement manufacture	935	2,490	786	2,388
Chemicals	W	W	W	43
Bedding materials	W	W	W	19
Other uses[2]	36	486	121	389
Total[3]	6,868	28,969	6,341	30,634

W Withheld to avoid disclosing company proprietary data; included with "Other uses."
[1]Includes limestone, traprock, and miscellaneous stone.
[2]Includes lime manufacture (1980) and roofing granules (1979).
[3]Data may not add to totals shown because of independent rounding.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Cyprus Hawaiian Cement Corp	1600 Kapiolani Blvd. Honolulu, HI 96814	Cement plant	Honolulu.
Kaiser Cement Corp	Waianae Plant 300 Lakeside Dr. Oakland, CA 94666	do	Do.
Lime:			
Hawaiian Commercial & Sugar Co., Ltd.	Box 266 Puunene, HI 96784	Rotary kiln and continuous hydrator.	Maui.
Pumice and volcanic cinder:			
Allied Aggregate Inc	160 Keaa St. Hilo, HI 96720	Open pit mine	Hawaii.
Davies Hamakua Sugar Co	Paauhau, HI 96775	do	Do.
Maui Concrete & Aggregate	8 Central Ave. Wailuku, HI 96793	do	Maui.
Vulcanite Ltd	Peuwaawaa, HI 96820	do	Hawaii.
Sand and gravel:			
Amelco Corp	645 Halekauwila St. Honolulu, HI 96813	Plant and pit	Maui.
Warren Corp	Ainahaina Professional Bldg. Honolulu, HI 96821	do	Honolulu.
Stone:			
Ameron Honolulu Construction & Drayage, Ltd.	Box 29968 Honolulu, HI 96820	Quarries	Honolulu and Maui.
Cyprus Hawaiian Cement Corp	1600 Kapiolani Blvd. Honolulu, HI 96814	Quarry	Honolulu.
Grove Farm Co., Inc	Puhi Rural Station Puhi, HI 96766	Quarries	Kauai.
Lone Star Industries	400 Alabama St. San Francisco, CA 94110	Quarry	Honolulu.
Pacific Concrete & Rock Co., Ltd	2344 Pahounui Dr. Honolulu, HI 96819	Quarries	Honolulu and Maui.
Herbert Tanaka Co	Waianae, HI 96792	Quarry	Honolulu.

The Mineral Industry of Idaho

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Idaho Bureau of Mines and Geology, Idaho Department of Lands, for collecting information on all nonfuel minerals.

By D. W. Lockard,[1] M. M. Miller,[2] and E. H. Bennett[3]

Idaho's nonfuel mineral production in 1980 rose to $522 million from $438 million in 1979. This increase continued the trend started in late 1976 when commodity production expanded, and the value of metallics—notably gold and silver—rose on world markets. For 1980, these price escalations more than offset the decline in unit production attributable to mining lower grade ores and to a major labor strike.

In terms of revenue, silver again was the leading commodity, followed by phosphate rock, lead, and zinc. Metallic minerals, mostly from the Coeur d'Alene district, accounted for nearly 72% of the total mineral revenue for 1980. During the year, events were set in motion that should make Idaho a significant producer of cobalt and molybdenum.

Controversy over Federal regulations (air quality and land use classification) continued throughout the year. Late in 1980, the Governor began preparation of a new mineral severance tax proposal to be submitted to the 1981 Idaho Legislature.

Table 1.—Nonfuel mineral production in Idaho[1]

Mineral	1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
Antimony ore and concentrate, antimony content ____ short tons	W	W	83	W
Clays ____ thousand short tons	28	$263	27	$301
Copper (recoverable content of ores, etc.) ____ metric tons	3,618	7,421	3,103	7,006
Gem stones	NA	60	NA	60
Gold (recoverable content of ores, etc.) ____ troy ounces	24,140	7,423	W	W
Lead (recoverable content of ores, etc.) ____ metric tons	42,636	49,479	38,607	36,139
Phosphate rock ____ thousand metric tons	4,880	95,728	4,991	100,873
Sand and gravel[2] ____ thousand short tons	7,719	18,149	5,299	14,203
Silver (recoverable content of ores, etc.) ____ thousand troy ounces	17,144	190,129	13,695	282,663
Stone[3] ____ thousand short tons	2,952	8,787	2,007	7,240
Zinc (recoverable content of ores, etc.) ____ metric tons	29,660	24,391	27,722	22,876
Combined value of cement, garnet (abrasive), gypsum, lime, perlite, pumice, sand and gravel (industrial), stone (dimension), tungsten (1980), vanadium, and values indicated by symbol W	XX	36,055	XX	50,734
Total	XX	437,885	XX	522,095

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes industrial sand; value included in "Combined value" figure.
[3]Excludes dimension stone; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Idaho, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Ada	$2,791	W	Sand and gravel, gold, silver, copper, lead.
Adams	W	W	Copper, stone, silver.
Bannock	W	W	Cement, sand and gravel, stone, gold, silver, lead, copper, zinc.
Bear Lake	772	W	Sand and gravel, stone, silver, lead, copper.
Benewah	W	W	Garnet, sand and gravel, clays, stone.
Bingham	W	W	Phosphate rock, sand and gravel, pumice.
Blaine	W	W	Lead, silver, gold, copper.
Boise	(2)	W	Stone, gold, silver, lead, copper, zinc.
Bonner	345	W	Sand and gravel, silver, lead, gold, zinc, copper.
Bonneville	2,712	$3,258	Sand and gravel, pumice, stone.
Boundary	121	W	Sand and gravel, stone.
Butte	--	(2)	Silver, copper, lead.
Canyon	W	W	Sand and gravel, lime.
Caribou	81,352	98,104	Phosphate rock, vanadium, stone, sand and gravel.
Cassia	W	W	Sand and gravel, stone, silver, lead, gold, copper, zinc.
Clark	W	84	Sand and gravel, stone, clays.
Clearwater	466	430	Stone.
Custer	1,130	1,750	Silver, lead, zinc, stone, copper, gold.
Elmore	W	W	Sand and gravel, clays, gold, silver, lead, copper.
Franklin	158	174	Stone, sand and gravel.
Fremont	533	702	Do.
Gem	1,697	1,918	Sand and gravel, stone.
Gooding	W	W	Sand and gravel.
Idaho	W	W	Stone, sand and gravel.
Jerome	115	--	
Kootenai	W	1,474	Sand and gravel, silver, gold, stone, copper, lead.
Latah	W	W	Stone, clays.
Lemhi	139	W	Lead, silver, sand and gravel, gypsum, gold, zinc, copper, stone.
Lewis	171	117	Stone.
Lincoln	148	3	Sand and gravel.
Madison	1,822	1,639	Do.
Minidoka	W	W	Lime, sand and gravel.
Nez Perce	1,342	W	Stone, sand and gravel, silver, lead, copper.
Oneida	W	W	Perlite, pumice.
Owyhee	W	W	Silver, gold.
Payette	130	130	Sand and gravel.
Power	350	44	Do.
Shoshone	W	W	Silver, lead, zinc, copper, gold, antimony.
Teton	40	--	
Twin Falls	W	W	Sand and gravel, lime.
Valley	146	249	Sand and gravel, stone.
Washington	W	W	Gypsum, stone.
Undistributed[3]	202,743	327,809	
Total	[4]299,227	437,885	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Camas and Jefferson Counties are not listed because no nonfuel mineral production was reported.
[2]Less than 1/2 unit.
[3]Includes some gem stones that cannot be assigned to specific counties and values indicated by symbol W.
[4]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Idaho business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	422.0	424.0	+0.5
Unemployment	do	24.0	33.0	+37.5
Employment (nonagricultural):				
Mining	do	4.3	4.6	+7.0
Manufacturing	do	58.3	54.9	-5.8
Contract construction	do	19.1	16.7	-12.6
Transportation and public utilities	do	20.5	20.4	-.5
Wholesale and retail trade	do	83.4	81.4	-2.4
Finance, insurance, real estate	do	23.4	23.5	+.4
Services	do	59.4	60.8	+2.4
Government	do	69.6	69.2	-.6
Total nonagricultural employment	do	338.0	331.5	-1.9

See footnotes at end of table.

Table 3.—Indicators of Idaho business activity —Continued

		1979	1980[p]	Change, percent
Personal income:				
Total	millions	$6,905	$7,682	+11.2
Per capita		$7,632	$8,126	+6.5
Construction activity:				
Number of private and public residential units authorized		8,974	5,374	-40.1
Value of nonresidential construction	millions	$116.0	$96.1	-17.2
Value of State road contract awards	do	$50.7	$23.5	-53.6
Shipments of portland and masonry cement to and within the State	thousand short tons	473	364	-23.0
Nonfuel mineral production value:				
Total crude mineral value	millions	$437.9	$522.1	+19.2
Value per capita, resident population		$484	$553	+14.3
Value per square mile		$5,241	$6,248	+19.2

[p]Preliminary.

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

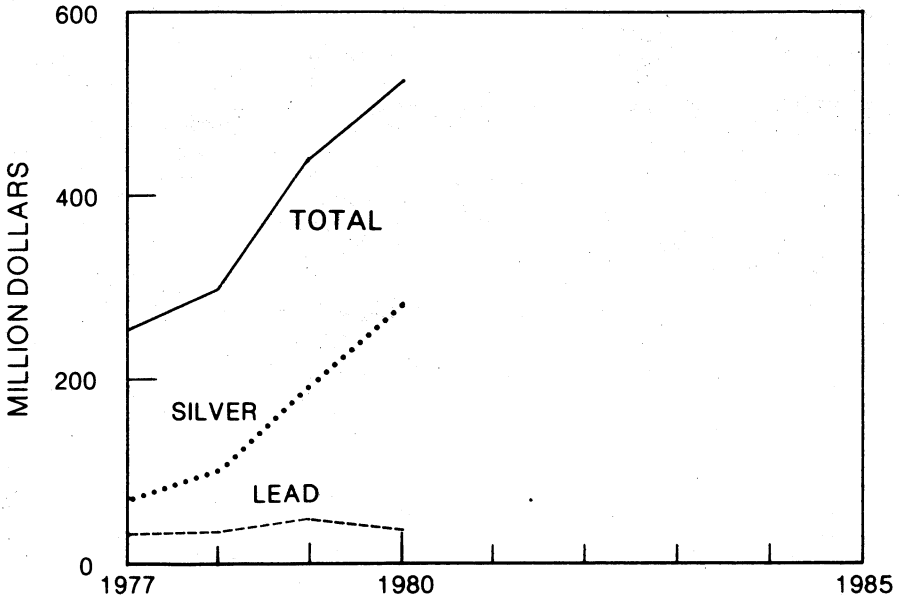

Figure 1.—Value of silver and lead, and total value of nonfuel mineral production in Idaho.

Trends and Developments.—Sometime during the past 2 years, the Coeur d'Alene mining district exceeded the total production of Potosí, Bolivia, to become the largest silver-producing district in the world. Total production from the Bolivian mines, discovered by the Spanish around 1514, is estimated to have been 875 to 900 million ounces, while the Coeur d'Alene district, discovered in 1884, has produced an estimated 936 million ounces. Total metal production value from the district, through 1980, is believed to be nearly $4 billion.

Projected costs of new mineral projects started in the Coeur d'Alene district in 1980 exceed $76 million. This includes sinking the Silver Shaft at Hecla's Lucky Friday Mine ($27 million), sinking a new shaft at Callahan Mining Corp.'s Caladay Project ($26 million), rehabilitating and reopening the Silver Summit Mine and Polaris mill by Consolidated Silver ($12 million), sinking the new No. 12 shaft at the Sunshine Mine ($4.5 million), and deepening the Crescent shaft ($1.6 million). Capital costs of exploration agreements between Coeur d'Alene operators that were signed during the year are conservatively estimated to be worth $4 million. Bunker Hill began expanding its electrolytic silver refinery ($1.5 million), and Sunshine Mining Co. started construction on its silver refinery ($6 million). The refinery will use a modified nitric-sulfuric acid pressure leach process that was developed by Sunshine and the U.S. Bureau of Mines.

The Bunker Hill Co. shut down its electrolytic zinc plant from late June to early August because the company could not obtain a sufficient supply of zinc concentrates; nearly 400 hourly employees were affected. Also, the company and employees signed a new 3-year labor contract in early fall. Early in the year, Placid Oil Co., a Hunt family subsidiary, made a $500 million tender offer for Gulf Resources and Chemical, the Bunker Hill parent company; the offer was subsequently refused, although Placid Oil did acquire 11.34% of Gulf Resources. Legal problems surrounding the Bunker Hill smelter continued throughout the year, and at one point it was widely rumored that the smelter was for sale for $150 million. In January, a Federal judge imposed a "gag order" on all parties involved in a lawsuit filed against the company by parents of Kellogg children because blood tests on the children showed high lead levels; the suit is for $20 million. The company denied smelter access to Environmental Protection Agency inspectors. The courts later ordered the company to allow the inspectors to proceed, pending an appeal. Because of legal and technical errors in safety inspections, the Occupational Safety and Health Administration (OSHA) dropped nearly $35,000 in fines it had levied against Bunker Hill. Another list (84 pages) of violations was presented to the company by OSHA in September, and the company expects to appeal all or most of these; fines for the alleged violations could exceed $82,000.

Production from the Sunshine Mine, normally the Nation's largest silver producer, declined significantly in 1980 because of an 8-1/2-month labor strike (March to November). The mine was run by supervisory personnel during this period. The strike slowed development on the No. 12 shaft. When operational, the shaft is expected to facilitate ore handling from the Sunshine Unit Area and enable the company to expand production to 6.5 million ounces in 1982 and eventually to 7.5 million ounces annually. In a unique capital raising venture, Sunshine issued $30 million in silver-backed bonds that can be redeemed for cash or silver bullion. The bonds pay 8-1/2% annual interest, and face value may be redeemed at maturity for $1,000 in cash or 50 ounces of silver, whichever is greater. Early in the year, Arab Investors S.A. purchased an additional 500,000 shares of Sunshine stock, bringing its total to 1.5 million shares for a 26% interest in the company.

Consolidated Silver Corp. announced approval of a joint lease venture between Hecla Mining Co., Coeur d'Alene Mines Corp., Silver Dollar Mining Co., and Sunshine Mining Co. to reopen the Silver Summit Mine, located between the Sunshine and Coeur Mines; Hecla Mining Co. is to be the property operator. The agreement covers extending the present shaft depth to 5,524 feet, 10,000 feet of drifting, and nearly 20,000 feet of exploration drilling; estimated project employment is 60.

Coeur d'Alene Mines Corp. continued exploration work on the CAMP Project (Coeur d'Alene Mines, Merger Mines, Plainview Mining) adjacent to the Coeur Mine. The company entered into an exploration program with Royal Apex Silver, Inc., on property it holds north of Osburn. The company's Coeur Mine, operated by ASARCO Incorporated, was the third leading silver

producer in the country during 1980.

Callahan Mining Corp. announced early in 1980 that it would undertake a major shaft sinking program on its Caladay property. Plans call for the shaft to be 5,100 feet deep; in June the shaft contract was let to Wallace Diamond Drilling Co. of Osburn. The structure will be a three-compartment timbered shaft, and sinking will take 4-1/2 years; it is planned to exploration drill and develop mining levels as shaft sinking proceeds.

Hecla's Lucky Friday and Star-Morning Mines operated at capacity during 1980. The company awarded a contract to J. S. Redpath Corp. to construct a new 7,700-foot shaft, called the Silver Shaft, at the Lucky Friday Mine. The shaft, 18 feet in diameter and concrete lined, will be the first circular shaft in the district. It is currently planned to reach the 5,500-foot level by late 1983, and production from the first mining level (5,300 feet) is scheduled by 1985. Production from the Lucky Friday should increase to 1,000 short tons per day at that time. This new access should allow increased production from Day's Hunter Ranch area and the DIA (Day Mines, Independence, and Abot) Project. Hecla was awarded $424,000 in a legal dispute with the Bunker Hill Co. involving ore concentrate purchases from the Star-Morning Mine, of which Bunker Hill controls 70%.

Asarco, operator of the Galena and Coeur Mines, worked out an agreement between Coeur d'Alene Mines Corp. and American Silver Mining Co., whereby Asarco will undertake exploration and development work on American Silver's ground near the Coeur Mine. Exploration will start on the 3,400-foot level from the Coeur Mine and cost $3 to $4 million.

Diamond drilling and other exploration efforts were conducted by Newmont Exploration, Ltd., on ground controlled by Capital Silver Mines, Inc., north of Wallace.

Numerous small firms were quite active in the district, including Merger Mines, Beacon Light Mining Co., Magna Mining Co., and Silver Star Mines, Inc. Because of high precious metal prices during the year, exploration activities occurred throughout the district's 26-mile length.

High commodity prices also meant activity upswings in the remainder of the State. Two major events, one each in Custer and Lemhi Counties, gathered most of the attention. Cyprus Mines Corp., recently acquired by AMOCO Standard Oil Co. (Indiana), announced plans for what will be the largest open pit mine in the State, the Thompson Creek Molybdenum Project in Custer County. A draft environmental impact statement on the project was released in early summer; public hearings were held, and a final statement was due in early 1981. Plans call for preproduction stripping and mill construction to begin in 1981, with mining to start in 1983. The open pit is projected to be 1 mile across and 1,600 feet deep at the high wall. With the ore body averaging 0.18% MoS_2, daily ore production is expected to reach 20,000 to 25,000 short tons for an annual yield of 17 to 20 million pounds of molybdenum. Anticipated mine life is 20 years. Cyprus estimates that nearly $300 million will be invested in the mine, mill, tailings pond, and ancillary facilities. Employment should reach about 550 people by 1983, with an annual payroll approaching $16 million. The total impact of this operation should raise the population of Custer County by nearly 40%.

In nearby Lemhi County, Noranda Mining Inc. announced the reopening of the Blackbird Mine, a past producer of cobalt and copper. The company began work on a draft environmental statement in September 1980. Noranda is spending in excess of $1 million per month for exploration, mine rehabilitation, water treatment plant construction, and mill refurbishing. Preproduction costs are estimated in the range of $150 to $200 million. Ore grade averages 0.6% Co and 1.6% Cu on defined reserves of 4 million tons; expected mill capacity is 2,000 tons per day. Underground mining methods will be utilized, and eventually a new shaft may be sunk. At yearend, employment reached 165; this is expected to be 400 to 600 when full production is attained. A major part of Noranda's effort includes environmental problems associated with a large-scale operation close to a wilderness area (River of No Return Wilderness). In this respect, the company has completed a 400-gallon-per-minute water treatment facility ($1 million). Other concerns involve a reclamation plan and tailing impoundment construction.

Earth Resources operated the Delamar open pit mine and mill at above design capacity for the year. At yearend, Earth Resources was merged into MAPCO, Inc., of Tulsa, Okla., through a stock tender offer; MAPCO subsequently announced the Delamar operation would be expanded in the near future. Increased metal prices extend-

ed reserves at the mine to more than 20 years. Other companies active in Owyhee County included Denison Mines and Freeport Minerals, who reportedly staked a large claim block north of the Delamar town site.

In Boise County, AMAX Inc. did more exploration drilling on its CUMO molybdenum prospect at Grimes Creek. Abella Resources did further evaluation on its Little Falls molybdenum prospect north and across the Payette River from the AMAX property. The Missouri Mine near Pioneerville was in operation during the year. Numerous small operators were probing in the Boise Basin area, an old gold mining region.

The Banner Mining Co., a joint venture between Silver Chief Mining Co. and National Resources, Ltd., of Dallas, Tex., continued development work on the Banner Mine outside of Idaho City. The company expended more than $1 million on mine rehabilitation work and expects to ship ore in 1981.

Several areas in Custer County had increased mineral activities during the year. Small gold-silver lode and placer operations were very active. Myko, Inc., shipped ore from the Phi Kappa Mine to its mill at Mackay, and production of lead-silver ore was reported from the Greyhound Mine near Seafoam. Tungsten ore was stockpiled at the Tungsten Jim property on Thompson Creek. Denison Mines made plans to evaluate the Lost Packer Mine, a dormant copper producer near Loon Creek. The Anaconda Company helicoptered a large drill rig into the Pioneer-Tango Creek area in preparation of drilling a newly discovered molybdenum showing. U.S. Antimony Corp. operated a 100-ton-per-day gold mill on the Yankee Fork of the Salmon River; mill feed consisted of dump material from the Charles Dickens Mine. Further north, Sunbeam Mining Corp. constructed three test gold heap-leach pads and a building to house gold recovery equipment; the plant uses a zinc-cyanide extraction process. Inspiration Development Co. continued work in the Bayhorse mining district west of Challis. The company now holds a significant land position and controls the Bayhorse, Pacific, Ramshorn, and Keystone Mines in the area; commodities located include silver, lead, and fluorspar. Bear Creek Mining Co., a Kennecott Corp. subsidiary, evaluated and later dropped options on a tungsten property in the Wildhorse Creek area north and west of Mackay.

Numerous exploration projects were underway in Lemhi County. Brenda Mines, Ltd., continued work on a molybdenum property on Spring Creek, near Shoup. Inspiration Development Co. continued feasibility studies on the Ima Mine, a dormant tungsten producer near Patterson, and further evaluated the Salmon River Copper Mine. COMINCO Ltd. drilled several holes on its recent molybdenum discoveries at Napoleon Ridge, north of Salmon. Cal-Ida Mines reportedly drilled a copper prospect on McDivett Creek, southeast of Salmon.

Canadian Superior Mining (U.S.) Ltd. did no further testing of its proposed gold heap leaching operation at Stibnite, Valley County. Work progressed by the U.S. Forest Service and an independent consultant on the draft environmental impact statement, which should be released in early 1981. The Golden Reef Joint Venture recovered gold from its operation at the Dewey Mine, about 20 miles east of Stibnite.

After being closed for a short time by the State for failure to submit an adequate reclamation plan, Silver King Mines continued operations at its Copper Cliffs Mine and mill at Cuprum, Adams County. The mill also processed ore from Texasgulf's Iron Dyke Mine in Oregon. Numerous claims were made in the press concerning Anglo-Bomarc Ltd.'s Hercules property near Cambridge. Media reports stated that this would be the largest open pit silver mine in the world. Anglo-Bomarc did complete an agreement with TRV Minerals, Inc. (Twin Rivers Development), which anticipates spending $1 million on the property this year, with $4 million to be spent during the next few years. This would give TRV a 51% share of the property.

In the Panhandle (northern counties), operators were pursuing good precious and base-metal target areas. Shipments from the Silver Strand Mine were made to Asarco's Tacoma smelter before the copper workers' strike; ore was then stockpiled for future shipping. Shoshone Silver Mining Co. milled 600 short tons of ore from an open pit at the Weber and Keep Cool Mines. Painted Desert and Uranium Co. announced it had entered into an agreement with Union Carbide Corp. concerning the Elk Mountain tungsten property near Coeur d'Alene.

In the nonmetallic sector, J. R. Simplot Co. announced it was making plans to develop its new Smokey Canyon Mine, a 2-

million-ton-per-year phosphate operation in Caribou County. Construction at the mine site is set for 1982, with production scheduled for 1984; identified reserves are expected to last 30 years. A unique feature will be the use of a 25-mile slurry pipeline from the mine to the plant at Conda. Work is well underway on the draft environmental statement.

Oneida Perlite Co. is building a new filler plant and plans to install five new furnaces for producing expanded perlite for the ceramic insulation market. It is also entering the precast panel construction business for building industrial firewall panels.

NL Baroid, a division of NL Industries Inc., plans to build a barite processing plant that should be completed by 1985 in the Hailey area of Blaine County; the barite will come from the Old Soldier and Bonnie May Claims. Cash Industries of Ketchum, operated a 100-ton-per-day barite processing mill on Warm Springs Creek. The company plans to start underground mining next year and has 5 to 7 years of reserves blocked out.

Industrial minerals used in the construction industry suffered through a declining year. Demand slackened and resulted in a fallback of production.

Legislation and Government Programs.—A bill creating the "River of No Return Wilderness" was approved by Congress and signed by President Carter during the year. The law created a 2.2-million-acre wilderness in the central part of the State, and was unique in that it set up a special mineral management zone. This zone, containing 39,000 acres, will be managed as wilderness; however, it has a high potential to contain significant strategic mineral deposits (cobalt) and will be further evaluated by the Department of Defense. If minable deposits of the metal are located, they can be extracted without special restrictions. In August, Noranda Exploration Co. staked numerous claims in this special management zone.

Out of a total of 11.9 million acres in Idaho, the Bureau of Land Management identified 1.6 million acres in 61 separate units for wilderness study areas. Special regulations have been drafted for mineral operations in these areas.

U.S. Department of the Interior mineral resource agencies were involved in mineral appraisal studies in the State. The U.S. Geological Survey worked in the Ten Mile area, while the Bureau of Mines worked in the Selway-Bitterroot Wilderness area.

The 45th Idaho Legislature, second regular session, met for 3 months and dealt with several bills that would affect the State's mineral industry. Many of the measures dealt with prohibiting dredge mining. One bill, to provide for enforcement of certain provisions of the Stream Channel Protection Act, was enacted. Bills raising the bond requirements for both surface and dredge mining were signed into law. A key bill to allow the prepayment of property tax for new businesses was also enacted. This bill was specifically intended to enable Cyprus Mines Corp. to prepay taxes to Custer County to help alleviate the impact of increased employment in regard to the Thompson Creek Molybdenum Project.

The Idaho Bureau of Mines and Geology (IBMG) continued to be active in delineating the State's geological and mineral resources. A new 1:250,000-scale map series was started during the year. These maps, prepared under a cooperative agreement with the U.S. Geological Survey, U.S. Bureau of Mines, U.S. Forest Service, and U.S. Bureau of Land Management, are designed to show all mines and prospects in the State; the first 10 maps are scheduled for release in 1981. Geologists continued field mapping and geological reconnaissance in Custer and Owyhee Counties; mapping also continued in Washington and Adams Counties. A program, in cooperation with the U.S. Geological Survey, to evaluate the phosphate resources in southeastern Idaho progressed with completion of the Upper Valley 7.5-minute quadrangle map. A publication is soon to be released covering a bibliography of papers relating to the Phosphoria Formation. IBMG noted a healthy rise in publication sales, nearly one-third more than those in 1979.

The Mining and Mineral Resources and Research Institute at the University of Idaho received $49,656 in new and continuing research grants, in addition to its annual allotment grant of $110,000. The money is to cover research in the extractive metallurgy and environmental research areas.

Employment.—At yearend, 4,600 people were employed directly in mining, an increase of nearly 7% from that reported at the end of 1979. The reported increase in metal mining for the same period was almost 10%. Total mineral industry employment in the State reached an estimated 12,500 at the end of 1980, including the approximately 700 construction workers at Cyprus's Thompson Creek Molybdenum Project.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Antimony.—Production dropped significantly in 1980 because of a labor strike at the Sunshine Mine, the State's sole producer. Reported production was only 20% of that for 1979; value was reduced a corresponding amount.

Cobalt.—There was no recorded production for 1980. Noranda Mining Inc. continued development work at its Blackbird Mine, Lemhi County, and nearly completed refurbishing the concentrator.

Copper.—In 1980, copper was produced from 12 mines in the State. Nearly 88% of the State total came from eight mines in the Coeur d'Alene district. Asarco's Coeur Mine was the largest producer, followed by the Galena Mine, and Hecla's Lucky Friday; only the Coeur and Galena produced more than 1 million pounds. The Copper Cliff Mine in Adams County, operated by Silver King Mines, Inc., was the only significant producer outside the Coeur d'Alenes. For the year, Idaho ranked ninth in the Nation. No large copper exploration program was reported in Idaho in 1980.

Table 4.—Idaho: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Lode mines producing	Material sold or treated (metric tons)	Gold		Silver	
			Troy ounces	Value	Troy ounces	Value
1978, total	26	2,171,546	20,492	$3,966,229	18,379,417	$99,248,848
1979, total	34	2,121,412	24,140	7,423,057	17,144,209	190,129,279
1980:						
Blaine	2	42	W	W	214	4,417
Boise	1	417	W	W	335	6,914
Kootenai	1	559	W	W	4,623	95,419
Lemhi	1	1,063	W	W	16,863	348,052
Nez Perce	1	147	--	--	2,273	46,915
Shoshone	9	1,405,856	2,639	1,616,546	12,021,191	248,117,382
Undistributed[1]	6	790,471	W	W	1,649,403	34,043,677
Total	21	[2]2,198,556	W	W	13,694,902	282,662,776

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1978, total	3,888	$5,700,750	44,761	$33,255,690	32,353	$22,110,812	$164,282,329
1979, total	3,618	7,420,583	42,636	49,479,186	29,660	24,390,724	278,842,829
1980:							
Blaine	--	--	1	1,382	--	--	W
Boise	--	--	1	1,174	--	--	W
Kootenai	(3)	(3)	1	893	--	--	126,117
Lemhi	(3)	(3)	212	198,118	--	--	652,222
Nez Perce	--	--	5	4,445	--	--	51,360
Shoshone	2,729	6,160,892	38,140	35,702,229	27,677	22,838,447	314,435,496
Undistributed[1]	374	844,874	247	231,009	46	37,817	W
Total	3,103	7,005,766	38,607	36,139,250	[2]27,722	22,876,264	W

W Withheld to avoid disclosing company proprietary data.
[1]Includes Adams, Custer, and Owyhee Counties combined to avoid disclosing company proprietary data.
[2]Data do not add to total shown because of independent rounding.
[3]Included in "Undistributed" in order to avoid disclosing company proprietary data.

Table 5.—Idaho: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1980, by class of ore or other source material

Source	Number of mines	Material sold or treated (thousand metric tons)	Gold (troy ounces)	Silver (thousand troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:							
Dry gold, gold-silver, and silver[1]	12	1,396,379	W	12,086	2,484	13,584	1,607
Copper, lead, lead-zinc, and zinc[1]	9	802,177	W	1,609	618	25,023	26,115
Total lode material	21	2,198,556	W	13,695	[2]3,103	38,607	27,722

W Withheld to avoid disclosing company proprietary data.
[1]Combined to avoid disclosing company proprietary data.
[2]Data do not add to total shown because of independent rounding.

Table 6.—Idaho: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1980, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (thousand troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:					
Cyanidation and direct smelting of ore[1]	W	1,573	6	225	--
Smelting of concentrates	2,692	12,122	3,096	38,382	27,722
Total	W	13,695	[2]3,103	38,607	27,722

W Withheld to avoid disclosing company proprietary data.
[1]Combined to avoid disclosing company proprietary data.
[2]Data do not add to total shown because of independent rounding.

Gold.—Idaho ranked seventh in the Nation in gold production in 1980. The value of production was more than double that of the previous year. MAPCO Inc.'s Delamar Mine, formerly owned by Earth Resources Co., and Hecla's Lucky Friday Mine were the State's leading producers. MAPCO announced at yearend that plans would be made to expand production at the Delamar Mine. Coeur d'Alene district gold production remained constant when compared with that of previous years.

Iron ore.—There was no reported production of iron ore in the State for 1980.

Lead.—Idaho ranked second in the Nation in 1980 in lead production, accounting for almost 7% of the newly mined total. Production and value both decreased when compared with those of 1979, primarily because of decreased lead output at the Lucky Friday Mine. Lead was produced at 16 mines, with 9 mines in the Coeur d'Alene district accounting for 99% of the State's total production; the Hilltop Mine (Lemhi County) and the Clayton Mine (Custer County) accounted for most of the remainder. The Bunker Hill Mine was the largest lead producer, followed closely by Hecla's Lucky Friday and Star Mines.

Molybdenum.—There was no recorded production in the State for 1980. This is expected to change in the near future when Cyprus Mines' Thompson Creek Mine comes onstream. Also, Inspiration Development Co. may produce molybdenum concentrates from the Ima Mine in Lemhi County by 1982.

Silver.—Although silver production decreased 25% when compared with that reported in 1979, Idaho still was the leading producing State in 1980, accounting for nearly 44% of the newly mined metal. Primary reasons for the decrease were the shutdown at the Sunshine Mine, resulting from a labor contract expiration, and the mining of lower grade ores. During 1980, only at Asarco's Coeur Mine, Hecla's Lucky Friday Mine, and MAPCO's Delamar Mine did silver production exceed that reported in 1979. Ranked nationally, Idaho's mines held 4 of the top 10 positions in silver production. The Galena was the Nation's top silver producer, followed by the Lucky Friday and the Coeur; the Delamar (Owy-

hee County) was ranked sixth. Four Idaho mines were in the second 10, led by the Sunshine Mine, which was 12th.

Although production decreased, rapid price fluctuations during the year caused silver revenues to reach an alltime high, up 49% more than reported in 1979.

Tungsten.—Tungsten production was reported from a small operator in Valley County; no production was reported in the State in 1979. Inspiration Development Co. continued to delineate tungsten resources at the inactive Ima Mine in Lemhi County.

Vanadium.—Production and value of vanadium pentoxide slipped slightly below the figures reported in 1979. Kerr-McGee Corp. was the sole producer from its plant at Soda Springs, Caribou County; the vanadium was recovered from ferrophosphorous slag. Idaho ranked third in the Nation in 1980 in vanadium output from domestic ores.

Zinc.—Idaho ranked fifth nationally in production of newly mined zinc during 1980. Output for the year was down slightly as a result of lower zinc production from Hecla's Star Mine. Production was from eight mines; of these, six in the Coeur d'Alene district recorded nearly 99% of total output. The Bunker Hill Mine was the State's largest producer, followed by the Star Mine. The Clayton Mine and the Phi Kappa Mine, both in Custer County, were the other two producers.

NONMETALS

Abrasives (Natural).—Production came from one operator with two properties in Benewah County. Output was nearly 77% more than that reported in 1979; value was almost doubled.

Barite.—There was no reported production of barite in Idaho in 1980. However, it was known that deposits in Custer and Blaine Counties were being worked during the year.

Cement.—Output of cement from Oregon Portland Cement Co.'s plant at Inkom, Bannock County, continued throughout the year.

Clays.—Output for 1980 remained nearly level with that reported in 1979, while values received rose slightly. Interpace Corp. was the State's largest producer of common clay from various pits, mostly in Benewah County; the company accounted for more than 50% of the State's total output. United States Gypsum Co.'s lease in Latah County was the largest producer of fire clay. Other production was reported from Clark and Elmore Counties.

Gem Stones.—Jasperoids and fire opals (Owyhee County), star garnets (Benewah County), and opals (Clark County) were recovered and sold within the State in 1980.

Gypsum.—Output for the year nearly doubled that reported in 1979. There were two producers, one each in Lemhi and Washington Counties. There was no reported calcined gypsum produced in the State during the year.

Lime.—All lime production was consumed in the State's agricultural industry (sugar beet processing). Output and value both rose for 1980 when compared with that reported in 1979 by 28% and 36%, respectively. Production occurred in Canyon, Minidoka, and Twin Falls Counties. Amalgamated Sugar Co. was the State's leading lime producer.

Perlite.-Oneida Perlite Co. in Oneida County continued to be the State's only producer of crude and expanded perlite. Output and value both increased in 1980 when compared with that reported in 1979. End uses of the expanded material were primarily for insulation and horticultural aggregates.

Phosphate Rock.—Idaho's production ranked second in the Nation for 1980. Total marketable production increased only slightly for the year when compared with that produced in 1979. Five companies produced from six mines. J. R. Simplot Co. was the State's largest producer, with production from the Gay and Conda Mines.

Public hearings were held on the proposed Smokey Canyon Mine being developed by J. R. Simplot Co. The mine is scheduled for operation in 1984 with a production rate of 2 million tons of phosphate rock per year; capital costs are estimated at $20 million.

Pumice and Volcanic Cinders.—Both output and value of pumice production rose in 1980 from that reported in 1979. Output increased 11%, while value received increased more than 40%. In 1980, there were three producers operating from three quarries; Producer's Pumice was the largest from its pit in Bonneville County. All the material produced was used in lightweight concrete aggregate.

Sand and Gravel.—Construction sand and gravel output fell below the 1979 reported level, although value per ton produced rose. The production dropoff can be attributed to decreased activity in the construction industry throughout the State. MONROC Inc. was the leading producer, utilizing operations in six different coun-

ties; other notable producers included Strang Sand and Gravel and R & T Construction. Production from Ada and Canyon Counties exceeded 1 million tons.

Martin Marietta Aggregate was the State's only producer of industrial sand from a deposit in Gem County. Output fell below that reported in 1979.

Table 7.—Idaho: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	2,402	$6,255	$2.60	2,194	$6,543	$2.98
Plaster and gunite sands	21	W	W	16	71	4.44
Concrete products	180	479	2.66	359	807	2.25
Asphaltic concrete	755	2,246	2.98	419	1,375	3.28
Roadbase and coverings	r3,491	7,476	2.14	1,963	4,602	2.34
Fill	579	941	1.62	301	706	2.35
Snow and ice control	W	49	W	29	37	1.28
Railroad ballast	183	429	2.35	--	--	--
Other	109	274	r2.51	19	61	3.21
Total[1] or average	7,719	18,149	2.35	5,299	14,203	2.68

rRevised. W Withheld to avoid disclosing company proprietary data; included in "Other."
[1]Data may not add to totals shown because of independent rounding.

Table 8.—Idaho: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	2,029	$4,931	$2.43	1,690	$4,745	$2.81
Gravel	5,690	13,218	2.32	3,609	9,458	2.62
Total or average	7,719	18,149	2.35	5,299	14,203	2.68
Industrial sand	W	W	W	W	W	14.22
Grand total or average	W	W	W	W	W	2.95

W Withheld to avoid disclosing company proprietary data.

Stone.—Stone output came from 46 quarries in 20 counties. The decrease in output from 1979 was the result of operating 18 fewer quarries in 1980 because of the decrease in demand. The U.S. Forest Service produced 24% of the total stone output for 1980.

[1]State mineral specialist, Bureau of Mines, Spokane, Wash.
[2]Director, Idaho Bureau of Mines and Geology, Moscow, Idaho.
[3]Associate director, Idaho Bureau of Mines and Geology, Moscow, Idaho.

Table 9.—Idaho: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	--	--	29	86
Poultry grit and mineral food	5	15	5	16
Dense-graded roadbase stone	122	324	41	123
Surface treatment aggregate	795	1,593	365	1,062
Other construction aggregate and roadstone	844	2,230	408	1,050
Riprap and jetty stone	369	796	419	1,673
Railroad ballast	--	--	55	104
Chemicals	31	93	--	--
Paper manufacture	50	117	17	45
Other[2]	736	3,620	668	3,082
Total[3]	2,952	8,787	2,007	7,240

[1]Includes limestone, granite, sandstone, traprock, and miscellaneous stone (1980).
[2]Includes bituminous aggregate, cement manufacture, flux stone, roofing granules, and other uses.
[3]Data may not add to totals shown because of independent rounding.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Emerald Creek Garnet Milling Co	Box 176 Fernwood, ID 83830	Placer mine	Benewah.
Idaho Garnet Abrasive Co	Box 1080 Kellogg, ID 83837	Placer mine and plant.	Do.
Antimony: Sunshine Mining Co	Box 1080 Kellogg, ID 83837	Mine, mill, plant	Shoshone.
Cement: Idaho Portland Cement Co	Old National Bank, Rm 622 Inkom, ID 83245	Surface mine and plant.	Bannock.
Clays:			
A. P. Green Refractories (U.S. Gypsum)	Box 158 Troy, ID 83871	do	Latah.
Interpace Corp	Box 785 Ione, CA 95640	Surface mine	Benewah.
J. R. Simplot Co	Box 912 Pocatello, ID 83201	do	Latah.
Copper:			
ASARCO Incorporated	Box 440 Wallace, ID 83873	Mine and mill	Shoshone.
The Bunker Hill Co	Box 29 Kellogg, ID 83837	Mine, mill, plant	Do.
Hecla Mining Co	Box 320 Wallace, ID 83873	do	Do.
Silver King Mines Inc	1204 Deseret Bldg. Salt Lake City, UT 84111	Surface mine and mill.	Adams.
Sunshine Mining Co	Box 1080 Kellogg, ID 83837	Mine and mill	Shoshone.
Gold:			
Hecla Mining Co	Box 320 Wallace, ID 83873	do	Shoshone.
MAPCO Inc	Box 52 Jordan Valley, OR 97910	Surface mine and mill.	Owyhee.
Gypsum:			
Consumers Coop Association	502 Pioneer Rd. Weiser, ID 83672	Surface mine	Washington.
E. J. Wilson & Sons	Dubois, ID 83423	do	Lemhi.
Lead:			
ASARCO Incorporated	Box 440 Wallace, ID 83873	Mine and mill	Shoshone.
The Bunker Hill Co	Box 29 Kellogg, ID 83837	Mine, mill, plant	Do.
Clayton Silver Mines	Box 890 Wallace, ID 83873	Mine and mill	Custer.
Hecla Mining Co	Box 320 Wallace, ID 83873	do	Shoshone.
Lime: Amalgamated Sugar Co	First Security Bank Bldg. Ogden, UT 84402	Plant	Various.
Perlite: Oneida Perlite Corp	Box 162 Malad City, ID 83552	Surface mine and plant.	Oneida.
Phosphate rock:			
Conda Partnership	Box 37 Conda, ID 83230	do	Caribou.
J. R. Simplot Co	Box 912 Pocatello, ID 83201	do	Various.
Monsanto Co	800 North Lindbergh St. Louis, MO 63166	Surface mine	Caribou.
Stauffer Chemical	Star Route Randolph, UT 84064	do	Do.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Pumice:			
Amcor, Inc	Box 1141 Idaho Falls, ID 83401	Quarry	Bonneville.
Hess Pumice Products	Box 209 Malad City, ID 83252	do	Oneida.
Producers Pumice	6001 Fairview Ave. Boise, ID 83704	do	Bonneville.
Sand and gravel:			
Bonneville County Engineer	Idaho Falls, ID 83401	Pits	Do.
MONROC Inc	Box 1221 Idaho Falls, ID 83401	do	Various.
R & T Construction	9755 Highway 55 Boise, ID 83703	Pit	Ada.
Strang Sand and Gravel	6703 East Flamingo Nampa, ID 83651	Pit	Canyon.
Silver:			
ASARCO Incorporated	Box 440 Wallace, ID 83873	Mine and mill	Shoshone.
The Bunker Hill Co	Box 29 Kellogg, ID 83837	Mine, mill, plant	Do.
Clayton Silver Mines	Box 890 Wallace, ID 83873	do	Custer.
Hecla Mining Co	Box 320 Wallace, ID 83873	Mine and mill	Shoshone.
MAPCO Inc	Box 52 Jordan Valley, OR 97910	Surface mine and mill.	Owyhee.
Silver King Mines Inc	1204 Deseret Bldg. Salt Lake City, UT 84111	do	Adams.
Sunshine Mining Co	Box 1080 Kellogg, ID 83837	Mine and mill	Shoshone.
Stone:			
FMC Corp	1356 North Main Pocatello, ID 83201	Quarry	Bannock.
Idaho Portland Cement Co	Old National Bank, Rm. 622 Inkom, ID 83245	Quarry and plant	Do.
Monsanto Co	800 North Lindbergh Blvd. St. Louis, MO 63166	Quarry	Caribou.
U.S. Forest Service, Region 4	U.S. Federal Bldg. Ogden, UT 84403	do	Various.
Vanadium: Kerr-McGee Corp	Box 478 Soda Springs, ID 83276	Plant	Caribou.
Zinc:			
The Bunker Hill Co	Box 29 Kellogg, ID 83837	Mine, mill, plant	Shoshone.
Clayton Silver Mines	Box 890 Wallace, ID 83873	Mine and mill	Custer.
Hecla Mining Co	Box 320 Wallace, ID 83873	do	Shoshone.

The Mineral Industry of Illinois

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the State Geological Survey Division, Illinois Institute of Natural Resources, for collecting information on all nonfuel minerals.

By James J. Hill[1] and Robert J. Tuchman[2]

The value of Illinois' nonfuel mineral production in 1980 dropped to $443.3 million, the first decrease in 10 years. Stone, sand and gravel, cement, and lime contributed the greatest amount of value to the State's mineral production. Other commodities produced were clays, peat, tripoli, and fluorspar. Byproducts from fluorspar production were barite, lead, silver, and zinc. Slag was produced at steelmaking operations, and byproduct sulfur was recovered during oil refining. Mineral commodities imported into the State for processing were gypsum, iron oxide pigments, perlite, and vermiculite. Nationally, Illinois ranked first in the production of fluorspar, tripoli, and industrial sand; and fourth in peat, crushed stone, and fuller's earth.

Table 1.—Nonfuel mineral production in Illinois[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement, portland thousand short tons	1,889	$79,604	1,649	$75,315
Clays[2] do.	542	2,355	459	1,919
Gem stones	NA	15	NA	15
Peat thousand short tons	86	1,610	79	1,505
Sand and gravel do.	45,448	134,190	31,725	122,332
Stone:				
Crushed do.	63,551	188,130	53,309	180,656
Dimension do.	3	128	2	103
Combined value of barite, cement (masonry), clays (fuller's earth), fluorspar, lead, lime, silver, tripoli, and zinc	XX	70,498	XX	61,436
Total	XX	476,530	XX	443,281

NA Not available. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes fuller's earth; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Illinois, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Adams	W	W	Stone, sand and gravel.
Alexander	W	W	Tripoli, sand and gravel.
Bond	$639	$1,075	Sand and gravel, clays.
Boone	W	W	Stone, sand and gravel.
Brown	W	W	Stone, clays.
Bureau	1,172	1,269	Sand and gravel.
Calhoun	W	45	Stone.
Carroll	759	1,064	Do.
Champaign	1,649	1,563	Sand and gravel.
Christian	1,500	1,379	Stone.
Clark	W	W	Stone, sand and gravel.
Clay	W	757	Stone.
Clinton	W	W	Stone, sand and gravel.
Coles	W	W	Do.
Cook	W	95,024	Stone, lime, sand and gravel, clays, peat.
Crawford	--	W	Sand and gravel.
Cumberland	559	542	Do.
De Kalb	W	W	Stone, sand and gravel.
De Witt	--	262	Sand and gravel.
Douglas	W	W	Stone.
Du Page	W	4,489	Sand and gravel, stone.
Effingham	W	W	Sand and gravel.
Fayette	W	W	Stone, sand and gravel, clays.
Ford	1,061	940	Sand and gravel.
Fulton	W	W	Do.
Gallatin	W	W	Do.
Greene	893	W	Stone.
Grundy	W	W	Sand and gravel, clays.
Hancock	W	W	Stone, sand and gravel.
Hardin	W	21,204	Fluorspar, stone, zinc, barite, lead, silver.
Henderson	1,170	1,205	Stone.
Henry	W	1,449	Do.
Iroquois	W	--	
Jackson	W	W	Stone, sand and gravel.
Jersey	302	333	Stone.
Jo Daviess	W	W	Stone, sand and gravel.
Johnson	W	2,990	Stone.
Kane	17,714	16,705	Sand and gravel, stone.
Kankakee	W	W	Stone, clays, sand and gravel.
Kendall	W	W	Stone, sand and gravel.
Lake	W	W	Sand and gravel, stone, peat.
La Salle	W	W	Sand and gravel, cement, stone, clays.
Lawrence	1,542	W	Sand and gravel.
Lee	W	W	Cement, stone.
Livingston	7,562	7,714	Stone, clays.
Logan	W	W	Stone, sand and gravel.
McDonough	W	W	Stone, clays.
McHenry	18,308	19,238	Sand and gravel.
McLean	1,875	2,918	Do.
Macon	2,027	2,027	Sand and gravel, stone.
Madison	4,845	4,873	Stone, sand and gravel.
Marion	W	W	Sand and gravel.
Marshall	W	W	Do.
Mason	35	28	Do.
Massac	W	W	Cement, sand and gravel.
Menard	2,191	W	Stone.
Mercer	--	236	Do.
Monroe	W	W	Do.
Montgomery	5,017	5,444	Do.
Moultrie	W	W	Sand and gravel.
Ogle	W	W	Sand and gravel, stone.
Peoria	2,090	1,866	Do.
Piatt	W	319	Sand and gravel.
Pike	W	W	Stone, sand and gravel.
Pulaski	W	W	Clays, stone, sand and gravel.
Putnam	W	W	Sand and gravel.
Randolph	W	W	Stone, sand and gravel.
Rock Island	W	W	Do.
St. Clair	W	W	Do.
Saline	W	--	
Sangamon	3,372	2,896	Sand and gravel.
Schuyler	W	W	Sand and gravel, stone.
Scott	W	W	Stone.
Shelby	W	803	Sand and gravel, stone.
Stephenson	1,276	1,101	Stone, sand and gravel.
Tazewell	W	3,165	Sand and gravel, clays.
Union	W	W	Stone, sand and gravel.
Vermilion	W	W	Do.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Illinois, by county[1] —Continued

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Wabash	$290	$301	Sand and gravel.
Warren	2,476	3,122	Stone.
Washington	W	W	Do.
White	W	W	Sand and gravel.
Whiteside	W	W	Peat, stone, sand and gravel.
Will	16,761	21,976	Stone, sand and gravel.
Williamson	--	27	Stone.
Winnebago	3,102	3,380	Stone, sand and gravel.
Woodford	2,810	3,573	Sand and gravel.
Undistributed[2]	336,568	239,233	
Total[3]	439,554	476,530	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Cass, Edgar, Edwards, Franklin, Hamilton, Jasper, Jefferson, Knox, Macoupin, Morgan, Perry, Pope, Richland, Stark, and Wayne Counties are not listed because no nonfuel mineral production was reported.
[2]Includes stone that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.
[3]Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Illinois business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	5,332.0	5,447.0	+2.2
Unemployment	do	293.0	454.0	+55.0
Employment (nonagricultural):				
Mining[1]	do	31.1	32.3	+3.9
Manufacturing	do	1,271.6	1,222.3	-3.9
Contract construction	do	188.0	191.5	+1.9
Transportation and public utilities	do	288.9	285.4	-1.2
Wholesale and retail trade	do	1,141.7	1,139.9	-.2
Finance, insurance, real estate	do	295.2	312.8	+6.0
Services	do	923.7	943.8	+2.2
Government	do	743.2	764.0	+2.8
Total nonagricultural employment[1]	do	[2]4,883.3	4,892.0	+.2
Personal income:				
Total	millions	$110,393	$121,039	+9.6
Per capita		$9,859	$10,658	+8.1
Construction activity:				
Number of private and public residential units authorized		45,807	24,676	-46.1
Value of nonresidential construction	millions	$1,634.5	$1,550.5	-5.1
Value of State road contract awards	do	$625.0	$769.0	+23.0
Shipments of portland and masonry cement to and within the State	thousand short tons	3,511	2,754	-21.6
Nonfuel mineral production value:				
Total crude mineral value	millions	$476.5	$443.3	-7.0
Value per capita, resident population		$42	$39	-7.1
Value per square mile		$8,449	$7,860	-7.0

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.
[2]Data do not add to total shown because of independent rounding.

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

Trends and Developments.—One important factor responsible for the decline in value of Illinois' mineral production in 1980 was the severe cutback in construction, which reduced demand for nonmetallic mineral commodities. Construction activity slumped as a result of high interest rates caused by tight credit controls to curb inflation and a lack of mortgage money.

The U.S. Department of Commerce reported a 46% drop in the number of residential units (private and public) for which construction permits were issued in Illinois. Also, highway construction programs were reduced when Federal highway funds allotted to the State were slashed from $526 million in fiscal year 1979 to $272 million in 1980. It was expected that in immediately succeeding years, funds for the State would continue to be about half those of 1979. High fuel costs discouraged motorists from driving, resulting in a drop in Federal gasoline tax revenues, which led to the funding cuts.

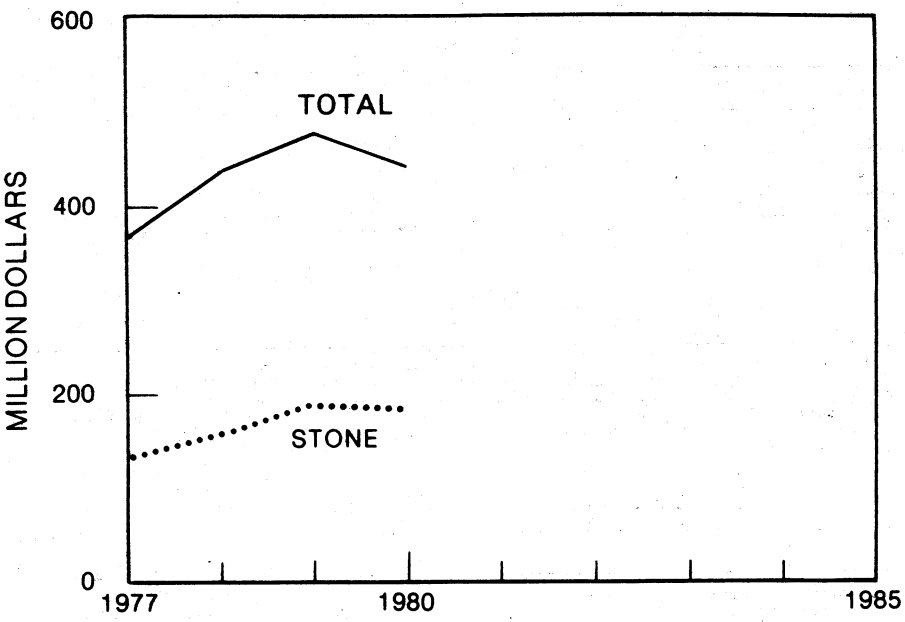

Figure 1.—Value of stone and total value of nonfuel mineral production in Illinois.

Legislation and Government Programs.—House bill 3289, passed by the State legislature and signed by Governor Thompson late in September 1980, allows corporations to deduct the full amount of what they pay to the State in personal property replacement taxes from their income tax. Previously, there had been a limited deduction for these taxes, which hindered business development. Mining firms and mining equipment manufacturers, among others, benefited from the tax reductions.

Southern Illinois University at Carbondale, the State's Mining and Mineral Resources and Research Institute, was awarded $595,000 in grants during the year by the Office of Surface Mining for new and continued research projects. Grants were awarded for seven major areas of study: Mining and exploration, extractive metallurgy, environmental research related to mining, legal and social aspects of mining, mineral economics, mineral processing, and petroleum and natural gas engineering.

The State Geological Survey Division continued research programs in basic geology, geochemistry, mineral resources, mineral economics, and the environment. Several studies completed during the year evaluated Illinois' clay, dolomite, limestone, and sand and gravel resources. In October, the Survey celebrated its 75th anniversary and presented a full-day symposium on "Perspectives in Geology," with about 300 persons in attendance. Papers presented at the symposium are expected to be published by the Survey in a special anniversary volume.

Under Federal law, the U. S. Bureau of Mines and the U. S. Geological Survey evaluate mineral potential in areas considered for wilderness designation. In 1980, the Bureau of Mines completed field investigations of two areas—Burden Falls and Lusk Creek in Shawnee National Forest. Both areas had been designated for further planning studies as to wilderness suitability under the U.S. Forest Service's Roadless Area Review and Evaluation (RARE II) program.

The U. S. Bureau of Mines had several active contracts and grants with industrial firms, educational institutions, and consulting firms during the year. Research was conducted on various types of mining equipment, mine health and safety, and mineral resources. Funding for these projects totaled approximately $2 million.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives.—Illinois ranked first in the production of tripoli, a natural abrasive. Production was from two underground mines operated by Illinois Minerals Co. and Tammsco, Inc., in Alexander County. Tripoli—a soft, fine-grained, porous, siliceous material—is commonly used as a soft abrasive in buffing and polishing compounds and as a filler. Most of the material was processed in the State.

In the north-central part of the State, ESK Corp., a subsidiary of Wacker Chemical Co., continued to produce silicon carbide, an artificial abrasive, at its plant near Hennepin, Putnam County. The product was used as an abrasive, as a refractory material, and in metallurgical applications.

Barite.—Inverness Mining Co. (subsidiary of Seaforth Mineral & Ore Co., Cleveland, Ohio) and Ozark-Mahoning Co. produced primary barite as a byproduct at their fluorspar mining operations in Hardin County. Inverness Mining purchased Allied Chemical Corp.'s Minerva fluorspar mining complex at Cave In Rock in 1980 and resumed production after midyear. Allied Chemical had closed the facility in late 1979. Ozark-Mahoning began producing byproduct barite in 1979. Barite was used in drilling muds as a weighting agent and in manufacturing paint, rubber, glass, and barium chemicals.

Cement.—Four companies manufactured portland cement in 1980. Illinois Cement Co. (subsidiary of Centex Corp.) and Marquette Co. (a division of Gulf + Western Industries, Inc.) had plants in La Salle County in north-central Illinois. Lone Star Industries, Inc., operated a plant at Dixon in adjoining Lee County; Missouri Portland Cement Co., a plant at Joppa in Massac County in southeastern Illinois. Lone Star and Missouri Portland also manufactured prepared masonry cement.

Shipments of all types of cement were down for the year owing to the depressed construction market. Cement was shipped mainly to ready-mix companies. Other leading users were concrete product manufacturers, highway contractors, and building material dealers. Consumers received most of their cement by truck.

In March, Lone Star purchased Medusa Corp.'s Dixon cement plant, plus a quarry and Chicago distribution terminals. The firm also announced a capital spending program to improve kiln operations and quarry and environmental control systems. A Federal Trade Commission divestiture order forced Medusa to sell the plant when it was acquired by Crane Co. Now Lone Star can enter markets in northern Illinois, including Chicago, and parts of Wisconsin and Iowa.

Table 4.—Illinois: Portland cement salient statistics

(Short tons)

	1979	1980
Number of active plants	4	4
Production	1,998,317	1,767,582
Shipments from mills:		
Quantity	1,888,594	1,648,674
Value	$79,603,714	$75,315,222
Stocks at mills, Dec. 31	228,132	254,703

Clays.—In 1980, clays were produced in 9 Illinois counties by 13 companies. Common clay accounted for most of the production, followed by fuller's earth (absorbent clay) and fire (refractory) clay. Fuller's earth was the only type of clay that increased in production during the year.

Common clay was produced in seven counties. La Salle County led in production, followed by Livingston County. Major uses of common clay, in order of tonnage, were for cement manufacture, common brick, face brick, sewer pipe, and drain tile.

Illinois remained fourth in production among the nine States that produced fuller's earth in 1980. Pulaski County, in the southernmost part of the State, accounted for all of the State's production. Fuller's earth was used as an oil and grease absorbent, for animal litter purposes, and as a paper filler.

Fire clay was mined in Grundy County in north-central Illinois. Major uses were for firebrick and other refractory products.

Fluorspar.—Illinois led the Nation in fluorspar production, followed by Nevada, the only other producing State. Production declined for the fourth consecutive year to the lowest level in 10 years because one mine was closed for part of the year.

Three companies mined in the southeastern Illinois fluorspar district. Hastie Mining Co. surface mined the Old Lead and Old Defender tracts at Spar Mountain near Cave In Rock in Hardin County. Metallurgical-grade gravel spar was produced

at the firm's heavy-media plant. Crushed limestone recovered from the operation was sold as road rock.

Inverness Mining Co.—a subsidiary of Seaforth Mineral & Ore Co. of Cleveland, Ohio—purchased Allied Chemical Corp.'s fluorspar complex at Cave In Rock during the year. After a suspension of several months, production resumed by midyear at the Minerva No. 1 and Spivey underground mines. Output was processed at the Minerva No. 1 mill to obtain an acid- and metallurgical-grade product. Some of the Cave In Rock production was shipped to Seaforth's drying and processing facility in East Liverpool, Ohio, and later sold to ceramic fluorspar consumers.

Ozark-Mahoning Co. continued to operate the Barnett Mine in Pope County and the Heavy Media Mine and Knight Mine in Hardin County. Some ore from the operations was put through the firm's heavy-media plant to produce metallurgical-grade fluorspar gravel. Fines were sent through the Rosiclare flotation mill to produce an acid-grade fluorspar.

Shaft sinking at Ozark-Mahoning's Denton Mine in Hardin County was completed in late 1979. Developmental work continued at the mine throughout 1980, and production was slated for August 1981. In Pope County, work began on the Henson Mine shaft in August and was well underway by yearend. Production is expected to begin in late 1981 or early 1982.

Gem Stones.—A small amount of gem stones, with an estimated value of $15,000, was collected by rockhounds and mineral dealers in the southern Illinois fluorspar district.

Gypsum.—National Gypsum Co. calcined gypsum at its plant in Waukegan, just north of Chicago, for use in wallboard. Crude gypsum was imported from Michigan and Canada.

Lime.—Illinois ranked tenth in output among the 40 lime-producing States. Marblehead Lime Co., an operating unit of General Dynamics Corp., produced quick and hydrated lime at its South Chicago and Thornton plants in Cook County. Vulcan Materials Co.'s plant, also in Cook County, produced quicklime. State production was down about 128,000 tons, mainly because of the slowdown in the steel industry, a major consumer of lime. Lime was also used for industrial waste treatment, glassmaking, water purification, sewage treatment, and power emission control.

Construction was completed on Marblehead's new rotary kiln at its South Chicago plant. The kiln, largest in the world, added 350,000 tons per year to the plant's capacity. Limestone for the plant was imported from Michigan via the Great Lakes and the Calumet River and stockpiled on the company's docks by self-unloading lake freighters.

Peat.—Illinois ranked fourth, behind Michigan, Florida, and Indiana, in output among the 21 peat-producing States. Peat was produced by five companies in three counties. Whiteside County, in northwestern Illinois, led in production. Output was also reported from Cook and Lake Counties in the northeastern part of the State. Peat was sold in bulk and packaged form for general soil improvement purposes, potting soil, and earthworm culture.

Perlite.—Of the 33 States that produced expanded perlite, Illinois continued to rank first, despite a drop in production of almost 19% from 1979 to 1980. A major factor in this decline was the depressed construction industry.

Crude perlite mined in other States was shipped into four counties and expanded by five firms. Will County led in production, followed by Cook, Lake, and De Kalb Counties. All of the plants are situated in the northeastern corner of the State and serve the Chicago-area markets.

Major sales of perlite were for insulation (roof board, low temperature and cavity fill), concrete and plaster aggregate, and fillers (paint texturizers and refractories). Some perlite was used as horticultural aggregate and as a filter aid.

Sand and Gravel.—Nationally, Illinois ranked sixth in the production of sand and gravel in 1980. Although output was down for the year owing to the decline in construction activity, sand and gravel remained the second leading commodity produced in Illinois, behind stone, in terms of value.

Construction sand was mined by 155 companies from 198 operations in 61 of the State's 102 counties. Major use was for concrete aggregate.

Illinois ranked first among the States in the production of industrial sand. Five companies mined eight deposits in Ogle and La Salle Counties in the north-central part of the State. Major uses were for glassmaking (containers and flat glass) and foundry molding sand. Most of the construction and industrial sand produced in Illinois was shipped by truck.

Manley Bros. of Indiana, Inc., an industri-

al sand producer in La Salle County, was acquired during the year by Hepworth Ceramics Holdings Ltd. through the company's wholly owned subsidiary in the United States, British Industrial Sand Ltd. The company's Troy Grove plant produces high-purity quartz sand chiefly for the glass and foundry markets.

In June, Springfield Sand & Gravel Co. placed its dredging operation onstream at a 600-acre site east of Springfield. Previously, the company had dredged a deposit about 1 mile north of the town.

Table 5.—Illinois: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	16,393	$37,429	$2.28	11,237	$31,720	$2.82
Plaster and gunite sands	47	150	3.19	92	324	3.52
Concrete products	1,705	4,454	2.61	1,236	3,554	2.88
Asphaltic concrete	5,967	13,005	2.18	4,079	12,644	3.10
Roadbase and coverings	10,048	22,143	2.20	6,741	20,246	3.00
Fill	5,403	8,710	1.61	3,452	8,873	2.57
Snow and ice control	116	223	1.92	60	204	3.40
Railroad ballast	1	3	3.00	--	--	--
Other uses	353	899	2.55	197	944	4.79
Total or average	40,033	87,016	2.17	27,094	[1]78,510	2.90

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

Table 6.—Illinois: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	18,222	$35,355	$1.94	12,939	$34,891	$2.70
Gravel	21,810	51,661	2.37	14,155	43,619	3.08
Total or average	[1]40,033	87,016	2.17	27,094	78,510	2.90
Industrial sand	5,416	47,174	8.71	4,631	43,822	9.46
Grand total or average	[1]45,448	134,190	2.95	31,725	122,332	3.86

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

Table 7.—Illinois: Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1979		1980	
	Quantity	Value	Quantity	Value
Bond	445	915	312	892
Boone	W	419	163	549
Bureau	546	1,269	373	1,426
Champaign	620	1,563	475	1,266
Clark	391	992	479	1,780
Cook	1,436	3,199	W	W
Cumberland	234	542	175	705
De Kalb	142	387	111	402
De Witt	77	262	3	11
Du Page	1,200	3,032	1,688	3,876
Fayette	128	187	W	W
Ford	333	940	257	918
Fulton	242	W	W	W
Kane	6,039	12,621	4,093	11,052
Kankakee	15	17	W	W

See footnotes at end of table.

Table 7.—Illinois: Sand and gravel sold or used by producers, by county —Continued

(Thousand short tons and thousand dollars)

County	1979		1980	
	Quantity	Value	Quantity	Value
Kendall	390	633	124	462
Lake	1,723	2,379	1,331	3,262
La Salle	5,504	43,896	4,686	41,102
Logan	261	568	195	714
McHenry	9,144	19,238	5,513	14,365
McLean	980	2,918	621	1,991
Macon	W	2,027	W	W
Madison	565	1,019	652	1,952
Marion	W	W	--	--
Mason	17	28	21	39
Peoria	587	1,166	232	671
Piatt	W	319	W	415
Sangamon	1,079	2,896	563	2,772
Shelby	W	639	195	422
Stephenson	69	173	56	215
Tazewell	1,109	3,105	849	2,619
Union	10	W	8	W
Vermilion	175	292	135	401
Wabash	144	301	96	291
Whiteside	288	610	216	794
Will	1,752	4,208	705	2,209
Winnebago	908	1,568	680	1,995
Woodford	1,269	3,573	913	3,248
Undistributed[1]	7,628	16,295	5,808	19,518
Total[2]	45,448	134,190	31,725	122,332

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

[1]Includes Adams, Alexander, Clinton, Coles, Crawford, Effingham, Gallatin, Grundy, Hancock, Henderson, Jo Daviess, Lawrence, Marshall, Massac, Moultrie, Ogle, Pike, Pulaski, Putnam, Randolph, Rock Island, St. Clair, Schuyler, and White Counties.

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

Slag (Iron and Steel).—Illinois ranked seventh nationally in the production of iron and steel slag, dropping from fifth place in 1979. Three companies produced 1.1 million tons valued at $3.2 million, a decline of 48% in output and 30% in value, compared with those of 1979. Of the total slag produced, 67% was iron slag, and 33%, steel slag. Slag was used mainly for construction aggregate.

Stone.—In 1980, Illinois ranked fourth, behind Texas, Florida, and Pennsylvania in stone production. Limestone was the only type of stone mined.

Crushed limestone was extracted in 56 counties at 196 quarries. Seven operations, each producing over 1 million tons, accounted for about 38% of the State's total production. Leading counties, in descending order of output, were Cook, Hardin, La Salle, Livingston, and Montgomery. Crushed stone was transported to market by truck (94%), rail (3%), and barge (3%).

A small amount of limestone was quarried for dimension stone by Fox River Stone Co. in Kane County. Uses included rubble, flagging, and house veneer.

During the year, Material Service Corp., Chicago, acquired the Hulcher Quarry near Nokomis, Montgomery County. The property, which includes a mineral filler plant, is known as the Material Service Hulcher Quarry.

In December 1979, Fox River Stone Co., South Elgin, relocated a plant from a nearby site to its former Butler Quarry between South Elgin and St. Charles. Production from the quarry, last operated in 1969, resumed in May 1980.

Table 8.—Illinois: Crushed limestone sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	5,241	16,445	5,158	17,647
Agricultural marl and soil conditioners	--	--	2	6
Poultry grit and mineral food	160	1,465	175	1,824
Concrete aggregate	8,720	26,222	7,233	24,520
Bituminous aggregate	7,240	21,236	5,728	19,972
Macadam aggregate	2,714	7,953	2,109	6,802
Dense-graded roadbase stone	19,909	57,471	16,605	53,446
Surface treatment aggregate	4,447	13,071	3,550	11,649

See footnotes at end of table.

Table 8.—Illinois: Crushed limestone sold or used by producers, by use —Continued

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Other construction aggregate and roadstone	7,824	20,264	6,022	18,177
Riprap and jetty stone	534	1,583	631	1,974
Railroad ballast	509	1,411	857	2,634
Filter stone	28	89	W	W
Manufactured fine aggregate (stone sand)	33	107	259	1,241
Cement manufacture	3,280	6,836	2,597	6,453
Flux stone	862	2,547	586	1,994
Asphalt filler	105	446	65	526
Other fillers or extenders	668	7,334	599	8,143
Fill	34	51	15	46
Other[1]	1,245	3,599	1,118	3,602
Total	[2]63,551	188,130	53,309	180,656

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes stone used for filter stone (1980), lime manufacture, mine dusting, and other uses.
[2]Data do not add to total shown because of independent rounding.

Table 9.—Illinois: Crushed limestone sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1979		1980	
	Quantity	Value	Quantity	Value
Adams	1,003	9,202	985	10,340
Brown	W	W	182	738
Bureau	--	--	40	109
Calhoun	21	45	37	87
Carroll	434	1,064	336	970
Christian	425	1,379	W	W
Clay	180	757	264	1,078
Clinton	113	245	99	230
Du Page	450	1,457	427	1,495
Fayette	W	751	W	W
Hancock	357	1,003	615	1,733
Hardin	2,948	6,636	2,308	5,850
Henderson	365	1,205	W	W
Henry	397	1,449	460	1,877
Jersey	105	333	95	W
Jo Daviess	466	848	375	775
Johnson	1,430	2,990	W	W
Kane	1,411	3,956	1,083	3,352
Lake	15	32	--	--
La Salle	2,272	6,388	2,265	6,668
Lee	1,409	3,208	1,165	3,787
Livingston	1,740	6,964	W	W
Macon	[1]	[1]	--	--
Madison	1,206	3,854	830	2,828
Mercer	150	236	183	296
Montgomery	1,801	5,444	1,221	4,058
Ogle	702	1,879	859	2,604
Peoria	199	700	169	633
Pike	640	2,079	618	2,151
Rock Island	1,380	4,977	1,405	5,527
St. Clair	2,739	7,089	2,412	7,112
Shelby	53	164	35	117
Stephenson	376	928	354	1,001
Union	1,759	4,687	W	W
Warren	1,001	3,122	W	W
Washington	149	W	W	W
Whiteside	W	W	439	1,233
Will	6,480	17,768	4,960	15,645
Williamson	10	27	--	--
Winnebago	932	1,812	799	1,881
Undistributed[2]	28,433	83,450	28,286	96,482
Total[3]	63,551	188,130	53,309	180,656

W Withheld to avoid disclosing individual company proprietary data; included with "Undistributed."
[1]Less than 1/2 unit.
[2]Includes Boone, Clark, Coles, Cook, De Kalb, Douglas, Greene, Jackson, Kankakee, Kendall, Logan, McDonough, Menard, Monroe, Pulaski, Randolph, Schuyler, Scott, and Vermilion Counties.
[3]Data may not add to totals shown because of independent rounding.

Sulfur.—Six companies in seven counties recovered sulfur as a byproduct from oil refinery operations. Sulfur shipments amounted to 208,000 metric tons valued at $12.5 million, reflecting a 6% increase in output and a 51% increase in value, compared with those of 1979.

Vermiculite.—Crude vermiculite shipped into Illinois was exfoliated by W. R. Grace & Co. in Du Page County; Mica Pellets, Inc., in De Kalb County; and International Vermiculite Co. in Macoupin County. Major end uses of the manufactured product were for block and loosefill insulation, concrete aggregate, and horticultural applications.

METALS

Aluminum.—Alcan Aluminum Corp. opened a can collection center in Joliet, Will County, in the last quarter of 1980. The center is located at the site of a secondary smelter, the capacity of which is being doubled to 25,000 tons per year. Reynolds Aluminum Recycling Co. was also active during the year in the collection of scrap aluminum, which was eventually shipped to its Belleville plant for crushing and processing.

Iron Oxide Pigments.—Illinois led the Nation in production of finished iron oxide pigments in 1980, with shipments totaling 36,267 tons valued at $23.8 million. Finished iron oxide pigments were shipped from plants in Adams, Kane, St. Clair, and Sangamon Counties, and were used mainly in paint manufacture.

Iron and Steel.—Illinois ranked fifth nationally in pig iron shipments and value. Shipments amounted to 4.4 million tons valued at $849.3 million, representing a 29% decrease in both quantity and value, compared with 1979 figures. The decline was attributed to depressed demand for automobiles and other durable goods, and foreign imports.

United States Steel Corp. shut down its South Works plant in Chicago for 2 weeks in July, idling 3,000 workers. The operation was reopened when orders began increasing, and recall of employees continued through August and September. Interlake, Inc., cut back production at its Riverdale operations, the company's main plant for producing flat-rolled steel. One of its two blast furnaces remained in operation at 65% capacity.

Republic Steel Corp. idled several hundred workers in August while repairs were made on its blooming mill. Layoffs reached about 1,400 by midsummer. The shutdown forced suspension of iron production from the mill's blast furnace, and steel production from the Q-BOP and three electric furnaces.

Wisconsin Steel Div. of Envirodyne Corp. shut down its Chicago plant in March in a bankruptcy action, idling over 3,000 employees. The closure was brought about when International Harvester Co., former parent company of Wisconsin Steel, withdrew its financial support and took over some of its iron and coal mining properties.

National Steel Corp. and the U.S. Environmental Protection Agency signed an agreement in October under which National Steel's Granite City plant will meet all requirements for controlling air and water pollution by the end of 1982. The agreement incorporates National's plans for modernizing and for replacing several basic steelmaking processes, and is expected to reduce particulate emissions by 80%.

Lead, Silver, and Zinc.—Inverness Mining Co. and Ozark-Mahoning Co. recovered small amounts of lead, silver, and zinc from their fluorspar-processing operations in Hardin County.

[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.
[2]Program assistant, Bureau of Mines, Pittsburgh, Pa.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives, tripoli:			
Illinois Minerals Co	2035 Washington Ave. Cairo, IL 62914	Underground mine	Alexander.
Tammsco, Inc	Box J Tamms, IL 62988	do	Do.
Cement:			
Illinois Cement Co., a subsidiary of Centex Corp.	Box 442 La Salle, IL 61301	Plant	La Salle.
Lone Star Industries, Inc	East River Rd. Dixon, IL 61021	do	Lee.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Cement —Continued			
Marquette Co., a division of Gulf + Western Industries, Inc.	Portland Ave. Oglesby, IL 61348	Plant	La Salle.
Missouri Portland Cement Co	Box 147 Joppa, IL 62953	do	Massac.
Clay and shale:			
American Brick Co	6558 West Fullerton Ave. Chicago, IL 60635	Pit and plant	Cook.
Lowe's, Inc	Box 68 Olmstead, IL 62970	do	Pulaski.
Richards Brick Co	234 Springer Ave. Edwardsville, IL 62025	do	Bond.
Streator Brick Systems, Inc	West 9th St. Streator, IL 61364	Pits and plants	La Salle and Livingston.
Fluorspar:			
Hastie Mining Co	Cave In Rock, IL 62919	Open pit	Hardin.
Inverness Mining Co., a subsidiary of Seaforth Mineral & Ore Co.[1]	do	Underground mines, mill, plant.	Do.
Ozark-Mahoning Co.[1]	Box 57 Rosiclare, IL 62982	do	Hardin and Pope.
Gypsum:			
National Gypsum Co	515 Sea Horse Dr. Box 139 Waukegan, IL 60085	Mill	Lake.
Iron oxide pigments, finished:			
Pfizer, Inc	2001 Lynch Ave. East St. Louis, IL 62201	Plant	St. Clair.
Prince Manufacturing Co., Inc	700 Lehigh St. Bowmanstown, PA 18030	do	Adams.
Iron and steel:			
Granite City Steel Co., a division of National Steel Corp.	20th and State Sts. Granite City, IL 62040	Iron and steel furnaces.	Madison.
Interlake, Inc	13500 South Perry Ave. Riverdale, IL 60627	Iron furnaces	Cook.
Republic Steel Corp	Suite 550, Commerce Plaza Oak Brook, IL 60521	Iron and steel furnaces.	Do.
United States Steel Corp	3426 East 89th St. Chicago, IL 60617	do	Do.
Wisconsin Steel Div. of Envirodyne Corp.	2800 West 106th St. Chicago, IL 60617	do	Do.
Lime:			
Marblehead Lime Co	300 West Washington St. Chicago, IL 60606	Plant	Do.
Vulcan Materials Co	500 Plainfield Rd. Box 6 Countryside, IL 60525	do	Do.
Peat:			
Anderson Peat Co. of Illinois	R.R. 3 Morrison, IL 61270	Bog and processing plant.	Whiteside.
Markman Peat Co	Route 3 Morrison, IL 61270	do	Do.
Perlite, expanded:			
Johns-Manville Perlite Corp	Route 6, Box 864 Joliet, IL 60434	Plant	Will.
Silbrico Corp	6300 South River Rd. Hodgkins, IL 60525	do	Cook.
Sand and gravel:			
Elmhurst-Chicago Stone Co	400 West 1st St. Box 57 Elmhurst, IL 60126	Pits and plants	Du Page, Kane, Will.
Material Service Corp., a subsidiary of General Dynamics Corp.	300 West Washington St. Chicago, IL 60606	do	Grundy, Kane, McHenry.
Meyer Aggregate	Box 56, Route 2 Algonquin, IL 60102	do	Kane and McHenry.
Thelen Sand & Gravel	Route 3, Box 330 Antioch, IL 60002	Pit and plant	Lake.
Vulcan Materials Co	500 Plainfield Rd. Box 6 Countryside, IL 60525	Pits and plants	Cook and McHenry.
Stone:			
Anna Quarries, Inc	Box 180 Anna, IL 62906	Quarry and plant	Union.
Columbia Quarry Co	Box 128 Columbia, IL 62236	Quarries and plants.	Monroe and Pulaski.
Material Service Corp., a subsidiary of General Dynamics Corp.	300 West Washington St. Chicago, IL 60606	Underground mine, quarries, plants.	Cook, Vermilion, Will.
Medusa Aggregates Co., a subsidiary of Crane Co.	Route 6, Box 111-A Lehigh Rd. Kankakee, IL 60901	Quarries and plants.	Clark, Henderson, Kankakee, Livingston.
Moline Consumers Co	313 16th St. Moline, IL 61255	do	Rock Island.
Vulcan Materials Co	500 Plainfield Rd. Box 6 Countryside, IL 60525	do	Cook and Will.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sulfur, recovered elemental:			
Marathon Oil Co	Robinson, IL 62454	Plant	Crawford.
Mobil Oil Corp	Box 874 Joliet, IL 60434	do	Will.
Union Oil Co. of California	1650 East Golf Rd. Schaumburg, IL 60196	do	Cook.
Vermiculite, exfoliated:			
W. R. Grace & Co	6051 West 65th St. Bedford Park, IL 60638	do	Du Page.
International Vermiculite Co	1st and Mound Sts. Girard, IL 62640	do	Macoupin.
Mica Pellets, Inc	1120 Oak St. De Kalb, IL 60115	do	De Kalb.

[1]Also barite, lead, silver, and zinc.

The Mineral Industry of Indiana

This chapter has been prepared under a Memorandum of Understanding 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 nonfuel minerals.

By James J. Hill[1]

The value of Indiana's nonfuel mineral production dropped to $288 million, down from the record $317 million set in 1979. Crushed stone led the State in value, followed by portland cement, construction sand and gravel, and lime. Other commodities produced were natural abrasives, clays, dimension stone, gypsum, industrial sand, masonry cement, and peat. Sulfur was recovered as a byproduct of refining operations. Imported materials processed in the State included fluorspar and perlite.

Table 1.—Nonfuel mineral production in Indiana[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement, portland thousand short tons	2,389	$95,549	1,769	$73,049
Clays do.	1,185	2,341	932	1,930
Peat do.	76	1,242	84	1,414
Sand and gravel do.	[2]27,050	[2]55,842	22,031	52,939
Stone:				
Crushed do.	[r]34,147	[r]92,630	30,910	92,106
Dimension do.	[r]181	[r]10,504	161	14,046
Combined value of abrasives (natural), cement (masonry), gypsum, lime, and sand and gravel (industrial, 1979)	XX	59,036	XX	52,986
Total	XX	[r]317,144	XX	288,470

[r]Revised. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes industrial sand and gravel; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Indiana, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Adams	W	W	Stone, sand and gravel.
Allen	W	W	Stone, sand and gravel, peat.
Bartholomew	W	W	Stone, sand and gravel.
Blackford	W	W	Stone.
Boone	W	W	Sand and gravel.
Carroll	W	W	Stone, sand and gravel.
Cass	W	W	Cement, stone, sand and gravel, clays.
Clark	W	W	Do.
Clay	$495	W	Clays.
Clinton	--	W	Sand and gravel.
Crawford	8,872	$8,148	Stone.
Daviess	263	263	Sand and gravel.
Dearborn	W	W	Do.
Decatur	W	W	Stone.
De Kalb	835	942	Sand and gravel.
Delaware	W	W	Stone, sand and gravel.
Dubois	W	7	Clays.
Elkhart	746	795	Sand and gravel, stone.
Fayette	W	528	Sand and gravel.
Floyd	W	W	Do.
Fountain	W	W	Sand and gravel, clays.
Franklin	W	W	Sand and gravel, stone.
Fulton	261	255	Sand and gravel.
Gibson	263	W	Do.
Grant	W	W	Stone, sand and gravel.
Greene	W	W	Sand and gravel.
Hamilton	W	W	Stone, sand and gravel, peat.
Hancock	W	W	Sand and gravel.
Harrison	W	W	Stone, sand and gravel.
Henry	1,110	W	Sand and gravel.
Howard	W	W	Sand and gravel, stone.
Huntington	W	W	Stone, sand and gravel, clays.
Jackson	W	W	Sand and gravel, clays.
Jasper	W	1,938	Sand and gravel, stone, peat.
Jay	W	W	Stone, sand and gravel.
Jennings	W	W	Stone.
Johnson	233	183	Sand and gravel.
Knox	1,195	1,240	Do.
Kosciusko	1,334	1,559	Sand and gravel, peat.
Lagrange	411	384	Sand and gravel.
Lake	W	47,146	Lime, cement, clays, sand and gravel.
La Porte	W	W	Sand and gravel, peat.
Lawrence	W	W	Cement, stone.
Madison	W	W	Stone, sand and gravel, peat.
Marion	W	W	Sand and gravel, stone.
Marshall	W	W	Sand and gravel, peat.
Martin	W	W	Gypsum.
Miami	W	W	Stone, sand and gravel.
Monroe	W	W	Stone.
Montgomery	W	W	Sand and gravel, clays.
Morgan	W	W	Sand and gravel, clays, stone.
Newton	W	W	Stone.
Noble	529	W	Sand and gravel, stone.
Ohio	W	W	Sand and gravel.
Orange	W	W	Stone, abrasives.
Owen	W	W	Stone, sand and gravel.
Parke	651	W	Sand and gravel, clays.
Perry	W	W	Stone.
Porter	W	W	Sand and gravel, clays.
Posey	W	15	Sand and gravel.
Pulaski	W	W	Stone.
Putnam	W	36,214	Cement, clays, stone, sand and gravel.
Randolph	W	W	Stone, sand and gravel.
Ripley	W	1,626	Stone.
Rush	W	725	Stone, sand and gravel.
St. Joseph	2,254	2,778	Sand and gravel, stone.
Scott	W	W	Stone.
Shelby	2,573	2,620	Stone, sand and gravel.
Steuben	2,271	775	Sand and gravel, stone.
Sullivan	W	W	Do.
Switzerland	W	W	Do.
Tippecanoe	2,378	W	Sand and gravel.
Tipton	W	W	Do.
Vanderburgh	W	191	Do.
Vermillion	W	W	Sand and gravel, clays.
Vigo	W	878	Sand and gravel.
Wabash	W	W	Do.
Warren	1,650	2,360	Do.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Indiana, by county[1] —Continued

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Washington	W	W	Stone.
Wayne	W	W	Sand and gravel, stone.
Wells	W	W	Stone, peat.
White	W	W	Stone.
Whitley	W	W	Sand and gravel.
Undistributed[2]	$262,658	$205,574	
Total	[3]290,989	317,144	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]The following counties are not listed because no nonfuel mineral production was reported: Benton, Brown, Hendricks, Jefferson, Pike, Spencer, Starke, Union, and Warrick.
[2]Includes sand and gravel (1979) that cannot be assigned to specific counties, and values indicated by symbol W.
[3]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Indiana business activity

	1979	1980[p]	Change, percent
Employment and labor force, annual average:			
Total civilian labor force, thousands	2,610.0	2,620.0	+0.4
Unemployment, do	167.0	253.0	+51.5
Employment (nonagricultural):			
Mining[1], do	10.2	10.1	-1.0
Manufacturing, do	733.2	658.0	-10.3
Contract construction, do	106.0	91.6	-13.6
Transportation and public utilities, do	111.8	105.0	-6.1
Wholesale and retail trade, do	494.9	478.2	-3.4
Finance, insurance, real estate, do	101.3	101.9	+.6
Services, do	331.7	337.1	+1.6
Government, do	347.6	355.2	+2.2
Total nonagricultural employment[1], do	[2]2,236.3	2,137.1	-4.4
Personal income:			
Total, millions	$46,280	$49,030	+5.9
Per capita	$8,570	$8,978	+4.8
Construction activity:			
Number of private and public residential units authorized	26,838	21,297	-20.6
Value of nonresidential construction, millions	$620.1	$694.0	+11.9
Value of State road contract awards, do	$173.0	$93.0	-46.2
Shipments of portland and masonry cement to and within the State, thousand short tons	1,827	1,408	-22.9
Nonfuel mineral production value:			
Total crude mineral value, millions	$317.1	$288.5	-9.0
Value per capita, resident population	$59	$53	-10.2
Value per square mile	$8,739	$7,949	-9.0

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.
[2]Data do not add to total shown because of independent rounding.

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

Trends and Developments.—Indiana's nonfuel mineral production was affected by the state of the general economy in 1980. Demand for nonmetallic mineral commodities used in construction slumped because of high interest rates, which hindered new construction activity. The U.S. Department of Commerce reported a 20% drop in the number of in-State residential units (private and public) for which construction permits were issued. The lack of demand for steel by the automotive industry and other durable goods manufacturers also caused a drop in demand for mineral commodities used in steel manufacturing.

Legislation and Government Programs.—During the year, the Indiana Legislature enacted several laws relating to the mineral industry.

Public Law 37 expanded property tax

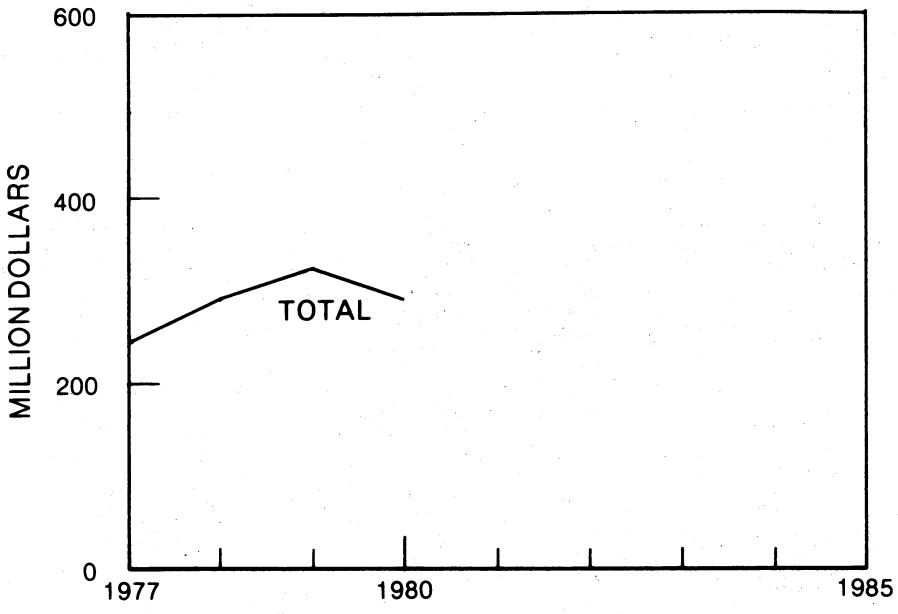

Figure 1.—Total value of nonfuel mineral production in Indiana.

exemptions for air pollution equipment to include unlicensed mobile systems.

Public Law 98 required the Department of Natural Resources to hold public hearings before authorizing water level changes or dredging of public lakes.

Other legislation amended the State's surface mining act, increased bonding to insure plugging of abandoned wells, and revised the qualification provisions for professional geologists.

On a local level, the City of Hammond's ordinance on sand mining was ruled unconstitutional by an Indiana appeals court. The statute had prohibited sand mining within 3 miles of a residential area, which the court found to be an arbitrary distance that in effect blocked all mining within the city limits. Also, the ordinance had given city council control over sand mining without providing standards to guide the council's decision.

Purdue University at West Lafayette, the State's Mining and Mineral Resources and Research Institute, was awarded $207,000 in grants during the year by the Office of Surface Mining for new and continued research projects. Grants were awarded for seven major areas of study: Mining and exploration, extractive metallurgy, environmental research related to mining, legal and social aspects of mining, mineral economics, mineral processing, and petroleum and natural gas engineering.

The Indiana Geological Survey, Department of Natural Resources, continued geological research and service programs. A directory of crushed stone, ground limestone, cement, and lime producers in Indiana was published, in addition to several geological maps and reports covering stratigraphy, mineral economics, and environmental geology.

Also, the survey began to administer the certification of professional geologists in the State, required by a new law that became effective July 1.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives.—Hindostan Whetstone Co., one of the oldest manufacturing establishments in Indiana, quarried sandstone near Orleans, Orange County, for shaping into cuticle removers and sharpening stones.

Wheelabrator-Frye, Inc., manufactured abrasives of aluminum and steel at a plant in Mishawaka, St. Joseph County, just east of South Bend. The abrasives were used for finishing steel products.

Cement.—Nationally, Indiana ranked 11th in shipments of portland cement and 2d in shipments of masonry cement. Three companies produced cement at four plants located in Cass, Clark, Lawrence, and Putnam Counties. One of the three companies also ground clinker at a newly purchased plant in Lake County.

Shipments of cement were down from those of the previous year because of the decline in construction activity. Most of the cement sold was used by ready-mix companies, followed by concrete product manufacturers, building material dealers, and highway contractors. The product was transported to consumers mainly by truck.

Lehigh Portland Cement Co., a subsidiary of Heidelberger Zement A.G., Heidelberg, Federal Republic of Germany, purchased United States Steel Corp.'s Universal Atlas Cement Div. during the year. The sale included United States Steel's Buffington cement facility in Lake County. United States Steel announced in late 1979 that the facility would be closed permanently. In 1980, cement shipments from the facility continued, and some imported clinker was ground. Lehigh Portland also operated a cement plant at Mitchell in Lawrence County, just south of Bedford.

Lone Star Industries, Inc., operated a cement plant in Greencastle, Putnam County, west of Indianapolis. The plant is considered one of the most energy-efficient wet-process facilities in the United States. In late 1979, the firm began supplying American Precast Concrete, Inc., Indianapolis, with a special portland cement, which is used in manufacturing spun concrete poles for transmission lines and light standards. These poles are 40 to 130 feet long and can be installed in pairs to form H-frame structures.

Louisville Cement Co. operated plants in Logansport, Cass County, and in Speed, Clark County. Depressed sales forced the company to shut down the Logansport plant for 4 weeks in June and the Speed plant for the same duration in July. In December, construction was started on a package warehouse at the Logansport plant.

Clays.—Nationally, Indiana ranked 16th in the production of clay and shale. Fifteen companies had operations in 13 counties. Morgan, Clay, Clark, and Putnam Counties led the State in production, accounting for over 75% of the clay produced. Most clay output was used in the manufacture of cement and in concrete block. Other uses included common brick, face brick, firebrick, sewer pipe, drain tile, flue linings, pottery, and electrical porcelain. Clay production was down for the year because of the decline in cement production and the overall slowdown in construction activity.

Two companies were inactive during the year. American Brick Co. closed its brick plant in Lake County because of restrictions imposed by the U.S. Environmental Protection Agency. Cardinal Clay Products, Inc., ceased manufacture of face brick at its plant in Morgan County because of declining brick sales.

Fluorspar.—National Briquet Corp., Lake County, continued to fabricate briquets of fluorspar imported from foreign and domestic sources. The product was used by the steel industry as flux.

Table 4.—Indiana: Clays sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Year	Fire clay		Common clay		Total[1]	
	Quantity	Value	Quantity	Value	Quantity	Value
1976	2	21	1,263	2,288	1,265	2,309
1977	1	20	1,266	2,216	1,268	2,237
1978	1	15	1,276	2,480	1,277	2,495
1979	1	15	1,184	2,325	1,185	2,341
1980	(2)	3	932	1,927	932	1,930

[1]Data may not add to totals shown because of independent rounding.
[2]Less than 1/2 unit.

Gypsum.—Nationally, Indiana ranked sixth in the production of crude gypsum and fifth in the production of calcined gypsum. Two firms, National Gypsum Co. and United States Gypsum Co., mined crude gypsum from underground mines at Shoals, Martin County, in the south-central part of the State. Both firms calcined gypsum at mine-plant sites, and United States Gypsum also calcined gypsum at a plant in Lake County in northwestern Indiana. Most gypsum was used in manufacturing wallboard, with lesser quantities used in making cement.

During the year, United States Gypsum's Shoals plant received the Lloyd H. Yeager Award, commemorating 2 million or more employee-hours without a lost workday case.

Lime.—Indiana ranked eighth nationally in the production of lime, down from sixth place in 1979. The drop was due partly to the slowdown in the steel industry, a major user of lime. Two firms produced lime in Lake County: Marblehead Lime Co. operated a plant at Buffington; Inland Steel Co., a plant at Indiana Harbor.

Peat.—Nationally, Indiana ranked third in peat production, behind Michigan and Florida. Nine companies produced peat in eight counties. La Porte and Jasper Counties, in northwestern Indiana, led in sales. Peat was sold in bulk and packaged form for soil conditioning and horticultural purposes.

Perlite.—Indiana ranked fourth nationally in sales of expanded perlite. Crude perlite mined outside the State was imported and expanded by five companies operating six plants in five counties. Sales totaled over 45,000 tons valued at $6 million, an increase over 1979 figures.

United States Gypsum Co. operated plants in Lake and Martin Counties; National Gypsum Co., a plant in Martin County. Other producers were Johns-Manville Sales Corp., Grefco, Inc., and Chemrock Corp., with plants in Madison, Montgomery, and Tippecanoe Counties, respectively. Johns-Manville Sales Corp. stopped expanding perlite in November and began using its facility as a warehouse.

Expanded perlite was used in roof insulation board and as cavity fill insulation. Other uses were as filter aid and in plaster aggregate.

Sand and Gravel.—Nationally, Indiana ranked 10th in the production of sand and gravel, the State's third leading commodity in terms of value. Production declined about 5.3 million tons from 1979 to 1980 because of the depressed construction industry.

Construction sand and gravel, which accounted for most of the State's production, was extracted in 63 counties by 125 operators. Major uses were for asphalt and concrete aggregate, roadbase, and fill.

Table 5.—Indiana: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	10,832	$25,126	$2.32	9,749	$24,712	$2.53
Plaster and gunite sands	W	W	W	45	122	2.74
Concrete products	747	1,574	2.11	844	2,100	2.49
Asphaltic concrete	5,576	11,654	2.09	3,730	9,019	2.42
Roadbase and coverings	4,530	8,694	1.92	4,286	9,162	2.14
Fill	4,463	7,094	1.59	2,556	5,336	2.09
Snow and ice control	459	861	1.88	289	626	2.16
Railroad ballast	[1]	1	2.80	12	120	9.74
Other	443	838	1.89	261	540	2.07
Total or average	27,050	55,842	2.06	21,772	[2]51,738	2.38

W Withheld to avoid disclosing company proprietary data; included in "Other."
[1]Less than 1/2 unit.
[2]Data do not add to total shown because of independent rounding.

Table 6.—Indiana: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	13,367	$25,579	$1.91	11,056	$24,750	$2.24
Gravel	13,683	30,263	2.21	10,716	26,988	2.52
Total or average	27,050	55,842	2.06	21,772	51,738	2.38
Industrial sand	W	W	W	259	1,201	4.64
Grand total or average	W	W	W	22,031	52,939	2.40

W Withheld to avoid disclosing company proprietary data.

Table 7.—Indiana: Construction sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1979		1980	
	Quantity	Value	Quantity	Value
Adams	232	457	199	495
Allen	512	795	397	750
Bartholomew	W	636	W	W
Carroll	37	81	29	75
Cass	328	624	157	409
Clark	150	263	W	W
Daviess	150	263	W	W
De Kalb	534	942	334	768
Delaware	396	678	206	403
Elkhart	380	785	410	991
Fountain	564	1,476	467	1,466
Fulton	W	255	W	235
Hamilton	1,942	4,602	1,399	3,544
Howard	W	W	331	987
Huntington	259	W	183	449
Jackson	W	648	W	600
Johnson	78	183	60	168
Knox	639	1,240	504	1,089
Kosciusko	899	1,459	657	1,043
Lagrange	224	384	W	W
Lake	W	W	--	--
Madison	691	1,491	490	1,174
Marion	2,377	5,613	2,178	5,384
Marshall	313	523	241	481
Miami	121	269	W	W
Morgan	1,014	2,227	781	2,110
Ohio	W	W	3	8
Parke	343	735	285	536
Posey	10	15	--	--
Rush	23	33	18	30
St. Joseph	1,564	2,776	1,247	2,844
Shelby	468	1,017	294	798
Steuben	523	774	405	803
Switzerland	1,520	W	W	W
Union	--	--	W	W
Vanderburgh	191	191	147	175
Vermillion	499	1,176	W	W
Vigo	377	878	W	W
Wayne	521	1,113	895	2,152
Undistributed[1]	9,171	21,243	9,456	21,773
Total[2]	27,050	55,842	21,772	51,738

W Withheld to avoid disclosing individual company proprietary data; included in "Undistributed."

[1]Includes Boone, Clinton, Dearborn, Fayette, Floyd, Franklin, Gibson, Grant, Greene, Hancock, Harrison, Henry, Jasper, Jay, La Porte, Montgomery, Noble, Owen, Putnam, Randolph, Sullivan, Tippecanoe, Tipton (1979), Wabash, Warren, and Whitley Counties, and some sand and gravel figures that cannot be assigned to specific counties.

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

Early in the year, Triple G Gravel opened a new operation near Silverwood, Fountain County, in west-central Indiana. In November, Allied Aggregates Corp. ended production in Eagle Creek Park, Marion County, under terms of an agreement with the City of Indianapolis. Mining activity began at the site in 1967.

Industrial sand was mined by three companies from deposits located in La Porte, Porter, and Warren Counties. Major uses were for foundry sand and refractories.

Slag.—Indiana ranked third nationally in the production of iron blast furnace slag and second in the production of steel slag. Three companies processed slag from Indiana's steel mills; two firms were located in Lake County and one in Porter County in the northwestern part of the State. Production was down for the year because of the depressed state of the steel industry and the slowdown in the construction industry, a major user of processed slag. Slag was used as asphalt and concrete aggregate, roadbase material, railroad ballast, filter media, and for septic tank absorption beds.

Stone.—Nationally, Indiana ranked 14th in value of total stone production and 5th in value of dimension stone. In terms of value, stone was the leading nonfuel mineral commodity extracted in the State. Stone was mined in 46 counties from 113 quarries. Limestone was the leading rock type mined, followed by marl and sandstone.

Table 8.—Indiana: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	2,198	6,727	2,446	7,881
Agricultural marl	13	19	38	317
Concrete aggregate	5,773	15,483	6,334	18,128
Bituminous aggregate	3,433	9,760	2,653	8,695
Macadam aggregate	1,656	4,777	1,299	3,989
Dense-graded roadbase stone	7,859	21,986	6,593	20,169
Surface treatment aggregate	1,272	3,729	1,050	3,260
Other construction aggregate and roadstone	6,867	17,917	6,148	17,666
Riprap and jetty stone	r327	r1,116	295	1,021
Railroad ballast	648	1,755	791	2,313
Manufactured fine aggregate (stone sand)	109	301	46	141
Terrazzo and exposed aggregate	1	2	--	--
Cement manufacture	3,388	6,206	2,769	5,936
Dead-burned dolomite	--	--	22	78
Fill	W	W	1	2
Other uses[2]	605	2,851	426	2,511
Total[3]	r34,147	r92,630	30,910	92,106

rRevised. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1]Includes limestone and marl.

[2]Includes stone used for poultry grit and mineral food, filter stone, flux stone, mine dusting, asphalt filler, glass manufacture, roofing granules (1979), sulfur removal from stack gases (1979), and "Other uses."

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

Table 9.—Indiana: Dimension stone[1] sold or used by producers, by use

Use	1979			1980		
	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)
Rough stone:						
Rough blocks	r110,763	r1,344	r$3,575	71,853	949	$3,002
Irregular-shaped stone	1,800	24	68	1,818	25	74
Dressed stone:						
Cut stone	r17,028	r233	r4,222	19,827	273	5,236
Sawed stone	r24,545	r336	r2,007	44,152	603	4,784
House stone veneer	r7,264	r99	r425	10,623	149	807
Other uses[2]	r19,175	r264	r208	12,518	173	144
Total[3]	r180,575	r2,301	r10,504	160,791	2,173	14,046

rRevised.

[1]Includes limestone and sandstone.

[2]Includes stone used for rubble, rough flagging, and dressed flagging.

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

Table 10.—Indiana: Crushed stone sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1979		1980	
	Quantity	Value	Quantity	Value
Allen	1,547	4,110	1,320	3,793
Bartholomew	W	W	754	2,484
Cass	1,180	2,326	W	W
Clark	3,114	7,268	2,429	6,599
Crawford	3,517	8,148	3,088	7,789
Elkhart	6	10	8	16
Grant	W	W	608	W
Hamilton	2,454	6,129	2,576	6,952
Harrison	453	1,179	385	1,106
Lawrence	2,491	6,843	2,137	6,259
Marion	W	W	1,373	4,019
Monroe	W	W	1,016	3,271
Newton	W	W	890	3,160
Noble	W	W	3	8
Orange	670	1,898	519	1,485
Perry	W	W	904	2,419
Putnam	3,024	8,309	2,870	9,229
St. Joseph	W	W	W	3
Shelby	515	1,603	W	W
Steuben	1	1	W	W
Sullivan	16	86	17	105
Switzerland	W	W	45	W
Tipton	--	--	W	W
Washington	W	W	176	443
Wayne	270	W	265	996
Undistributed[1]	14,878	44,717	9,525	31,970
Total[2]	r34,147	r92,630	30,910	92,106

rRevised. W Withheld to avoid disclosing individual company proprietary data; included in "Undistributed."

[1]Includes Adams, Blackford, Carroll, Decatur, Delaware, Franklin, Howard (1979), Huntington, Jasper, Jay, Jennings, Madison, Miami, Morgan, Owen, Pulaski, Randolph, Ripley, Rush, Scott, Wells, and White Counties.

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

Table 11.—Indiana: Crushed calcareous marl sold or used by producers

Year	Number of producers	Short tons	Value
1976	7	23,972	$39,973
1977	7	16,581	25,901
1978	5	15,029	18,762
1979	4	12,728	19,424
1980	4	13,437	26,764

Crushed stone was produced at 98 sites. Crawford County led the State in production, while Putnam County had the greatest number of operating quarries.

During the year, work continued on Martin Marietta Aggregate's underground limestone mine in Indianapolis. Construction of the 700-foot slant shaft was over halfway completed by yearend. The mine, being developed at a cost of $8 million, is expected to yield 1.5 million tons per year of limestone from a deposit 130 feet below the surface. Mine construction is scheduled for completion in 1981.

In Monroe County, Indiana Cal-Pro began producing crushed limestone from a new site near Stinesville, northwest of Bloomington.

Dimension stone was quarried at 21 sites; some quarries also produced crushed stone. Lawrence and Monroe Counties in south-central Indiana led in production and value.

Indiana Limestone Co.'s quarry near Bedford, Lawrence County, began supplying cut stone for what will be Indiana's tallest building when completed in 1982. About 90,000 cubic feet of limestone will be used for the exterior walls of American United Life Insurance Co.'s new tower under construction in downtown Indianapolis.

Sulfur.—Three firms—Amoco Oil Co., Energy Cooperative, Inc., and Northern Indiana Public Service Co.—recovered sulfur

as a byproduct in Lake County. Stauffer Chemical Co. produced liquid sulfur dioxide at its plant in Hammond, Lake County.

METALS

Aluminum.—Aluminum Co. of America (Alcoa) continued to produce ingots and sheets at its Warrick County smelter and fabricating plant near Evansville, in southwestern Indiana. Alcoa facilities in Alabama, Texas, and Jamaica supplied raw materials for the plant. Almost all of the power used at the site was generated by Alcoa with coal. One potline was temporarily shut down during the year because of the economic slowdown and the firm's need to reduce inventories.

Alcoa also operated finishing mills at Fort Wayne, Lafayette, and Richmond, Ind. Rea Magnet Wire Co., a wholly owned subsidiary, operated a research facility at Fort Wayne.

Alcoa announced an expansion in hard alloy aluminum extrusion capacity at its Lafayette Works to meet current and future demands of aerospace customers in domestic and foreign markets. At the same time, coiled-drawn tube production was being phased out because of low volume sales and subpar forecasts.

Apex International Alloys, Inc., continued to recover aluminum at its dross-processing plant in Knox County in southwestern Indiana.

In April, Kaiser Aluminum & Chemical Corp. announced a $15.2 million expansion at its Bedford plant to reclaim aluminum scrap. The facility will remelt used beverage cans into an estimated 62 million pounds of aluminum per year for use at the firm's Ravenswood, W. Va., plant.

Iron and Steel.—Indiana ranked first among the States in shipments of pig iron, surpassing Pennsylvania, which led in 1979. Production was down for the year because of the depressed economy and a slowdown in automobile and other durable goods sales, which reduced manufacturers' demand for steel.

Indiana's steel industry is centered in Lake and Porter Counties in the northwestern corner of the State. Major producers were Bethlehem Steel Corp., Inland Steel Co., Jones & Laughlin Steel Corp., and United States Steel Corp.

During the year, Inland Steel Co.'s new No. 7 furnace went onstream at the Indiana Harbor Works, culminating a 6-year, $1 billion expansion program that boosted the mill's capacity by over 1 million tons.

Jones & Laughlin Steel Corp. reached an agreement with the U.S. Environmental Protection Agency to install air pollution controls at its furnaces and coke oven batteries in East Chicago. In December, the firm concluded the sale of its Indianapolis plant, which produced carbon, alloy, and stainless strip products, to Cold Metal Products Co., Inc., Youngstown, Ohio.

In November, United States Steel announced plans to improve continuous casting operations at its Gary Works to increase the volume of steel produced for the automotive and container markets. The project, slated for 1981, is expected to boost continuous casting capacity for high-quality, aluminum-treated steel by 30%.

Other Metals.—Federated Metals Corp., a subsidiary of ASARCO Incorporated, continued to produce plate anodes, zinc dust, brass and bronze ingot, and tin-lead alloys at its Whiting facility in Lake County. The products were used by the electroplating industry, paint and chemical manufacturers, foundries, and other manufacturers.

U.S.S. Lead Refinery, Inc., a division of UV Industries, Inc., operated a secondary refinery in Lake County to recover antimonial lead and other lead alloys.

Mincon Corp., a lead recycler in Muncie, was purchased during 1980 by a partnership—Paul Bergoe & Son A/S Glowstrup, Denmark, and Boliden AB, Stockholm, Sweden. The new owners planned to increase output by installing a special battery furnace for smelting unbroken batteries.

M. K. Metals, Inc., operated a metal pellet plant in Kosciusko County, in northern Indiana. Nonferrous metals were recovered by a mechanical process and formed into pellets suitable for refining.

Consolidated Silver Recovery, Inc., recovered silver from photographic film at a plant north of Indianapolis.

[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasive stone:			
Hindostan Whetstone Co	Box 432 Bedford, IN 47421	Quarry and plant	Orange.
Abrasives, metallic:			
Wheelabrator-Frye, Inc	400 South Byrkit St. Mishawaka, IN 46544	Plant	St. Joseph.
Aluminum:			
Aluminum Co. of America	Newburgh, IN 47530	Smelter	Warrick.
Cement:			
Lehigh Portland Cement Co.[1]	718 Hamilton Mall Allentown, PA 18105	Plants	Lake and Lawrence.
Lone Star Industries, Inc.[1 2]	2511 East 46th St. Indianapolis, IN 46205	Plant	Putnam.
Louisville Cement Co.[1 2]	Box 35750 Louisville, KY 40232	Plants	Cass and Clark.
Clays:			
C & F Shale Co	203 South Walnut St. Brazil, IN 47834	Pit	Clay.
E & E Shale Co	304 South Depot St. Brazil, IN 47834	Pit and plant	Do.
General Shale Products Corp	Box 86 Mooresville, IN 46158	Pits and plant	Morgan.
Hydraulic-Press Brick Co	705 Olive St. St. Louis, MO 63101	Pit and plant	Do.
Log Cabin Coal Co	304 South Depot St. Brazil, IN 47834	Pits and plant	Clay.
Gypsum:			
National Gypsum Co.[3]	4100 First International Bldg. Dallas, TX 75270	Underground mine and plant.	Martin.
United States Gypsum Co.[3]	101 South Wacker Dr. Chicago, IL 60606	do	Do.
Iron and steel:			
Bethlehem Steel Corp	Box 248 Chesterton, IN 46304	Blast furnaces	Porter.
Inland Steel Co	3210 Watling St. East Chicago, IN 46312	do	Lake.
Jones & Laughlin Steel Corp	3001 Dickey Rd. East Chicago, IN 46312	do	Do.
United States Steel Corp	1 North Broadway Gary, IN 46402	do	Do.
Lime:			
Inland Steel Co	3210 Watling St. East Chicago, IN 46312	Plant	Do.
Marblehead Lime Co	300 West Washington St. Chicago, IL 60606	do	Do.
Peat:			
Michigan Peat Co	Box 66388 Houston, TX 77006	Bog and plant	Jasper.
Millburn Peat Co., Inc	Box 236 La Porte, IN 46350	do	La Porte.
Organic Products Co	2695 Cicero Rd. Noblesville, IN 46060	do	Hamilton.
Perlite, expanded:			
Chemrock Corp	Box 7151 Nashville, TN 37210	Plant	Tippecanoe.
Grefco, Inc	3450 Wilshire Blvd. Los Angeles, CA 90010	do	Montgomery.
Sand and gravel:			
American Aggregates Corp	Drawer 160 Greenville, OH 45331	Pits and plants	Hamilton, Marion, Wayne.
Hilltop Basic Resources, Inc	Box 11056 Cincinnati, OH 45211	Pit and plant	Switzerland.
Martin Marietta Aggregates	Box 789 Cedar Rapids, IA 52406	Pits and plants	Various.
Western Materials Co.[1]	Box 150, 600 Morland Dr. Lafayette, IN 47901	do	Do.
Stone:			
American Aggregates Corp	Box 21247 Indianapolis, IN 46204	Quarries and plants	Hamilton, Marion, Owen.
France Stone Co	Box 1928 Toledo, OH 43603	Pits and plants	Allen and Putnam.
Irving Bros. Gravel Co., Inc.[4]	3888 Garthwaite Rd. Marion, IN 46952	Quarries and plants	Delaware, Grant, Huntington.

See footnotes at end of table.

Table 12.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Martin Marietta Aggregates	6340 Castleplace Dr. Box 50815 Indianapolis, IN 46204	Quarries and plants	Madison, Putnam, Vigo.
Mulzer Crushed Stone Co	Box 248 Tell City, IN 47586	Quarries, mines, plants	Crawford and Perry.
Ralph Rogers & Co., Inc.[2 4]	Box 147 Kentland, IN 47951	Quarries and plants	Lawrence, Monroe, Newton.
Sulfur:			
Amoco Oil Co	2815 Indianapolis Blvd. Indianapolis, IN 46204	Refinery	Lake.
Energy Cooperative, Inc	3500 Indianapolis Blvd. East Chicago, IN 46312	____do	Do.

[1]Also stone.
[2]Also clays.
[3]Also expanded perlite.
[4]Also sand and gravel.

The Mineral Industry of Iowa

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Iowa Geological Survey for collecting information on all nonfuel minerals.

By James H. Aase[1]

Nonfuel mineral production in Iowa during 1980 was slightly below that of 1979, marking the first time in more than a decade that the State's total nonfuel mineral production value did not increase annually.

Ranked third in the Nation in gypsum production, Iowa accounted for about 12% of the U.S. output during 1980. In total value of nonfuel mineral production, the State was ranked near the midpoint among the States; output was reported from more than 500 operations in 96 of Iowa's 99 counties. Cement, the leading commodity produced in terms of value, accounted for more than $4 out of every $10 of the State total, followed by stone and sand and gravel. All seven of the nonmetallic minerals produced in the State, except peat, decreased in total production tonnages compared with 1979 output. This decline reflected the general softening in demand nationwide for industrial minerals the construction industry uses.

Table 1.—Nonfuel mineral production in Iowa[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	69	$3,844	48	$3,340
Portland	do	2,371	109,628	1,998	101,008
Clays	do	870	2,883	754	2,555
Gypsum	do	1,695	13,777	1,468	13,136
Peat	do	11	270	11	276
Sand and gravel	do	17,495	39,686	[2]12,683	[2]32,722
Stone:					
Crushed	do	32,471	103,215	26,542	92,603
Dimension	do	10	508	10	509
Combined value of other nonmetals		XX	4,090	XX	5,727
Total		XX	277,901	XX	251,876

XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Iowa, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Adair	W	W	Stone.
Adams	W	W	Do.
Allamakee	$757	$1,241	Stone, sand and gravel.
Appanoose	2,864	3,243	Stone, clays, sand and gravel, talc.
Audubon	W	W	Sand and gravel.
Benton	W	W	Stone, sand and gravel.
Black Hawk	W	W	Do.
Boone	860	686	Sand and gravel.
Bremer	637	706	Stone, sand and gravel.
Buchanan	W	W	Do.
Buena Vista	216	217	Sand and gravel.
Butler	W	W	Stone, sand and gravel.
Calhoun	71	71	Sand and gravel.
Carroll	475	398	Do.
Cass	W	W	Stone.
Cedar	W	W	Stone, sand and gravel.
Cerro Gordo	W	W	Cement, stone, clays, sand and gravel.
Cherokee	372	612	Sand and gravel.
Chickasaw	W	W	Stone.
Clarke	790	1,101	Do.
Clay	230	220	Sand and gravel.
Clayton	3,192	3,180	Sand and gravel, stone.
Clinton	1,809	2,092	Stone, sand and gravel.
Crawford	W	W	Sand and gravel.
Dallas	W	W	Sand and gravel, clays.
Davis	W	W	Stone.
Decatur	703	1,176	Do.
Delaware	W	W	Sand and gravel, stone.
Des Moines	5,643	6,194	Gypsum, stone, sand and gravel.
Dickinson	308	289	Sand and gravel.
Dubuque	W	W	Stone, sand and gravel.
Emmet	432	531	Sand and gravel.
Fayette	1,272	1,611	Stone, sand and gravel.
Floyd	773	W	Do.
Franklin	1,098	W	Stone, sand and gravel, clays.
Fremont	561	496	Stone, sand and gravel.
Greene	398	453	Sand and gravel.
Grundy	27	38	Do.
Guthrie	26	W	Do.
Hamilton	W	W	Stone, sand and gravel.
Hancock	1,483	1,421	Stone, sand and gravel, peat.
Hardin	5,040	5,464	Stone, sand and gravel.
Harrison	W	W	Do.
Henry	244	125	Do.
Howard	W	507	Do.
Humboldt	1,579	W	Do.
Ida	--	W	Sand and gravel.
Iowa	W	W	Do.
Jackson	W	W	Stone, sand and gravel.
Jasper	W	W	Sand and gravel, stone.
Jefferson	W	W	Stone.
Johnson	3,144	3,336	Stone, sand and gravel.
Jones	1,862	2,898	Do.
Keokuk	W	W	Stone.
Kossuth	156	93	Sand and gravel.
Lee	W	1,589	Stone, sand and gravel.
Linn	6,622	6,207	Stone, sand and gravel, peat.
Louisa	W	1,525	Stone, sand and gravel.
Lucas	13	--	
Lyon	W	W	Sand and gravel.
Madison	W	W	Stone, clays.
Mahaska	W	W	Sand and gravel.
Marion	W	W	Sand and gravel, stone, gypsum.
Marshall	W	4,332	Stone, sand and gravel.
Mills	W	W	Stone.
Mitchell	W	1,409	Stone, sand and gravel.
Monona	W	W	Sand and gravel.
Monroe	W	W	Stone.
Montgomery	W	1,372	Stone, sand and gravel.
Muscatine	W	W	Do.
O'Brien	227	338	Sand and gravel.
Osceola	W	W	Do.
Page	W	W	Stone, sand and gravel.
Palo Alto	W	W	Sand and gravel.
Plymouth	2,201	W	Do.
Pocahontas	W	W	Do.
Polk	W	W	Cement, sand and gravel, clays.
Pottawattamie	W	W	Stone, sand and gravel.
Poweshiek	W	W	Stone.
Sac	W	W	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Iowa, by county[1] —Continued

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Scott	$34,051	$40,162	Cement, stone, lime, sand and gravel, clays.
Shelby	W	W	Sand and gravel.
Sioux	1,623	1,876	Do.
Story	1,548	W	Sand and gravel, stone, clays.
Tama	W	W	Stone, sand and gravel.
Taylor	87	3	Stone.
Union	W	W	Do.
Van Buren	W	W	Stone, sand and gravel.
Wapello	W	W	Sand and gravel, clays.
Warren	W	W	Do.
Washington	W	W	Stone.
Wayne	W	--	
Webster	11,601	12,922	Gypsum, stone, sand and gravel, clays.
Winnebago	W	186	Sand and gravel, peat.
Winneshiek	1,640	1,325	Stone, sand and gravel.
Woodbury	W	W	Sand and gravel, clays.
Worth	1,530	W	Stone, sand and gravel, peat.
Wright	371	400	Sand and gravel.
Undistributed[2]	161,026	165,856	
Total	[3]259,560	277,901	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Ringgold County is not listed because no nonfuel mineral production was reported.
[2]Includes sand and gravel that cannot be assigned to specific counties and values indicated by symbol W.
[3]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Iowa business activity

	1979	1980[p]	Change, percent
Employment and labor force, annual average:			
Total civilian labor force, thousands	1,432.0	1,449.0	+1.2
Unemployment, do	59.0	83.0	+40.7
Employment (nonagricultural):			
Mining[1], do	2.6	2.3	-11.5
Manufacturing, do	259.8	243.5	-6.3
Contract construction, do	59.9	47.4	-20.9
Transportation and public utilities, do	58.2	55.5	-4.6
Wholesale and retail trade, do	286.4	280.4	-2.1
Finance, insurance, real estate, do	56.8	57.7	+1.6
Services, do	203.4	207.7	+2.1
Government, do	204.5	206.9	+1.2
Total nonagricultural employment[1], do	[2]1,131.7	1,101.4	-2.7
Personal income:			
Total, millions	$25,163	$26,705	+6.1
Per capita	$8,669	$9,178	+5.9
Construction activity:			
Number of private and public residential units authorized	13,365	8,523	-36.2
Value of nonresidential construction, millions	$354.8	$292.2	-17.6
Value of State road contract awards, do	$139.7	$122.8	-12.1
Shipments of portland and masonry cement to and within the State, thousand short tons	1,807	1,313	-27.3
Nonfuel mineral production value:			
Total crude mineral value, millions	$277.9	$251.9	-9.4
Value per capita, resident population	$96	$86	-10.4
Value per square mile	$4,937	$4,475	-9.4

[p]Preliminary.
[1]Includes bituminous coal.
[2]Data do not add to total shown because of independent rounding.

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

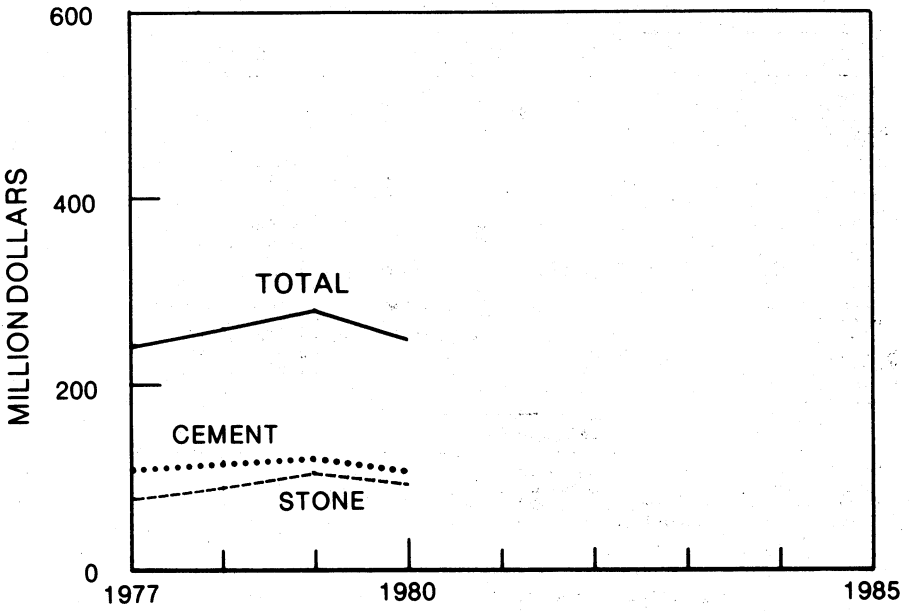

Figure 1.—Value of cement, stone, and total value of nonfuel mineral production in Iowa.

Cerro Gordo County was the leader in value of nonfuel mineral output and along with 46 other counties recorded production valued in excess of $1 million.

Trends and Developments.—Iowa's industrial expansion sagged dramatically during 1980 compared with that of 1979, showing an underlying effect of the economic recession. Industrial development investments for new facilities and expansion of existing facilities was $644.9 million, a 16% decrease below that of the previous year, according to information compiled by the Iowa Development Commission. Mineral-related processing and manufacturing industries included among the 231 new or expanded facilities reported for 1980 were 5 within the Standard Industrial Classification (SIC) 32, Stone, Clay, Glass and Concrete Products; and 4 within SIC 33, Primary Metal Industries.

As an addition to its Fort Madison molybdenum-conversion facility, the AMAX Tungsten division of AMAX Inc., announced plans for a plant to produce ammonium paratungstate from tungsten concentrates. The plant will be designed to process a wide variety of tungsten concentrates with most of the feed material being scheelite from Canada.

Hawkeye Chemical Co. announced plans for a multimillion-dollar expansion program at its nitrogen complex in Clinton. The expansion will provide a 50% increase in production of anhydrous ammonia to about 220,000 tons per year.

United States Gypsum Co.'s underground gypsum mine and plant near Sperry in Des Moines County received the Sentinels of Safety Award for being the safest mine in the Nation in the nonmetal category. The award was presented jointly by the American Mining Congress and the Federal Mine Safety and Health Administration.

The Board of Water and Light Trustees of Muscatine ordered an air-pollution control system that will be the first in the country to generate commercial-grade gypsum as a byproduct. To be installed on the coal-fired 150-megawatt Unit 9 of Muscatine Power & Water, the system will consist of an electrostatic precipitator and a flue gas desulfurization (FGD) system. The limestone FGD system will treat emissions from coal with a sulfur content of 2.5% to 3.2%. Through an oxidation process, this system will produce a commercial-quality gypsum byproduct suitable for use in such building materials as wallboard or cement. Until now, the sludge from FGD processes has

been a waste landfill material requiring long-term disposal. Engineering work on the $24 million project was underway, and construction was scheduled to begin in January 1981.

Employment.—Near yearend 1980, the Iowa Department of Job Service reported employment in the mining industry of the State was at 2,100, compared with 2,500 for the same period in 1979. The average hourly earnings of mining production and related nonsupervisory workers was $7.16 in December 1980, approximately a 6% increase compared with the same month of the previous year.

Legislation and Government Programs.—During 1980, the Iowa Geological Survey was engaged in a variety of activities directed toward a better understanding of the State's geology and mineral and water resources. Included among the projects were the following: (1) Developing a three-part map series of the Silurian-Devonian aquifer system summarizing the geologic and hydrologic characteristics of the system and its regional significance as a ground water supply source for a large portion of Iowa; (2) ending a 5-year coal research project to determine the stratigraphy of Iowa coal; (3) studies delineating favorable geological areas for hazardous waste disposal; and (4) continuing a cooperative topographic mapping project with the U.S. Geological Survey, advancing the State coverage of the 7 1/2-minute quadrangle series to about 79%.

The Iowa Geological Survey completed studies of the gypsum deposits in central Iowa. Findings indicated that gypsum reserves on land controlled by the gypsum industry in the Fort Dodge area were sufficient to keep two of the four active companies in the State in operation for 50 to 60 years. The other two companies have less reserves. In addition, the report indicated that gypsum resources outside of areas now controlled by the gypsum producers could extend the life of the industry in the Fort Dodge area by about 15 years at the current annual production rate.

Iowa State University, Ames, was selected by the U.S. Department of the Interior to become the site of a new Mining and Mineral Resources Research Institute. Creation of the Mineral Institute program was authorized by the Surface Mining Control and Reclamation Act of 1977.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Cement manufactured in Iowa during 1980 came from 5 companies operating a total of 13 kilns at 3 wet-process and 2 dry-process plants in Mason City, Des Moines, and Buffalo.

The quantity of cement produced during the year fell to its lowest level in more than a decade, whereas the unit price of both portland and masonry cement rose to record highs of $50.56 per ton and $69.15 per ton, respectively. Nationwide, the State was ranked 9th in portland cement production and 19th in output of masonry cement.

During 1980, approximately 3.8 million tons of nonfuel minerals and related raw materials were consumed in manufacturing Iowa's 2 million tons of finished cement.

The largest end users of portland cement produced were ready-mix companies, consuming approximately two-thirds of the 1980 production. Other users, in descending order of amounts consumed, were concrete product manufacturers, highway contractors, building material dealers, other contractors and miscellaneous customers, and government agencies. Most of the shipments from cement plants to end users were handled by truck in bulk form.

Penn-Dixie Industries, Inc., operators of a cement manufacturing plant in Des Moines, filed for protection under Chapter 11 of the Federal Bankruptcy Act. Under Chapter 11, the company continues to operate while working out a plan for settling its debts by seeking long-term financing and the possible sale of assets.

Clays.—Compared with that of the previous year, common clay and shale production during 1980 decreased in both quantity and total value. Although the quantity produced was at the lowest level in more than a quarter century, the average unit price of the output rose to an alltime high of $3.39 per ton.

Cerro Gordo County continued its historic role as the leading county in the State for quantity of clay produced. The State's clay output during the year came from 13 mines operated by 10 companies in 11 counties. Three firms accounted for approximately three-fourths of Iowa's total output.

The largest use of the clay produced was

in cement manufacturing, consuming 56% of the 1980 output. Other uses, in descending order of quantity consumed, included building-brick manufacturing, lightweight aggregate for concrete block, drain tile, and roofing granules.

Gypsum.—Decreases were recorded in both the quantity and value of crude gypsum produced in 1980 compared with that of the previous year. Output dropped to the lowest level of the past 5 years, while the average unit value of the crude gypsum produced soared to a record high of $8.95 per ton.

The State was ranked second nationally in value of crude gypsum produced during 1980, following Texas. Production during the year was by five companies from six mines in three counties. Webster, the leading county in production, accounted for more than half of the State's total output. United States Gypsum Co., National Gypsum Co., Georgia-Pacific Corp., and Jim Walter Corp. operated surface mines near Fort Dodge. United States Gypsum Co. and Kaser Corp. operated underground mines near Sperry and Harvey, respectively. With the exception of Kaser Corp., all companies operated calcining plants near their mine sites for processing the crude gypsum.

Lime.—Lime production in Iowa declined slightly below that of 1979; however, an increase in the unit price resulted in a total value gain. All output came from a single plant near Buffalo in Scott County. Principal uses of the quicklime and hydrated lime produced included water purification and softening, paper and pulp, road and soil stabilization, and steel furnace operation.

Peat.—Four companies mined peat classified as either reed-sedge, hypnum moss, or humus at bogs in Hancock, Linn, Winnebago, and Worth Counties.

Reed-sedge production accounted for approximately nine-tenths of the total; most was sold in bulk form for use on golf courses. Other uses of peat produced during the year were for general soil improvement, mixed fertilizers, ingredient for potting soils, nursery applications, and other horticultural uses.

The average unit value of the State's peat sold in 1980 was $24.57 per ton. Small increases were recorded in both the quantity and total value compared with that of 1979.

Perlite.—Crude perlite, mined out of State, was expanded at the gypsum calcining plants of National Gypsum Co. and United States Gypsum Co. near Fort Dodge, Webster County. Although the tonnage produced declined from that of 1979, the total sales value increased slightly. The expanded product was used exclusively as aggregate in manufacturing building plaster.

Sand and Gravel.—Iowa's output of construction sand and gravel during 1980 dropped to its lowest level in more than two decades, while the average unit value escalated to a record high of $2.58 per ton. Compared with those of 1979, the quantity and attendant value of the year's production decreased 27% and 14%, respectively.

Iowa was ranked 20th among the States in construction sand and gravel production in 1980, with output reported by 178 companies and government agencies, operating from 208 sites in 74 of the State's 99 counties. Accounting for 11% of the State total, Polk County was the leader in quantity produced.

The quantity of material produced at the individual pit operations during the year varied, with 82 operations yielding less than 25,000 tons, 89 between 25,000 and 100,000 tons, 36 between 100,000 and 500,000 tons, and 1 operation producing in excess of 500,000 tons. Twelve companies, operating out of 64 sites, accounted for more than half of the 1980 production.

Table 4.—Iowa: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	7,820	$19,127	$2.45	5,101	$14,836	$2.91
Plaster and gunite sands	186	664	3.56	146	490	3.36
Concrete products	367	1,009	2.75	497	1,529	3.08
Asphaltic concrete	1,970	4,087	2.07	1,014	2,674	2.64
Roadbase and coverings	3,846	7,685	2.00	3,897	8,482	2.18
Fill	2,636	4,059	1.54	1,756	3,820	2.17
Snow and ice control	182	535	2.94	111	301	2.70
Railroad ballast	10	27	2.68	4	13	3.05
Other	280	675	2.41	156	576	3.68
Total[1] or average	17,297	37,867	2.19	12,683	32,722	2.58

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

The major use of the construction sand and gravel was for concrete aggregates, accounting for 40% of the total. Other uses included roadbase and coverings, 31%; fill, 14%; asphaltic concrete, 8%; and the remainder for miscellaneous uses.

Martin Marietta Aggregates, Central Div., produced industrial sand from an underground mine in Clayton County. The output was consumed principally by the foundry industry.

Table 5.—Iowa: Sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	10,278	$21,775	$2.12	7,272	$17,917	$2.46
Gravel	7,019	16,092	2.29	5,412	14,805	2.74
Total or average	17,297	37,867	2.19	[1]12,683	32,722	2.58
Industrial sand	198	1,819	9.18	W	W	10.38
Grand total or average	17,495	39,686	2.27	W	W	2.67

W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.

Table 6.—Iowa: Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1979			1980[1]		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Allamakee	1	18	26	2	22	W
Benton	2	122	209	1	16	47
Black Hawk	6	476	1,028	5	377	820
Boone	5	344	686	6	277	724
Buena Vista	3	161	217	3	61	109
Calhoun	1	47	71	2	W	W
Carroll	5	202	398	5	153	329
Cerro Gordo	3	228	710	2	W	W
Cherokee	4	244	612	6	395	856
Clay	3	93	220	5	159	320
Clayton	4	351	2,157	5	W	W
Clinton	4	150	347	4	105	274
Dallas	4	280	630	5	292	876
Des Moines	1	W	W	1	W	278
Dickinson	6	176	289	6	244	617
Emmet	4	320	531	4	174	381
Fayette	4	25	67	5	34	101
Floyd	2	100	146	3	W	W
Franklin	3	124	221	4	145	259
Greene	5	250	453	4	W	W
Grundy	1	12	38	1	8	30
Guthrie	1	W	W	3	127	304
Hamilton	3	57	65	4	75	103
Hancock	7	195	483	5	170	361
Hardin	5	185	349	6	204	467
Howard	2	6	13	2	12	59
Jones	6	310	815	4	251	815
Kossuth	3	87	93	3	61	73
Lee	2	W	W	1	125	293
Linn	4	595	1,300	2	W	W
Marion	5	877	1,883	5	446	1,322
Muscatine	4	646	1,164	4	578	1,177
O'Brien	3	134	338	4	204	467
Osceola	2	W	W	3	196	402
Polk	9	2,119	5,109	8	1,376	3,838
Scott	3	384	925	3	190	498
Sioux	7	957	1,876	6	489	1,521
Van Buren	1	96	W	1	65	W
Wapello	1	217	615	2	W	W

See footnotes at end of table.

Table 6.—Iowa: Sand and gravel sold or used by producers, by county —Continued

(Thousand short tons and thousand dollars)

County	1979			1980[1]		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Webster	4	253	600	5	198	559
Winnebago	2	W	W	1	52	58
Winneshiek	1	71	209	1	50	165
Worth	3	213	458	3	138	332
Wright	3	193	400	3	176	440
Undistributed[2]	r55	6,177	13,935	50	5,037	13,447
Total	207	17,495	39,686	208	[3]12,683	32,722

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1]Data exclude industrial sand to avoid disclosing company proprietary data.

[2]Includes Appanoose, Audubon, Bremer, Buchanan, Butler, Cedar, Crawford, Delaware, Dubuque, Fremont (1979), Harrison, Henry (1979), Humboldt, Ida, Iowa (1979), Jackson, Jasper, Johnson, Louisa, Lyon, Mahaska (1979), Marshall, Mitchell, Monona, Montgomery, Page, Palo Alto, Plymouth, Pottawattamie, Sac, Shelby, Story, Tama, Warren (1979), and Woodbury Counties, sand and gravel that cannot be assigned to specific counties (1979), and data indicated by symbol W.

[3]Data do not add to total shown because of independent rounding.

Stone.—Consisting solely of limestone in crushed and dimension form, total stone production was at its lowest level of the past decade. The 1980 output, derived from 300 quarries in 65 counties, decreased 18% in quantity and 10% in total value compared with that of 1979.

Crushed stone output, marketed most extensively as a dense roadbase material, was obtained from individual quarry operations having a wide range of tonnage output during the year. In 1980, 115 quarries produced less than 25,000 tons; 102 between 25,000 and 100,000 tons; 78 between 100,000 and 500,000 tons; 4 between 500,000 and 1,000,000 tons; and 1 quarry produced more than 1,000,000 tons. Scott County was the leader among the State's top-ranking four counties that produced more than 1 million tons each and collectively accounted for 27% of Iowa's total production. Nearly 98% of the crushed stone output was shipped by truck, 2% by railroad, and a small amount by waterway.

Dimension stone was produced at two quarries in Dubuque County and one quarry in Jones County by Wm. Becker & Sons Stone Co. and Weber Stone Co., respectively. Most of the output was marketed as dressed construction stone. Other uses of the material included house stone veneer, rubble, flagging, sawed stone, cut stone, curbing, and miscellaneous uses.

[1]State mineral specialist, Bureau of Mines, Minneapolis, Minn.

Table 7.—Iowa: Crushed limestone sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	2,806	9,469	3,074	11,041
Poultry grit and mineral food	W	W	266	3,849
Concrete aggregate	4,189	15,601	3,196	13,753
Bituminous aggregate	1,699	5,828	1,190	4,605
Macadam aggregate	193	517	355	1,048
Dense-graded roadbase stone	6,451	19,988	4,930	16,116
Surface treatment aggregate	5,493	17,782	4,903	17,482
Other construction aggregate and roadstone	5,589	17,225	3,883	13,326
Riprap and jetty stone	363	1,341	278	1,128
Railroad ballast	1,071	2,801	659	1,881
Filter stone	98	358	89	270
Cement manufacture	3,362	5,990	2,864	4,944
Fill	86	161	W	W
Other[1]	1,071	6,153	855	3,160
Total	32,471	[2]103,215	26,542	92,603

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

[1]Includes stone used for manufactured fine aggregate (stone sand), lime manufacture, flux stone, asphalt filler, disinfectant (1979), roofing granules, sulfur removal from stack gases, and "Other."

[2]Data do not add to total shown because of independent rounding.

Table 8.—Iowa: Crushed limestone sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1979			1980		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Allamakee	17	446	1,215	14	262	888
Buchanan	13	475	1,327	11	330	1,017
Butler	6	232	614	5	188	565
Cedar	6	346	859	5	154	447
Cerro Gordo	6	2,131	4,422	4	1,992	4,651
Chickasaw	4	W	W	6	209	582
Clarke	1	385	1,101	1	336	1,037
Clayton	12	432	1,023	23	421	1,124
Clinton	12	598	1,745	12	570	1,728
Decatur	4	410	1,176	2	262	809
Delaware	13	495	1,253	13	388	1,026
Des Moines	4	W	W	3	332	W
Dubuque	13	1,122	2,259	15	825	1,971
Fayette	18	628	1,544	16	911	2,402
Franklin	4	209	588	4	121	367
Fremont	2	W	W	2	117	423
Hamilton	1	W	W	1	135	574
Hancock	3	269	889	2	W	W
Hardin	4	669	5,115	4	752	5,826
Harrison	2	265	869	2	304	994
Howard	9	177	494	5	157	465
Humboldt	4	348	1,076	1	206	718
Jackson	8	329	985	9	420	1,412
Jones	10	546	1,609	8	493	1,680
Linn	10	1,563	4,902	12	1,061	3,650
Lucas	—	—	—	1	19	41
Madison	10	1,837	5,398	10	1,191	3,671
Mills	2	W	W	2	76	349
Monroe	1	W	W	1	306	1,383
Montgomery	1	W	W	1	260	1,381
Page	1	316	1,082	1	240	886
Scott	4	3,261	9,670	4	3,002	9,333
Story	1	140	461	1	124	440
Tama	1	204	W	1	W	W
Taylor	1	1	3	1	50	181
Van Buren	5	549	2,095	5	529	2,162
Webster	3	565	2,281	3	W	W
Winneshiek	19	388	1,116	17	418	1,281
Worth	6	339	938	4	211	670
Undistributed[1]	r74	12,796	45,105	68	9,167	36,470
Total[2]	315	32,471	103,215	300	26,542	92,603

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1]Includes Adair, Adams, Appanoose, Benton, Black Hawk, Bremer, Cass, Davis, Floyd, Henry, Jasper, Jefferson, Johnson, Keokuk, Lee, Louisa, Mahaska (1980), Marion, Marshall, Mitchell, Muscatine, Pocahontas, Pottawattamie, Poweshiek, Union, and Washington Counties and data indicated by symbol W.

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

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Lehigh Portland Cement Co	Box 1882 Allentown, PA 18105	Plant	Cerro Gordo.
Martin Marietta Cement Corp	Box 4288 Davenport, IA 52808	do	Scott.
The Monarch Cement Co	Humboldt, KS 66748	do	Polk.
Northwestern States Portland Cement Co.	Box 1008 Mason City, IA 50401	do	Cerro Gordo.
Penn-Dixie Industries, Inc	Box 152 Nazareth, PA 18064	do	Polk.
Clays and shale:			
Can-tex Industries, Div. of Harsco Corp.	101 Ashworth Rd. Des Moines, IA 50265	Pits and plants	Dallas, Polk, Wapello.
Carter-Waters Corp	Box 19676 Kansas City, MO 64141	Pit and plant	Appanoose.
Martin Marietta Cement Corp	Box 4288 Davenport, IA 52808	do	Scott.
Northwestern States Portland Cement Co.	Box 1008 Mason City, IA 50401	do	Cerro Gordo.
Sioux City Brick & Tile	Box 56 Sergeant Bluff, IA 51054	Pits and plants	Dallas and Woodbury.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Gypsum:			
Celotex Div., Jim Walter Corp	1500 North Dale Mabry Tampa, FL 33607	Mine and plant	Webster.
Georgia-Pacific Corp	900 SW 5th Ave. Portland, OR 97204	do	Do.
National Gypsum Co	2001 Rexford Rd. Charlotte, NC 28211	do	Do.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	Mines and plant	Des Moines and Webster.
Lime:			
Linwood Stone Products Co., Inc.	Route 2 Davenport, IA 52804	Plant	Scott.
Peat:			
C-IT-GRO	Route 2 Garner, IA 50438	Bog and plant	Hancock.
Eli Colby Co	Box 248 Lake Mills, IA 50450	do	Winnebago.
Colby Pioneer Peat Co	Box 8 Hanlontown, IA 50444	do	Worth.
Hughes Peat Co	Route 2 Marion, IA 52302	do	Linn.
Perlite, expanded:			
National Gypsum Co	2001 Rexford Rd. Charlotte, NC 28211	Plant	Webster.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Do.
Sand and gravel:			
Acme Fuel & Material Co	Box 34 Muscatine, IA 52761	Pit and plant	Muscatine.
B. L. Anderson, Inc	327 Guaranty Bldg. Cedar Rapids, IA 52401	do	Jones.
G. A. Finley, Inc	Box 465 Harlan, IA 51537	Pits and plants	Audubon, Crawford, Dallas, Montgomery, Page, Pottawattamie, Shelby.
Hallett Construction Co	Box 13 Boone, IA 50036	do	Boone, Buena Vista, Calhoun, Carroll, Cherokee, Clay, Crawford, Franklin, Hamilton, Marshall, Montgomery, Polk, Sac, Story, Wright.
Kaser Corp	7200 Hickman Rd. Des Moines, IA 50322	do	Marion.
Martin Marietta Aggregates, Central Div.	Box 789 Cedar Rapids, IA 52406	Pits and plants. Industrial sand and construction sand and gravel.	Black Hawk, Clayton, Linn, Marshall, Polk, Wapello, Worth.
Maudlin Construction Co	Box 634 Webster City, IA 50595	Pits and plants	Boone, Buena Vista, Dickinson, Franklin, Hamilton, Hardin, O'Brien, Osceola, Webster.
Peters Construction Co	Route 1 Cumming, IA 50061	do	Ida, Monona, Polk, Woodbury.
Stevens Sand & Gravel Co., Inc	2525 Highway 218 South Iowa City, IA 52240	Pit and plant	Johnson.
Van Dusseldorp Sand & Gravel, Inc.	Box 156 Colfax, IA 50054	Pits and plants	Jasper and Marion.
Stone:			
Alpha Crushed Stone, Inc	Box 267 Marion, IA 52302	Quarries and plants	Cedar, Clinton, Dubuque, Jackson, Jones, Linn.
B. L. Anderson, Inc	327 Guaranty Bldg. Cedar Rapids, IA 52401	do	Benton, Cedar, Jackson, Jones, Linn, Tama.
Kaser Corp	7200 Hickman Rd. Des Moines, IA 50322	do	Des Moines, Fremont, Jasper, Keokuk, Marion, Mills, Monroe, Montgomery, Poweshiek, Washington.
McCarthy Improvement Co., Linwood Stone Products Co., Inc.	Route 2 Davenport, IA 52804	Quarry and plant	Scott.
Martin Marietta Aggregates, Central Div.	Box 789 Cedar Rapids, IA 52406	Quarries and plants	Black Hawk, Bremer, Chickasaw, Hancock, Hardin, Jefferson, Johnson, Keokuk, Linn, Madison, Marshall, Scott, Worth.
Moline Consumers Co. LeClaire Quarries, Inc.	Box 206 LeClaire, IA 52753	do	Scott.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Northwestern States Portland Cement Co.	Box 1008 Mason City, IA 50401	Quarry and plant	Cerro Gordo.
E. I. Sargent Quarries, Inc	2525 West Euclid St. Des Moines, IA 50310	Quarries and plants	Clarke, Decatur, Lucas, Madison, Story.
Schildberg Construction Co., Inc.	Box 358 Greenfield, IA 50849	do	Adair, Adams, Cass, Madison, Pottawattamie, Union.
Weaver Construction Co	Box 817 Iowa Falls, IA 50126	do	Cerro Gordo, Franklin, Hamilton, Hancock, Hardin.

The Mineral Industry of Kansas

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the State Geological Survey of Kansas, for collecting information on all nonfuel minerals.

By Jane P. Ohl[1]

The value of nonfuel minerals produced in Kansas was $261.6 million, a 1.1% decrease from the 1979 record high. The slight drop was due mainly to nationwide recession and inflation that forestalled some housing and highway construction. Quantities of every important mineral commodity and manufactured cement products decreased from 1979 output. Only high-purity helium, lime, and salt increased in total values for 1980 over those of 1979.

Monthly employment figures of the Kansas Department of Human Resources showed mining and quarrying operations for nonfuel minerals employed an average of 1,421 persons per month in 1980. The employment picture could not be called abnormal; it began with the year's low of 1,270 employees in February, rose to a midyear high of 1,510 in August, and after a steady decline throughout the fall ended with 1,371 employees.

Table 1.—Nonfuel mineral production in Kansas[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	89	$4,525	60	$3,310
Portland	do.	2,086	88,619	1,835	86,103
Clays	do.	[2]1,061	[2]2,636	886	2,325
Pumice	do.	W	W	([3])	W
Salt[4]	do.	1,900	61,184	1,572	64,276
Sand and gravel	do.	14,280	26,490	[5]12,124	[5]23,817
Stone:					
Crushed	do.	19,308	56,038	17,398	54,731
Dimension	do.	W	W	18	937
Combined value of clays (bentonite, 1979), gypsum, helium (crude and high purity), lime, salt (brine), sand and gravel (industrial, 1980), and values of items indicated by symbol W		XX	[r]25,074	XX	26,094
Total		XX	[r]264,566	XX	261,593

[r]Revised. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure.
XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes bentonite; value included in "Combined value" figure.
[3]Less than 1/2 unit.
[4]Excludes salt in brines; value included in "Combined value" figure.
[5]Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Kansas, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Allen	W	W	Cement, stone, clays.
Anderson	W	W	Stone.
Atchison	W	W	Do.
Barber	W	W	Gypsum, sand and gravel.
Barton	$538	W	Sand and gravel, clays.
Bourbon	862	W	Stone.
Butler	1,361	$2,037	Do.
Chase	W	109	Do.
Chautauqua	W	--	
Cherokee	W	W	Sand and gravel, stone, clays.
Cheyenne	110	128	Sand and gravel.
Clark	40	40	Do.
Clay	W	W	Sand and gravel, stone.
Cloud	W	W	Sand and gravel, clays.
Coffey	W	W	Stone, sand and gravel.
Comanche	3	6	Sand and gravel.
Cowley	2,120	2,687	Stone, sand and gravel.
Crawford	W	W	Stone, clays.
Decatur	74	93	Sand and gravel.
Dickinson	W	2,024	Stone, sand and gravel.
Doniphan	W	W	Do.
Douglas	W	W	Do.
Edwards	156	W	Sand and gravel.
Elk	W	W	Stone.
Ellis	363	603	Sand and gravel, stone.
Ellsworth	W	W	Helium, salt, clays, sand and gravel.
Finney	W	W	Sand and gravel, stone.
Ford	579	719	Sand and gravel.
Franklin	W	W	Stone, clays.
Geary	W	W	Sand and gravel, stone.
Gove	57	57	Sand and gravel.
Graham	146	W	Stone, sand and gravel.
Grant	W	W	Helium, sand and gravel.
Gray	194	W	Sand and gravel.
Greeley	--	18	Do.
Greenwood	792	290	Stone.
Hamilton	156	143	Sand and gravel.
Harper	160	32	Do.
Harvey	W	W	Do.
Haskell	170	W	Do.
Hodgeman	W	W	Do.
Jackson	125	107	Stone, sand and gravel.
Jefferson	2,206	2,129	Stone.
Jewell	W	W	Do.
Johnson	W	W	Stone, sand and gravel.
Kearny	332	W	Sand and gravel.
Kingman	48	48	Do.
Kiowa	W	W	Do.
Labette	975	1,076	Stone.
Leavenworth	1,431	1,854	Do.
Lincoln	W	W	Stone, sand and gravel.
Linn	598	847	Stone.
Lyon	W	W	Stone, sand and gravel.
McPherson	W	W	Clays, sand and gravel.
Marion	909	W	Stone.
Marshall	W	W	Gypsum, sand and gravel, stone.
Meade	W	W	Sand and gravel.
Miami	483	1,169	Stone.
Mitchell	W	--	
Montgomery	W	W	Cement, stone, clays.
Morris	2	45	Stone.
Morton	W	W	Helium, sand and gravel.
Nemaha	W	218	Stone.
Neosho	W	W	Cement, stone, clays, sand and gravel.
Ness	W	728	Sand and gravel.
Norton	W	W	Sand and gravel, pumice.
Osage	173	W	Stone.
Ottawa	--	27	Sand and gravel.
Pawnee	130	181	Do.
Phillips	33	367	Stone, sand and gravel.
Pottawatomie	W	W	Do.
Pratt	W	W	Sand and gravel.
Rawlins	36	36	Do.
Reno	34,754	41,754	Salt, sand and gravel.
Republic	W	W	Sand and gravel.
Rice	15,673	17,231	Salt, stone, sand and gravel.
Riley	W	W	Stone, sand and gravel.
Rooks	24	14	Sand and gravel.
Rush	W	W	Helium.
Russell	W	W	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Kansas, by county[1] —Continued

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Saline	$587	$779	Sand and gravel.
Scott	15	—	
Sedgwick	W	W	Sand and gravel, salt.
Seward	330	330	Sand and gravel.
Shawnee	W	3,641	Stone, sand and gravel.
Sheridan	W	W	Sand and gravel.
Sherman	W	W	Lime, sand and gravel.
Smith	W	W	Stone.
Stafford	W	W	Sand and gravel.
Stevens	18	22	Do.
Sumner	W	W	Do.
Thomas	192	239	Do.
Trego	142	115	Do.
Wabaunsee	163	485	Stone.
Wallace	8	13	Sand and gravel.
Washington	W	W	Stone, sand and gravel.
Wichita	33	33	Sand and gravel.
Wilson	W	W	Cement, stone, clays.
Woodson	W	W	Stone.
Wyandotte	W	W	Cement, sand and gravel, stone.
Undistributed	162,715	182,088	
Total	230,016	[2]264,566	

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

[1]Brown, Lane, Logan, Osborne, and Stanton Counties are not listed because no nonfuel mineral production was reported.

[2]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Kansas business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,198.0	1,198.0	—
Unemployment	do	40.0	53.0	+32.5
Employment (nonagricultural):				
Mining[1]	do	13.7	15.3	+11.7
Manufacturing	do	198.9	189.5	-4.7
Contract construction	do	49.9	46.4	-7.0
Transportation and public utilities	do	65.3	64.1	-1.8
Wholesale and retail trade	do	225.7	226.2	+.2
Finance, insurance, real estate	do	46.3	47.1	+1.7
Services	do	163.7	171.6	+4.8
Government	do	183.3	188.8	+3.0
Total nonagricultural employment[1]	do	946.8	949.0	+.2
Personal income:				
Total	millions	$21,555	$23,464	+8.9
Per capita		$9,099	$9,958	+9.4
Construction activity:				
Number of private and public residential units authorized		13,292	10,891	-18.1
Value of nonresidential construction	millions	$352.0	$242.2	-31.2
Value of State road contract awards	do	$235.0	$118.0	-49.8
Shipments of portland and masonry cement to and within the State	thousand short tons	1,323	1,231	-7.0
Nonfuel mineral production value:				
Total crude mineral value	millions	$264.6	$261.6	-1.1
Value per capita, resident population		$112	$111	-.9
Value per square mile		$3,216	$3,180	-1.1

[p]Preliminary.

[1]Includes bituminous coal and oil and gas extraction.

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

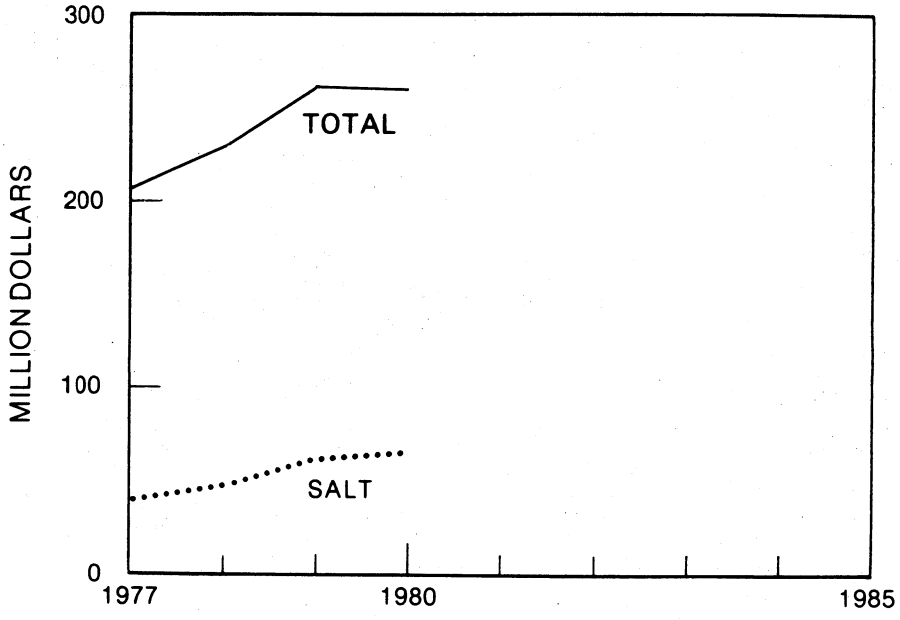

Figure 1.—Value of salt and total value of nonfuel mineral production in Kansas.

Legislation and Government Programs.—A bill imposing a severance tax on Kansas oil and natural gas production was introduced in the State Senate. Proponents later suggested that the tax could be applied to such other mineral resources as cement, coal, and salt. Revenues would be used to construct and repair highways and to support schools. Debate on the issue continued through the end of the year without final legislative action.

Kansas Bill H-2769, killed by the Senate Energy and Natural Resources Committee, would have given the legislature veto power over siting nuclear waste storage facilities. During the first 60 days of a session, the legislature would have been permitted to veto any waste-dump application approved by the Department of Health and Environment of the State of Kansas. This proposed legislation had been prompted by a request from Rickano Corp. to locate a low-level nuclear waste storage facility in a 1,000-foot-deep salt mine under the town of Lyons.

William W. Hambleton, director, Kansas Geological Survey, stated that exploration for metallic minerals in the State should be accelerated. In his proposal he recommended that the survey help private exploration firms with some of the necessary groundwork, including learning more about the conditions under which minerals exist in the Earth's crust. Hambleton fixed part of the blame for the current low level of mineral production on a lack of new investment capital. The thrust of the program, called the Habitat of Metallic Minerals, would involve building on data already gathered and on refocusing some already-existing programs of the survey.

In April 1980, the Kansas Geological Survey issued a 110-page illustrated report titled "A Kansas Plan for Water, Energy, Minerals, and Land Resource Research and Development—Creating Management Options for the Future."

In December 1979, a report titled "Kansas State Water Plan Studies" was issued. The report dealt with studies of long-range water-supply problems projected well into the 21st century. Findings indicated that in the eastern part of the State, from which most of the 1980 nonfuel mineral production was mined or quarried, all projected water needs can be met. In the western part of the State, however, severe water shortages will occur starting in the late 1990's. The studies found that the projected annual water requirement for the State in the year 2020 would be nearly 16 million acre-feet, whereas the total water supply available for use within the State is predicted to be 7.4 million acre-feet. Costs of transporting or

transferring water from areas of surpluses to areas of shortages may be prohibitive.

The Rock Island Railroad, in liquidation under Federal bankruptcy law, was shut down March 2. Some segments of track were economically attractive to other rail lines that wanted to start up service for shippers of agricultural products, coal, refinery products, and some nonfuel minerals. The high cost of shipping one nonfuel mineral (crushed gravel) by truck could add $500 to the price of a house in Oklahoma City, 93 miles from the gravel quarry.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Lone Star Industries, Inc., at Bonner Springs near Kansas City in Wyandotte County, and four companies in southeastern Kansas produced portland and masonry cement. The southeastern Kansas firms were: The Monarch Cement Co., Allen County; Lehigh Portland Cement Co., Montgomery County; Ash Grove Cement Co., Neosho County; and General Portland, Inc., Wilson County. On September 1, 1980, Lehigh Portland purchased the Independence plant and properties (Montgomery County) of United States Steel's Universal Atlas Cement Div., which sold its Independence property to generate cash and income.

The recent upward trend in quantity and value of cements was reversed in 1980. Portland cement shipments decreased 12% from 1979 and value decreased 3%; masonry cement shipments decreased 33% and value decreased 27%. The total value of portland cement sold and used, given as shipments from mills, was 1,834,580 short tons valued at $86.1 million. For masonry cement, the total quantity was 59,616 short tons valued at $3.3 million. Inflation and the resulting slowdown in the construction industries contributed greatly to these decreases from the levels of the previous year.

Finished portland cements are classified as white or gray. White cement is made from iron-free materials of exceptional purity, usually limestone, china clay or kaolin, and silica. Other, darker, less pure cements are called "gray." Both types were used as general-purpose moderate-heat portland cements; however, only the gray cements were used for high-early-strength, high-sulfate-resistant, and oil-well-type cements. Prepared masonry cements also were manufactured and sold.

In decreasing order of quantity used, finished portland cements were distributed as follows: 73% to ready-mix companies, 8.2% to other contractors, 7.5% to concrete product manufacturers, 4.9% to building materials dealers, 3.8% to highway contractors, and 2.6% to miscellaneous consumers. Although distribution was nearly the same as that for 1979, sales to ready-mix companies were down 2.5%; other sales figures also differed, either slightly up or down from 1979 statistics.

The industry consumed 2.9 million tons of cement rock and limestone, 325,000 tons of clay and shale, 102,000 tons of sand and sandstone, nearly 3,800 tons of ferriferous materials, and about 87,000 tons of gypsum. During 1980, the industry operated 15 kilns having a total production capacity of 7,312 tons of cement per 24 hours, unchanged from 1979 statistics. These kilns were served by four glass bag and eight electrostatic-precipitator air pollution control devices.

Energy requirements for the industry in 1980 varied, depending on the type of fuel. Natural gas consumption was 3.4 billion cubic feet, less than half the 1979 consumption; fuel oil declined to less than 25,000 barrels; and electric power decreased to just less than 250 million kilowatt-hours. Conversely, bituminous coal consumption, 282,000 tons during the year, increased about 68% over 1979 coal use in the Kansas cement industry.

More than 1 million short tons of finished portland cement was shipped to consumers by truck, approximately 687,000 short tons by rail, and the remainder by other means. The average value of all types of portland cement rose to $46.93 per short ton, an increase of 10% over that of 1979. The average value of prepared masonry cement was $55.52 per short ton.

Table 4.—Kansas: Portland cement salient statistics

(Short tons)

	1979	1980
Number of active plants	5	5
Production	2,117,038	1,968,341
Shipments from mills:		
Quantity	2,086,373	1,834,580
Value	$88,619,196	$86,103,446
Stocks at mills, Dec. 31	136,981	190,813

Table 5.—Kansas: Masonry cement salient statistics

(Short tons)

	1979	1980
Number of active plants	5	5
Production	87,942	62,832
Shipments from mills:		
Quantity	88,798	59,616
Value	$4,525,476	$3,309,604
Stocks at mills, Dec. 31	13,812	17,047

Clays.—Common clay and shale and a comparatively small amount of bentonitic clay were mined in Kansas. During 1980, however, the quantity of clays (excluding bentonite) produced and their total value declined from that of the previous year; quantity decreased 19.3% and value decreased 25.8%. Twelve companies extracted common clays from 19 mines in a dozen counties. One company, Micro-Lite, Inc., in Chanute, Neosho County, produced bentonitic clay from its mine in secs. 29 and 32, T26S, R15E, in Woodson County. The bulk of clay production, 58%, came from Allen, Cherokee, Crawford, Montgomery, Neosho, Wilson, and Woodson Counties in southeastern Kansas. Allen County continued as the State's leading producer. The next highest production came from McPherson County in central Kansas, followed by Franklin County in eastern Kansas. Among the producing companies, Buildex, Inc., a division of Clemens Coal Co., ranked first; Buildex had operations in Franklin and McPherson Counties.

Almost 37% of the clay was used in manufacturing portland cement. Nearly 25% was used to produce concrete blocks and structural concrete products. More than 20% was used for common and face brick. Clay also was used in manufacturing sewer pipe, roof and drain tiles, highway surfacing, and other items. Animal feeds were manufactured from the bentonitic clay.

Unit values for the common clays ranged from $1.23 to $3.14. The unit value for bentonitic clay was $12.29 per short ton; the total average value for all clays was $2.62.

Gypsum.—National Gypsum Co. has several facilities within 20 miles of each other in Barber County. The company's plant is at Medicine Lodge; its underground mine, quarry, crusher, and mill are 2 to 5 miles southwest of Sun City. Workings at the 90-foot depth yield about 300,000 tons of gypsum per year. Kansas' other gypsum producer is Georgia-Pacific Corp., Gypsum Div., which operates an underground mine, a mill, and a plant at Blue Rapids in Marshall County. The number one grade gypsum is about 99% pure; number two grade contains such impurities as shale and dolomite. The ore is mined by the room-and-pillar method from a 6-foot bed of gypsum 90 feet below the surface. Care is taken to leave the overlying bed of gray shale undisturbed when a face is undercut, drilled, and blasted. A one-man combination loader and shuttle car can move 11 tons per load to a newly installed PVC (polyvinyl chloride) conveyor belt; each shift can move 1,000 tons to the surface. The processing plant manufactures various gypsum products from this high-purity rock. After the gypsum is crushed and ground to a powder, it is calcined to drive off three-quarters of its water of crystallization. The ground gypsum is then fed into large, 10- to 15-ton kettles and heated (calcined) at about 335° F. The resulting product has many uses: Abrasives, cement retardant, chalk, chinaware, fertilizer, orthopedic casts, talcum powder, toothpaste, wall plaster, and wallboard. In addition, ground gypsum is used to make molds or molding materials for dental impressions, metal parts or forms, plate glass, and silverware, to name a few.

Helium.—Five companies produced crude and high-purity helium during 1980. All had been in operation since the 1960's, except for Union Carbide Corp.'s high-purity plant in Bushton, which started up in November 1977. The plants range in production capacity from 170 million cubic feet per year of high-purity helium (at Phillips Petroleum Co.'s Elkhart plant) to 675 million cubic feet per year of crude helium (at Northern Helex Co.'s Bushton plant). The 1980 combined production, however, for both crude and high-purity helium was only 37% of available capacity, yet it was nearly as high as in 1979, a record year. The 1980 decrease in production amounted

to a 50% drop in crude helium production. More high-purity helium was produced in 1980 than in 1979.

Lime.—Great Western Sugar Co. prepared quicklime for use in manufacturing and refining sugar at its beet sugar plant near Goodland, Sherman County. Although lime used in 1980 more than doubled, the unit price declined nearly 50%.

Perlite.—Lite-Weight Products, Inc., Kansas City, processed perlite obtained from out-of-State sources at its plant in Wyandotte County. The product was used as horticultural aggregates, plaster and concrete aggregates, filter aids, and as cavity-fill insulation.

Pumice.—Calvert Mines, Inc., mined and processed high-grade pumicite at Calvert in Norton County in 1980. This high-grade ore had a much higher total value than all of Calvert's 1979 production, half of which was low-grade pumicite sold for use in asphalt road construction. In 1980, half the high-grade pumicite was used in manufacturing abrasive cleaning compounds and half as concrete admixture.

Salt.—Six firms in Kansas produced 1.6 million short tons of salt or salt brine valued at $64.3 million during 1980. Although the amount of salt was approximately the same as in 1979, the value increased about 5%. The six firms were Independent Salt Co. in Ellsworth County; Carey Salt Co., Cargill, Inc., and Morton Salt Div. of Morton-Norwich Products, Inc., all in Reno County; American Salt Co. in Rice County; and Vulcan Materials Co. in Sedgwick County, which produces salt brines for use in chemical production processes.

A new conveyor system and other related changes at American Salt Co.'s mine at Lyons, Rice County, increased its salt production 50% in 1980. Carey Salt at Hutchinson, in Reno County, formed a cooperative agreement with Kansas Power and Light (KPL). Carey used steam to evaporate water from the salt, and the same steam also ran a 2,500-kilowatt turbine generator that produced more than Carey's electrical needs. KPL purchased the surplus electricity from the salt company to supply some of KPL's local users.

Geologists at the Kansas Geological Survey completed a 2-year study of Kansas salt, particularly the Hutchinson Salt Member of the Wellington Formation. Underlying 27,000 square miles of central Kansas, the Hutchinson has a 250-foot average thickness; however, southwest of the town of Hutchinson the salt member is 375 feet thick. The quantity of salt has been estimated to be 13.1 trillion tons; at an annual production rate of about 2 million tons, resources should last for many generations.

Bulletin 214 of the Kansas Geological Survey, titled "Land Subsidence in Central Kansas Related to Salt Dissolution," published in 1978, deals with subsidence associated with solution mining of salt and with solution of salt beds in relation to oil and gas wells. As a long-term objective, ongoing investigations will lead to the development of salt-production technology that will preclude the recurrence of subsidences such as the crater that formed at Hutchinson in 1974. Solution Mining Research Institute, Inc., of Flossmoor, Ill., sponsored the investigation.

Sand and Gravel.—Both quantity and value decreased in 1980, reversing the recent upward trend evident through 1979. Quantities of construction sand and gravel barely exceeded 12 million tons, down nearly 14% from that of 1979; and values dropped about 4% to less than $24 million. Sand and gravel, ranked fourth in value among the raw nonfuel minerals produced in Kansas, was recovered from 148 operations in 66 counties, 6 fewer counties than in 1979. Brown County was the only addition to the 1980 list of producing counties. Sand and gravel is a short-haul commodity; profits can be made, usually, only on sources that are near consumers. Fifty-two operations, each producing 25,000 short tons or less, yielded only 4.8% of the State's output of construction sand and gravel. From the remaining 96 operations, all but 7.4% of production was from operations producing less than 500,000 short tons. In decreasing order of value, leading counties for construction sand and gravel were Wyandotte, Sedgwick, Johnson, and Cowley. Sedgwick, with 13 operations and 9 plants, had the largest number of activities, followed by Wyandotte, which had 9 operations and 8 plants. In decreasing order of quantity used, construction sand and gravel was sold for concrete aggregate, road bases and covering, asphaltic concrete, fill, concrete products, and several other uses. Unit values for these products ranged from about $1.00 to about $3.30, and averaged $2.12. A comparatively small amount of industrial sand was produced in Kansas during 1980. Industrial sands were used for fiberglass, blasting, traction, roofing granules, and other uses; their average value per ton was

about $9.40. Most construction and industrial sand and gravel was shipped; of the 96% shipped, 99.8% went by truck and the remainder by rail.

Stone.—Production of crushed stone dropped to 17.4 million short tons in 1980 from the 1979 high of 19.3 million short tons. The total value of crushed stone decreased 2% in the same period to $54.7 million; however, the average unit value rose to $3.15 per ton.

Among raw nonfuel minerals produced in the State—excluding cement, a manufactured material—crushed stone ranked second in value after salt. Crushed and dimension stones were produced from 184 quarries in 50 counties. Six of the 184 quarries also produced crushed stone from sandstone formations, and 5 quarries in 4 of the 50 counties produced dimension limestone. Those four counties were, from north to south, Pottawatomie, Riley, Chase, and Cowley. The geologic map of Kansas (1964) shows that the Pottawatomie-Cowley source area is underlain by rocks of the Permian System. The Permian includes many of the limestone and sandstone formations within the State that are exposed in a 25- to 80-mile-wide, north-trending belt in eastern Kansas. Older, Pennsylvanian age rock sources underlie most of the other stone-producing counties as far as the eastern border of the State. Anderson, Finney, and Trego Counties, all of which recorded no stone production in 1978-79, were added to the 1980 list of producing counties.

The value per short ton by type of product was $50.83 for dimension limestone, $5.26 for crushed sandstone, and $3.09 for crushed limestone. The average for all three types was $3.20.

The majority of the quarries were small operations; 105 quarries were smaller than 50,000-short-ton operations and produced only 10% of the combined total of crushed and dimension stone. On the other hand, the greatest tonnage, 56%, came from operations in the 100,000- to 500,000-ton category; only one quarry was classified in the largest tonnage category in Kansas, an 800,000- to 899,999-ton operation.

In descending order of tonnage produced, Martin Marietta Aggregates, Central Div., which operated 20 quarries, ranked first out of 61 private and government-run operations; Ash Grove Cement Co. and Midwest Minerals, Inc., ranked second and third. Yearly output of the individual firms ranged from 500 tons to nearly 2 million tons. The combined output from 13 firms, each of which produced more than 500,000 tons during 1980, accounted for nearly 60% of the State's total output.

More than 50% of all stone produced was used as aggregates. About 19% was used in manufacturing cement. The largest nonconstruction use of crushed stone was for agricultural limestone and marl, which absorbed less than 5% of the product. In 1980, only three firms supplied dimension stone, which was sold as cut and sawed stone, as rubble, and as veneer for building facades.

Nearly 97% of the States's stone was shipped by truck. Railroads transported 3% of the stone from sources in Dickinson, Doniphan, Jewell, and Lincoln Counties, and only a fraction was moved by barge on the Missouri River.

Table 6.—Kansas: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	4,305	$8,637	$2.01	3,662	$7,829	$2.14
Plaster and gunite sands	63	120	1.92	102	247	2.43
Concrete products	788	1,704	2.16	1,064	2,207	2.07
Asphaltic concrete	2,422	4,561	1.86	2,191	4,637	2.12
Road base and coverings	2,873	4,759	1.66	2,599	4,914	1.89
Fill	2,729	3,459	1.27	1,978	2,889	1.43
Snow and ice control	154	355	2.30	109	363	3.33
Railroad ballast	331	497	1.50	W	W	2.63
Other uses	419	689	1.65	420	782	2.63
Total[1] or average	14,084	24,780	1.76	12,124	23,817	1.96

W Withheld to avoid disclosing company proprietary data; included in "Other uses."
[1]Data may not add to totals shown because of independent rounding.

Table 7.—Kansas: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	9,618	$17,052	$1.77	8,220	$15,990	$1.95
Gravel	4,466	7,728	1.73	3,904	7,828	2.00
Total or average	14,084	24,780	1.76	12,124	[1]23,817	1.96
Industrial sand	196	1,710	8.72	W	W	9.41
Grand total or average	14,280	26,490	1.86	W	W	2.05

W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.

Table 8.—Kansas: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	767	2,000	719	1,828
Agricultural marl and other soil conditioners	7	24	3	13
Concrete aggregate (coarse)	3,540	12,940	2,949	12,414
Bituminous aggregate	2,593	9,095	1,820	7,253
Macadam aggregate	520	1,093	467	1,162
Dense-graded roadbase stone	3,420	9,738	2,834	8,715
Surface treatment aggregate	836	2,500	790	2,860
Other construction aggregate and roadstone	3,432	9,378	3,464	10,066
Riprap and jetty stone	114	440	394	1,365
Railroad ballast	104	542	126	687
Filter stone	88	303	226	650
Manufactured fine aggregate (stone sand)	36	127	133	450
Cement manufacture	3,690	7,544	3,372	6,982
Lime manufacture	W	3	--	--
Asphalt filler	W	208	W	W
Other uses[2]	160	104	99	288
Total[3]	19,308	56,038	17,398	54,731

W Withheld to avoid disclosing company proprietary data; included in "Other uses."
[1]Includes limestone and sandstone.
[2]Includes stone used in terrazzo and exposed aggregate, fill, roofing granules (1979), and other uses.
[3]Data may not add to totals shown because of independent rounding.

Sulfur (Recovered Elemental).—Elemental sulfur was recovered in refinery operations by Getty Refining & Marketing Co. at El Dorado, Butler County; by CRA, Inc., at Coffeyville, Montgomery County; and by Phillips Petroleum Co., at Kansas City, Wyandotte County. Total production for 1980 was 21,000 metric tons valued at $1.3 million. Midyear 1980, Mobil Oil began building a desulfurization unit at Augusta, Butler County. Designed to produce 7 to 8 tons of sulfur per day, the unit is to come onstream in October 1981.

Vermiculite.—Shelter Shield Products, a division of Insulation Sales Co., began producing exfoliated vermiculite at its plant in Wellsville, Franklin County. The company imports crude vermiculite from Libby, Mont., and Africa, and sells the exfoliated vermiculite for use as horticultural aggregate, masonry for textured ceilings, and loose-fill insulation.

[1]State mineral specialist, Bureau of Mines, Denver, Colo.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ash Grove Cement Co.[1 2]	912 Main St., Suite 1000 Kansas City, MO 64105	Plant and quarry	Neosho.
General Portland, Inc., Victor Div.[2]	7701 East Kellogg St. Wichita, KS 67207	do	Wilson.
Lehigh Portland Cement Co	Box 428 Independence, KS 67301	do	Montgomery.
Lone Star Industries, Inc.[2]	2511 East 46th St. Indianapolis, IN 46205	do	Wyandotte.
The Monarch Cement Co.[1 2]	Box 187 Humboldt, KS 66748	do	Allen.
Clays:			
Buildex, Inc., Div. of Clemens Coal Co	Box 62299 Pittsburg, KS 66762	Pit, mine, mill and plant.	Franklin and McPherson.
W. S. Dickey Clay Manufacturing Co	Box 6 Pittsburg, KS 66762	Mines and plant	Cherokee and Crawford.
Cloud Ceramics, Div. of General Finance Inc.	Box 369 Concordia, KS 66901	Pits and plant	Cloud.
Justin Industries, Inc., Acme Brick Co	Box 425 Fort Worth, TX 76101	do	Cherokee and Ellsworth.
Micro-Lite, Inc	1100 South Katy St. Chanute, KS 66720	Mine	Woodson.
Gypsum:			
Gypsum Div. of Georgia-Pacific Corp	900 SW. 5th Ave. Portland, OR 97204	Mine and plant	Marshall.
National Gypsum Co	2001 Rexford Rd. Charlotte, NC 28211	do	Barber.
Helium:			
Alamo Chemical Co	Richfield, KS 67953	Plant	Morton.
Cities Service Cryogenics, Inc	Route 3 Scott City, KS 67871	do	Scott.
Kansas Refined Helium Co	Otis, KS 67565	do	Rush.
Northern Helex Co	Bushton, KS 67427	do	Rice.
Union Carbide Corp., Linde Div	do	do	Do.
Lime:			
Great Western Sugar Co	Box 5308 Denver, CO 80217	do	Sherman.
Perlite, expanded:			
Lite-Weight Products, Inc	1706 Kansas Ave. Kansas City, KS 66105	do	Wyandotte.
Salt:			
American Salt Corp	3142 Broadway Kansas City, MO 64111	Wells and underground mine.	Rice.
Independent Salt Co	Box 36 Kanopolis, KS 67454	Underground mine	Ellsworth.
Carey Salt Co	1800 Carey Blvd. Hutchinson, KS 67501	do	Reno.
Morton Salt Div. of Morton-Norwich Products, Inc.	Box 1547 Hutchinson, KS 67501	Evaporation pond	Do.
Vulcan Materials Co., Chemical Div	Box 7689 Birmingham, AL 35223	Wells	Sedgwick.
Sand and gravel:			
Ballou Construction, Inc	Box 206 Salina, KS 67401	Pit and plant	Saline.
Builders Sand Co	78th & Holliday Dr. Kansas City, KS 66106	Dredges and plant	Johnson and Wyandotte.
Dodge City Sand Co	Box 430 Dodge City, KS 67801	Pit and plant	Ford.
Lawrence Sand Co	Box 490 Lawrence, KS 66044	Dredge and plant	Douglas.
McFarland Gravel Co	Route 2 Arkansas City, KS 67005	Pit and plant	Cowley.
Miles Sand Inc	4852 North Meridian Wichita, KS 67204	do	Sedgwick.
Ritchie Sand Co	6500 West 21st St. Wichita, KS 67212	Dredge	Do.
J. H. Shears & Sons, Inc	819 West 1st St. Hutchinson, KS 67501	Plant	Reno.
Superior S & G Co	2751 South 88th Kansas City, KS 66111	Pit	Wyandotte.
Tarbet, Inc.	Box 563 Ulysses, KS 67880	do	Hamilton.
Stone:			
Beatrice Foods Co., Thompson Strauss Quarries.	7000 Holliday Dr. Kansas City, KS 66106	Quarry and plant	Wyandotte.
Hallett Construction Co	Box 13 Boone, IA 50036	do	Dickinson, Jefferson, Marion, Rice.
N. R. Hamm Quarry Inc	Box 17 Perry, KS 66073	do	Various (15 counties).
Ideal Basic Industries, Inc., Ideal Cement.	Box 8789 Denver, CO 80201	Quarry	Jewell.
L. A. Knebler & Son Rock Co	Box 446 Augusta, KS 67010	Quarries	Butler.

See footnotes at end of table.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Martin-Marietta Aggregates, Central Div.	Box 789 Cedar Rapids, IA 52406	Quarries and plants	Various (15 counties).
Midwest Minerals, Inc	Box 412 Pittsburg, KS 66762	do	Cherokee, Crawford, Labette, Montgomery, Neosho, Wilson.
Quartzite Stone Co., Inc	Box 97 Lincoln, KS 67455	do	Lincoln.
Sulfur (byproduct):			
CRA, Inc	North Linden St. Coffeyville, KS 67337	Secondary recovery	Montgomery.
Phillips Petroleum Co	Bartlesville, OK 74004	do	Wyandotte.
Getty Refining & Marketing Co	Box 1121 El Dorado, KS 67042	do	Butler.

[1]Also clays.
[2]Also stone.

The Mineral Industry of Kentucky

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Kentucky Geological Survey for collecting information on all nonfuel minerals.

By Donald K. Harrison[1] and Preston McGrain[2]

The value of Kentucky's nonfuel mineral production in 1980 was $204.3 million, down from $207.9 million in 1979. Stone continued to be the leading nonfuel mineral commodity produced, accounting for more than 50% of the State's value. Other commodities produced included cement, clays, synthetic graphite, pig iron, regenerator iron oxides, lime, mullite, and sand and gravel. The State produced one-fifth of the Nation's ball clay and ranked third nationally in primary aluminum output. In addition, perlite and vermiculite were processed from crude ore shipped from out-of-State.

Table 1.—Nonfuel mineral production in Kentucky[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2]	thousand short tons	794	$3,259	748	$3,692
Gem stones		NA	1	NA	1
Sand and gravel[3]	thousand short tons	11,726	23,721	7,767	17,637
Combined value of cement, ball clay, lime, sand and gravel (industrial), and stone		XX	180,946	XX	182,970
Total		XX	207,927	XX	204,300

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; value included in "Combined value" figure.
[3]Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Kentucky, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Adair	W	W	Stone.
Allen	W	W	Do.
Anderson	W	W	Do.
Barren	W	$848	Do.
Bell	--	W	Sand and gravel.
Boone	W	3,755	Do.
Bourbon	W	W	Stone.
Boyle	W	W	Do.
Breckinridge	W	W	Sand and gravel, stone.
Bullitt	W	W	Stone, clays.
Butler	W	W	Stone.
Caldwell	W	W	Do.
Calloway	$117	W	Sand and gravel.
Carlisle	W	W	Clays, sand and gravel.
Carroll	2,053	2,363	Sand and gravel.
Carter	W	W	Stone, clays.
Casey	374	546	Stone.
Christian	4,899	4,749	Do.
Clinton	W	W	Stone, sand and gravel.
Crittenden	W	W	Stone.
Cumberland	W	W	Do.
Daviess	2,020	2,025	Sand and gravel.
Edmonson	W	W	Stone.
Estill	503	634	Do.
Fayette	W	W	Do.
Fleming	W	W	Do.
Floyd	W	W	Sand and gravel.
Franklin	W	W	Stone.
Fulton	147	140	Sand and gravel.
Gallatin	W	W	Do.
Garrard	372	W	Stone.
Graves	W	W	Clays, sand and gravel.
Grayson	W	W	Stone.
Green	W	W	Do.
Hancock	314	251	Clays.
Hardin	3,531	3,247	Stone.
Harlan	879	975	Do.
Harrison	W	W	Do.
Hart	W	W	Sand and gravel, stone.
Henderson	W	--	
Henry	W	W	Stone.
Hickman	--	W	Sand and gravel.
Jackson	223	327	Stone.
Jefferson	31,782	34,154	Cement, stone, sand and gravel, clays.
Jessamine	W	W	Stone.
Lee	W	W	Do.
Letcher	3,607	3,872	Do.
Lewis	W	W	Sand and gravel.
Livingston	W	W	Stone, sand and gravel.
Logan	W	W	Stone.
McCracken	W	W	Sand and gravel.
McCreary	W	W	Do.
Madison	W	W	Stone.
Marion	241	256	Do.
Martin	155	W	Sand and gravel.
Mason	W	W	Lime, stone, sand and gravel.
Meade	W	4,393	Stone.
Menifee	W	W	Do.
Mercer	W	W	Do.
Metcalfe	228	258	Do.
Monroe	464	W	Do.
Montgomery	W	W	Do.
Morgan	W	W	Do.
Muhlenberg	W	2,710	Do.
Nelson	W	W	Do.
Nicholas	132	155	Do.
Ohio	W	W	Do.
Oldham	W	4,390	Stone, sand and gravel.
Pendleton	W	W	Lime, stone.
Pike	W	1,834	Stone.
Powell	1,835	2,274	Stone, clays.
Pulaski	3,213	4,007	Stone.
Rockcastle	W	W	Do.
Scott	W	W	Do.
Simpson	W	W	Do.
Taylor	W	W	Do.
Todd	W	W	Do.
Trigg	W	W	Do.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Kentucky, by county[1] —Continued

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Union	W	W	Sand and gravel.
Warren	W	W	Stone.
Washington	W	W	Do.
Wayne	W	W	Do.
Whitley	--	W	Clays.
Wolfe	$433	$666	Stone.
Undistributed[2]	133,826	129,101	
Total[3]	191,347	207,927	

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

[1]The following counties are not listed because no nonfuel mineral production was reported: Ballard, Bath, Boyd, Bracken, Breathitt, Campbell, Clark, Clay, Elliott, Grant, Greenup, Hopkins, Johnson, Kenton, Knott, Knox, Larue, Laurel, Lawrence, Leslie, Lincoln, Lyon, McLean, Magoffin, Marshall, Owen, Owsley, Perry, Robertson, Rowan, Russell, Shelby, Spencer, Trimble, Webster, and Woodford.

[2]Includes gem stones and values indicated by symbol W.

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

Table 3.—Indicators of Kentucky business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,563.0	1,621.0	+3.7
Unemployment	do.	87.0	131.0	+50.6
Employment (nonagricultural):				
Mining[1]	do.	54.5	52.7	-3.3
Manufacturing	do.	297.2	276.1	-7.1
Contract construction	do.	69.2	57.9	-16.3
Transportation and public utilities	do.	70.2	68.8	-2.0
Wholesale and retail trade	do.	268.1	259.6	-3.2
Finance, insurance, real estate	do.	51.0	51.8	+1.6
Services	do.	204.8	209.1	+2.1
Government	do.	230.4	233.4	+1.3
Total nonagricultural employment	do.	1,245.4	1,209.4	-2.9
Personal income:				
Total	millions	$26,016	$28,121	+8.1
Per capita		$7,377	$7,718	+4.6
Construction activity:				
Number of private and public residential units authorized		13,116	10,446	-20.4
Value of nonresidential construction	millions	$219.9	$232.9	+5.9
Value of State road contract awards	do.	$240.0	$180.0	-25.0
Shipments of portland and masonry cement to and within the State	thousand short tons	1,347	1,034	-23.2
Nonfuel mineral production value:				
Total crude mineral value	millions	$207.9	$204.3	-1.7
Value per capita, resident population		$59	$56	-5.1
Value per square mile		$5,147	$5,058	-1.7

[p]Preliminary.

[1]Includes bituminous coal and oil and gas extraction.

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

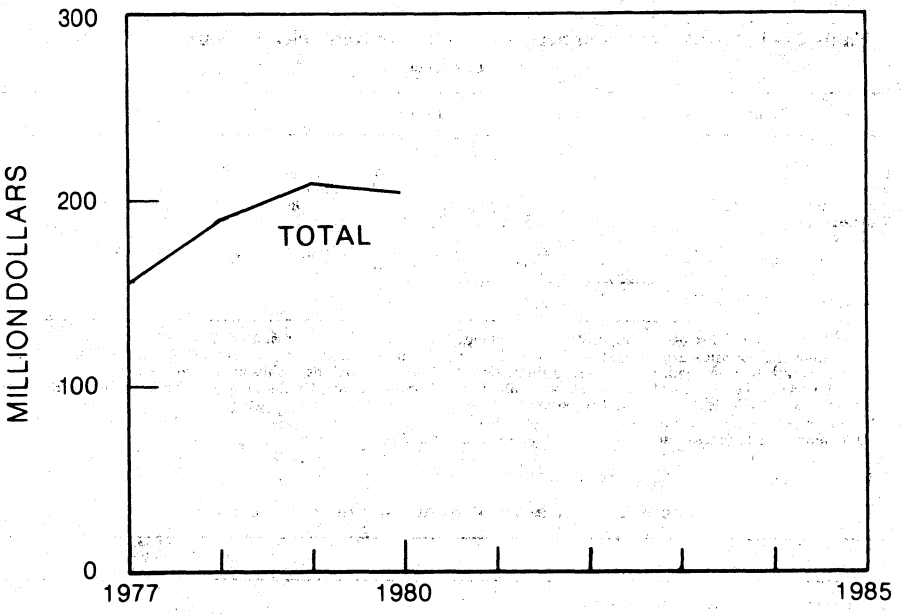

Figure 1.—Total value of nonfuel mineral production in Kentucky.

Trends and Developments.—Output of most construction mineral commodities declined during the year primarily because of high interest rates and a slowdown in construction activity in the State. Decreases in output were reported for cement (14%), clays (6%), sand and gravel (34%), and stone (13%). Although the State's total nonfuel mineral value also decreased, the percentage was lower than output because of increased unit values for most mineral commodities produced.

Legislation and Government Programs.—During the year, three State House bills concerning mining—H.R. 968, H.R. 970, and H.R. 675—were signed into law. H.R. 968 imposed a 4.5% severance tax on all depletable nonfuel minerals produced in the State. The new tax, which became effective July 1, 1980, applies to the sales price, excluding transportation costs. H.R. 970 requires that beginning July 1, 1981, 50% of all the collected severance taxes be returned to the office of the county treasurer where the tax was collected for use as general funds.

H.R. 675, signed into law in early 1980, requires that participants of mine rescue operations shall not be liable for civil damages stemming from a mine rescue operation. Included are all mine rescue team members, mine rescue instructors, and any person designated by an operator who assists, plans, or is connected with mine rescue planning. A proposed Federal regulation by the Mine Safety and Health Administration (MSHA) requiring mine rescue teams to be available at each underground mine is expected to go into effect in 1981.

In late 1980, the Eastern Kentucky Port Authority applied to the U.S. Army Corps of Engineers for a permit to construct a river port in Ashland. The $5 million project will involve dredging of port facilities and repairing of loading docks. Construction aggregate materials, fabricated metal products, chemicals, coal, and other products will be moved to market by barge after project completion.

During 1980, the Kentucky Geological Survey conducted investigations on barite, fluorspar, limestone, sand and gravel, and zinc. Investigations included identification and characterization studies to evaluate their resource potential and to determine their application for developing and utilizing the State's energy resources. The latter application included evaluation of carbonate-rock resources for environmental control measures and inventories of barite

deposits for use in heavy muds for oilfield drilling.

Other Survey work included sampling selected deposits of dolomite and limestone to evaluate potential use of this stone in fluidized-bed combustion systems. In a report published by the Survey, chemical and lithologic characteristics of carbonate rock in the High Bridge Group (Middle Ondovician) from a Fayette County core were described. Samples indicated that several thick zones of high-carbonate, low-silica stone are present at a minable depth and suggest the potential of large reserves for industrial use.

A bibliography of the maps and reports published by the Kentucky Geological Survey from 1839 through 1978, and a catalog of well samples, cores, and auger samples on file at the Survey, were issued during the year.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—At yearend, Moore McCormack Resources, Inc., purchased the only cement plant in the State from The Flintkote Co., a subsidiary of Genstar, Ltd., Montreal, Quebec. The Kosmos plant, situated on the Ohio River near Louisville, has an annual production capacity of about 670,000 tons of portland and masonry cement. Under the agreement, Moore McCormack will assume approximately $15 million worth of Jefferson County air pollution control bonds issued about 4 years ago for the facility.

Shipments of both portland and masonry cement declined 14% from 1979 to 1980 because of recessionary factors that reduced construction activity. Most of the cement produced by the dry process was used by ready-mix companies, concrete product manufacturers, highway contractors, and building material dealers. Raw material consumed during manufacture included limestone, clay, gypsum, and iron-bearing materials.

Clays.—Fourteen companies operating 25 pits mined common, fire, and ball clay in the State.

Common clay and shale were produced by eight companies at nine operations in Bullitt, Hancock, Jefferson, Powell, and Whitley Counties. They were used in the manufacture of common and face brick, quarry tile, lightweight aggregate, and portland cement.

Fire clay was mined by 4 companies at 12 operations in Carter and Graves Counties, while ball clay was mined by 3 companies at 5 operations in Carlisle, Carter, and Graves Counties. Recently, the ceramic industry estimated that as much as one-fifth of North America's ball clay is produced in Graves County. Both fire and ball clays were processed or packaged, and shipped in bulk to manufacturers of pottery ware, floor and wall tile, or used as paper filler, in refractory ware, and in firebrick.

Fluorspar.—No fluorspar was mined in the State for the second consecutive year, but exploratory drilling continued in the Western Kentucky fluorspar district. Fluorspar was last produced from the Frontier Spar Corp.'s Babb-Barnes Mine near Salem, which closed in late 1978. In 1980, the company kept the operation on a standby status. During the year, Ozark-Mahoning continued an aggressive exploration program on some of its large holdings in Kentucky and Illinois, and Hastie Mining Co. attempted to sell several deposits containing proven ore reserves in the State.

Graphite.—Superior Graphite Co., Carborundum Co., and Sigri Carbon Corp. produced synthetic graphite in Christian and Fulton Counties for electrodes for steelmaking and other uses. During the year, Carborundum Co. sold its graphite electrode plant in Hickman to Sigri Carbon Corp., a newly formed subsidiary of Sigri Elektrographic GmbH, Meitingen, Federal Republic of Germany.

Lime.—Kentucky ranked fifth nationally in lime production. Two companies produced lime from operations in Mason and Pendleton Counties. Black River Lime Co. (formerly Black River Mining Co.) produced lime from an underground mine and calcining facility at Carntown in Pendleton County. In mid-1980, the company began operating a new $4 million, 30-metric-ton-per-day hydrate facility, which enabled the firm to produce hydrate in addition to pulverized and pebbled quicklime.

Dravo Lime Co., a subsidiary of Dravo Corp., produced lime from an underground mine and calcining facility at Maysville in Mason County. The company signed a 10-

year agreement to supply 60,000 tons per year of Thiosorbic lime to the Cincinnati Gas & Electric Co. for its electric generating station near Union. Thiosorbic lime is used for scrubbing sulfur dioxide from generating plant stack gases.

Mullite.—Didier-Taylor Refractories Corp. produced high-temperature sintered synthetic mullite at its Greenup County plant, primarily for use in refractory products.

Perlite.—Perlite, mined in other States, was imported and expanded by Grefco, Inc., in Boone County and W. R. Grace & Co. in Campbell County. Both output and value were lower in 1980. The expanded perlite was used in the manufacture of roofing materials, for horticultural purposes, and as a lightweight construction aggregate.

Sand and Gravel.—Output of sand and gravel declined nearly 34% in 1980 compared with 1979 levels, primarily because of the slowdown in construction activity in the State. Sand and gravel was produced by 26 companies operating 35 pits and floating dredge operations in 22 counties. Leading counties, in descending order of tonnage, were Livingston, Daviess, Boone, and Breckinridge.

Construction sand and gravel comprised most of the production. Main uses included concrete aggregate, asphaltic concrete, and fill. A small amount of industrial sand was also produced for use as foundry sand, blasting sand, traction sand, and for refractories.

Stone.—In terms of value, stone continued to be the most important nonfuel mineral commodity produced in Kentucky. Crushed stone was produced by 54 companies at 101 mines and quarries. Limestone, which is abundant and widespread throughout the State, is the principal stone produced. A small amount of sandstone was also quarried and crushed in the eastern part of the State. Of the 67 counties that produced crushed stone, only Floyd and Knott Counties produced sandstone, each county having 1 operation. Main uses of all crushed stone were for roadstone, roadbase aggregate, and riprap.

Table 4.—Kentucky: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	6,506	$13,449	$2.07	4,582	$10,413	$2.27
Plaster and gunite sands	811	1,643	2.02	119	415	3.48
Concrete products	669	1,533	2.29	486	1,102	2.27
Asphaltic concrete	1,339	3,133	2.34	1,150	2,936	2.55
Roadbase and coverings	320	832	2.60	359	996	2.78
Fill	1,932	2,712	1.40	954	1,433	1.50
Snow and ice control	46	117	2.52	12	35	2.91
Railroad ballast	9	18	1.99	W	W	1.28
Other uses	93	284	3.05	105	306	2.92
Total[1] or average	11,726	23,721	2.02	7,767	17,637	2.27

W Withheld to avoid disclosing company proprietary data; included in "Other uses."
[1]Data may not add to totals shown because of independent rounding.

Table 5.—Kentucky: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	9,378	$18,210	$1.94	6,151	$13,231	$2.15
Gravel	2,349	5,512	2.35	1,616	4,406	2.73
Total[1] or average	11,726	23,721	2.02	7,767	17,637	2.27
Industrial sand	W	W	W	W	W	19.37
Grand total or average	W	W	W	W	W	2.30

W Withheld to avoid disclosing company proprietary data.
[1]Data may not add to totals shown because of independent rounding.

Table 6.—Kentucky: Crushed limestone sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	1,675	5,346	2,111	7,008
Poultry grit and mineral food	6	72	6	90
Concrete aggregate (coarse)	4,076	13,032	3,002	10,324
Bituminous aggregate	4,097	13,184	3,050	10,427
Macadam aggregate	1,465	3,952	1,038	2,840
Dense-graded roadbase stone	9,352	27,547	8,156	25,078
Surface treatment aggregate	1,122	3,360	1,119	3,752
Other construction aggregate and roadstone	10,578	30,187	7,862	24,917
Riprap and jetty stone	2,744	7,297	3,413	9,357
Railroad ballast	280	750	308	943
Filter stone	216	694	193	622
Manufactured fine aggregate (stone sand)	797	2,424	647	2,027
Flux stone	66	218	31	110
Mine dusting	281	2,022	301	2,177
Asphalt filler	(1)	3	(1)	4
Other fillers or extenders	W	W	6	55
Other uses[2]	2,543	6,552	2,444	5,477
Total[3]	39,298	116,641	33,687	105,207

W Withheld to avoid disclosing company proprietary data; included in "Other uses."
[1]Less than 1/2 unit.
[2]Includes stone used for cement manufacture, lime manufacture, acid neutralization (1979), fill, and other uses.
[3]Data may not add to totals shown because of independent rounding.

Vermiculite.—Crude vermiculite, mined in other States, was exfoliated by W. R. Grace & Co. at a plant in Wilder. Production was up slightly in 1980 compared with 1979 levels. The product was used primarily for block and loose-fill insulation, fireproofing, lightweight aggregate, and soil conditioning.

METALS

Aluminum.—Kentucky ranked third, behind Washington and Texas, in the production of primary aluminum. Output was up nearly 10% above 1979 levels. Two companies, using imported alumina, produced primary aluminum in 1980. National-Southwire Aluminum Co. operated a 180,000-ton-per-year aluminum reduction plant at Hawesville, Hancock County. Anaconda Aluminum Co. also operated a 180,000-ton-per-year aluminum smelter at Sebree, Webster County. In 1980, Anaconda purchased a 262-acre site near Russellville for construction of a $400 million rolling mill complex, which will have an initial capacity of 200,000 tons per year. Construction will begin in early 1981; completion is scheduled for mid-1983.

Iron and Steel.—Armco Inc. produced both pig iron and regenerator iron oxides at its Ashland plant in Boyd County. In late 1980, the company announced plans to build a $90 million-plus, 720,000-ton-per-year continuous caster for production of blooms for "oil-country" tubular products. The caster will supply blooms for a company-proposed $400 million tubular steel mill at Ashland.

Interlake Inc. closed two of its steel plants in Wilder and Newport, affecting 1,200 workers, after the United Steelworkers union rejected a company proposal to contain costs. At yearend, a group of former employees of Interlake was negotiating to purchase and reopen the facility under the ownership of a new firm called Newport Steel Corp.

Ohio River Steel Co., a division of Intercontinental Metals Corp. of Charlotte, N.C., planned to construct a $50 million rolling minimill at Calvert City. The plant is expected to be operational by mid-1982.

Lead and Zinc.—No zinc or lead was produced in 1980. The last reported production of these minerals was in 1978 when they were recovered as byproducts of fluorspar mining.

In 1980, Cominco American Corp., in a joint venture with ASARCO Incorporated and NL Industries, Inc., capped the 2,210-foot shaft at the Prewitt Hollow zinc prospect in Cumberland County. The shaft was completed in 1979.

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[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.
[2]Assistant State geologist, Kentucky Geological Survey, University of Kentucky, Lexington, Ky.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum (primary):			
Anaconda Aluminum Co	Box 1654 Louisville, KY 40201	Smelter	Henderson.
National-Southwire Aluminum Co.	Box M Hawesville, KY 42348	do	Hancock.
Cement:			
Kosmos Cement Co., Inc.[1]	Dixie Highway Kosmosdale, KY 40272	Plant	Jefferson.
Clays:			
Corbin Brick Co., Inc	Box 452 Corbin, KY 40701	Mine and plant	Whitley.
Kentucky Solite Corp	Box 27211 Richmond, VA 23261	do	Bullitt.
Kentucky-Tennessee Clay Co	Box 77 Mayfield, KY 42066	do	Carlisle and Graves.
Iron (pig):			
Armco, Inc	Middletown, OH 45202	do	Boyd.
Interlake, Inc	135th & Perry Aves. Chicago, IL 60627	do	Campbell.
Lime:			
Black River Lime Co	Route 1 Butler, KY 41006	do	Pendleton.
Dravo Lime Co	650 Smithfield St. Pittsburgh, PA 15222	do	Mason.
Perlite (expanded):			
W. R. Grace & Co.[2]	62 Whittemore Ave. Cambridge, MA 02140	Plant	Campbell.
Grefco, Inc	Box 35 Florence, KY 41042	do	Boone.
Sand and gravel:			
Evansville Materials, Inc	624 NW. Riverside Dr. Evansville, IN 47708	Dredge	Breckinridge and Daviess.
Ingram Materials, Inc	Box 1049 Nashville, TN 37202	do	Livingston.
Martin Marietta Corp.[3]	Box 789 Cedar Rapids, IA 52406	Dredge and pits	Boone, Carroll, Jefferson, Oldham.
E. T. Slider, Inc	1602 East Market Jeffersonville, IN 47130	Dredge	Oldham.
Stone:			
Kentucky Stone Co	400 Sherburn Lane Louisville, KY 40207	Underground mines, quarries, plants.	Various.
Medusa Aggregates Co	175 Moore Dr. Lexington, KY 40502	do	Fayette.
Reed Crushed Stone Co	Box 35 Gilbertsville, KY 42044	Quarry and plant	Livingston.
Three Rivers Rock Co	Box 218 Smithland, KY 42081	do	Do.

[1]Also clays.
[2]Also exfoliated vermiculite.
[3]Also stone.

The Mineral Industry of Louisiana

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Louisiana Geological Survey, for collecting information on all nonfuel minerals.

By Albert E. Ward[1]

Total value of nonfuel minerals produced in Lousiana increased 28.2% to $584 million in 1980, compared with the 27.8% increase to $455 million in 1979, and 1.7% rise to $356 million in 1978. Louisiana led the Nation in salt output and was second in Frasch sulfur production; both of these important minerals were marketed nationwide. The State also produced cement, clays, gypsum, lime, sand and gravel, and stone; these minerals or their products were marketed mostly in-State or in nearby States.

Table 1.—Nonfuel mineral production in Louisiana[1]

Mineral	1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
Clays thousand short tons	416	$6,073	380	$5,841
Salt do	14,207	113,167	12,662	132,182
Sand and gravel do	[2]20,446	[2]54,081	18,505	66,413
Sulfur (Frasch) thousand metric tons	2,858	W	2,590	W
Combined value of cement, gypsum, lime, sand and gravel (industrial, 1979), stone, and values indicated by symbol W	XX	281,955	XX	379,330
Total	XX	455,276	XX	583,766

W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

[2]Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Louisiana, by parish[1]

(Thousands)

Parish	1978	1979	Minerals produced in 1979 in order of value
Allen	W	W	Sand and gravel.
Ascension	W	W	Salt.
Assumption	W	W	Do.
Beauregard	$2,684	$2,937	Sand and gravel.
Bienville	W	W	Clays.
Caddo	W	W	Do.
Calcasieu	W	W	Salt.
Catahoula	470	417	Sand and gravel.
East Baton Rouge	W	W	Sand and gravel, clays.
East Carroll	38	--	
East Feliciana	2,928	2,790	Sand and gravel.
Grant	3,757	3,432	Do.
Iberia	56,237	59,441	Salt.
Iberville	W	W	Do.
Jefferson	W	W	Sulfur, salt.
Jefferson Davis	W	W	Sand and gravel.
Lafayette	418	687	Do.
Lafourche	W	W	Sulfur.
La Salle	W	967	Sand and gravel.
Lincoln	6	--	
Livingston	836	739	Sand and gravel.
Madison	W	--	
Morehouse	W	W	Sand and gravel.
Natchitoches	W	W	Clays, sand and gravel.
Orleans	W	W	Cement, stone, lime.
Ouachita	3,179	3,417	Sand and gravel.
Plaquemines	W	W	Sulfur, salt.
Pointe Coupee	W	W	Clays.
Rapides	4,969	4,892	Sand and gravel.
Red River	658	358	Do.
Sabine	W	3	Do.
St. Bernard	W	W	Do.
St. Helena	W	W	Sand and gravel, clays.
St. James	W	W	Salt.
St. Martin	W	W	Salt, sand and gravel, clays.
St. Mary	W	W	Salt, lime, stone.
St. Tammany	W	W	Sand and gravel, stone, clays.
Tangipahoa	3,158	3,753	Sand and gravel.
Union	276	276	Sand and gravel.
Vernon	845	982	Do.
Washington	4,797	4,929	Do.
Webster	6,750	6,304	Do.
West Feliciana	673	1,063	Do.
Winn	W	W	Stone, gypsum.
Undistributed	263,582	357,890	
Total[2]	356,255	455,276	

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

[1]No nonfuel mineral production was reported for Acadia, Avoyelles, Bossier, Caldwell, Cameron, Claiborne, Concordia, De Soto, Evangeline, Franklin, Jackson, Richland, St. Charles, St. John the Baptist, St. Landry, Tensas, Terrebonne, Vermilion, West Baton Rouge, and West Carroll Parishes.

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

Table 3.—Indicators of Louisiana business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,679.0	1,723.0	+2.6
Unemployment	do	112.0	115.0	+2.7
Employment (nonagricultural):				
Mining[1]	do	78.5	87.3	+11.2
Manufacturing	do	213.6	212.2	-.7
Contract construction	do	131.8	140.6	+6.7
Transportation and public utilities	do	119.1	124.3	+4.4
Wholesale and retail trade	do	354.2	355.9	+.5
Finance, insurance, real estate	do	73.3	74.7	+1.9
Services	do	257.2	270.0	+5.0
Government	do	289.7	306.1	+5.7
Total nonagricultural employment[1]	do	1,517.4	1,571.1	+3.5
Personal income:				
Total	millions	$30,508	$34,787	+14.0
Per capita		$7,594	$8,282	+9.1

See footnotes at end of table.

Table 3.—Indicators of Louisiana business activity —Continued

	1979	1980[p]	Change, percent
Construction activity:			
Number of private and public residential units authorized	23,637	20,359	-13.9
Value of nonresidential construction millions	$595.8	$530.4	-11.0
Value of State road contract awards do	$275.0	$486.8	+77.0
Shipments of portland and masonry cement to and within the State thousand short tons	2,846	2,808	-1.3
Nonfuel mineral production value:			
Total crude mineral value millions	$455.3	$583.8	+28.2
Value per capita, resident population	$113	$139	+23.0
Value per square mile	$9,383	$12,031	+28.2

[p]Preliminary.
[1]Includes oil and gas extraction.

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

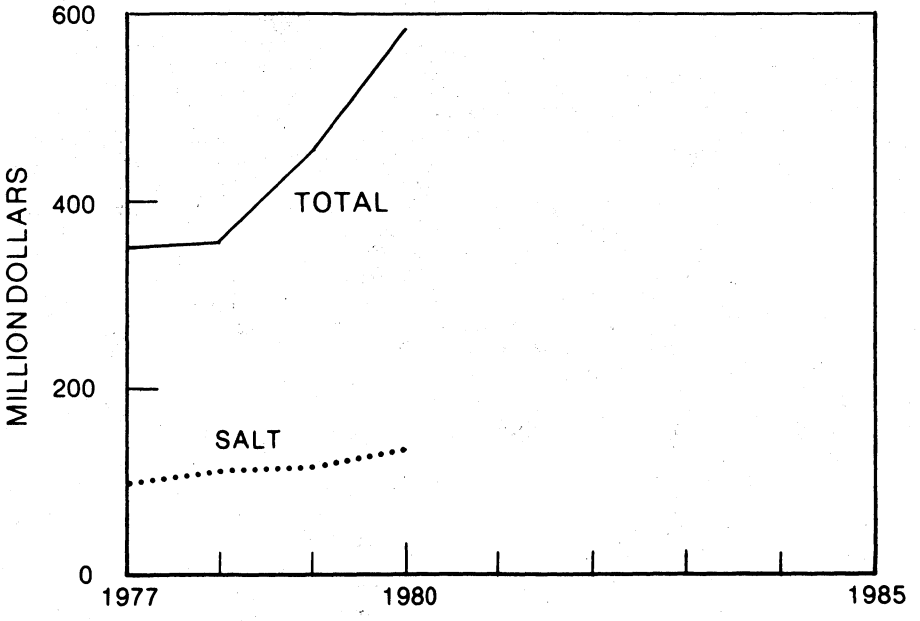

Figure 1.—Value of salt and total value of nonfuel mineral production in Louisiana.

Trends and Developments.—The State's aluminum industry has been forced to make huge capital investments to reduce electricity needs, and Louisiana's nickel refinery, petrochemical plants, and chemical operations (which utilize a significant share of the State's salt and sulfur output) are all burdened by rising energy costs and the threat, when it is deregulated, of sharply higher costs for natural gas. Soaring fuel and electricity costs in the the 1970's undermined the competitive advantage of ore- and concentrate-processing operations and threatened the continued existence of some

older plants, which in past years had abundant supplies of low-cost oil and gas. Even cement plants in southern Louisiana, facing the possibility of competing with waterborne cement imports, may be forced to make the costly conversion from natural gas to coal. Lignite reserves in northwest Louisiana and the mine-mouth powerplants that soon will be constructed are located a costly 300 miles or so from coastal Louisiana's nonfuel minerals-processing plants. In 1980, expensive solutions to energy problems, as well as environmental considerations and increased safety measures, were still being phased into established plants. If the State's nonfuel-minerals industry is to retain its competitive position in the future, reduced energy needs and changes in the energy mix to help control escalating costs will be required.

Legislation and Government Programs.—In 1980, the State Legislature did not pass any acts of major, direct consequence to the nonfuel minerals industry. However, as in past years, considerable legislation was introduced relating to environmental protection and hazardous waste disposal.

The Legislature's generally favorable past position on the development of in-State mineral resources is expected to prevail in the oncoming development of Louisiana's lignite resources, which may, in turn, cushion some of the rising operational costs of aluminum, nickel, and chemical plants lining the Mississippi River in the Baton Rouge-New Orleans area.

The Louisiana Geological Survey, through a cooperative program with Louisiana State University (LSU) and funding provided by the Department of Natural Resources, was developing a deep-basin research program. The study, in its second year in 1980, concentrated on regional stratigraphy, structure, and diagenesis at depths below 15,000 feet, primarily in the Mesozoic section. In a second cooperative effort with LSU, the survey was the manager of and a participant in a $2 million geopressured-geothermal research program that included resource assessment, test well site selection, environmental monitoring, reservoir studies, and operations research. The survey continued its industrial minerals studies (principally clay and gravel resources), fluvial processes, geologic mapping, and the parish-bulletin series. It also initiated a study of the surface effects of the Jefferson Island salt dome collapse of November 1980, with completion expected in 1981. Funding for the survey's ongoing environmental, hydrologic, and ground water research came from the State, the U.S. Environmental Protection Agency, and grants.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Barite.—Although no barite was mined in Louisiana, economics of the industry and technical factors favor producing bulk barite or barite-based drilling mud near the point of use. Eight companies ground crude barite at nine plants in five parishes for use as a weighting agent in oil well drilling fluids. The barite was shipped to Louisiana from mines in Arkansas, Missouri, Nevada, and several Latin American countries.

Halliburton Co.'s Imco Services division completed a 100,000-ton-per-year barite grinding plant at Houma to help satisfy growing regional demand for barite in drilling muds.

Cement.—During 1980, Lone Star Industries, Inc., operated two wet-process cement plants in New Orleans; one of the plants was acquired from Louisiana Cement Co., a division of OKC Corp. OKC, headquartered in Dallas, Tex., was undergoing voluntary liquidation as a corporate entity during the year. Most of the output was portland cement; however, both plants produced small amounts of masonry cement.

Demand for cement in Louisiana, strong in recent years, increased 5% in total sales in 1980. About two-thirds of the cement was sold to ready-mix companies and building materials dealers; the rest was sold to highway and other contractors, concrete products manufacturers, government agencies, and miscellaneous users. Although natural gas continued to be the principal fuel used, consumption in the cementmaking process was sharply reduced as economies in operations were introduced to counter rising gas prices. In contrast, electrical energy use declined only moderately in 1980.

Clays.—Six companies produced common clay at eight mines in the following six

parishes: Bienville, Caddo, Natchitoches, Pointe Coupee, St. Helena, and St. Tammany. Louisiana clay output decreased 8.7% in 1980, continuing a 2-year downtrend from the interim peak of 1978, and a general downtrend from the peak 1.08-million-ton production in 1970. Average price of $15.37 per unit ton was up 5.3%, continuing an uptrend begun in 1977.

Leading producers were Big River Industries, Inc., and Kentwood Brick & Tile Manufacturing Co., Inc. End uses of the clay were face brick and concrete block, about one-third of total output for each; and structural concrete and highway surfacing, about one-sixth of total output for each.

Table 4.—Louisiana: Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1976	513	1,158
1977	401	785
1978	517	4,786
1979	416	6,073
1980	380	5,841

Gypsum.—Winn Rock, Inc., continued to quarry gypsum near Winnfield in Winn Parish. The crude gypsum was used mostly for construction uses, with a lesser amount as cement retarder. Largely owing to curtailed housing construction, output fell by about one-third in 1980; price per short ton, however, rose by about one-third.

Lime.—Oystershell continued as the principal raw material used to manufacture lime at the Morgan City plant of Pelican State Lime Co. (a division of Southern Industries Corp.) and at the United States Gypsum Co. plant in New Orleans. The hydrated and quicklime output from these operations was used mostly for alumina, petrochemicals, sewage, and trade waste treatment. Lime production increased slightly in 1980, and the price per short ton increased about 10%.

Perlite (Expanded).—Filter Media Co. of Louisiana continued to expand perlite at its plant in Reserve, St. John the Baptist Parish. American Perlite Products discontinued operations in 1979. W.R. Grace & Co. did not produce expanded perlite at its New Orleans plant in 1980, but did use the facility as a warehouse and shipping point.

Salt.—Louisiana, one of 17 salt-producing States, retained its leading position in output with 31.4% of the Nation's salt production in 1980, up from 31.0% in 1979. State salt output in 1980 was off 10.9% from that of 1979, whereas national production declined 11.9%. Fourteen companies recovered salt from 17 operations in southern Louisiana parishes. Five of the mines were underground; the remainder were solution mines. About 60% of the salt was produced and consumed as brine in Louisiana's extensive chemical industry.

Owing to tight salt supplies, particularly early in 1980, prices were firm. Average price per short ton unit was $10.44 in Louisiana, up 31.0% from the $7.97 average price in 1979. Nationally, the average price was $16.26, up 38.3% from 1979's $11.76 price. Depending upon end use, price at the various plants in the State ranged from about $1.30 to almost $90.00 per ton.

The Diamond Crystal Salt Co.'s Jefferson Island salt mine was completely flooded by surface water and waterborne debris in late 1980. In the predawn hours on November 20, Lake Peigneur, a shallow, collapse-type, 1- by 2-mile lake began to drain into the salt mine. The 47-person day shift and 4 visitors from Louisiana State University began their descent to the 1,500-foot level at 7:00 a.m. By 8:00 a.m., most of the shift had descended by personnel cage to the 1,300-foot level and headed down a decline to the 1,500-foot working level. At about 8:30 a.m., the mine's master electrician working on the 1,300-foot level observed a 2-foot-deep stream of muddy, debris-laden water moving toward the shaft. A warning was sounded, lights to the 1,500-foot level were flashed to signal evacuation, and all personnel safely climbed inclines to the 1,300- or 1,000-foot levels and were raised to the surface.

In about 3 to 5 hours, Lake Peigneur (volume about 5,500 acre-feet or 240 million cubic feet) was completely drained into the Jefferson Island Mine (volume 12,600 acre-feet or 550 million cubic feet). Lake water, lake-bottom mud, some local subsidence, and water from Delcambre Canal completely filled and destroyed the mine. Two days later, Lake Peigneur returned to its normal level, and Delcambre Canal resumed its normal flow into Vermilion Bay.

Texaco, Inc., is the operator of a gasfield on the south flank of the Jefferson Island salt dome. On the morning of the lake drawdown, Peigneur well No. 20 was being developed in the southern part of Lake Peigneur. During drilling at about 1,200 to 1,300 feet, circulation was lost and the

drilling rig soon began to tip. The seven-person crew abandoned the rig, which was soon drawn into the hole at the bottom of the lake. A small tugboat, a crane, and several barges also were lost to the downdraw.

Environmental damage around the lake was extensive; included was the loss of some homes, wooded areas, and much of Live Oak Gardens, a noted botanical development and tourist attraction. Except for a few workers retained at the Jefferson Island salt mine for cleanup and salvage operations, most of the 290 employees were terminated. Litigation among Diamond Crystal, Texaco, and the State to determine responsibility was initiated at yearend. Along with the loss of the 6,000-ton-per-day-capacity salt mine and other property losses, the State has lost part of its royalty income from Jefferson Island salt, oil, and gas production that recently had averaged about $6,000 per month.

Cargill, Inc., announced an $8 to $10 million, 40% capacity expansion and modernization at its vacuum-pan salt plant at Breaux Bridge, St. Martin Parish. Cargill's Belle Isle Mine returned to normal operation following a 6-month shutdown caused by a methane gas explosion in June 1979. Reclassification of the mine to gassy status significantly increased operating costs because of additional safety-related equipment and other precautions in operations. Plans by the U.S. Government to convert the Belle Isle Mine to a crude oil storage site were dropped.

Domtar Chemicals, Inc., planned to increase production at its Cote Blanche Mine, St. Mary Parish, to the rated capacity of 1.4 million tons per year by early 1982. The U.S. Department of Energy (DOE) was to purchase the mine for crude oil storage as part of the strategic petroleum reserve program; however, because of delays in the program, DOE canceled plans to buy the mine. Largely because of the expected sale of the mine and some equipment problems, salt production was below capacity. Tight supplies of chemical and road salt in recent years justified the multimillion dollar investment to reattain rated mine capacity.

Sand and Gravel.—Louisiana, the 19th most populous State, was ranked 14th in output of sand and gravel in 1980. The State produced 2.3% of the national output, up from 2.1% in 1979. Tonnage figures were off; however, Louisiana construction sand and gravel output slipped only 11.2%, whereas U.S. production dropped 19.2%. Heavy construction related to energy industry developments, especially in most of the southern parishes, served as a prop for much of the State's sand and gravel industry.

In 1980, sand and gravel was mined at 102 operations and processed in 72 plants in 25 parishes. The top five producers accounted for about 35% of the tonnage, and the top nine produced 51%. Ten operations mined more than 500,000 tons each or about 38% of the total; 41 produced 100,000 to 500,000 tons for 50%, and those producing less than 100,000 tons mined 12%. Parishes yielding in excess of 1 million tons of sand and gravel in 1980 were East Baton Rouge, East Feliciana, Rapides, St. Helena, St. Tammany, Tangipahoa, Washington, and Webster. These eight parishes yielded 70.7% of the State's production; St. Helena, the leading parish, yielded 17.4%.

The 18.5-million-ton sand and gravel output was down from the 20- to 22-million-ton plateau of output during 1976-79. Most major end uses of construction sand and gravel declined; however, tonnage for roadbases and covering was up 34.3%. Average price per short ton of sand and gravel for all uses rose 30.2% in 1980, compared with the 8.6% increase in 1979, and 8.9% gain in 1978.

Table 5.—Louisiana: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	11,023	$31,072	$2.82	9,318	$32,681	$3.51
Plaster and gunite sands	--	--	--	W	W	7.50
Concrete products	1,515	3,692	2.44	W	W	3.83
Asphaltic concrete	3,200	10,172	3.18	2,874	12,343	4.29

See footnotes at end of table.

Table 5.—Louisiana: Construction sand and gravel sold or used, by major use category —Continued

Use	1979 Quantity (thousand short tons)	1979 Value (thousands)	1979 Value per ton	1980 Quantity (thousand short tons)	1980 Value (thousands)	1980 Value per ton
Roadbase and coverings	2,866	$6,580	$2.30	3,850	$12,836	$3.33
Fill	1,716	2,204	1.28	1,635	2,781	1.70
Other uses	127	362	2.86	475	1,929	4.06
Total or average	[1]20,446	[1]54,081	2.65	18,152	62,568	3.45

W Withheld to avoid disclosing company proprietary data: included in "Total."
[1]Data may not add to totals shown because of independent rounding.

Table 6.—Louisiana: Sand and gravel sold or used by producers

	1979 Quantity (thousand short tons)	1979 Value (thousands)	1979 Value per ton	1980 Quantity (thousand short tons)	1980 Value (thousands)	1980 Value per ton
Construction:						
Sand	8,593	$18,173	$2.11	8,233	$23,252	$2.82
Gravel	11,853	35,907	3.03	9,919	39,316	3.96
Total or average	20,446	[1]54,081	2.65	18,152	62,568	3.45
Industrial sand	W	W	W	353	3,845	10.88
Grand total or average	W	W	W	18,505	66,413	3.59

W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.

Stone.—Total stone output in Louisiana declined in 1980. Shell production, representing more than 90% of the State's total stone output, was off 15.2%; but average unit price per short ton rose 13%, from $3.32 in 1979 to $3.75 in 1980.

Four companies produced shell in Orleans, St. Mary, and St. Tammany Parishes at nine operations. Anhydrite was quarried from the caprock overlying a near-surface salt dome in Winn Parish. Anhydrite output was essentially unchanged in 1980, but price per ton moved up substantially.

About 64% of Louisiana shell is used in aggregates; 34% in cement manufacture, riprap and jetty stone, and roadbeds; and the remaining 2% in bituminous aggregate, poultry grit, and other uses. All of the anhydrite is used for roadbeds. All stone operations in the State produced more than 300,000 tons each; the leading operations produced more than 1 million tons yearly. Because most of the shell was dredged from shallow bays and near-gulf lakes, about 75% of the shell is transported by waterway, the remainder by truck.

Table 7.—Louisiana: Crushed shell sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979 Quantity	1979 Value	1980 Quantity	1980 Value
Dense-graded roadbase stone	2,410	8,533	1,476	8,098
Other construction aggregate and roadstone	4,840	16,140	4,708	16,085
Other uses[1]	1,407	4,077	1,154	3,350
Total	8,657	28,750	[2]7,339	27,533

[1]Includes stone used for poultry grit and mineral food, bituminous aggregate, riprap and jetty stone, cement manufacture, lime manufacture, and unspecified uses (1980).
[2]Data do not add to total shown because of independent rounding.

Sulfur.—Louisiana was ranked second nationally in Frasch sulfur output and sixth in recovered elemental sulfur production. In total sulfur recovery, the State produced 21.3% of national output. Freeport Sulphur Co., a division of Freeport Minerals Co., mined Frasch sulfur in Jefferson, Plaquemines, and Terrebonne Parishes. Eight oil companies recovered elemental sulfur from eight operations in seven parishes.

Demand for sulfur was strong in 1980. Frasch sulfur output eased 9.4%, recovered sulfur was up 12.4%, and stocks of total sulfur were depleted about 31%. Average price per metric ton was in a general uptrend, rising from about $90 in January to $114 at yearend.

Freeport began sulfur production 2 months ahead of schedule at Caillou Island in Timbalier Bay, Terrebonne Parish, about 35 miles southeast of Houma. The operation, which will have an annual capacity of 350,000 tons, required an investment of $26 million. Firm sulfur prices in recent years helped justify developing this relatively small sulfur deposit. The operation uses a 200-foot barge with a powerplant capable of heating 2.5 million gallons of water per day to 320° F. Overhauled for this operation, the 30-year-old barge had been used in sulfur production from Bay Ste. Elaine in the 1950's and at Lake Pelto from 1960 to 1975.

Table 8.—Louisiana: Sulfur produced and shipped from Frasch mines

(Thousand metric tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1976	2,527	2,484	W
1977	2,461	2,494	W
1978	1,928	1,984	W
1979	2,460	2,858	W
1980	2,309	2,590	W

W Withheld to avoid disclosing company proprietary data.

Vermiculite.—Crude vermiculite shipped into the State was exfoliated by W.R. Grace & Co. in New Orleans. Vermiculite has been mined in three States in recent years—Montana, South Carolina, and Virginia—and exfoliated vermiculite has been produced in 33 States. In Louisiana, the product was used for concrete aggregate and plaster, in loose and block-fill insulation, in horticulture, and as a soil conditioner. Output and price per short ton increased moderately at the W.R. Grace plant in 1980.

METALS

Aluminum.—Kaiser Aluminum & Chemical Corp. initiated a 3-year, $154 million investment program at its Baton Rouge alumina plant to reduce energy costs by 25%. The capital expenditure will not affect productive capacity. Plans primarily involve a substantial increase in the use of heat exchangers to recycle heat during the production process. Kaiser also began a 2-year program to triple the capacity of its alumina substrate production unit adjacent to the alumina plant. Crystalline substrate alumina is used principally in manufacturing catalysts for petroleum hydrodesulfurization and for automobile emission control. Expanded output will come from modernization and enhanced capacity of the existing facility in 1980, and from construction of a second plant identical to the enlarged facility, to be completed in 1981. A new $1 million wastewater treatment plant will remove solids from the effluent of both facilities.

Potlines at Consolidated Aluminum Corp.'s 35,000-ton-per-year primary aluminum smelter at Lake Charles were frozen when a dredge cut natural gas lines in April, resulting in a loss of production for about 4 months.

Nickel.—Following a 4-month strike, activities were resumed in early 1980 at the AMAX Nickel, Inc., nickel-copper-cobalt refinery at Braithwaite in Plaquemines Parish. The operation treats matte materials imported from Australia, Botswana, New Caledonia, and the Republic of South Africa. The AMAX plant is the only facility in the United States refining pure nickel. Annual capacity of the facility is 80 million pounds of nickel, 50 million pounds of copper, 1 million pounds of cobalt, and 100,000 tons of ammonium sulfate.

[1]State mineral specialist, Bureau of Mines, Denver, Colo.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	Parish
Aluminum:			
Consolidated Aluminum Corp	Box LL Lake Charles, LA 70601	Plant	Calcasieu.
Kaiser Aluminum & Chemical Corp	Box 1600 Chalmette, LA 70043	do	St. Bernard.
Cement:			
Lone Star Industries, Inc	1 Greenwich Plaza Greenwich, CT 06830	Plants	Orleans.
Clays:			
Big River Industries, Inc	Box 66377 Baton Rouge, LA 70806	Mine and plant	Pointe Coupee.
Kentwood Brick & Tile Manufacturing Co., Inc.	Drawer F Kentwood, LA 70444	do	St. Helena.
Gypsum:			
Winn Rock, Inc	Box 790 Winnfield, LA 71483	Quarry and plant	Winn.
Lime:			
Southern Industries Corp	Box 26223 Birmingham, AL 35226	Plant	St. Mary.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Orleans.
Salt:			
Cargill, Inc	Cargill Bldg. Minneapolis, MN 55402	Underground mine	St. Mary.
Diamond Crystal Salt Co	916 Riverside Ave. St. Clair, MI 48079	do	Iberia.
Domtar Chemicals, Inc., Shifto Salt Div	9950 West Lawrence Suite 400 Shiller Park, IL 60276	do	St. Mary.
The Dow Chemical Co	Midland, MI 48640	Brine wells	Iberville.
International Salt Co	Clarks Summit, PA 18411	Underground mine	Iberia.
Morton Salt Co	110 North Wacker Dr. Chicago, IL 60606	do	Do.
PPG Industries, Inc	Box 1000 Lake Charles, LA 70604	do	Calcasieu.
Sand and gravel:			
Gifford-Hill & Co., Inc	Box 47127 Dallas, TX 75247	Plants, dredges, and pits.	Jefferson Davis, Rapides, Tangipahoa, Webster.
Louisiana Sand and Gravel Co	Box 963 Baton Rouge, LA 70821	Plant and dredge	St. Helena.
Texas Industries Inc	Box 5472 Alexandria, LA 71301	Plants, dredges, and pits.	Beauregard, La Salle, Ouachita, Rapides, St. Tammany, Washington.
Shell:			
Louisiana Materials Co	Box 8214 New Orleans, LA 70182	Dredge	St. Tammany.
Southern Industries, Inc	Box 2068 Mobile, AL 36601	do	Orleans.
Pontchartrain Dredging Corp	Box 8005 New Orleans, LA 70182	do	Orleans.
Stone:			
Winn Rock, Inc	Box 790 Winnfield, LA 71483	Quarry and plant	Winn.
Sulfur, native:			
Freeport Minerals Co	161 East 42d St. New York, NY 10017	Frasch process	Jefferson, Plaquemines, and Terrebonne:
Sulfur, recovered:			
Cities Service Oil Co	Box 300 Tulsa, OK 74102	Refinery	Calcasieu.
Exxon Co., U.S.A	Box 551 Baton Rouge, LA 70821	Plant	East Baton Rouge.
Vermiculite, exfoliated:			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	do	Orleans.

The Mineral Industry of Maine

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Maine Geological Survey, for collecting information on all nonfuel minerals.

By L. J. Prosser, Jr.,[1] Walter Anderson,[2] and Carolyn Lepage[3]

The value of nonfuel mineral production in Maine dropped to $37 million in 1980, a decline of about $9 million from that of 1979. Decreased output of cement, clays, sand and gravel, and stone reflected depressed conditions in the State's construction industry. Other mineral commodities mined in Maine were garnet and peat. Maine was the only cement-producing State in New England.

Table 1.—Nonfuel mineral production in Maine[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	90	$163	78	$174
Peat do	3	202	8	534
Sand and gravel do	11,022	20,534	6,978	15,434
Stone (crushed) do	2,069	7,492	1,130	3,969
Combined value of other nonmetals	XX	r17,507	XX	16,856
Total	XX	r45,898	XX	36,967

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

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

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Androscoggin	W	W	Sand and gravel, clays.
Aroostook	W	W	Sand and gravel, stone.
Cumberland	W	W	Stone, sand and gravel, clays.
Franklin	$918	$851	Sand and gravel.
Hancock	1,070	W	Sand and gravel, clays.
Kennebec	W	W	Sand and gravel, stone.
Knox	W	19,564	Cement, stone, sand and gravel, clays.
Lincoln	510	478	Sand and gravel.
Oxford	W	W	Sand and gravel, garnet.
Penobscot	3,595	3,106	Sand and gravel.
Piscataquis	334	489	Do.
Sagadahoc	W	124	Do.
Somerset	891	782	Do.
Waldo	W	W	Sand and gravel, peat.
Washington	W	W	Do.
York	2,526	2,426	Sand and gravel, stone.
Undistributed[1]	32,934	18,077	
Total[2]	42,782	45,898	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes gem stones and values indicated by symbol W.
[2]Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Maine business activity

	1979	1980[p]	Change, percent
Employment and labor force, annual average:			
Total civilian labor force, thousands	488.0	500.0	+2.5
Unemployment, do	35.0	39.0	+11.4
Employment (nonagricultural):			
Mining, do	(1)	(1)	--
Manufacturing, do	114.6	113.2	-1.2
Contract construction, do	19.4	19.7	+1.6
Transportation and public utilities, do	18.7	18.8	+.5
Wholesale and retail trade, do	89.6	89.2	-.4
Finance, insurance, real estate, do	16.2	16.5	+1.9
Services, do	[2]74.8	[2]78.5	+5.0
Government, do	82.6	83.3	+.8
Total nonagricultural employment, do	415.9	419.2	+.8
Personal income:			
Total, millions	$7,737	$8,693	+12.4
Per capita	$7,052	$7,734	+9.7
Construction activity:			
Number of private and public residential units authorized	4,310	3,331	-22.7
Value of nonresidential construction, millions	$80.8	$49.8	-38.4
Value of State road contract awards, do	$46.0	$42.5	-7.6
Shipments of portland and masonry cement to and within the State, thousand short tons	254	230	-9.4
Nonfuel mineral production value:			
Total crude mineral value, millions	$45.9	$37.0	-19.4
Value per capita, resident population	$42	$33	-21.4
Value per square mile	$1,382	$1,113	-19.5

[p]Preliminary.
[1]Included with "Services."
[2]Includes mining.

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

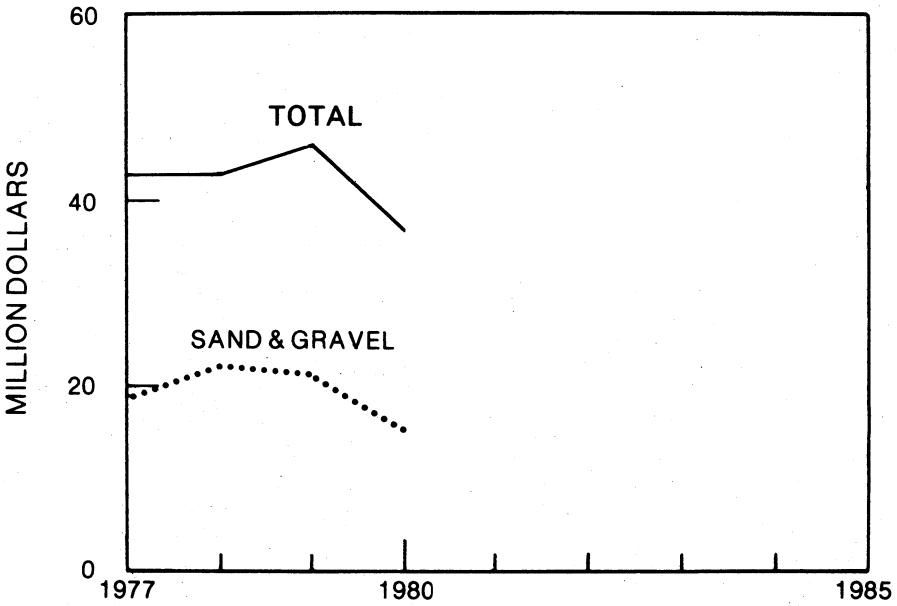

Figure 1.–Value of sand and gravel and total value of nonfuel mineral production in Maine.

Trends and Developments.—Superior Mining Co. (a subsidiary of Superior Oil Co.) and LL&E Mining Inc. (a subsidiary of Louisiana Land & Exploration Co.), operating as a joint venture, continued to gather environmental and metallurgical information on a massive sulfide deposit discovered in 1977 near Bald Mountain. Located about 200 miles northeast of Augusta in Aroostook County, the deposit has indicated reserves of approximately 25 million tons of 1.54% copper ore and about 10 million tons of 2.50% zinc ore. Trace amounts of gold and silver were also present.[4]

The company, which has invested over $5 million in the project, expected to complete a final feasibility study in mid-1981, with production tentatively slated for 1985. The deposit, if mined, would be an open pit operation 800 to 850 feet deep. After removal of about 150 feet of overburden and excavation of the ore, the broken material would be hauled by truck to onsite crushing and milling facilities.

Although no major mineral discoveries were reported in Maine in 1980, exploration activity continued. Major areas of investigation encompassed two belts: One extending from the New Hampshire border to New Brunswick, Canada, in the north-central part of the State, and the other in Maine's southeastern coastal region. Included among the commodities sought were copper, gold, kyanite, molybdenum, nickel, peat, silver, tin, tungsten, uranium, and zinc.

Metal mining ceased in Maine in 1977 with the closing of Kerramerican, Inc.'s zinc-copper-lead mine at Blue Hill in Hancock County. The company, a joint venture of Kerr Addison Mines, Ltd., and Black Hawk Mining, Ltd., decided to sell the operation in 1980. Mounting costs for the labor and energy needed to maintain the mine and plant prompted the decision. In addition to mineral rights to the ore body, the sale included all mining equipment, land, and buildings. The predominately zinc ore body lies about 1,800 feet below the

surface, and also contains traces of copper and lead.

The Saco Tanning Corp., a division of Kirstein Leather Co., continued work on a chrome recovery and reuse process. The firm, which operates a tannery at Saco, York County, became involved in the work to handle large volumes of waste water treatment plant sludge. The company planned to conduct a pilot plant demonstration project in 1981 pending financial arrangements.

Legislation and Government Programs.—In September, Maine voters participated in the Nation's first referendum aimed at closing an existing reactor. Metalworking firms, banks, utiltities, and numerous manufacturers, fearing higher energy costs, generally favored continued operation of the State's only nuclear powerplant. The Maine Yankee plant, located in Wiscasset about 20 miles south of Augusta, supplies nearly 33% of the State's electricity.

The discovery of the 36-million-ton copper-zinc deposit at Bald Mountain and increased exploration activity in Maine provided the impetus for the formation of a committee to help draft a State mineral policy. During the year, the Mineral Policy Advisory Committee developed recommendations for additional mining-related legislation. Proposals included in the recommendations concerned environmental issues, land use regulations, and taxation on metal and mineral mining. The proposals were expected to be reviewed and then introduced in the 1981 legislative session.

The Maine Geological Survey (MGS) continued bedrock and surficial mapping programs in various parts of the State. Additional bedrock mapping was conducted in cooperation with the U.S. Geological Survey to evaluate mineral resources in western Maine. The MGS also completed the second year of work on the Peat Resource Evaluation Project. About 60 peat deposits, ranging in size from 80 to 2,600 acres, were surveyed and sampled in the west-central part of the State.

The MGS, which administers the Maine Mining Law on State-owned lands, reported that the following exploration firms were active in 1980: J. S. Cummings, Inc; Superior Mining Co.; Phelps Dodge Exploration East, Inc; North American Exploration Co; Houston Oil & Minerals Corp.; Chiasma Consultants, Inc.; Noranda, Ltd.; Northgate Exploration Co.; Newmont Exploration, Ltd.; Chevron Oil Co.; ASARCO Incorporated; Union Carbide Corp.; Kerr-McGee Resources Corp.; Minatom Corp.; Urangesellschaft; St. Joe American Corp.; Gulf Chemical & Metallurgical Co.; Scintillore Explorations, Ltd.; American Copper & Nickel Co.; Getty Oil Co.; and AMAX Inc. Also during the year, MGS issued 29 prospector's permits to individuals wishing to explore for minerals on State lands; 13 were renewals and 16 were newly issued.

The MGS and North American Exploration Co. completed a study designed to determine the presence of metallic minerals in the Upper St. John River Valley, Aroostook County. Funded by the U.S. Army Corps of Engineers, the study was conducted in the vicinity of the proposed $850 million Dickey-Lincoln hydroelectric project. Geochemical and geophysical exploration indicated eight areas with metal anomalies, all of which were below projected impoundment elevations of the project. The study also recommended that private interests determine if the eight areas have economic potential.

Toward yearend, State and U.S. Department of Energy officials discussed studying some of Maine's granite formations as possible testing sites for disposal of nuclear waste. Other Northeastern States, along with Maine, were considered as potential testing areas because of the thickness, depth, and physical characteristics of the granite found in the region.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Martin Marietta Corp., Thomaston, Knox County, operated New England's only cement plant. The company produced portland and masonry cement. Shipments of portland cement for the year dropped about 10% compared with that of 1979, reflecting a decline in construction that affected cement producers nationwide.

Raw materials used to produce the cement included limestone and clay mined by the company, sand purchased locally, iron-bearing material shipped from Pennsylvania, and gypsum, imported from Nova Scotia, Canada. Because of the high moisture content of the clay, the wet process was used in grinding the raw materials. Grinding facilities consisted of two 100-ton-capacity mills to produce general use and

moderate heat cement, and one 10-ton-capacity mill to produce high-early-strength cement. The cement was sold primarily to ready-mix companies, concrete product manufacturers, and building material dealers in Maine and Massachusetts. About three-fourths of the production was shipped in 25-ton container trucks.

During the year, Martin Marietta converted heating facilities at the cement plant from oil to coal. The coal was shipped from Pennsylvania and West Virginia to Searsport on the Atlantic Coast, and then trucked about 35 miles to the Thomaston plant.

Clays.—In the past decade, production ranged from a low of 40,000 tons (1972) to a high of 146,000 tons (1974). In 1980, output declined for the second consecutive year, dropping to 78,000 tons (valued at $174,000). A lack of demand for brick coupled with increasing energy costs have adversely affected clay producers.

The State's clay industry in 1980 consisted of five producers operating pits in Androscoggin, Cumberland, and Knox Counties. Clay was marketed for use in cement and brick manufacturing. Two companies produced water-struck brick used in restoration projects to preserve the historic appearance of structures.

Garnet.—Maine, Idaho, and New York were the only States producing garnet in 1980. Garnet, an iron-aluminum silicate, was mined by Industrial Garnet Extractives, Inc., in Oxford County in the southwestern part of the State. Recovered by open pit methods, the material was ground, concentrated, and kiln-dried. The garnet was sold for use as a filter medium, an abrasive, and for heavy-media applications.

Gem Stones.—Semiprecious and gem-quality mineral specimens attracted hundreds of professional and amateur rock and mineral collectors to the State. Among the specimens recovered were tourmaline, aquamarine, amethyst, citrine, and topaz. In the 1970's, Plumbago Mining Inc. of Rumford, Oxford County, discovered gem-quality tourmaline at the Dunton Mine in Newry. This tourmaline has been supplied to jewelers and lapidarists throughout the world. The firm continued to explore for gem-quality material from Maine pegmatite localities in 1980.

Peat.—In 1980, three companies mined peat in Waldo and Washington Counties. Output increased about 5,000 tons compared with that of 1979. Most sales were for general soil improvement and mushroom cultivation.

The Maine Geological Survey received Federal funds to investigate the State's peat resources and conducted studies in northern Penobscot, eastern Piscataquis, eastern Aroostook, and Washington Counties. The data collected from these areas indicated resources of about 45 million tons of air-dried commercial quality peat. The project was scheduled for continuation in 1981 with investigations in northern Aroostook, western Piscataquis, Somerset, and Franklin Counties.

Perlite.—Chemrock Corp. expanded perlite in Rockland, Knox County. In 1980, the company produced about 7,000 tons valued at $1.1 million. The crude perlite, shipped by rail from New Mexico, was expanded and sold for use as a filter aid. Maine was one of two New England States that expanded perlite in 1980; Massachusetts was the other.

Sand and Gravel.—Output in 1980 decreased more than 4 million tons compared with that of the previous year and dropped below the 7-million-ton level for the first time in 30 years. Five of the State's largest operators each reported that production fell 200,000 tons or more compared with 1979 levels. A sharp decline in tonnage was also reported by Maine's Department of Transportation, which mined 1.5 million tons of sand and gravel in 1980 compared with nearly 2.2 million tons the previous year. A decline in gasoline sales in 1980 resulted in less tax revenues for State highway projects. This lack of revenue contributed to the depressed conditions in the State's sand and gravel industry.

During the year, residents of Acton, York County, established a 1-year moratorium on all sand and gravel mining operations in the town. A committee was formed to study problems associated with mining, including safety hazards, aesthetic degradation, and impact on water resources. A decision to extend the moratorium was expected in 1981.

Table 4.—Maine: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,069	$2,720	$2.55	735	$2,073	$2.82
Concrete products	W	W	2.50	88	202	2.30
Asphaltic concrete	2,061	4,608	2.24	1,225	3,248	2.65
Roadbase and coverings	4,285	6,596	1.54	2,934	6,124	2.09
Fill	2,173	3,565	1.64	948	1,515	1.60
Snow and ice control	715	1,046	1.46	648	979	1.51
Railroad ballast	64	228	3.53	45	194	4.29
Other	656	1,771	2.70	356	1,101	3.10
Total[1] or average	11,022	20,534	1.86	6,978	15,434	2.21

W Withheld to avoid disclosing company proprietary data; included in "Other."
[1]Data may not add to totals shown because of independent rounding.

Table 5.—Maine: Construction sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	4,714	$9,084	$1.93	2,769	$5,750	$2.08
Gravel	6,308	11,450	1.82	4,209	9,685	2.30
Total or average	11,022	20,534	1.86	6,978	[1]15,434	2.21

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

Table 6.—Maine: Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1979		1980	
	Quantity	Value	Quantity	Value
Androscoggin	1,019	2,050	639	1,603
Aroostook	1,109	1,855	402	1,045
Cumberland	1,936	3,476	1,000	1,978
Franklin	345	851	304	656
Hancock	552	1,182	420	818
Kennebec	593	908	515	901
Knox	395	966	W	W
Lincoln	300	478	207	398
Oxford	170	288	146	198
Penobscot	1,694	3,106	904	2,352
Piscataquis	246	489	178	369
Sagadahoc	83	124	11	11
Somerset	458	782	246	395
Waldo	588	1,077	435	1,116
Washington	335	506	199	284
York	1,200	2,396	810	1,648
Undistributed[1]	--	--	563	1,663
Total[2]	11,022	20,534	6,978	15,434

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes some sand and gravel that cannot be assigned to specific counties, and items indicated by symbol W.
[2]Data may not add to totals shown because of independent rounding.

Stone.—Production of crushed stone in 1980 dropped to about 1.1 million tons after a record high output of over 2 million tons in 1979. Limestone was the leading type of stone produced, followed by sandstone, traprock, and marl. Nearly four-fifths of the State's production came from six limestone quarries—two in Aroostook County in northern Maine; and one in Kennebec County, and three in Knox County in the

southwestern part of the State. Sandstone was mined at two operations in Cumberland County in southwestern Maine. Output of sandstone decreased more than 80% in 1980 compared with that of the previous year, mainly because of a local lack of demand for concrete and bituminous aggregate. Traprock was produced at one quarry in Cumberland County and one in Washington County. Most of the tonnage was sold for concrete aggregate. Marl, used for agricultural applications, was mined by one company in Aroostook County. No dimension stone was produced in Maine in 1980.

[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.
[2]State geologist and director, Maine Geological Survey, Augusta, Maine.
[3]Geologist, State geological survey, Augusta, Maine.
[4]The Superior Oil Co. 1980 Form 10-k, p. 10.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Martin Marietta Corp.[1]	6801 Rockledge Dr. Bethesda, MD 20034	Quarry and plant	Knox.
Clays:			
LaChance Brick Co., a division of Morin Brick Co.	Mosher Rd. Gorham, ME 04038	Pit and mill	Cumberland.
Morin Brick Co	Danville, ME 04223	do	Androscoggin.
Garnet:			
Industrial Garnet Extractives, Inc.	Box 56A West Paris, ME 04289	Quarry and mill	Oxford.
Peat:			
Deer Hill Farms, Inc	Weeks Mills, ME 04361	Bog and plant	Waldo.
Down East Peat Co	Star Route Deblois, ME 04622	do	Washington.
Pioneer Peat Moss Co	Columbia Fall, ME 04623	do	Do.
Perlite (expanded):			
Chemrock Corp	End of Osage St. Nashville, TN 37208	Plant	Knox.
Sand and gravel:			
Cianbro Corp	Box D Pittsfield, ME 04967	8 pits and mills	Androscoggin, Franklin, Hancock, Oxford, Penobscot, Somerset.
George C. Hall Construction	Box 506 Rockland, ME 04841	2 pits and plant	Knox.
Lane Construction Corp	965 East Main St. Bangor, ME 04401	4 pits and mills	Aroostook, Penobscot, Waldo, Washington.
Maine Dept. of Transportation	Augusta, ME 04333	16 pits and mills	Androscoggin, Aroostook, Franklin, Hancock, Oxford, Penobscot, Somerset, Waldo, Washington.
H. E. Sargent, Inc	101 Bennoch Rd. Stillwater, ME 04489	7 pits and mills	Kennebec, Penobscot, Sagadahoc, Somerset.
Stone:			
Blue Rock Industries	58 Main St. Westbrook, ME 04092	Quarries and mill	Cumberland and Kennebec.
Lane Construction Corp	965 East Main St. Bangor, ME 04401	Quarry	Aroostook.
Lime Products Corp	Box 357 Union, ME 04862	2 quarries and mill	Knox.

[1]Also clays and stone.

The Mineral Industry of Maryland

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Maryland Geological Survey for collecting information on all nonfuel minerals.

By Doss H. White, Jr.,[1] and Karen R. Kuff[2]

In 1980, the value of nonfuel mineral production in the "Old Line" State totaled $186 million, a $6.8 million reduction from that reported in 1979. This decrease paralleled the depressed state of the mineral industry throughout the United States, and was attributable to the general recession that extended from mid-1979. Although the value of mineral production dropped in 1980, during the past decade nonfuel mineral output has added over $1.3 billion to Maryland's economy and has created thousands of jobs in mining, processing, and manufacturing.

Table 1.—Nonfuel mineral production in Maryland[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2]	thousand short tons	975	$2,854	733	$2,267
Lime	do.	12	444	12	497
Peat	do.	3	W	4	W
Sand and gravel	do.	13,988	39,033	10,732	33,625
Stone:					
Crushed	do.	21,561	80,550	18,945	77,431
Dimension	do.	30	1,150	15	612
Combined value of cement, clays (ball clay), and values indicated by symbol W		XX	68,931	XX	71,703
Total		XX	192,962	XX	186,135

W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

[2]Excludes ball clay; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Maryland, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Allegany	W	W	Stone.
Anne Arundel	$4,996	$4,382	Sand and gravel.
Baltimore[2]	W	W	Stone, sand and gravel, clays.
Caroline	W	29	Sand and gravel.
Carroll	W	40,761	Cement, stone, clays.
Cecil	10,996	12,594	Stone, sand and gravel.
Charles	3,910	3,938	Sand and gravel.
Dorchester	W	W	Do.
Frederick	W	W	Cement, stone, clays, lime.
Garrett	W	1,662	Stone, sand and gravel, peat.
Harford	3,540	W	Stone, sand and gravel.
Howard	1,881	1,646	Stone.
Kent	W	W	Clays.
Montgomery	W	W	Stone.
Prince Georges	13,679	18,340	Sand and gravel, clays.
Queen Annes	W	2,486	Stone.
St. Marys	398	531	Sand and gravel.
Washington	W	W	Cement, stone, clays.
Wicomico	W	W	Sand and gravel.
Worcester	1,048	804	Do.
Undistributed	124,182	105,788	
Total[3]	164,635	192,962	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Calvert, Somerset, and Talbot Counties are not listed because no nonfuel mineral production was reported.
[2]Includes Baltimore City.
[3]Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Maryland business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,092.0	2,133.0	+2.0
Unemployment	do	124.0	137.0	+10.5
Employment (nonagricultural):				
Mining[1]	do	(2)	(2)	
Manufacturing	do	247.7	237.9	-4.0
Contract construction	do	107.9	103.3	-4.3
Transportation and public utilities	do	86.4	86.3	-.1
Wholesale and retail trade	do	401.1	408.6	+1.9
Finance, insurance, real estate	do	89.1	92.2	+3.5
Services	do	[3]344.5	[3]359.9	+4.5
Government	do	404.0	407.0	+.7
Total nonagricultural employment[1]	do	1,680.7	1,695.2	+.9
Personal income:				
Total	millions	$38,718	$43,338	+11.9
Per capita		$9,333	$10,322	+10.6
Construction activity:				
Number of private and public residential units authorized		26,696	19,538	-26.8
Value of nonresidential construction	millions	$678.9	$714.2	+5.2
Value of State road contract awards	do	$100.6	$79.2	-21.3
Shipments of portland and masonry cement to and within the State	thousand short tons	1,480	1,405	-5.1
Nonfuel mineral production value:				
Total crude mineral value	millions	$193.0	$186.1	-3.6
Value per capita, resident population		$47	$44	-6.4
Value per square mile		$18,244	$17,598	-3.5

[p]Preliminary.
[1]Includes bituminous coal and gas extraction.
[2]Included in "Services."
[3]Includes "Mining."

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

Trends and Developments.—The economic decline that developed during 1979 continued into the first half of 1980, characterized by layoffs, plant closings, and a general slowdown in construction activity. However, the year ended with industry recalling some workers and announcing a number of new projects.

During the first half of 1980, the Nation's automotive industry drastically reduced production, which adversely affected segments of Maryland's mineral manufacturing industry. In May, Bethlehem Steel Corp. shut down one of four open-hearth facilities at the Sparrows Point steel plant, idling 3,000 steelworkers. At midyear, Kaiser Aluminum & Chemical Corp. closed the Frostburg refractories plant, citing a major decline in sales. The facility produced linings for the steel, glass, and cement industries.

Throughout the year, record-high interest rates, coupled with a scarcity of funds for new commercial and residential building, severely restricted the State's construction industry—the major consumer of Maryland's mineral production. Production of clay, sand and gravel, and stone was over 6 million tons below the 1979 level; sales were off more than $10 million. The slowdown also affected fabricators of glass, wallboard, insulation, and other building products manufactured from mineral raw materials.

During the latter half of 1980, a resurgence in the automotive and other steel-dependent industries resulted in the recall of 300 employees at the Sparrows Point steel facility. Two furnaces at the plant's No. 4 open hearth, banked in June, were restarted. Market research indicated, however, that 1981 will be the earliest that all workers could expect to be recalled.

Other Maryland industry projections indicated improved market conditions and increased demand for a variety of products during the 1980's. To satisfy this demand, the construction or expansion of a number of mineral-related manufacturing facilities was announced.

SCM Corp.'s Glidden Pigments Group, planned to increase output at its Baltimore chloride process titanium dioxide pigment plant by 10,000 tons per year to reach 42,000 tons per year by 1982. Solarex Corp. planned to construct a $20 million plant in Frederick to produce silicon material for photovoltaic devices. Atlantic Cement Co., Inc., completed plans to construct a $77 million slag cement plant at Bethlehem Steel's Sparrows Point facility. Completion is scheduled for mid-1982.

Other developments that will impact on the State's construction mineral producers include a $450 million renovation and expansion of General Motors Corp.'s Baltimore automotive assembly plant, and a $100 million expansion of Westinghouse Electric Corp.'s facility at Baltimore-Washington International Airport. Consolidation Coal Co., Island Creek Coal Co., and a group of private investors announced plans to build three coal export terminals on Chesapeake Bay.

Conflicts between mineral producers and local citizen and environmental groups arose during 1980. Residents of Temple Hills in Prince Georges County protested the application by Silver Hill Sand & Gravel Co. to mine a 60-acre tract in Temple Hills. Application for exemption of the tract from residential zoning, filed in June, was pending at yearend. Silver Hill also sought to obtain permits to build a gravel washing plant near Zekiah Swamp in Prince Georges County. Environmental groups and local residents opposed construction, fearing damage to Maryland's largest natural hardwood swamp. The county council denied the application, and Silver Hill planned to appeal the decision to the county circuit court.

In October, Lehigh Portland Cement Co., Woodsboro, requested permission to mine cement raw materials closer to the company's property line. This request was met with opposition by local citizens. The Frederick County Board of Appeals heard testimony on the proposed variance, and the request was under consideration at yearend.

Legislation and Government Programs.—During the year, the Surface Mining Division, Department of Natural Resources (DNR), was created to regulate mineral extraction in the State. Formerly, this was the responsibility of the Watershed Permit Division of the Water Resources Administration, DNR.

The Maryland Geological Survey was active in a number of mineral resource projects. One of the Survey's major programs was the preparation by quadrangle of mineral resource-mined land and environmental geology studies. At yearend, 26 quadrangle-base geologic maps had been completed and 12 published.

During the year, the Survey published a "Directory of Mineral Producers in Maryland" (Information Circular 30) and a report

entitled "Mineral Resources and Mineral Land Inventory of Prince Georges County." The Maryland Geological Survey worked with the U.S. Geological Survey (USGS) to prepare maps of lands for potential mineral resource development in the State's western counties. In cooperation with USGS, the Survey continued work on the geologic and hydrologic characteristics of Maryland's water resources. Also studied were the physical, chemical, and biological characteristics of the surficial sediments of Chesapeake Bay.

The Maryland Department of Transportation and DNR continued studies on the disposal of material to be dredged from Baltimore Harbor. The U.S. Army Corps of Engineers has been authorized by U.S. Congress to dredge the harbor to a depth of 50 feet. An estimated 71 million cubic yards of spoil would be excavated during the 20-year dredging project. During the year, a proposal was drafted to study use of the dredged material. The draft included a review of construction options regarding brick or aggregate manufacture from consolidated dredged materials.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Industrial minerals, mainly those used by the construction industry, are the primary commodities produced by the State's extractive mineral industry.

Calcite.—Flintkote Stone Products Co. (name changed to Genstar Stone Products Co. in 1981), Hunt Valley, mined a series of calcite veins near its Texas-Maryland quarry. Both surface and underground mining methods were used. After processing, the calcite was sold for use in paper, paints, and plastics.

Cement.—In 1980, the State's cement industry consisted of three companies with operations in Washington, Frederick, and Carroll Counties in north-central Maryland. All three companies—Lehigh Portland Cement Co., Alpha Portland Cement Co., and Marquette Co.—produced portland cement; Marquette also produced masonry cement.

Cement output during 1980 was below the 1979 level. High interest rates and a shortage of capital for new projects severely limited new starts in the construction industry.

At yearend, Atlantic Cement Co., Inc., announced plans to construct a $77 million slag cement plant at Bethlehem Steel Corp.'s facility at Sparrows Point. Atlantic Cement signed a long-term contract for slag from Bethlehem's "L" blast furnace. Construction is scheduled to be completed by mid-1982.

The Lehigh Portland Cement Co. plant at Union Bridge conducted a 22-day test using shredded paper and plastic refuse as a partial substitute for coal normally used for kiln fuel. The test, which resulted in a 30% savings of coal, was described as successful by the State Environmental Service.

Clays.—Maryland's clay producers mined both common and ball clay from nine mines in six counties. During the past 10 years, the State's output of common clay was valued at over $20 million; production and value data on ball clay are company proprietary.

All of the State's clay production was from surface operations; after mining, the clay was trucked to nearby facilities for processing. Common clay was produced in Baltimore, Carroll, Frederick, Kent, Prince Georges, and Washington Counties. Approximately 16% of the common clay production was used in cement manufacture, while the remainder was used for fabrication of brick, tile, and clay products. Washington County was the leading producer followed by Frederick and Carroll Counties.

Cyprus Industrial Minerals Co. produced ball clay from a mine in Baltimore County. Major sales were to the rubber and fiberglass industries.

One company in Frederick County mined and expanded phyllite for lightweight aggregate.

Funded by a National Science Foundation grant, the University of Maryland's Department of Civil Engineering continued work on the use of municipal and industrial sludge in ceramic building materials. Research personnel investigated the structural integrity and physical strength of ceramic materials made with sludge.

Gypsum.—Two companies, National Gypsum Co. and United States Gypsum Co., imported gypsum from mines in Nova Scotia and New Brunswick. The crude gypsum, shipped through the Port of Baltimore, was calcined at company facilities in the Baltimore area. Calcined gypsum was used principally for the manufacture of construction

materials: Standard and fire-resistant wallboard, lath, and plaster. Like other construction-related materials, calcined gypsum production fell below that reported for the previous year.

Lime.—The State's sole lime producer was located in Frederick County in north-central Maryland. S. W. Barrick & Sons, Inc., calcined limestone to produce quick and hydrated lime. Sales were principally for agricultural purposes, and most of the output was used by Maryland farmers. A limited amount was sold for use in construction and soil stabilization.

Peat.—Over the past decade, more than 25,000 tons of peat has been produced in the State. During 1980, Garrett County Processing & Packing Co. recovered peat from a bog near the community of Accident, in Garrett County, in the extreme northwestern part of the State. The peat was used in horticultural applications.

Sand and Gravel.—Over the past 10 years, the State's sand and gravel producers mined over 120 million tons of sand and gravel valued at more than $300 million. Sand and gravel ranked third, behind stone, in value and output during the past decade.

However, during 1980, sales of sand and gravel declined $5.4 million because of the downturn in construction activity. Production dropped 3.3 million tons below that reported during the previous year.

Table 4.—Maryland: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	6,203	$18,177	$2.93	6,376	$20,058	$3.15
Plaster and gunite sands	W	W	5.00	W	W	5.85
Concrete products	1,311	3,418	2.61	394	1,190	3.02
Asphaltic concrete	3,335	9,443	2.83	1,568	4,816	3.07
Roadbase and coverings	1,631	4,157	2.55	1,286	3,823	2.97
Fill	1,007	1,895	1.88	929	3,066	3.30
Snow and ice control	4	9	2.06	2	5	2.23
Other uses	W	W	3.84	W	W	3.58
Total or average	13,988	39,033	2.79	10,732	33,625	3.13

W Withheld to avoid disclosing company proprietary data; included in "Total."

Table 5.—Maryland: Construction sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	8,024	$21,326	$2.66	5,895	$18,801	$3.19
Gravel	5,965	17,707	2.97	4,837	14,825	3.06
Total[1] or average	13,988	39,033	2.79	10,732	33,625	3.13

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

During 1980, the construction sand and gravel industry was comprised of 46 companies with 51 operations in 12 of Maryland's 23 counties. Prince Georges County led the State in output, followed by Anne Arundel and Cecil Counties. Major sales were for concrete aggregate, asphaltic concrete, and roadbase material.

Harford Sands, Inc., at Joppa in Harford County, was the State's only industrial sand producer. The company marketed a specially formulated sand for water-treatment plants and an abrasive sand used at airports to increase skid resistance on runways. The abrasive is shipped to many parts of the country, including Washington (D.C.) Na-

tional and Dulles International Airports.

Slag.—Historically, Maryland has ranked among the Nation's top 10 slag-producing States. This trend continued through 1980, although slag output decreased below the previous year's level. Iron blast furnace slag, a byproduct of steelmaking at the Sparrows Point facility of Bethlehem Steel Corp., was recovered in both air-cooled and expanded form. Highway construction aggregate was the principal market for the air-cooled variety, while the lighter weight, expanded material was used in the manufacture of lightweight concrete block.

Stone.—Crushed and dimension stone were again the leading mineral commodities in Maryland, in terms of output and value. Since 1971, the State's stone industry has produced over 179 million tons of stone valued at over $500 million and has accounted for approximately 40% of the extractive mineral value in Maryland.

In 1980, the State's crushed stone producers mined and crushed limestone, marble, sandstone, granite, serpentinite, and gneiss in 10 of Maryland's 23 counties.

Limestone (including marble) was produced by 12 companies operating 14 surface and 2 underground mines in 6 northern Maryland counties. Output was reported at 12 million tons valued at $51 million, 63% of the State's total tonnage of crushed stone. Principal sales were for roadbase, concrete aggregate, and cement manufacture. One of the five largest ground marble producers in the United States, Flintkote Stone Products Co., operated in Baltimore, Carroll, Harford, and Frederick Counties. The company produced a number of stone products, including high-quality, wet-ground, calcium carbonate fillers.

One company, Langenfelder & Sons, Inc., dredged oyster shell from Chesapeake Bay. The shells were used principally in poultry grit, fertilizer, and for aggregate and fill.

Table 6.—Maryland: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Concrete aggregate	2,704	9,376	2,589	9,540
Bituminous aggregate	2,833	9,450	1,963	7,064
Macadam aggregate	2,266	7,404	2,127	7,590
Dense-graded roadbase stone	1,439	4,955	1,234	4,572
Surface treatment aggregate	436	1,442	364	1,374
Other construction aggregate and roadstone	7,171	23,800	6,537	23,531
Riprap and jetty stone	310	1,252	280	1,276
Railroad ballast	108	276	126	352
Manufactured fine aggregate (stone sand)	204	726	170	751
Cement manufacture	2,477	3,934	2,250	3,807
Lime manufacture	23	74	W	W
Other uses[2]	1,589	17,860	1,305	17,574
Total[3]	21,561	80,550	18,945	77,431

W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1]Includes limestone, granite, sandstone, shell, traprock, and miscellaneous stone.

[2]Includes stone used for agricultural limestone, agricultural marl and other soil conditioners, poultry grit and mineral food, flux stone, refractory stone, mine dusting, asphalt filler, whiting or whiting substitute, other fillers or extenders, other uses, and uses indicated by symbol W.

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

Crushed sandstone was produced in Garrett and Allegany Counties in the western part of Maryland. Five mines and crushing plants were operated by five companies to produce a product used principally for concrete aggregate and as a flux in steelmaking. Granitic rock, mainly gneiss, was mined and crushed in northeastern Maryland. Sales were for aggregate applications.

Dimension sandstone, quartzite, and gneiss were quarried by seven companies in four counties. Most sales were for construction applications. Dimension sandstone and quartzite were produced at five quarries in Baltimore, Garrett, and Howard Counties. Major sales were rough blocks and rubble. Gneiss was quarried by two companies in Montgomery County. Principal sales were for construction applications with minor tonnage sold for flagging.

Talc.—Harford Talc Co., Street, Harford County, founded in 1916, purchased talc from United Sierra Corp. in Colorado as raw material for insulator manufacture. The talc was shipped by rail to the compa-

ny's Street facility and ground, extruded, molded, and fired to fabricate electrical insulators, which were marketed worldwide. The company also produced limited amounts of steatite as an artist's medium.

Vermiculite.—W. R. Grace & Co. expanded vermiculite at its plant in Prince Georges County. The vermiculite was shipped by rail from company mines in South Carolina. Production of the exfoliated product, sold primarily for concrete aggregate and fireproofing material, increased from 1979 because of the depressed construction industry.

METALS

During the 18th and 19th centuries, Maryland was a major producer of iron, copper, and chromite. With changing economic conditions, the State's metal industries began to import ores and concentrates. Currently, significant tonnages of aluminum, copper, iron and steel, and lead are processed from these imports.

Aluminum.—Maryland's aluminum industry consists of one primary producer, Eastalco Aluminum Co., owned by Howmet Corp., located near Buckeystown in Frederick County in the north-central part of the State and two secondary producers, Cambridge Iron & Metal Co., Inc., and Tomke Aluminum Co., both with operations in the Baltimore area.

The Eastalco facility operated two potlines to reduce alumina imported from Australia. The company produced approximately 176,000 tons of aluminum in the form of rolling ingots, melt ingots, and billets. Cambridge Iron & Metal Co., Inc., and Tomke Aluminum Co. melted aluminum scrap to produce a number of aluminum products.

Copper.—Kennecott Refining Co.'s Hawkins Point refinery, in Anne Arundel County, is one of four primary copper refineries in the Eastern United States. Copper from smelters in Hayden, Ariz.; Garfield, Utah; McGill, Nev.; and Santa Rita, N. Mex., was shipped by rail to the Baltimore facility for refining. Output is in the form of copper cathode and rod. Shipments are worldwide.

Iron and Steel.—At Sparrows Point, Baltimore, Bethlehem Steel Corp. produced pig iron, raw steel, and semifabricated steel products from ore imported from South America. The company's new "L" blast furnace, which went onstream in late 1979, holds the record for the highest production rate in North America. During the year, the company began work on a new $170 million coke oven complex at Sparrows Point. The coke battery, consisting of 80 ovens, is scheduled for startup in late 1981.

Lead.—In the Baltimore area, Bethlehem Steel Corp., Western Electric Co., Industrial Metal Melting Co., Crown Cork & Seal Co., and Signode Corp. produced products from soft lead and lead alloys.

Titanium Dioxide.—Glidden Pigments Group, SCM Corp., was expanding capacity of its chloride process titanium dioxide pigment plant at Baltimore. The expansion, due for completion in 1981, will increase capacity of that plant to 42,000 tons per year.

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[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

[2]Geologist, Maryland Geological Survey, Baltimore, Md.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Portland:			
Alpha Portland Cement Co.[1]	15 South 3d St. Easton, PA 18042	Plant and quarry.	Frederick.
Lehigh Portland Cement Co.[2]	718 Hamilton St. Allentown, PA 18101	do	Carroll.
Portland and masonry:			
Marquette Co.[1]	One Commerce Place Nashville, TN 37238	do	Washington.
Clays:			
Baltimore Brick Co	501 St. Paul Pl. Baltimore, MD 21202	Pits	Baltimore and Frederick.
Victor Cushwa & Sons, Inc	Box 228 Williamsport, MD 21795	Pit	Washington.
Cyprus Industrial Minerals Co	7000 Yosemite St. Box 3299 Englewood, CO 80155	Pit	Baltimore.
Gypsum (calcined):			
National Gypsum Co	4100 First International Bldg. Dallas, TX 75270	Plant	Do.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Do.
Lime:			
S. W. Barrick & Sons, Inc.[1]	Woodsboro, MD 21798	do	Frederick.
Peat:			
Garrett County Processing & Packing Corp.	Route 1 Accident, MD 21520	Bog	Garrett.
Sand and gravel:			
Harry T. Campbell Sons Co., a division of Flintkote Stone Products Co.[3]	White Marsh Plant Towson, MD 21225	Pits	Baltimore.
Contee Sand & Gravel Co., Inc	Box 460 Laurel, MD 20810	Pit	Prince Georges.
York Building Products Co., Inc	Box 1708 York, PA 17405	Pit	Cecil.
Stone:			
Arundel Corp	501 St. Paul Pl. Baltimore, MD 21202	Quarries	Baltimore and Howard.
Flintkote Stone Products Co.[3]	Executive Plaza #4 11350 McCormick Rd. Hunt Valley, MD 21031	do	Baltimore, Carroll, Frederick, Harford.
Rockville Crushed Stone, Inc	Box 407 Rockville, MD 20850	do	Montgomery.

[1]Also stone.
[2]Also clays and stone.
[3]Name changed to Genstar Stone Products Co., 1981.

The Mineral Industry of Massachusetts

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Massachusetts Department of Environmental Quality, Office of the State Geologist, for collecting information on all nonfuel minerals.

By L. J. Prosser, Jr.,[1] and Joseph A. Sinnott[2]

Massachusetts' value of nonfuel mineral production in 1980 was $91.2 million, the third consecutive year above the $90 million level, but down from the 1979 record of $92.5 million. In New England, the Bay State again ranked first in value of mineral output, contributing about one-third of $268.2 million generated in the six-State region.

Commodities produced, in descending order of value, were stone (crushed and dimension), sand and gravel (construction and industrial), lime, clays, and peat. About 210 mining operations reported production throughout the State in 1980. Worcester County—with 49 sand and gravel pits, 4 stone quarries, and 1 peat bog—was first in the number of operations among Massachusetts' 14 counties.

Another segment of the State's mineral industry processed imported commodities, including gypsum, perlite, and vermiculite. Synthetic graphite was also manufactured, and the combined output of these four commodities accounted for about $8 million in sales plus numerous jobs in the manufacturing sector.

Table 1.—Nonfuel mineral production in Massachusetts[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	156	$367	210	$870
Lime	do.	198	9,918	180	10,806
Peat	do.	2	56	W	W
Sand and gravel[2]	do.	16,705	37,164	13,925	34,459
Stone:					
Crushed	do.	8,586	39,570	7,316	36,804
Dimension	do.	48	4,389	51	7,018
Combined value of other nonmetals and value indicated by symbol W		XX	1,082	XX	1,254
Total		XX	92,546	XX	91,211

W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes industrial sand; value included in "Combined value" figure.

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

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Barnstable	$1,720	$1,504	Sand and gravel.
Berkshire	W	W	Stone, lime, sand and gravel.
Bristol	7,404	W	Stone, sand and gravel.
Dukes	107	110	Sand and gravel.
Essex	7,501	5,722	Stone, sand and gravel.
Franklin	W	W	Do.
Hampden	W	W	Do.
Hampshire	W	1,411	Sand and gravel, stone.
Middlesex	19,303	18,738	Stone, sand and gravel.
Nantucket	100	W	Sand and gravel.
Norfolk	W	W	Stone, sand and gravel, clays.
Plymouth	W	W	Sand and gravel, clays, stone.
Suffolk	W	1,160	Stone.
Worcester	9,119	10,748	Sand and gravel, stone, peat.
Undistributed[1]	44,816	53,154	
Total[2]	90,068	92,546	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes gem stones 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

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,891.0	2,893.0	+0.1
Unemployment	do	160.0	163.0	+1.9
Employment (nonagricultural):				
Mining	do	(1)	(1)	--
Manufacturing	do	672.1	673.1	+.2
Contract construction	do	75.6	73.1	-3.3
Transportation and public utilities	do	120.5	122.3	+1.5
Wholesale and retail trade	do	566.3	571.2	+.9
Finance, insurance, real estate	do	150.4	159.0	+5.7
Services	do	[2]601.9	[2]638.6	+6.1
Government	do	416.7	410.3	-1.5
Total nonagricultural employment	do	2,603.5	[3]2,647.8	+1.7
Personal income:				
Total	millions	$51,349	$57,243	+11.5
Per capita		$8,901	$9,992	+12.3
Construction activity:				
Number of private and public residential units authorized		21,453	15,751	-26.6
Value of nonresidential construction	millions	$705.7	$815.8	+15.6
Value of State road contract awards	do	NA	$190.0	--
Shipments of portland and masonry cement to and within the State	thousand short tons	1,047	994	-5.1
Nonfuel mineral production value:				
Total crude mineral value	millions	$92.5	$91.2	-1.4
Value per capita, resident population		$16	$16	--
Value per square mile		$11,208	$11,047	-1.4

[p]Preliminary. NA Not available.
[1]Included with "Services."
[2]Includes mining.
[3]Data do not add to total shown because of independent rounding.

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

Trends and Developments.—Historically, commodities used in construction have accounted for over 95% of the value of mineral production in Massachusetts. In 1980, the trend continued with stone contributing about 48%, construction sand and

gravel 38%, lime 12%, and clays 1% of the State's value of output. Construction activities in most parts of the country were affected by fluctuating interest rates, which caused potential investors and home buyers to wait for a return to lower rates. Nationally, the combined production of stone, sand and gravel, lime, and clays decreased about 14% in 1980, reflecting the change in economic conditions from 1979. A similar economic climate prevailed in Massachusetts in 1980; output of mineral commodities used predominantly in construction dropped approximately 16% compared with 1979 levels.

Despite the high interest rates, over $500 million in new and rehabilitation construction projects were started in the Boston area in 1980.[3] Also, the State's mineral industry benefited from openings and expansions by computer, electronic, and medical instrument firms. These high-technology companies required manufacturing and engineering facilities, which provided additional building trade jobs.

Also during the year, the State's manufacturing sector announced and completed a number of projects. Wyman-Gordon Co., a leading manufacturer of forged metal components, invested $12 million in metal-forming technology over the past 2 years. The company also announced a 4-year, $25 million capital expenditure program, which included adding an 8,000-ton-capacity isothermal press. Die forgings of aluminum, steel, titanium, and high-temperature alloys were manufactured at the company's plants in Worcester, Grafton, and Millbury. These forgings were marketed to the aerospace and nuclear industries.

Nuclear Metals, Inc., continued work on a $3 million expansion project of powder manufacturing facilities at Concord. Production of titanium powder and titanium alloy powders was expected to increase when the project is completed in mid-1981.

Norton Co., Worcester, announced a $5.1 million expansion plan for increasing capacity to manufacture large-diameter vitrified grinding wheels. Demand from the aerospace and bearing manufacturing industries prompted the expansion, scheduled for completion in 1982.

Legislation and Government Programs.—No legislation directly affecting the mineral industry was enacted in 1980. The Massachusetts Institute of Technology received $227,000 in research grants from the Office of Surface Mining, U.S. Department of the Interior. Of the four projects funded, one covered aspects of mineral economics in the U.S. copper industry, two dealt with mining and exploration techniques, and the fourth was concerned with mineral processing.

The Massachusetts Office of State Geologist continued cooperative research projects with the U.S. Geological Survey. A bedrock geologic map of the State was completed in 1980, culminating 40 years of work. A related surficial geology map was also near completion at yearend.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Clays.—Production increased for the fifth consecutive year, and during that period, nearly 800,000 tons of clay and shale valued at about $2.1 million were mined. Massachusetts ranked first among the four States producing clay in New England.

In 1980, three companies were in operation—two in southeastern Massachusetts in Plymouth County, and one in the east-central part of the State in Norfolk County. Approximately 200 workers were employed by the industry, making brick, concrete products, and tile.

Gem Stones.—Although gem stones added only a small amount to the State's mineral value, numerous collecting sites provided a glimpse of Massachusetts' mining history. One of the area's oldest operations, the Loudville lead-silver mines near Easthampton, Hampshire County, was worked sporadically for nearly 200 years dating back to the 1670's. Today rockhounds and collectors scour the mine dump for specimens of anglesite, barite, cerussite, chalcopyrite, galena, malachite, pyrite, quartz, silver, and wulfenite.[4]

Graphite.—Massachusetts was 1 of 13 States that manufactured synthetic graphite in 1980. Two companies—Avco Corp. and Stackpole Fibers Co., both in Middlesex County—produced synthetic graphite fibers. Fiber was used primarily by the aerospace industry because of the lightweight, high-strength characteristics of the material.

Gypsum.—United States Gypsum Co. imported gypsum from company-owned mines in Canada. The crude gypsum was crushed and calcined for wallboard manufacture

near Boston in Suffolk County. The wallboard was shipped throughout New England for use in construction and home remodeling projects.

Lime.—Output dropped slightly in 1980 but value increased, reflecting about a $10-per-ton boost in prices compared with that of the previous year. Nationally, lime prices went up about $3 per ton from 1979 to 1980 as fuel costs and inflationary conditions continued to affect operating expenses.

The State's lime industry consisted of two companies operating in Berkshire County in western Massachusetts. Pfizer, Inc., Mineral Pigments & Metals Div., Adams, manufactured quicklime sold for chemical and industrial uses. Some of the lime was shipped to the company's plant in Canaan, Conn., for use in calcium metal manufacture.

Lee Lime Corp. manufactured quicklime and hydrated lime, mostly sold for agricultural and construction applications. Late in the year, Lee announced plans to switch from oil to coal to fire the company's rotary kiln. Cost of the conversion was estimated at $400,000 with work scheduled for completion by mid-1981.

Peat.—Sterling Peat Co., Worcester County, in north-central Massachusetts, was the State's sole peat producer in 1980. Reed sedge peat was mined and sold mostly for agricultural applications.

Perlite.—Crude perlite was imported by Whittemore Products, Inc., and expanded at the company's facility in Andover, Essex County. Shipped by rail from New Mexico, the perlite was expanded for use in insulation and for horticultural applications.

Sand and Gravel.—In 1980, sand and gravel was the leading mineral commodity produced in Massachusetts and ranked second to stone in terms of value of output. In the past decade, mining of about 167 million tons of sand and gravel added about $300 million to the value of the State's mineral output. During that period, the price per ton rose from $1.33 in 1971 to $2.54 in 1980.

Massachusetts ranked 18th nationally in production of construction sand and gravel, but was first in New England, accounting for about one-third of the six-State region's output. About 160 pits were reported active in Massachusetts in 1980. Thirty operations

Table 4.—Massachusetts: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	6,027	$16,622	$2.76	4,983	$14,439	$2.90
Plaster and gunite sands	83	185	2.22	62	222	3.59
Concrete products	469	1,183	2.52	1,032	2,342	2.27
Asphaltic concrete	2,098	4,774	2.28	1,635	4,268	2.61
Roadbase and coverings	3,830	7,091	1.85	3,346	7,015	2.10
Fill	3,075	4,548	1.48	1,821	3,143	1.73
Snow and ice control	713	1,444	2.03	634	1,411	2.22
Other	410	1,319	3.22	412	1,618	3.93
Total[1] or average	16,705	37,164	2.22	13,925	34,459	2.47

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

Table 5.—Massachusetts: Sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	7,138	$14,717	$2.06	6,072	$14,306	$2.36
Gravel	9,567	22,447	2.35	7,853	20,152	2.57
Total or average	16,705	37,164	2.22	13,925	[1]34,459	2.47
Industrial sand	W	W	W	W	W	10.10
Grand total or average	W	W	W	W	W	2.54

W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.

Table 6.—Massachusetts: Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1979		1980	
	Quantity	Value	Quantity	Value
Barnstable	642	1,504	611	1,484
Berkshire	869	1,906	826	2,052
Bristol	1,089	2,722	795	2,379
Dukes	58	110	52	109
Essex	1,025	1,925	376	1,042
Franklin	500	1,041	412	1,000
Hampden	1,200	2,383	1,178	2,470
Hampshire	369	789	W	W
Middlesex	2,791	7,211	W	W
Nantucket	W	W	W	W
Norfolk	2,067	5,833	1,839	5,579
Plymouth	W	W	W	W
Worcester	4,155	8,643	3,566	7,623
Undistributed[1]	1,940	3,098	4,269	10,722
Total[2]	16,705	37,164	13,925	34,459

W Withheld to avoid disclosing individual company proprietary data; included in "Undistributed."
[1]Includes some sand and gravel that cannot be assigned to specific counties, and items indicated by symbol W.
[2]Data may not add to totals shown because of independent rounding.

each mined between 100,000 and 200,000 tons, accounting for 30% of the State's output. Approximately 10% of the State's sand and gravel was mined from 80 pits, each producing less than 50,000 tons per year. Construction sand and gravel was used primarily for aggregate, roadbase, and fill.

Industrial sand was produced at two operations—one in Middlesex County and the other in Plymouth County. Company output and value data are proprietary. Most industrial sand was marketed to foundries for use in moldings and castings.

Stone.—Output of stone in 1980 added almost $44 million, nearly 50%, to the value of mineral production in Massachusetts. Over the past 10 years, about 80 million tons of stone was mined. Besides contributing approximately $334 million to the State's economy during that period, the stone industry directly or indirectly provided jobs in the building trades and transportation sector.

In New England, Massachusetts ranked second in crushed stone and third in dimension stone output. Nationally, the State was 31st and 7th in crushed and dimension stone production, respectively.

Dimension stone was quarried in Berkshire County in western Massachusetts and in a north-south trending belt in the eastern part of the State encompassing Middlesex, Norfolk, and Plymouth Counties. In 1980, six companies mined granite (seven quarries), and one extracted marble (one quarry). About four-fifths of the dimension granite was marketed for curbing; other sales were primarily for paving block, cut stone, and rubble. The small tonnages of dimension marble mined were sold for cut stone and rough block.

Crushed stone was produced in 11 of the State's 14 counties. In 1980, about one-third of the 7.3 million tons of crushed stone produced came from eight quarries in Middlesex County and six in Norfolk County. Output of traprock, the leading type of stone mined in Massachusetts, dropped about 800,000 tons compared with the previous year's level. Approximately 5.8 million tons of traprock was extracted and crushed at 24 operations in 3 counties. About two-thirds of the output was sold for aggregate.

Other types of crushed stone produced in Massachusetts included limestone and granite from 15 operations. Limestone was mined in Berkshire County and used primarily in the manufacture of lime. Most of the granite was quarried in Norfolk County and sold mainly for aggregate.

Vermiculite.—W. R. Grace & Co. exfoliated imported vermiculite at the company's plant in Easthampton, Hampshire County. Major uses were in insulation and as a fireproofing material in wallboard.

[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.
[2]Massachusetts State geologist, Boston, Mass.
[3]The Boston Globe. Jan. 11, 1981, pp. H1-2.
[4]Lapidary Journal. February 1981, pp. 2470-74.

Table 7.—Massachusetts: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	W	W	142	1,421
Concrete aggregate	456	1,687	417	1,642
Bituminous aggregate	2,910	11,622	2,150	9,094
Macadam aggregate	203	746	300	1,135
Dense-graded roadbase stone	755	2,603	582	2,341
Surface treatment aggregate	65	224	55	229
Other construction aggregate and roadstone	1,953	7,223	1,740	6,906
Riprap and jetty stone	106	304	123	433
Railroad ballast	790	2,644	901	3,049
Manufactured fine aggregate (stone sand)	277	706	135	431
Flux stone	6	55	W	W
Roofing granules	212	755	115	468
Other uses[2]	854	11,001	655	9,656
Total[3]	8,586	39,570	7,316	36,804

W Withheld to avoid disclosing company proprietary data; included with "Other uses."
[1]Includes limestone, granite, traprock, and miscellaneous stone.
[2]Includes stone used for poultry grit and mineral food, filter stone, lime manufacture, asphalt filler, other fillers or extenders, and uses indicated by symbol W.
[3]Data may not add to totals shown because of independent rounding.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
K-F Brick Co., Inc	River St. Middleboro, MA 02346	Pit	Plymouth.
Plainville Corp., Masslite Div.[1]	Box 327 Walpole, MA 02081	Pit	Norfolk.
Stiles & Hart Brick Co	Box 367 Bridgewater, MA 02324	Pit	Plymouth.
Gypsum, calcined:			
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	Plant	Suffolk.
Lime:			
Lee Lime Corp.[2]	Marble St. Lee, MA 01238	Plant and pit	Berkshire.
Pfizer, Inc.[2]	260 Columbia St. Adams, MA 01220	do	Do.
Peat:			
Sterling Peat Co	Sterling Junction, MA 01565	Bog	Worcester.
Perlite, expanded:			
Whittemore Products, Inc	Dundee Park Andover, MA 01810	Plant	Essex.
Sand and gravel:			
Construction:			
Baldarelli Bros. Inc	71 Temple St. West Boylston, MA 01583	Pit	Worcester.
E. L. Dauphinais, Inc	160 Worcester Rd. North Grafton, MA 01536	Pits	Middlesex and Worcester.
Nemasket Construction Co., Inc.	Box 296 Middleboro, MA 02341	Pit	Plymouth.
West Sand & Gravel Co	331 West St. Walpole, MA 02081	Pit	Norfolk.
Industrial:			
Holliston Sand Co., Inc	303 Lowland St. Holliston, MA 01746	Pit	Middlesex.
Whitehead Bros. Co	60 Hanover Rd. Florham Park, NJ 07932	Pit	Plymouth.
Stone:			
John S. Lane & Son, Inc	Box 125 Westfield, MA 01085	Quarries	Hampden and Hampshire.
S. M. Lorusso & Sons, Inc	331 West St. Walpole, MA 02081	do	Norfolk.
Old Colony Crushed Stone & Construction Co., Inc.	Box 230 Quincy, MA 02169	Quarry	Do.
Tilcon Warren Quarries, Inc.	Box 114 Acushnet, MA 02743	do	Bristol.
Vermiculite, exfoliated:			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	Hampshire.

[1]Also sand and gravel.
[2]Also stone.

The Mineral Industry of Michigan

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey Division, Michigan Department of Natural Resources, for collecting information on all nonfuel minerals.

By James J. Hill[1] and Robert J. Tuchman[2]

The value of nonfuel mineral production in Michigan fell to $1.49 billion in 1980, down from the record $1.51 billion in 1979. Leading mineral commodities, in terms of value, were iron ore, portland cement, magnesium compounds, salt, sand and gravel, and stone. The State was the Nation's leading producer of calcium chloride, crude iron oxide pigments, magnesium compounds, and peat. Michigan ranked second nationally in the production of industrial sand and iron ore; the State was one of two that produced bromine and crude iodine. Other mineral commodities produced were clays, copper, crude gypsum, lime, masonry cement, and silver. Perlite and vermiculite were imported for processing. Sulfur was recovered as a byproduct at oil refineries and natural gas processing plants. Minor amounts of gem stones were collected by amateur collectors.

Table 1.—Nonfuel mineral production in Michigan[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	262	$16,455	206	$14,292
Portland	do.	5,682	252,058	4,651	224,685
Clays	do.	2,072	7,430	1,982	7,212
Gem stones		NA	10	NA	10
Gypsum	thousand short tons	2,526	14,633	1,383	8,605
Iron ore (usable), thousand long tons	gross weight	17,196	596,478	15,895	634,355
Lime	thousand short tons	1,057	43,373	836	36,750
Peat	do.	258	4,847	253	4,739
Salt	do.	3,080	82,540	2,406	104,842
Sand and gravel	do.	50,169	116,597	36,597	98,354
Stone:					
Crushed	do.	39,809	99,832	32,121	91,727
Dimension	do.	9	166	7	144
Combined value of bromine, calcium chloride, copper, iodine, iron oxide pigments (crude), magnesium compounds, and silver		XX	r272,107	XX	259,735
Total		XX	r1,506,526	XX	1,485,450

rRevised. 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 nonfuel mineral production in Michigan, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Alcona	$30	$138	Sand and gravel.
Alger	29	29	Do.
Allegan	W	W	Sand and gravel, stone, peat.
Alpena	W	W	Cement, stone, clays, sand and gravel.
Antrim	W	W	Clays, sand and gravel.
Arenac	1,229	1,089	Stone, sand and gravel.
Baraga	92	149	Sand and gravel.
Barry	297	222	Do.
Bay	16,157	19,095	Cement, sand and gravel, lime.
Benzie	100	51	Sand and gravel.
Berrien	6,716	2,902	Do.
Branch	W	515	Do.
Calhoun	712	1,512	Do.
Cass	W	W	Sand and gravel, stone.
Charlevoix	W	W	Cement, stone, sand and gravel.
Cheboygan	W	340	Sand and gravel, stone.
Chippewa	W	W	Stone, sand and gravel.
Clare	596	567	Sand and gravel.
Clinton	W	W	Sand and gravel, clays.
Delta	W	W	Sand and gravel, stone.
Dickinson	W	W	Iron ore, sand and gravel, stone.
Eaton	W	W	Sand and gravel, stone, peat.
Emmet	W	W	Cement, stone, clays, sand and gravel.
Genesee	414	W	Sand and gravel.
Gladwin	15	W	Do.
Gogebic	444	202	Do.
Grand Traverse	110	97	Do.
Gratiot	W	459	Do.
Hillsdale	1,110	1,594	Do.
Houghton	469	W	Sand and gravel, stone.
Huron	W	W	Stone, sand and gravel, lime.
Ingham	514	W	Sand and gravel, peat.
Ionia	194	122	Sand and gravel.
Iosco	W	13,162	Gypsum, sand and gravel.
Iron	W	W	Iron ore, sand and gravel.
Isabella	W	W	Sand and gravel.
Jackson	711	W	Sand and gravel, stone.
Kalamazoo	1,839	1,940	Sand and gravel.
Kalkaska	--	27	Do.
Kent	W	W	Sand and gravel, gypsum, peat.
Lake	144	144	Sand and gravel.
Lapeer	2,238	W	Peat, sand and gravel, calcium chloride.
Leelanau	W	W	Sand and gravel.
Lenawee	864	900	Do.
Livingston	2,859	3,592	Do.
Luce	28	28	Do.
Mackinac	16,459	W	Stone, sand and gravel.
Macomb	2,973	7,313	Sand and gravel.
Manistee	80,233	96,643	Magnesium compounds, salt, bromine, sand and gravel.
Marquette	W	W	Iron ore, sand and gravel, crude iron oxide pigments, stone.
Mason	W	98,737	Magnesium compounds, calcium chloride, lime, bromine, sand and gravel.
Mecosta	W	W	Sand and gravel, peat.
Menominee	135	502	Sand and gravel.
Midland	W	W	Bromine, calcium chloride, magnesium compounds, iodine, salt.
Missaukee	W	W	Sand and gravel.
Monroe	43,413	51,785	Cement, stone, clays, peat.
Montcalm	509	W	Sand and gravel.
Muskegon	W	W	Sand and gravel, salt.
Newaygo	W	W	Sand and gravel.
Oakland	22,827	25,693	Sand and gravel, peat.
Oceana	2,361	3,429	Sand and gravel.
Ogemaw	640	736	Do.
Ontonagon	53,153	W	Copper, silver, stone, sand and gravel.
Osceola	430	483	Sand and gravel.
Otsego	155	204	Do.
Ottawa	3,844	5,643	Do.
Presque Isle	W	W	Stone, sand and gravel.
Saginaw	W	W	Sand and gravel, lime.
St. Clair	W	W	Salt, sand and gravel.
St. Joseph	W	W	Sand and gravel, stone, peat.
Sanilac	W	W	Peat, sand and gravel, lime.
Schoolcraft	W	W	Stone, sand and gravel.
Shiawassee	W	W	Clays, peat, sand and gravel.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Michigan, by county[1] —Continued

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Tuscola	W	W	Sand and gravel, lime.
Van Buren	$332	$297	Sand and gravel.
Washtenaw	3,207	3,531	Do.
Wayne	W	99,406	Cement, lime, salt, sand and gravel, stone, clays.
Wexford	1,875	1,979	Sand and gravel.
Undistributed[2]	r1,089,911	1,061,268	
Total	r1,360,368	[3]1,506,526	

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1]Crawford, Keweenaw, Montmorency, Oscoda, and Roscommon Counties are not listed because no nonfuel mineral production was reported.

[2]Includes gem stones and some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

[3]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Michigan business activity

	1979	1980p	Change, percent
Employment and labor force, annual average:			
Total civilian labor force thousands	4,314.0	4,298.0	-0.4
Unemployment do	335.0	541.0	+61.5
Employment (nonagricultural):			
Mining[1] do	13.2	12.5	-5.3
Manufacturing do	1,160.2	1,007.2	-13.2
Contract construction do	139.5	117.1	-16.1
Transportation and public utilities do	160.6	150.5	-6.3
Wholesale and retail trade do	761.3	737.8	-3.1
Finance, insurance, real estate do	154.5	156.1	+1.0
Services do	626.7	645.1	+2.9
Government do	621.0	627.7	+1.1
Total nonagricultural employment[2] do	3,637.1	3,454.1	-5.0
Personal income:			
Total millions	$86,369	$90,976	+5.3
Per capita	$9,381	$9,847	+5.0
Construction activity:			
Number of private and public residential units authorized	49,305	28,854	-41.5
Value of nonresidential construction millions	$1,148.0	$1,053.8	-8.2
Value of State road contract awards do	$193.1	$152.0	-21.3
Shipments of portland and masonry cement to and within the State thousand short tons	3,043	2,102	-30.9
Nonfuel mineral production value:			
Total crude mineral value millions	$1,506.5	$1,485.4	-1.4
Value per capita, resident population	$164	$160	-2.4
Value per square mile	$25,877	$25,516	-1.4

pPreliminary.

[1]Includes oil and gas extraction.

[2]Data do not add to total shown because of independent rounding.

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

Trends and Developments.—According to the Michigan State Economic Record, published by Michigan State University, contracts for future building (residential and nonresidential) dropped 22% during the first 11 months of 1980, compared with those of the same period in 1979. Nonbuilding construction contracts (highways, bridges, dams, utility systems, etc.) decreased by 37%. Declines in construction resulted from high interest rates caused by the tight money policy and a shortage of mortgage money. These factors influenced demand for nonmetallic construction materials produced or processed in the State, such as cement, clays, gypsum, perlite, sand and gravel, stone, and vermiculite.

Decreased demand for steel by the auto industry and other durable goods manufacturers depressed other portions of the State's mineral economy. Iron ore production in the Upper Peninsula was cut back; this had a severe impact on the State's shipping industry. Also, production of lime

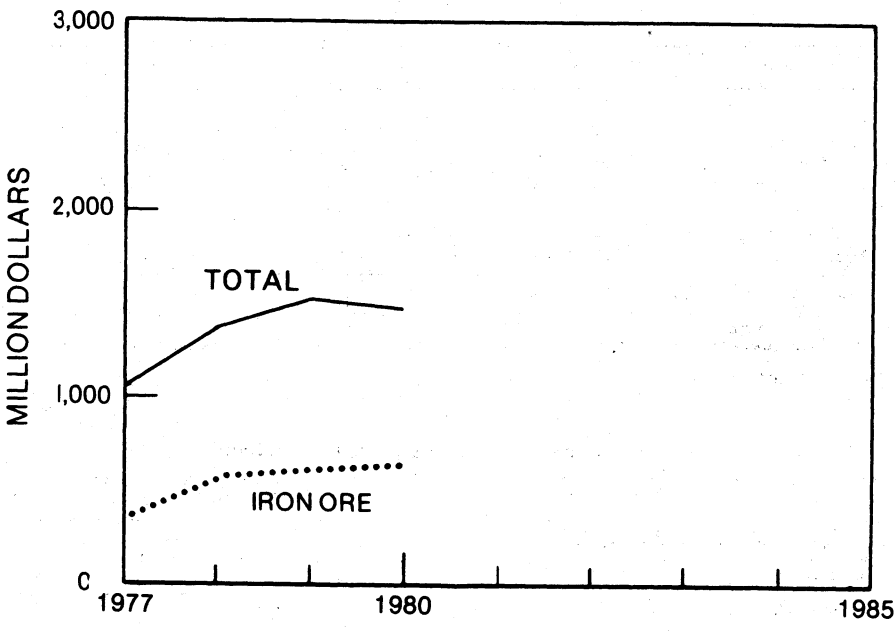

Figure 1.—Value of iron ore and total value of nonfuel mineral production in Michigan.

and limestone used in steelmaking dropped, as did production of industrial sand used in foundries that provide castings for the auto industry. A 2-month labor dispute at the State's only copper mine resulted in lost production. In retrospect, 1980 was a bleak year for the State's mineral industry.

Exploration.—In the Upper Peninsula, several companies conducted geochemical and geophysical surveys and diamond drilling programs to explore for base metals, iron, gold, and uranium. Ten companies drilled during the year; of these, seven reported drilling approximately 82,000 feet. Firms have up to 2 years to submit drill logs to the State.

Cleveland-Cliffs Iron Co. (CCI) and Chevron Resources Co., a subsidiary of Standard Oil Co. of California, continued evaluating properties in the Upper Peninsula under their joint venture prospecting agreement.

Pickands Mather & Co. drilled five holes, about 3,000 feet, in an area northwest of Iron Mountain on the Menominee Iron Range. The firm has been evaluating an iron formation in the Pine Creek, Traders Mine, Lake Antoine, and Fumee Lake area since 1978, and acquiring surface rights as they become available.

Callahan Mining Corp. continued evaluating the long inactive Ropes Gold Mine near Ishpeming in Marquette County. Work on the property began in 1979 by Resource Exploration, Inc., a consulting firm based in Marquette. By September 1980, surface drilling had been completed with 20 holes totaling more than 10,000 feet. After State water permits were received, pumps were installed to dewater the mine's 15 levels. Exploration began on the third level when the mine water receded. Depths below the 15th level will be probed by underground diamond drilling after the mine is dewatered.

The press reported several other mining companies active in the Upper Peninsula. Minatome Corp., based in Iron Mountain, leased approximately 88,000 acres of mineral rights in a five-county area from Ford Motor Co. and conducted drilling operations in 1980. Kerr-McGee Resources Corp., based in Marquette, completed a 27-hole drilling program in Baraga and Iron Counties in the spring of 1980, and then focused efforts in Wisconsin. Anaconda Copper Co., a subsidiary of Atlantic Richfield Co., Denver, Colo., was issued a sampling permit by the U.S. Forest Service on lands west of Watersmeet in Ottawa National Forest. In Baraga County, St. Joe American Corp. reportedly acquired mineral leases from several private landowners.

Most mining companies maintained a low profile because of the keen competition for

mineral leases on private lands. State lands have not been available for leasing since 1976, when a moratorium was effected as a result of concern over the environment and financial returns to the State. Currently, in the Upper Peninsula, there are only about 3,900 acres of State-owned mineral rights under lease for copper, iron, and other metallic minerals.

In July, the State held two public hearings on a proposed metallic mineral lease that the Department of Natural Resources (DNR) had been developing for several years. The lease, which affected about 385,000 acres of State-owned mineral rights in the western Upper Peninsula, provided for royalties to the State and environmental controls on exploration and mining. At the public hearings, mining companies denounced the lease as too restrictive, whereas others felt that effects on the environment were not adequately covered.

Shipping.—In July, Lake Superior & Ishpeming Railroad (LS&I) was forced to lay off personnel because of declining iron ore shipments from CCI's iron ore operations on the Marquette Range. Approximately 98% of LS&I's business results from ore shipments through its Presque Isle terminal at Marquette. CCI and its partners cut back production and ceased mining at two operations because of reduced demand for iron ore pellets by the steel industry.

During the last quarter, shipments of iron ore pellets improved. The American Iron Ore Association reported about 5.7 million gross tons (railroad weights) shipped through the Presque Isle terminal by yearend. This was approximately 400,000 tons more than that shipped during the previous year.

The Chicago & Northwestern Transportation Co. (C&NW) shipped fewer Marquette Range iron ore pellets through its Escanaba terminal in 1980. At yearend, the American Iron Ore Association reported 9.7 million gross tons (railroad weights) shipped through the facility, down from the record 11.8 million tons shipped in 1979.

During the year, C&NW received a permit from the Michigan Air Pollution Control Commission to install a new car-dumping station at its ore dock in Escanaba. The $21 million project was expected to increase the capacity of the facility from 12 million to 16.4 million gross tons per year, and reduce dust emissions from 1,600 to 350 tons annually.

For the first time in years, two locks were idled during the peak shipping season at Sault Ste. Marie, where the locks join Lake Superior and Lake Huron on the St. Marys River. In July, the U.S. Army Corps of Engineers placed the Davis Lock on standby because of the shipping slowdown caused by the economic downturns in the steel and auto industries. Earlier in the year, the Sabin Lock was closed because of the shipping decline.

On December 31, 1980, the Soo Locks closed for the winter, the earliest closing date since the Corps began a federally financed winter navigation program about a decade ago. U.S. Congress failed to pass legislation to extend the season to January 31, 1981.

The Corps has been studying the economic and engineering feasibility of winter navigation. In a final report on the program, released in January 1980, the Corps concluded that winter navigation was economically and technically feasible and would cause minimal environmental damage. Funding was recommended for a year-round shipping program on the Great Lakes.

During the shipping slump, about one-fourth of the American flag Great Lakes vessels were idle, with about 8,000 sailors and longshoremen unemployed.

The Lake Carriers' Association reported Great Lakes shipments of basic bulk commodities—iron ore, coal, and grain—totaled 154.1 million net tons in 1980, down from 177.2 million tons in 1979. In 1980, iron ore shipments were 81.3 million net tons, compared with 102.4 million tons in 1979. Grain was the only commodity that increased in tonnage from 1979 to 1980.

Toward yearend, the Detroit-Wayne County Port Authority was formed to expand domestic and international shipping in the Port of Detroit. Authorized by the legislature, the new authority can acquire land through condemnation for new shipping projects and issue general revenue bonds for financing. Detroit is a leading inland domestic port, with an estimated 25 million tons of cargo loaded and unloaded each year.

Environment.—Several problems related to past mining activity developed during the year. Near Iron River in Iron County, acid water from abandoned iron mines discharged into the Iron River, which flows into the Brule River on the Michigan-Wisconsin border. At yearend, the U.S. Environmental Protection Agency announced pumps would

be installed in some of the mine shafts to halt the flow of pollutants.

In Negaunee, Marquette County, caving ground over an abandoned iron mine threatened the community's main sewer interceptor line. An engineering firm was hired to conduct a study of the area and investigate possibilities of an alternate route for a new line.

In January, at the request of the Marquette County Board of Commissioners, the County Planning Commission began a study to identify areas affected by mining. Particular attention was directed toward subsidence areas. Preliminary results of the study, to be completed in 1981, indicated more areas were affected by mining than anticipated.

Legislation and Government Programs.—A 12-year controversy ended when Public Act 316 was passed by the legislature and signed by the Governor in December. The law, a compromise between environmentalists and drilling interests, allows exploration in the 96,000-acre Pigeon River Country State Forest. Located in the northern part of the Lower Peninsula, the forest is home for the State's only elk herd.

During the year, ground water quality rules were approved by the Joint Legislature Rules Committee and the Michigan Water Resources Commission. The new rules require permits for discharges into ground water. Hydrogeologic evaluations have to be made at a potential discharge site, and continued monitoring is required to insure water quality in aquifers.

The State's land inventory established by Public Act 204 got underway in April. A 20-member Inventory Advisory Committee was formed to coordinate DNR and local efforts to devise a comprehensive listing of Michigan's land, mineral, and water resources. The committee will set standards for the inventory and assure that information is compiled uniformly. This inventory, estimated to cost $3.5 to $4.5 million over the next 5 years, should aid local governments in making land use planning decisions.

Public hearings were held in June on the proposed Series II sand dune areas as required by Michigan's Sand Dune Protection and Management Act (Public Act 222, 1976.) Six areas on Lake Michigan's eastern shore were identified to come under protection of the act. Previously, in 1978, seven high-priority areas were designated by DNR as Series I sand dune areas.

In 1980, there were eight industrial sand operations in dune areas permitted under the act; five applications were pending and two permits were denied for environmental reasons and were under appeal. Aerial surveillance and onsite field inspections of active and potential sand dune mining operations continued during the year. Low-altitude imagery is used to determine mining advances, reclamation progress, and mining violations. Funding for some of the State's sand dune activities was provided by Michigan's Coastal Management Programs.

Several studies related to sand dune mining were begun during the year. They include (1) Ecological and Floristic Studies of the Eastern Shore of Lake Michigan Sand Dunes, (2) Revegetation Techniques and Testing of Sand Dune Areas, (3) Barrier Dune Impacts on the Environment, and (4) Use and Recycling of Sand, as Used in the Foundry Industry.

Michigan Technological University and its Institute of Mineral Research (IMR) at Houghton continued research on the geology and mineral resources of Michigan and provided technical services to industry and State and Federal agencies. Studies initiated or ongoing during the year included (1) developing guidelines for closing underground mines and (2) determining the effects of increasing energy costs on future relationships between open pit and underground mining. Also, IMR continued to monitor subsidence at the Sherwood Mine, which was closed in 1978. During the year, UOP, Inc., deeded Michigan Tech over 100,000 items relating to the history of mining in the Upper Peninsula. The historic material, dating from 1880 to 1940, was acquired by UOP when it purchased Calumet & Hecla's copper mining operations in 1968.

An academic team from Minnesota, Wisconsin, and Michigan, funded by the Upper Great Lakes Regional Commission, began studying the possibility of establishing a steel mill in the Great Lakes region. Five sites were under consideration: The Marquette and Escanaba areas in Michigan; two sites in the Duluth, Minn.-Superior, Wis., area; and the Mesabi Iron Range in Minnesota.

The Geologic Survey Div. of DNR continued ongoing programs to evaluate the quantity, quality, and distribution on mineral resources in the State in cooperation with local, State, and Federal agencies. Lack of funding, caused by the downturn in

the State's economy, hindered some Survey programs and necessitated a reduction in staff. During the year, the Survey began a reorganization to deal more effectively with its regulatory and service functions.

The U.S. Geological Survey, in cooperation with the State Survey, continued work on geologic maps of the Wakefield Quadrangle in the Upper Peninsula, and Gogebic County.

The Lakes State Office of the U.S. Bureau of Land Management released three quadrangle maps in 1980 showing the surface and mineral estate on land owned by the Federal Government in the western Upper Peninsula. Maps released were Ontonagon, L'Anse, and Iron River Quadrangles.

No action was taken by U.S. Congress on the seven national forest areas previously nominated for wilderness designation under the Forest Service's Roadless Area Review and Evaluation (RARE II) program. In fiscal year 1979, the Federal Government returned approximately $729,600 to the State for activities (timbering, minerals leasing, recreation, user fees, etc.) in the State's national forests. Approximately $827,900 was returned to the State in fiscal year 1980.

During the year, the Federal Bureau of Mines had several active contracts and grants with industrial firms, educational institutions, and consulting firms in Michigan. Research was conducted on various types of mining equipment, mine health and safety, and mineral resources. Funding totaled approximately $240,000.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives, Manufactured.—Two companies manufactured metallic abrasives during 1980. Ervin Industries, Inc., Lenawee County, made steel shot and grit, and Abrasive Materials, Inc., Hillsdale County, manufactured cut wire shot.

Bromine.—Michigan was one of two States that produced bromine in 1980. Extracted from salt brines, bromine was processed at Dow Chemical Co.'s plants in Mason and Midland Counties and Morton Chemical Co.'s plant in Manistee County. Bromine and its compounds were used in leaded gasoline, flame retardants, pesticides, agricultural chemicals, pharmaceuticals, and well-completion fluids.

Calcium Chloride.—Michigan remained the Nation's leading producer of natural calcium chloride. Two companies reported production from salt brines: Dow Chemical Co., in Mason and Midland Counties, and Wilkinson Chemical Corp., in Lapeer County. Dow Chemical began expanding its calcium chloride facility at Ludington, which will double production capacity; completion is anticipated by 1983. Calcium chloride was used mainly for deicing, dust control, industrial applications, oil recovery, and concrete acceleration.

Cement.—Michigan ranked fourth in portland cement shipments behind Texas, California, and Pennsylvania. Of the State's seven cement plants, four were located adjacent to the company quarries, one received raw materials from pits and quarries situated elsewhere, and two purchased clinker for processing.

Most cement shipped to distrubution terminals was by lake freighter and barge. Shipments to consumers were by truck and rail. Ready-mix companies purchased the most cement, followed by concrete product manufacturers, highway contractors, and building material dealers.

In 1979, Gifford-Hill & Co., Inc., acquired Amcord, Inc., and its Peerless Cement Co. division located in Detroit. The Peerless cement plant is one of several Amcord properties that Gifford-Hill purchased and put up for sale.

Dundee Cement Co. began construction of a $1.8 million corporate office building near its plant in Dundee Township, Monroe County. Slated for completion in 1981, the building will serve as the firm's national headquarters.

Medusa Corp., a subsidiary of Crane Co., completed a 2-year, $56 million program to modernize and expand its Charlevoix plant in late 1979. Plant capacity was increased by approximately 80% to 1.4 million tons, and per-ton fuel consumption was reduced by about 33%. In 1980, the firm experienced some normal startup problems that affected production.

On December 29, 1979, National Gypsum Co. announced its intent to sell its cement division, including a mill at Alpena. General Dynamics Corp. was considering the purchase, but no sale developed by yearend.

Penn-Dixie Industries Corp. began reorganization proceedings in April under chapter 11 of the Federal Bankruptcy Code. Approximately 130 workers were laid off at the company's cement plant in Petoskey,

Emmet County, in November.

Table 4.—Michigan: Portland cement salient statistics

(Short tons)

	1979	1980
Number of active plants	7	7
Production	5,775,667	4,766,911
Shipments from mills:		
Quantity	5,682,500	4,650,942
Value	$252,057,568	$224,685,322
Stocks at mills, Dec. 31	411,790	397,035

Table 5.—Michigan: Masonry cement salient statistics

(Short tons)

	1979	1980
Number of active plants	5	5
Production	277,708	205,419
Shipments from mills:		
Quantity	261,609	205,523
Value	$16,455,056	$14,292,353
Stocks at mills, Dec. 31	77,181	70,869

Clays.—In 1980, eight companies, each operating one mine, produced common clay and shale. Output and value decreased only slightly compared with 1979 levels. Principal producers were National Gypsum Co., Medusa Corp., Dundee Cement Co., Gifford-Hill & Co., Inc., and Penn-Dixie Industries, Inc. Clay was used mainly as an ingredient in cement manufacture. Other uses were for the manufacture of bricks, drain tile, flower pots, flue linings, and sewer pipe.

Gem Stones.—A small amount of gem stones, with an estimated value of $10,000, was collected by amateur collectors and mineral dealers. Agates are found in several locations on the Lake Superior shore. Petoskey stone, found on the Lake Michigan shore, has been Michigan's official State stone since 1965; legislation in 1972 designated chlorastrolite, a rare Isle Royale mineral, as the State gem.

A kimberlite deposit located in Iron County, Mich., was described in a paper presented at the 26th Annual Institute on Lake Superior Geology in May. In the Abstracts of Proceedings, the authors postulated that diamonds found in glacial deposits in central and southern Wisconsin at the turn of the century may have originated from this locality or from similar undiscovered deposits in northern Wisconsin and Michigan. Previously, the closest known occurrences of kimberlite were in Canada.

Gypsum.—Michigan dropped to fourth place in the production of crude gypsum, after leading the Nation in 1978-79. Crude gypsum was mined by five companies in two counties. Michigan Gypsum Co., National Gypsum Co., and United States Gypsum Co. produced from open pit mines in Iosco County. Georgia-Pacific Corp. and Grand Rapids Gypsum Co. operated underground mines in Kent County. Grand Rapids Gypsum ceased operations in August and was put up for sale. Michigan ranked 12th among the States in the production of calcined gypsum. Four companies in Iosco, Kent, and Wayne Counties reported output. Gypsum was used in the manufacture of plaster wallboard, in portland cement, and for agricultural purposes.

Iodine.—Michigan was one of two States that produced iodine, accounting for approximately 17% of the Nation's output in 1980. Dow Chemical Co. in Midland, the State's only producer, recovered iodine, along with bromine, from subterranean salt brines. End product uses included animal feed supplements, pharmaceuticals, catalysts, stabilizers, and inks and colorants.

Lime.—Output of lime decreased for the fourth consecutive year. In 1980, lime was produced by five companies at eight plants. Dow Chemical Co. and Marblehead Lime Co., a subsidiary of General Dynamics Corp., were principal producers in the State. Lime was used in steelmaking, water purification, sewage treatment, alkalies, and sugar refining.

Magnesium Compounds.—Michigan led the Nation in production of magnesium compounds from brines, contributing 66% to the national output in 1980. Three companies operated production facilities: Dow Chemical Co., Martin Marietta Chemicals, and Morton Chemical Div. of Morton-Norwich Products, Inc. Dow Chemical produced in Mason and Midland Counties; Martin Marietta and Morton Chemical produced in Manistee County.

Martin Marietta added a third multiple-hearth furnace to its Manistee plant in 1980 as part of a $15 million expansion program scheduled for completion in 1981. Chemical and refractory magnesia capacity is expected to increase by 11% to 350,000 tons annually.

Chemical magnesia was used in a variety of manufacturing and agricultural applications, including automotive lubricants, fertilizers, animal feed, and fuel oil additives. Refractory magnesia was used for repairing and maintaining the lining of steelmaking

furnaces and making refractory brick.

Peat.—Michigan continued to rank first among the 21 peat-producing States, accounting for about 32% of the U.S. production in 1980. Peat was mined at 15 sites in 11 counties by 13 operators, and sold in bulk and packaged form. Eight operators packaged peat for sale to K-Mart, A&P Supermarkets, and other retail establishments in several States. Most of the packaged peat was moved to market in flat-bed trailer trucks. Peat was used for general soil improvement and as an ingredient in potting soils. To meet customer specifications, vermiculite, perlite, sand, etc., are added for potting soil mixes. Anderson Peat Co.; Michigan Peat, Inc.; and Al-Par Peat Co. were principal producers. Types of peat produced were reed-sedge, humus, hypnum moss, and sphagnum moss.

Perlite.—Harborlite Corp. at Vicksburg, in Kalamazoo County, and U.S. Gypsum Co. at Detroit, in Wayne County, expanded crude perlite, imported from other States. The product was used as a filter aid by breweries and water companies and as a plaster aggregate.

Salt.—Michigan remained in fifth place among the 17 salt-producing States in 1980. Production dropped for the fourth consecutive year, partly the result of a mild winter, which depressed sales for ice and snow removal. A total of eight companies in five counties produced nearly 6% of the U.S. output during the year. Salt was extracted by underground mining and solution mining. International Salt Co., Inc.'s underground mine in Detroit was the sole producer of rock salt. Uses included table salt, food processing, chemical applications, and snow and ice control.

Sand and Gravel.—Production and value of sand and gravel in Michigan in 1980 dropped 27% and 16%, respectively, compared with 1979 figures. Michigan ranked fifth among the States in sand and gravel output, preceded by California, Texas, Alaska, and Ohio. Also, Michigan ranked second in the production of industrial sand and gravel, dropping from first place in 1979.

Leading counties in output of construction sand and gravel were Oakland, Washtenaw, and Livingston in the Detroit area; and Ottawa and Kent in the Grand Rapids area. These counties accounted for 45% of the State's production. Construction sand and gravel was used mainly as roadbase and for concrete and asphalt aggregate.

Industrial sand was produced in 11 of Michigan's 83 counties by 13 companies. The major source of industrial sand was the sand dunes located along Lake Michigan's eastern shoreline. According to the Michigan Industrial Sand Association, sand mining companies lease or own about 4% of the 67,645 acres of sand dunes in the State. Michigan dune sand was used to make 90% of castings fabricated for American automobiles and about 40% of all castings for other purposes in the United States. The second major use of Michigan's industrial sand was glassmaking.

American Aggregates Corp. began construction of a 1,000-ton-per-hour sand and gravel processing plant at Oxford, Oakland County, during the summer. The $3.6 million facility, which will serve the Detroit market area, was expected to become operational by September 1981.

Manley Bros. of Indiana, Inc., an industrial sand producer in Macomb County, was acquired during the year by Hepworth Ceramics Holdings Ltd. through the company's wholly owned subsidiary in the United States, British Industrial Sand Ltd. Manley Bros. has a plant in Bridgman where sand is processed for foundries and glassmaking.

Table 6.—Michigan: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	14,019	$32,464	$2.32	9,735	$25,853	$2.66
Plaster and gunite sands	273	658	2.41	241	694	2.89
Concrete products	1,885	4,210	2.23	1,809	5,305	2.93
Asphaltic concrete	6,572	11,964	1.82	5,704	12,801	2.24
Roadbase and coverings	15,380	28,366	1.84	10,673	22,020	2.06
Fill	4,993	6,048	1.21	3,242	4,109	1.27
Snow and ice control	629	846	1.34	448	673	1.50
Railroad ballast	40	88	2.21	56	118	2.11
Other	806	1,992	2.47	628	1,593	2.54
Total[1] or average	44,596	86,635	1.94	32,536	73,166	2.25

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

Table 7.—Michigan: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	17,901	$30,016	$1.68	13,336	$27,872	$2.09
Gravel	26,696	56,619	2.12	19,200	45,294	2.36
Total[1] or average	44,596	86,635	1.94	32,536	73,166	2.25
Industrial:						
Sand	5,572	29,962	5.38	4,062	25,188	6.20
Gravel	--	--	--	--	--	--
Total	5,572	29,962	5.38	4,062	25,188	6.20
Grand total[1] or average	50,169	116,597	2.32	36,597	98,354	2.69

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

Table 8.—Michigan: Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1979		1980	
	Quantity	Value	Quantity	Value
Alcona	84	138	W	W
Alger	14	29	11	25
Allegan	1,178	2,162	845	1,792
Antrim	W	127	47	112
Arenac	36	37	W	W
Baraga	93	149	190	270
Barry	127	222	W	W
Benzie	51	51	40	44
Berrien	529	2,902	527	2,510
Branch	265	515	286	522
Calhoun	517	1,512	264	840
Cass	529	783	489	900
Charlevoix	322	647	296	701
Cheboygan	105	184	38	65
Chippewa	389	632	259	480
Clare	329	567	224	448
Clinton	1,132	2,518	785	2,136
Delta	166	385	270	719
Dickinson	327	793	208	457
Eaton	496	1,065	315	810
Emmet	W	W	69	173
Genesee	W	W	214	505
Gogebic	134	202	80	119
Grand Traverse	43	97	30	78
Gratiot	250	459	214	435
Hillsdale	881	1,594	648	1,225
Houghton	560	833	W	W
Huron	126	217	98	189
Ingham	619	1,063	707	1,488
Ionia	100	122	77	105
Iosco	104	104	82	92
Iron	277	412	135	285
Jackson	515	1,036	399	900
Kalamazoo	941	1,940	785	1,985
Kalkaska	27	27	21	24
Kent	3,246	7,219	1,434	3,587
Lake	77	144	60	126
Lapeer	397	621	348	585
Lenawee	441	900	428	964
Livingston	2,014	3,592	1,436	3,440
Luce	14	28	20	69
Mackinac	149	245	31	71
Macomb	1,966	7,313	1,360	6,321
Manistee	86	116	48	58
Marquette	597	1,212	436	1,173
Mason	755	W	W	W
Mecosta	334	609	116	284
Menominee	442	502	192	393
Missaukee	W	W	2	3
Montmorency	--	--	W	W
Muskegon	802	4,330	594	3,712
Newaygo	23	W	--	--
Oakland	12,288	25,623	8,574	21,857

See footnotes at end of table.

Table 8.—Michigan: Sand and gravel sold or used by producers, by county —Continued

(Thousand short tons and thousand dollars)

County	1979		1980	
	Quantity	Value	Quantity	Value
Oceana	803	3,429	667	2,704
Ogemaw	359	736	511	1,107
Ontonagon	62	94	49	82
Osceola	253	483	W	W
Otsego	110	204	102	208
Ottawa	2,578	5,643	1,946	5,063
Saginaw	626	2,105	413	1,480
St. Clair	262	906	241	821
St. Joseph	460	764	267	555
Sanilac	377	653	377	755
Shiawassee	199	225	217	260
Tuscola	764	1,339	659	1,546
Van Buren	230	297	202	266
Washtenaw	2,447	3,531	1,869	3,449
Wayne	1,456	7,879	1,136	6,870
Wexford	844	1,979	381	1,230
Undistributed[1]	3,443	10,351	3,828	8,886
Total[2]	50,169	116,597	36,597	98,354

W Withheld to avoid disclosing company proprietary data; included in "Undistributed."
[1]Includes Alpena, Bay, Gladwin, Isabella, Leelanau, Montcalm, Presque Isle, and Schoolcraft 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.

Slag—Iron and Steel.—Michigan ranked fourth in 1980 in the production of iron and steel slag, behind Pennsylvania, Ohio, and Indiana. Slag, a byproduct of steelmaking, was used mainly by the construction industry. Edward C. Levy Co., in Wayne County, processed slag from Ford Motor Co.'s Steel Div., Great Lakes Steel, and McLouth Steel Corp. Types of iron slag produced included air-cooled, expanded, and granulated.

Stone.—In 1980, stone was extracted in 25 counties at 43 quarries. Leading counties, in descending order of output, were Presque Isle, Mackinac, Alpena, Monroe, and Chippewa.

Crushed stone comprised most of the stone produced in the State. Limestone remained the leading rock type mined, followed by traprock, marl, and sandstone. United States Steel Corp.'s Calcite quarry and Presque Isle Corp.'s Stoneport quarry, both in Presque Isle County, were among the leading limestone-producing quarries in the Nation.

Table 9.—Michigan: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	366	956	221	773
Agricultural marl and other soil conditioners	23	50	27	54
Concrete aggregate (coarse)	4,761	9,882	3,223	7,761
Bituminous aggregate	2,151	5,972	1,732	5,355
Macadam aggregate	603	1,307	372	1,008
Dense-graded roadbase stone	1,277	3,526	1,044	3,279
Surface treatment aggregate	138	428	162	482
Other construction aggregate and roadstone	4,089	11,159	1,817	5,753
Riprap and jetty stone	588	1,607	443	1,168
Railroad ballast	437	1,075	W	W
Terrazzo and exposed aggregate	W	4	W	W
Cement manufacture	7,234	15,159	6,589	14,455
Lime manufacture	9,810	25,027	7,698	22,580
Flux stone	7,468	21,489	7,702	25,909
Other uses[2]	862	2,191	1,090	3,150
Total[3]	39,809	99,832	32,121	91,727

W Withheld to avoid disclosing company proprietary data; included with "Other uses."
[1]Includes limestone, granite (1979), marl, sandstone, and traprock.
[2]Includes stone used for poultry grit and mineral food, manufactured fine aggregate (stone sand), chemical stone, asphalt filler (1979), paper manufacture, sugar refining, and waste material.
[3]Data may not add to totals shown because of independent rounding.

Minor amounts of limestone and sandstone were quarried for use as dimension stone. Four counties—Eaton, Jackson, Presque Isle, and Schoolcraft—had production valued at about $144,000. Sales included cut stone, flagging, and house stone veneer.

United States Steel Corp.'s Cedarville quarry in Mackinac County in the Upper Peninsula was awarded the Sentinels of Safety award during the year for having the best quarry safety record in the United States. The annual award, cosponsored by the American Mining Congress and the U.S. Department of Labor's Mine Safety and Health Administration, has been given since 1925.

United States Steel's Calcite quarry in Rogers City, Presque Isle County, was forced to curtail production during the year because of the downturn in the steel and construction industries. The quarry produces limestone for cement and lime manufacture and flux stone for steelmaking.

Sulfur.—Byproduct sulfur was recovered from refining crude petroleum by Marathon Oil Corp. in Wayne County and by Total Petroleum Ltd. in Gratiot County. Shell Oil Co. recovered sulfur from natural gas at its plant in Manistee County.

Vermiculite.—Crude vermiculite, imported from other States, was exfoliated at W. R. Grace & Co.'s plant in the Detroit area. Major end uses of the manufactured product were for insulation, agricultural applications, and fireproofing.

METALS

Copper and Silver.—All copper produced in Michigan, along with byproduct silver, was mined from Copper Range Co.'s White Pine Mine in Ontonagon County, in the western Upper Peninsula. Production slumped during the year because of a 2-month strike by employees over a contract agreement. In November, the company announced plans to construct a $78 million, 60,000-ton-per-year electrolytic refinery at White Pine, with completion anticipated by late 1982. The expansion is expected to improve copper quality and broaden the range of refined copper shapes for sale. Also, additional silver will be recovered.

Iron Ore.—Michigan remained the Nation's second leading iron ore producer, contributing approximately 23% to the U.S. output. Production decreased 4% compared with 1979 levels because of reduced demand by the steel industry, which necessitated the temporary closure of two mines. Iron ore was produced from four open pit mines in the Upper Peninsula. The Tilden, Empire, and Republic Mines were operated by CCI in Marquette County; the Groveland Mine was operated by Hanna Mining Co. in Dickinson County.

A strike at the Empire Mine was averted when a 3-year labor agreement between CCI and the United Steel Workers of America was successfully negotiated. In late June, over 2,000 employees at the Empire and Republic Mines were laid off because of reduced demand for taconite pellets. Marquette County's unemployment rate jumped to over 16%. Moderately improved economic conditions led to resumption of partial operations at the Empire Mine in the fourth quarter, with a gradual buildup to full production by yearend. The Republic Mine remained closed.

Table 10.—Michigan: Usable iron ore[1] 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		
				Ore[2]	Iron content	Iron content (percent)
1854-1975	439,122	305,037	249,625	993,785	NA	NA
1976	14,663	2,318	--	16,980	10,759	63.4
1977	9,799	2,520	--	12,319	7,798	63.3
1978	W	W	--	16,752	10,652	63.6
1979	W	W	--	17,132	10,933	63.8
1980	W	W	--	16,421	10,482	63.8
Total	507,608	[3]316,157	[3]249,625	1,073,389	NA	NA

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Exclusive after 1905 of iron ore containing 5% or more manganese.
[2]Data may not add to totals shown because of independent rounding.
[3]Distribution by range partly estimated before 1906.

Table 11.—Michigan: Iron ore shipped from mines

(Thousand long tons)

Year	Direct-shipping ore[1]	Concentrates and agglomerates, total	Total usable ore[2]	Proportion of beneficiated ore to total usable ore (percent)
1976	356	15,888	16,245	97.8
1977	253	11,756	12,009	97.9
1978	W	W	17,538	W
1979	W	W	17,196	W
1980	W	W	15,895	W

W Withheld to avoid disclosing company proprietary data.
[1]Includes crushed, screened, and sized ore not further treated.
[2]Data may not add to totals shown because of independent rounding.

Iron Oxide Pigments.—Michigan led the Nation in shipments of crude iron oxide pigments in 1980. Shipments decreased 47%, compared with 1979 figures, because of the slowdown in the iron mining industry. Crude iron oxide pigments were mined by CCI in Marquette County and were used as a colorant in paint manufacture. BASF Wyandotte Corp. produced synthetic finished iron oxide pigments at its plant in Wyandotte, Wayne County.

Iron and Steel Scrap.—Production of steel began early in 1980 at North Star Steel Co.'s new minimill in Monroe on Lake Erie, between Detroit and Toledo, Ohio. The mill recycles scrap and specializes in quality bars for the automotive industry. Capacity was rated at 400,000 tons annually. Later in the year, North Star acquired Magnimet Corp., a Monroe firm and a major ferrous scrap supplier.

In November, the Oldsmobile division of General Motors Corp. (GMC) put its 50,000-ton-per-year scrap recycling minimill up for sale. To operate economically, the mill had to run on a three-shift basis, and the GMC division was producing more forging bar than it could utilize because of the automobile slump.

Pig Iron and Steel.—Michigan ranked fourth nationally in output of pig iron and fifth in output of raw steel in 1980. Production decreased markedly, over 25%, from 1979 to 1980, because of the sagging automotive market and foreign competition, notably from Japan and Europe. Personnel layoffs were rampant throughout the industry due to reduced operations.

Michigan's steel industry, consisting of three integrated producers situated along the Detroit River, has an annual capacity of about 12 million tons. Ford Motor Co., the ninth largest U.S. producer, operated the River Rouge complex at Dearborn to provide steel for automobile manufacturing and for sale on the open market. At a plant south of Detroit at Trenton, McLouth Steel Corp., the Nation's 11th largest producer, produced steel for the automotive industry. National Steel Co.'s Great Lakes Steel Division, located south of Detroit at Ecorse, produced steel for the automotive, appliance, and agricultural equipment markets.

In June, Ford Motor Co. decided to market steel because of depressed automobile sales. In the early 1970's, the company had consumed about 80% of its output. In 1980, Ford consumed only about one-third of its steel production. Ford continued to be the only U.S. automobile company with its own steelmaking facilities.

In May, McLouth Steel Corp. was forced to shut down one of two blast furnaces at its Trenton plant in Wayne County because of the severe decline in flat-rolled steel orders from automobile manufacturers and suppliers. Other production facilities operated on reduced schedules. A strike in October at three of the firm's Detroit-area plants also hindered operations.

During the year, McLouth announced the purchase of a 70-oven coke battery complex in New Boston, Ohio, from the Empire-Detroit Steel division of Cyclops Corp. Renamed the New Boston Coke Corp., it will operate as a wholly owned subsidiary and provide coke for steel production.

National Steel's Great Lakes Steel Div. began the year with one blast furnace shut down and was later forced to remove two electric furnaces and a second blast furnace from production. As a result, other operations reduced production during the year.

Great Lakes Steel entered into a joint venture with Levy-Reclasource Co. in 1980 to construct a facility to recycle waste "coke breeze" by briqueting into a blast furnace fuel. The facility, first of its kind in the world, is expected to produce approximately

250,000 tons annually when completed in mid-1983 and bring Great Lakes' coke supply into balance with its needs.

[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

[2]Program assistant, Bureau of Mines, Pittsburgh, Pa.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:[1]			
Dundee Cement Co[1 2]	Box 122 Dundee, MI 48131	Quarry and plant	Monroe.
Medusa Cement Co., Medusa Corp., a subsidiary of Crane Co.[1 2]	Box 5668 Cleveland, OH 44101	do	Charlevoix.
National Gypsum Co., Cement Div.[1 2]	17515 West 9 Mile Rd. Southfield, MI 48075	do	Alpena.
Peerless Cement Co., Gifford-Hill & Co., Inc.[1]	9333 Dearborn St. Detroit, MI 48209	do	Wayne.
Penn-Dixie Industries Inc.[1]	Box 152 Nazareth, PA 18064	do	Emmet.
Clay and shale:			
Michigan Brick Inc	3820 Serr Rd. Corunna, MI 48817	Pit and plant	Shiawassee.
Copper:			
White Pine Copper Div. of Copper Range Co.[3]	Box 427 White Pine, MI 49971	Underground mine and plant.	Ontonagon.
Gypsum:			
Michigan Gypsum Co	2840 Bay Rd. Saginaw, MI 48605	Open pit mine and plant.	Iosco.
National Gypsum Co	4100 First International Bldg. Dallas, TX 75270	do	Do.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Iosco and Wayne.
Iron ore:			
Cleveland-Cliffs Iron Co.[4]	504 Spruce St. Ishpeming, MI 49849	Open pit mines and plants.	Marquette.
Hanna Mining Co	Star Route 1, Box 131 Iron Mountain, MI 49801	Open pit mine and plant.	Dickinson.
Iron and steel:			
Ford Motor Co	American Rd. Dearborn, MI 48121	Plant	Wayne.
McLouth Steel Corp	300 South Livernois Ave. Detroit, MI 48209	do	Do.
National Steel Corp	2800 Grant Bldg. Pittsburgh, PA 15219	do	Do.
Lime:			
Detroit Lime Co., a subsidiary of Edward C. Levy Co.	8800 Dix Ave. Detroit, MI 48209	do	Do.
Dow Chemical Co., Ludington Div	2020 Dow Center Midland, MI 48640	do	Mason.
Marblehead Lime Co., a division of General Dynamics Corp.	300 West Washington Chicago, IL 60606	do	Wayne.
Natural salines:[5]			
Dow Chemical Co	2020 Dow Center Midland, MI 48640	Brine wells and plant	Mason and Midland.
Martin Marietta Chemicals, Refractories Div.	Executive Plaza II Hunt Valley, MD 21030	do	Manistee.
Morton Chemical Co	110 North Wacker Dr. Chicago, IL 60606	do	Do.
Peat:			
Al-Par Peat Co	9551 Krouse Ovid, MI 48866	Bog and plant	Shiawassee.
Anderson Peat Co	Box 575 Perry, MI 48872	do	Lapeer and Shiawassee.
Michigan Peat, Inc	Box 66388 Houston, TX 77006	Bogs and plants	Sanilac.
Salt:			
BASF Wyandotte Corp	1609 Biddle Ave. Wyandotte, MI 48192	Brine wells and plant	Wayne.
Diamond Crystal Salt Co	916 South Riverside St. Clair, MI 48079	do	St. Clair.
International Salt Co., Inc	12841 Saunders St. Detroit, MI 48217	Underground mine	Wayne.
Sand and gravel:			
Construction:			
American Aggregates Corp	Drawer 160 Greenville, OH 45331	Surface pits and stationary plants.	Kalamazoo, Livingston, Macomb, Oakland.
Grand Rapids Gravel Co	2700 28th St., SW Grand Rapids, MI 49509	do	Kent.
Holly Sand and Gravel Co., Aggregate Div. of J. P. Burroughs & Son, Inc.	Box 1468 Saginaw, MI 48605	Surface pit, stationary and portable plants.	Oakland.

See footnotes at end of table.

Table 12.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel —Continued			
Construction —Continued			
Medusa Materials Co	3135 Trabue Rd. Columbus, OH 43204	Surface pit and stationary plant.	Oakland.
Spartan Aggregates	Box 25 Holt, MI 48842	Surface pits and stationary plants.	Clinton, Genesee, Ingham, Jackson, Oakland, Ottawa.
Whittaker & Gooding Co	5800 Cherry Hill Rd. Ypsilanti, MI 48197	____do	Washtenaw.
Industrial:			
Manley Bros. of Indiana, Inc., a subsidiary of Hepworth Ceramics Holdings Ltd.	Box 67 Chesterton, IN 46304	Surface pit and stationary plant.	Berrien.
Nugent Sand Co., Inc	Box 1209 Muskegon, MI 49443	____do	Muskegon.
Ottawa Silica Co., Michigan Silica Div	Box 100 Rockwood, MI 48173	____do	Wayne.
Sargent Sand Co	2840 Bay Rd. Saginaw, MI 48608	____do	Mason and Tuscola.
Slag:			
Edward C. Levy Co	8800 Dix Ave. Detroit, MI 48209	Plant	Wayne.
Stone:			
Limestone:			
Drummond Dolomite Inc., Div. of Bethlehem Steel Corp.	701 East 3d St. Bethlehem, PA 18016	Quarry and plant	Chippewa.
The France Stone Co	Box 1928, Toledo Trust Bldg. Toledo, OH 43603	Quarry	Monroe.
Inland Lime and Stone Co., a division of Inland Steel Co.	Gulliver, MI 49840	Quarry and plant	Mackinac and Schoolcraft.
Presque Isle Corp	Box 426 Alpena, MI 49707	Quarry	Presque Isle.
United States Steel Corp., Michigan Limestone Operations.	Rogers City, MI 49779	____do	Mackinac and Presque Isle.
Marl:			
Poehlman & Son	Route 2 Cassopolis, MI 49031	____do	Cass.
Sandstone:			
Jude Stone Quarry Co	338 Austin Rd. Napoleon, MI 49261	____do	Jackson.

[1]Also clay and shale.
[2]Also stone.
[3]Also silver.
[4]Also iron oxide pigments.
[5]Includes bromine, bromine compounds, calcium compounds, iodine, and magnesium compounds.

The Mineral Industry of Minnesota

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Mineral Resources Research Center, University of Minnesota, for collecting information on all nonfuel minerals.

By James H. Aase[1]

The value of nonfuel mineral production in Minnesota for 1980 was $1,782.3 million, a 14% decrease from the alltime high value set in 1979. This decrease was attributed principally to the reduced level of taconite pellet production, reflecting the weakened demand for steel nationally. Closures or production cutbacks at six of the State's eight taconite facilities on the Mesabi Range resulted in output declining to approximately 67% of total combined rated production capacity.

Continuing to lead the Nation in the value of iron ore produced, the State was ranked in the upper 10% among the States in total value of nonfuel mineral output.

Mineral production, consisting of 2 metallic and 7 nonmetallic mineral commodities, was reported from 432 operations in 80 of the State's 87 counties. St. Louis County, the leading county in value of mineral output, accounted for 89% of the State total. Twenty-three counties recorded production valued in excess of $1 million during the year.

Table 1.—Nonfuel mineral production in Minnesota[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ---- thousand short tons	[2]135	[2]$1,905	94	$1,206
Gem stones	NA	5	NA	5
Iron ore (usable) ---- thousand long tons, gross weight	59,682	1,965,710	45,472	1,686,839
Lime ---- thousand short tons	140	5,133	162	3,562
Manganiferous ore ---- short tons	181,503	W	119,029	W
Peat ---- thousand short tons	21	827	25	1,140
Sand and gravel[3] ---- do	30,939	55,427	25,110	49,180
Stone:				
Crushed ---- do	9,751	22,175	8,606	21,731
Dimension ---- do	38	11,543	44	14,189
Combined value of abrasive stone, clays (kaolin, 1979), industrial sand, and values indicated by symbol W ----	XX	5,265	XX	4,458
Total ----	XX	2,067,990	XX	1,782,310

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

[2]Excludes kaolin; value included in "Combined value" figure.

[3]Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Minnesota, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Aitkin	$167	$115	Peat, sand and gravel.
Anoka	W	432	Sand and gravel.
Becker	452	220	Do.
Beltrami	248	299	Do.
Benton	W	161	Do.
Big Stone	1,851	W	Stone, sand and gravel.
Blue Earth	2,551	W	Do.
Brown	W	W	Sand and gravel, clays.
Carlton	W	W	Peat, sand and gravel.
Carver	W	W	Sand and gravel.
Cass	159	903	Do.
Chippewa	455	228	Do.
Chisago	280	270	Do.
Clay	2,260	6,191	Sand and gravel, lime.
Clearwater	100	137	Sand and gravel.
Cook	42	55	Do.
Cottonwood	199	W	Do.
Crow Wing	W	W	Manganiferous ore, sand and gravel.
Dakota	W	4,565	Sand and gravel, stone.
Dodge	616	680	Stone, sand and gravel.
Douglas	651	498	Sand and gravel.
Faribault	W	W	Do.
Fillmore	925	1,505	Stone, sand and gravel.
Freeborn	834	819	Sand and gravel.
Goodhue	627	899	Sand and gravel, stone.
Grant	W	W	Sand and gravel.
Hennepin	8,357	W	Sand and gravel, clays.
Houston	W	759	Stone, sand and gravel.
Hubbard	361	399	Sand and gravel.
Isanti	143	--	
Itasca	148,501	147,353	Iron ore, sand and gravel.
Jackson	--	W	Sand and gravel.
Kanabec	W	153	Do.
Kandiyohi	913	1,056	Do.
Kittson	491	453	Do.
Koochiching	331	378	Do.
Lac qui Parle	469	W	Stone, sand and gravel.
Lake	331	268	Sand and gravel.
Lake of the Woods	78	78	Do.
Le Sueur	W	W	Sand and gravel, stone.
Lincoln	11	11	Sand and gravel.
Lyon	75	W	Do.
McLeod	159	19	Do.
Mahnomen	130	240	Do.
Marshall	397	328	Do.
Meeker	278	335	Do.
Mille Lacs	W	W	Stone, sand and gravel.
Morrison	1,866	403	Sand and gravel.
Mower	1,384	558	Stone, sand and gravel.
Murray	85	27	Sand and gravel.
Nicollet	1,327	1,256	Stone, sand and gravel.
Nobles	W	W	Sand and gravel.
Norman	382	271	Do.
Olmsted	3,208	W	Stone, sand and gravel.
Otter Tail	216	269	Sand and gravel.
Pennington	W	243	Do.
Pine	W	160	Do.
Polk	2,907	3,544	Lime, sand and gravel.
Pope	296	227	Sand and gravel.
Ramsey	W	W	Do.
Red Lake	5	5	Do.
Redwood	W	W	Sand and gravel, clays, stone.
Renville	2,471	2,496	Lime, stone, sand and gravel.
Rice	741	722	Sand and gravel, stone.
Rock	584	W	Sand and gravel, abrasives, stone.
Roseau	5	W	Sand and gravel.
St. Louis	1,483,066	W	Iron ore, sand and gravel, peat, stone.
Scott	3,304	4,456	Stone, sand and gravel.
Sherburne	2,815	2,983	Sand and gravel.
Sibley	W	W	Do.
Stearns	W	W	Stone, sand and gravel.
Steele	W	W	Sand and gravel, stone.
Stevens	W	W	Sand and gravel.
Swift	178	W	Do.
Todd	476	569	Do.
Wabasha	963	798	Stone, sand and gravel.
Wadena	161	10	Sand and gravel.
Waseca	150	W	Do.
Washington	7,808	8,264	Sand and gravel, stone.
Watonwan	31	121	Sand and gravel.
Wilkin	344	158	Do.
Winona	2,162	W	Stone, sand and gravel.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Minnesota, by county[1] —Continued

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Wright	$755	W	Sand and gravel, stone.
Yellow Medicine	W	W	Stone, sand and gravel.
Undistributed[2]	33,598	$1,870,641	
Total[3]	1,724,732	2,067,990	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Martin, Pipestone, and Traverse Counties are not listed because no nonfuel mineral production was reported.
[2]Includes gem stones, 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 Minnesota business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,063.0	2,116.0	+2.6
Unemployment	do	86.0	120.0	+39.5
Employment (nonagricultural):				
Mining	do	17.3	15.5	-10.4
Manufacturing	do	382.0	372.5	-2.5
Contract construction	do	83.2	76.2	-8.4
Transportation and public utilities	do	100.2	100.0	-.2
Wholesale and retail trade	do	443.1	441.2	-.4
Finance, insurance, real estate	do	91.5	94.5	+3.3
Services	do	354.4	368.9	+4.1
Government	do	295.6	301.2	+1.9
Total nonagricultural employment	do	[1]1,767.2	1,770.0	+.2
Personal income:				
Total	millions	$35,507	$38,738	+9.1
Per capita		$8,746	$9,519	+8.8
Construction activity:				
Number of private and public residential units authorized		29,417	21,933	-25.4
Value of nonresidential construction	millions	$756.7	$672.2	-11.2
Value of State road contract awards	do	$202.1	$138.8	-31.3
Shipments of portland and masonry cement to and within the State	thousand short tons	1,772	1,490	-15.9
Nonfuel mineral production value:				
Total crude mineral value	millions	$2,068.0	$1,782.3	-13.8
Value per capita, resident population		$509	$437	-14.2
Value per square mile		$24,599	$21,201	-13.8

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

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

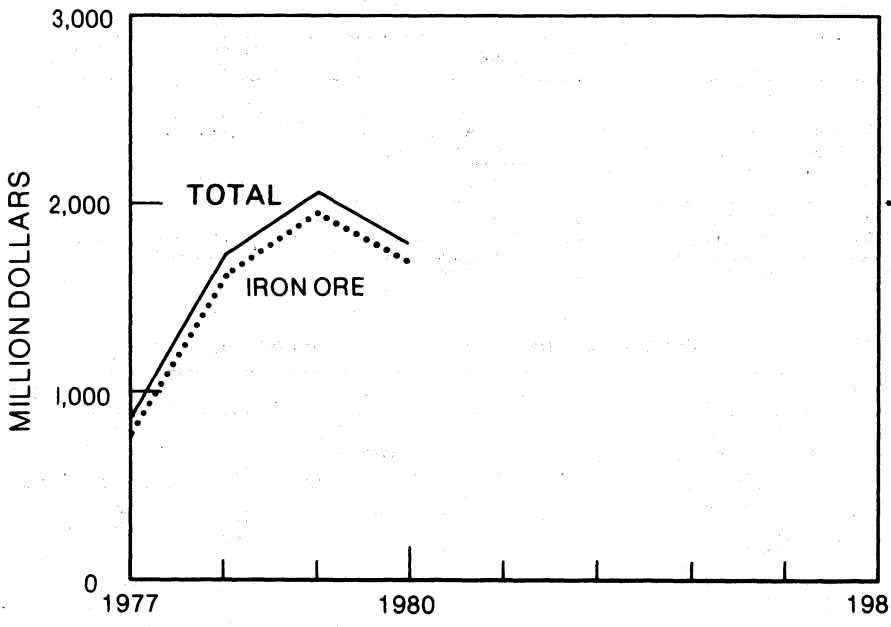

Figure 1.—Value of iron ore shipments and total value of nonfuel mineral production in Minnesota.

Approximately $9 out of every $10 of the State's total mineral value was assignable to the metallic sector, principally iron ore. Leading the nonmetallic commodities was sand and gravel, followed by stone. All mineral commodities in the State, except lime and peat, decreased in output compared with that of 1979. This decline paralleled the nationwide downturn in demand for metallic and industrial minerals by the manufacturing and construction industries.

Near midyear, Reserve Mining Co., Silver Bay, completed and began using its new onland disposal system for taconite tailings.

Copper-nickel mine development activities at the AMAX Exploration, Inc., Minnamax project site near Babbitt remained at a standstill during the year. The company, which had been active in exploration and mining-technique studies in northeastern Minnesota since 1974, originally targeted 1980 for actual mining to begin at the Minnamax site. The company's new projections set 1990 as the earliest date that a commercial operation might be put on-stream. These projections are contingent on future decisions regarding the further commitment of capital expenditures and completion of other activities, including renegotiation with mineral-rights holders of mineral leases due to expire in 1982; further evaluation of the project to determine its economic and environmental feasibility, including the construction and operation of a pilot plant to test milling, smelting, and refining techniques; and preparation of the final engineering plans.

Gold Fields Mining Corp., a subsidiary of Consolidated Gold Fields, Ltd., explored for gold in northeastern Minnesota during the year. A drilling program, consisting of more than a score of holes, was completed at a prospect site near Ely. To date, the State has not had any commercial production of precious metals.

Employment.—Employment in the mining and quarrying industries was marked by monthly fluctuations during most of 1980. These variances in employment significantly reflected the closures, cutbacks, and restarts of taconite pellet production facilities on northeastern Minnesota's Mesabi Range. Statistics published by the Minnesota Department of Economic Security indicated that employment in the mining and quarrying industries ranged from a low

of 13,500 persons in November to a high of 16,100 persons in July. At yearend, employment was at 14,200 compared with 16,400 for the same period the previous year. At yearend 1980, approximately 90% of the total work force was employed in the metal-mining sector, with average hourly earnings of $12.42, a rate 19% above that for the same period a year earlier.

Legislation and Government Programs.—The first State policy for regulating and licensing exploratory mineral borings was enacted into law by the Minnesota Legislature in 1980. Effective May 1, 1980, the new law outlines a procedure for registering exploratory boring sites with the Departments of Health and Natural Resources; grants the Commissioners of Health and Natural Resources, the Director of the Pollution Control Agency, and the county health officer access to the boring sites; prescribes regulation for temporary and permanent abandonment of exploratory borings; and establishes a procedure by which the Commissioner of Natural Resources may determine what information about the exploratory borings may be made public. The new law, designed to offer assurances to landowners and area residents near the exploratory sites who are concerned about their water quality, establishes safeguards and permits State agencies to monitor the boring sites.

Under an omnibus tax bill, another enactment allows counties to impose a production tax on gravel for sale from gravel pits and sets the maximum amount of the tax at 10 cents per cubic yard. The monies derived from the tax are to be distributed 60% to the county road and bridge fund, 30% to the town road and bridge fund, and 10% to a special reserve fund for restoring abandoned gravel pits on county or tax-forfeited land. The measure became effective June 30, 1980.

The State's Iron Range Resources & Rehabilitation Board provided funding to the Mineral Resources Research Center of the University of Minnesota to evaluate Minnesota's Cuyuna Range as a national strategic manganese resource site. The project was prompted in part by a 1976 National Academy of Sciences study of manganese recovery technology that identified the Cuyuna Range as a major domestic resource site for development under proper economic conditions.

Maps showing the surface ownership and Federal mineral rights on seven 2,000-square-mile areas in the northern part of the State were published by the U.S. Department of the Interior, Bureau of Land Management (BLM), during the year. These maps, in addition to the 15 others BLM completed in 1979, ended a program of map coverage for areas of mineral interest in northeastern and north-central Minnesota.

The Minnesota Geological Survey continued its program of investigating the State's mineral resources and its underlying geology. Included among the projects in progress, or completed during the year, were the following: A study of manganese resources on the Cuyuna Range; an appraisal of catlinite (pipestone) resources in the Pipestone National Monument; preparation of high-resolution aeromagnetic maps covering a five-county area in northeastern Minnesota and also along nine profiles extending between Park Rapids and Mountain Lake in west-central Minnesota; and completion of a number of geologic mapping projects done in connection with an evaluation of the State's peat resources, Paleozoic aquifers in southeastern Minnesota, and Precambrian bedrock maps covering the International Falls and Roseau areas.

Minnesota's Department of Natural Resources, Division of Minerals, continued its responsibility for providing management of 10 million acres of State-owned trust fund and tax-forfeited mineral rights during the year. Additional management activities included mineland reclamation and explorer registration, mineral leasing, evaluation of mineral potential in selected areas, inventory of peat resources, data input in land-use decisions, and development and implementation of mineland reclamation rules.

During the year, the Bureau of Mines was engaged in a broad spectrum of activities related to the State's mineral resource and mining activities, including evaluation of mine parameters for copper-nickel deposits,[2] estimation and evaluation of Mesabi Range iron ore reserves,[3] the use of plants to stabilize copper-nickel ore-processing waste in northern Minnesota, and beneficiation testing of Mesabi Range hematitic-goethitic taconite.[4]

Personnel at the Twin Cities Research Center of the Federal Bureau of Mines, in cooperation with a host of private companies and the Department of Energy, conducted research on producing low-British-thermal-unit gas from coal and testing its potential as a primary fuel in pellet induration.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Iron Ore.—The downturn in the national economy and the reduced demand for steel products during the year resulted in a 24% decline in the State's iron ore production. Accompanying the decline were reduced work schedules and layoffs at most of the State's iron ore mining operations, severely impacting the local economies. Preliminary figures released by the Lake Superior Industrial Bureau showed that wages to the State's iron ore industry in 1980 fell approximately 11%, or $45 million, from those of 1979. Similarly, monies reportedly paid for goods and services declined 15%, or $108 million, during the year, compared with those of 1979.

As the Nation's leader in iron ore production, Minnesota supplied approximately two-thirds of the total usable iron ore shipped from all mines in the United States during the year. The State's shipments came from 20 open pit mines or mine groups operated by 10 companies on the Mesabi Range in Itasca and St. Louis Counties.

Near yearend, the Cleveland-Cliffs Iron Co. announced plans to terminate operations at the Canisteo Mine near Coleraine. The Canisteo Mine, which began production of natural ore 73 years ago, has had an annual output of approximately 800,000 tons. During its lifetime, the mine produced in excess of 53 million tons of ore.

Table 4.—Minnesota: Iron ore[1] data in 1980, by county

(Thousand long tons)

County	Crude ore production[2]	Usable ore				
		Stocks, Jan. 1	Production	Iron content of production	Shipments	Stocks, Dec. 31
Itasca	10,617	W	3,525	2,170	3,414	W
St. Louis[3]	134,863	W	41,637	26,461	42,059	W
Total[4]	145,479	4,815	45,162	28,631	45,472	4,504

W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Exclusive of ore containing 5% or more manganese.
[2]Entire production from Mesabi Range open pit mines.
[3]Includes Lake County.
[4]Data may not add to totals shown because of independent rounding.

Table 5.—Minnesota: Production and shipments of usable iron ore[1]

(Thousand long tons)

Year	Production				Shipments			
	Natural ore and concentrates	Pellets	Total	Iron content (percent)	Natural ore and concentrates	Pellets	Total	Proportion of pellets to total ore (percent)
1976	9,152	40,612	49,764	61.3	8,806	39,068	47,874	81.6
1977	4,600	26,343	30,943	61.9	5,123	25,122	30,245	83.1
1978	5,829	49,487	55,316	62.4	5,445	51,029	[2]56,473	90.3
1979	4,028	55,292	59,320	62.8	3,626	56,056	59,682	93.9
1980	2,050	43,112	45,162	63.4	2,371	43,101	45,472	94.8

[1]Exclusive of ore containing 5% or more manganese.
[2]Data do not add to total shown because of independent rounding.

At Reserve Mining Co.'s Silver Bay plant, the new onland taconite-tailings disposal system transported tailings in a water slurry approximately 5 miles to a 5.8-square-mile interior basin designed to hold more than 800 million tons of tailings. Completing the $370 million project made it possible, for the first time since the company began operations in 1955, to terminate discharging tailings into Lake Superior and to comply with a Federal court order directing a halt to tailings discharges into the lake by

April 15, 1980.

Two new 1,000-foot-long, self-unloading supercarriers were added to the Great Lakes ore carrier fleet in 1980, bringing the total number of such vessels in service to 10. The new vessels, named *Edgar B. Speer* and *Burns Harbor*, are owned by United States Steel Corp. and Bethlehem Steel Corp., respectively, and each is capable of carrying more than 60,000 gross tons of iron ore pellets.

Combined rail and lake freight rates, excluding storage and dock-handling charges, for transporting iron ore from the Mesabi Range to lower lake ports ranged from $9.61 to $10.72 per gross ton at mid-year, compared with a range of $8.18 to $8.91 per gross ton in mid-1979.

Published prices for most classifications of Lake Superior iron ore advanced slightly during the year. Prices in effect at yearend follow: Mesabi Nonbessemer, $28.50 per gross ton; Old Range Nonbessemer, $28.75 per gross ton; and manganiferous, $24.85 per gross ton. Price quotations, reflecting ore delivered at rail-of-vessel at lower Lake ports, are based on a natural iron content of 51.50%. The lower Lake port price for pellets was 73.66 cents per long ton unit. Minnesota iron ore shipped in 1980 had an average weighted mine value of $37.10 per gross ton, compared with $32.94 per gross ton in 1979.

Table 6.—Dates of first and final cargoes of Minnesota iron ore shipped from Upper Great Lakes ports

Port and dock	1979			1980		
	First shipment	Final shipment	Total tonnage (thousand long tons)	First shipment	Final shipment	Total tonnage (thousand long tons)
Duluth, Minn.: DM&IR	Apr. 15	Dec. 27	15,039	Mar. 30	Dec. 22	13,263
Silver Bay, Minn.: Reserve	Apr. 21	Dec. 20	8,267	Apr. 3	Dec. 16	4,399
Superior, Wis.: Burlington-Northern	Apr. 19	Dec. 30	13,675	Apr. 3	Dec. 25	10,146
Taconite Harbor, Minn.: Erie	Apr. 20	Dec. 22	9,467	Apr. 15	Dec. 28	6,097
Two Harbors, Minn.: DM&IR	[1]	[2]Jan. 14	11,124	Apr. 2	Dec. 30	10,010
Total			57,572			43,915

[1]Vessel loadings at the Duluth, Missabe & Iron Range Railway (DM&IR) docks at Two Harbors continued without interruption during the 1977-79 shipping seasons.
[2]1980.

Sources: American Iron Ore Association and various issues of Skillings' Mining Review.

Manganiferous Ore.—Shipments of manganiferous ore (containing 5% to 35% manganese, natural) were down 34% in 1980 compared with those of 1979. The State's entire output came from the Algoma-Zeno Mine, on the Cuyuna Range near Ironton in Crow Wing County, operated by the Pittsburgh Pacific Co. All ore shipped was derived from processing stockpiled crude material mined in previous years.

Table 7.—Minnesota: Shipments of manganiferous ore[1] from the Cuyuna Range

Year	Ferruginous manganese ore (10% to 35% Mn, natural)		
	Quantity (long tons)	Contents (natural)	
		Fe (percent)	Mn (percent)
1976	180,599	27.00	12.80
1977	148,607	29.17	13.39
1978	226,249	28.22	12.98
1979	162,056	28.82	14.09
1980	106,276	32.00	14.04

[1]All manganiferous ore shipped from the Cuyuna Range during 1976-80 was ferruginous manganese ore containing 10% to 35% manganese. There have been no shipments of manganiferous iron ore containing 5% to 10% manganese since 1969.

NONMETALS

Abrasive Stone.—Quartzite was quarried at a site near Jasper in Rock County by the Jasper Stone Co. The company used the material in fabricating grinding cubes and mill-liner blocks. The product was used extensively by industrial processing plants for grinding a variety of mineral materials and was marketed both domestically and abroad.

Clays.—Common clay and shale were produced by Ochs Brick & Tile Co., near Springfield in Brown County, and by Aglite, Inc., near Minneapolis in Hennepin County.

The kaolin clay mining operation of Ochs Brick & Tile Co. in Redwood County, which has been active in recent years, was closed throughout 1980.

Common clay and shale production decreased approximately 30% in quantity and 37% in value compared with that of 1979. Most of the clay output was consumed in manufacturing face brick and lightweight aggregate for use in concrete products.

Lime.—Lime was produced by American Crystal Sugar Co. and by Southern Minnesota Sugar Coop. American Crystal Sugar's production was from plants at Moorhead in Clay County, and at Crookston and East Grand Forks in Polk County. Southern Minnesota Sugar's plant was at Renville in Renville County. The high-quality lime rock used in manufacturing the lime was obtained from out-of-State sources. All of the lime produced was consumed by the companies in their sugar-refining operations at these same locations.

Approximately 271,000 tons of domestically produced lime was consumed in Minnesota during the year.

Peat.—Three companies harvested reed-sedge and sphagnum-type peat from bogs in Aitkin, Carlton, and St. Louis Counties. The quantity and total value of the 1980 output increased over those of 1979. Principal use of the peat sold was for general soil improvement and other horticultural purposes; the bulk of this output was marketed in packaged form.

Approximately 21,400 acres of peat bogs on Federal lands in Koochiching County were the subject of a BLM wilderness review in 1979. Early in 1980, BLM decided to drop these lands from further wilderness consideration because they lacked in outstanding opportunities for solitude and recreation and in naturalness characteristics.

The Minnesota Department of Natural Resources, Minerals Division, continued studying the peatland environment, utilization alternatives, reclamation potential, and socioeconomic topics. Findings and recommendations based on these studies will be presented in a final report to the legislature early in 1981.

A proposal by the Minnesota Gas Co. to study the possibility of building a peat gasification plant in Minnesota was awarded funding by the U.S. Department of Energy. The company's $4 million plan calls for a 19-month study to assess the feasibility of designing, constructing, and operating a facility to produce synthetic natural gas from peat. The company began preliminary research on the peat project in 1975.

Duluth served as host city to more than 500 delegates from 30 nations for the 6th International Peat Congress in August. It was the first time that the Congress, which was first held in 1954, met in the United States. The session included the presentation of 165 papers on soil classification of peat bogs, peat as an energy and agricultural resource, and environmental considerations of utilizing peat resources. Post-Congress tours were arranged to a number of U.S. and Canadian peat operations and natural peatlands.

Perlite (Expanded).—The Conwed Corp. processed crude perlite mined out of State at its plant near Cloquet in Carlton County. The expanded product was used principally in manufacturing acoustic tile.

Sand and Gravel.—The quantity of sand and gravel produced in Minnesota during the year was at its lowest level of the past 2-1/2 decades. Compared with that of 1979, output decreased 19% in quantity, with attendant values decreasing 11%. The average unit value of 1980 construction sand and gravel was $1.96 per ton, the highest level on record.

With approximately 300 pits being worked by more than 250 companies and government agencies, sand and gravel operations represented the most widespread mining activity in the State, with production reported from all but 9 of Minnesota's 87 counties during the year. Nationwide, the State was ranked eighth in quantity of sand and gravel produced during 1980.

Industrial sand for glassmaking, hydraulic fracturing, foundry use, and fillers was produced by UNIMIN Corp. and by Twin City Silica, Inc., in Le Sueur and Washing-

ton Counties, respectively.

Although Minnesota has had an adequate supply of aggregates for road and construction purposes, the availability of sand and gravel and other industrial minerals is becoming a critical problem in certain areas. The Division of Minerals, Minnesota Department of Natural Resources, outlined in its 1980 biennial report that urban development continues to encroach upon valuable sand and gravel deposits without regard to the impacts on economic development, especially in the metropolitan areas. Zoning by local government is gradually eliminating historic, commercial gravel operations and precluding the future mining of essential gravel resources. At the request of the State legislature, the Department of Natural Resources recently published a report giving a general overview on the availability and quantity of aggregates, the aggregate industry, and local zoning regulations.[5]

Minnesota's Jordan Sandstone Formation has been receiving increased attention as an important source of industrial sand for use by the oil industry in a process known as hydrofracturing, used to increase oil well production. Hydrofracturing sand requires a high percentage of 20- to 40-mesh silica granules such as those found in the Jordan Sandstone Formation deposits along the Minnesota River Valley in the southern part of the State. Once the necessary permits are acquired, the UNIMIN Corp., a Connecticut-based firm, plans to mine these unique sands from a 627-acre section of land it owns southwest of Kasota in Le Sueur County. The company estimates its deposits contain up to 20 million tons of sand from which it intends to produce up to 500,000 tons of processed sand annually for the oil industry.

Interest in mining silica sand was also expressed by the J. L. Shiely Co. which obtained a conditional use permit in mid-1980. The permit authorizes the company to produce hydrafrac and other specialty use sands from a 190-acre site north of Jordan in Scott County. Plant construction and site preparation were underway by yearend. The $6.6 million project is to be completed in late summer of 1981. Production is planned to be at the rate of 100,000 tons of salable product the first year, 200,000 tons the second year, and 300,000 tons the third year and succeeding years. Estimated life of the operation is 15 to 25 years.

Table 8.—Minnesota: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete	9,802	$21,172	$2.16	7,758	$18,327	$2.36
Plaster and gunite sands	295	782	2.65	211	571	2.71
Concrete products	2,141	4,598	2.15	1,981	4,539	2.29
Asphaltic concrete	5,291	8,652	1.64	3,892	7,202	1.85
Road base and coverings	8,452	13,939	1.65	7,294	12,284	1.68
Fill	4,117	4,575	1.11	2,601	3,197	1.23
Snow and ice control	257	424	1.65	307	434	1.41
Railroad ballast	9	35	3.90	37	99	2.66
Other	575	1,251	2.17	1,031	2,528	2.45
Total[1] or average	30,939	55,427	1.79	25,110	49,180	1.96

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

Table 9.—Minnesota: Sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	11,046	$18,491	$1.67	9,609	$17,271	$1.80
Gravel	19,893	36,936	1.86	15,501	31,909	2.06
Total or average	30,939	55,427	1.79	25,110	49,180	1.96
Industrial sand	W	W	W	W	W	7.91
Grand total or average	W	W	W	W	W	2.03

W Withheld to avoid disclosing company proprietary data.

Table 10.—Minnesota: Construction sand and gravel sold or used by producers, by county[1]

County	1979			1980		
	Number of mines	Quantity (thousand short tons)	Value (thousands)	Number of mines	Quantity (thousand short tons)	Value (thousands)
Aitkin	3	24	$35	--	--	--
Anoka	1	W	432	1	W	W
Becker	4	110	220	3	65	$143
Beltrami	4	150	299	2	W	135
Benton	3	98	161	2	W	W
Brown	3	469	798	3	400	446
Carlton	6	229	346	4	77	102
Cass	4	216	903	3	305	751
Chippewa	4	163	228	4	121	172
Chisago	3	170	270	5	233	336
Clay	12	3,440	5,329	14	1,445	2,582
Clearwater	3	70	137	2	W	W
Cook	2	W	55	2	W	47
Cottonwood	2	W	W	3	191	399
Crow Wing	9	297	652	3	156	349
Dakota	10	1,948	3,787	12	3,161	6,074
Douglas	5	231	498	4	147	413
Fillmore	3	122	192	2	W	W
Freeborn	8	480	819	7	322	625
Goodhue	6	408	582	6	254	399
Hennepin	18	4,320	6,968	15	3,185	6,046
Hubbard	5	146	399	3	97	333
Itasca	5	633	1,424	4	599	1,441
Kanabec	4	121	153	3	110	117
Kandiyohi	4	508	1,056	2	W	W
Kittson	4	279	453	2	W	W
Koochiching	8	213	378	8	212	346
Lac qui Parle	1	41	W	1	32	W
Lake	3	175	268	2	W	W
Lake of the Woods	1	52	78	--	--	--
Lincoln	1	7	11	--	--	--
McLeod	2	13	19	2	W	W
Mahnomen	2	129	240	2	100	208
Marshall	6	242	328	6	154	255
Meeker	3	249	335	3	168	255
Mille Lacs	3	150	320	3	174	426
Morrison	5	229	403	3	134	278
Mower	3	97	247	3	64	75
Murray	5	26	27	5	64	68
Norman	4	217	271	3	188	244
Olmsted	3	478	991	4	354	595
Otter Tail	8	209	269	8	265	460
Pennington	2	144	243	1	W	79
Pine	3	67	160	1	W	W
Polk	8	473	742	5	510	825
Pope	3	114	227	3	108	216
Red Lake	1	3	5	--	--	--
Redwood	3	98	148	2	W	W
Rice	6	467	641	4	389	543
Roseau	2	W	W	1	70	70
St. Louis	23	1,101	2,440	21	589	1,557
Scott	3	465	717	2	W	W
Sherburne	9	1,449	2,983	9	1,034	2,440
Stearns	5	165	295	4	124	251
Steele	5	404	696	4	326	685
Swift	1	128	W	1	114	115
Todd	9	325	569	9	266	517
Wabasha	3	181	344	2	115	333
Wadena	1	8	10	1	99	99
Watonwan	3	67	121	3	52	105
Wilkin	3	128	158	3	W	W
Winona	4	334	967	5	314	809
Wright	7	350	685	5	180	622
Yellow Medicine	3	W	W	3	81	135
Undistributed[2]	r46	7,311	12,894	41	7,962	15,659
Total[3]	346	30,939	55,427	294	25,110	49,180

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1]Isanti, Martin, Pipestone, and Traverse Counties are not listed because no production was reported.

[2]Includes Big Stone (1979), Blue Earth, Carver, Dodge, Faribault, Grant, Houston, Jackson, Le Sueur, Lyon, Nicollet, Nobles, Ramsey, Renville, Rock, Sibley, Stevens, Waseca, and Washington Counties, sand and gravel that cannot be assigned to specific counties, and data indicated by symbol W.

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

Stone.—During 1980, stone production, consisting of granite, limestone, quartzite, and traprock, came from 105 quarry sites, operated by 38 firms in 25 counties. Combined output for all types of crushed and dimension stone decreased 12% in quantity and rose 7% in attendant value compared with that of 1979. The average unit value of all types of crushed stone and dimension stone produced in 1980 reached an alltime high of $2.53 per ton and $319.12 per ton, respectively.

Nationally, Minnesota was ranked 32d in terms of value among the 48 States reporting crushed stone production and 4th among the 38 States having dimension stone output in 1980.

Crushed limestone was produced at 85 quarry sites in 14 counties in the south-central and southeastern sections of the State. Leading in production was Washington County, followed by Scott and Olmsted Counties, respectively. The most extensive use of the crushed material was as a dense-graded roadbase material, and, secondly, as concrete aggregate. Output of crushed limestone decreased 18% in quantity and 7% in value compared with that of 1979.

Four quarries in Blue Earth, Le Sueur, and Winona Counties yielded dimension limestone, marketed most extensively as house stone veneer and cut stone. Output increased in both quantity and value at 5% and 22%, respectively, over that of 1979.

Six companies quarried granite at 14 quarry sites in 7 counties in central Minnesota and in the Upper Minnesota River Valley of west-central Minnesota. Output of dimension granite, used most extensively for monuments, increased 21% in quantity and 23% in value compared with that of 1979.

Crushed granite production increased 6% in quantity and 11% in value compared with that of 1979. Approximately 80% of the crushed material was marketed for use as railroad ballast, with the remainder for various road aggregates, poultry grit, and other uses.

Jasper Stone Co. produced quartzite at its quarry in Rock County, with output mainly for its own use in manufacturing grinding pebbles and tube-mill liners. In Nicollet County, New Ulm Quartzite Quarries, Inc., produced crushed material used most extensively as an aggregate in concrete and bituminous mixtures and as riprap. Total quartzite output decreased approximately 6% in both quantity and value below that of 1979.

Traprock was quarried at Duluth in St. Louis County by Arrowhead Blacktop Co. Output was down slightly in quantity and value from that of 1979. The crushed material was used for bituminous aggregate, dense-graded roadbase material, riprap, and railroad ballast.

Sulfur (Recovered Elemental).—Sulfur was recovered as a byproduct of the petroleum-refining operations of Koch Refining Co., a division of Koch Industries, Inc., near Pine Bend in Dakota County; and Northwestern Refining Co., a division of Ashland Oil Co., Inc., near St. Paul Park in Washington County. Shipments decreased in quantity but increased in total value compared with those of 1979.

Table 11.—Minnesota: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	383	959	527	1,411
Concrete aggregate (coarse)	740	1,955	720	1,988
Bituminous aggregate	459	1,129	425	1,099
Macadam aggregate	137	336	W	530
Dense-graded roadbase stone	3,074	6,199	2,640	5,873
Surface treatment aggregate	514	881	507	1,264
Other construction aggregate and roadstone	1,807	4,270	819	2,295
Riprap and jetty stone	100	322	153	509
Railroad ballast	2,000	4,850	2,216	5,449
Filter stone	11	27	22	90
Lime manufacture	--	--	5	19
Asphalt filler	117	519	W	W
Other[2]	409	728	571	1,206
Total[3]	9,751	22,175	8,606	21,731

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

[1]Includes granite, limestone, quartzite, and traprock.

[2]Includes stone used for poultry grit and mineral food, terrazzo and exposed aggregate, fill (1979), other miscellaneous uses, and uses indicated by symbol W.

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

Table 12.—Minnesota: Dimension stone[1] sold or used by producers, by use

Use	1979			1980		
	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)
Rough stone:						
Other rough stone	r1,794	r22	r$32	1,766	22	$34
Dressed stone:						
Cut stone	16,834	204	6,726	19,916	241	8,203
Sawed stone	W	W	W	704	9	154
House stone veneer	4,066	51	400	4,011	50	421
Monumental	W	W	W	12,234	147	4,869
Other[2]	r15,752	r181	r4,385	5,833	65	509
Total	38,446	458	11,543	44,464	534	[3]14,189

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes granite, limestone, and quartzite.
[2]Includes stone used for rough blocks, rubble, rough monumental, rough and dressed flagging, other miscellaneous uses, and uses indicated by symbol W.
[3]Data do not add to total shown because of independent rounding.

Table 13.—Minnesota: Crushed limestone sold or used by producers, by county

County	1979			1980		
	Number of quarries	Quantity (thousand short tons)	Value (thousands)	Number of quarries	Quantity (thousand short tons)	Value (thousands)
Blue Earth	2	W	W	3	478	1,158
Dakota	3	323	778	2	292	739
Fillmore	6	436	1,313	10	402	1,205
Goodhue	7	171	317	7	161	322
Mower	1	173	311	1	82	159
Olmsted	7	W	W	11	673	1,564
Rice	1	50	81	1	43	76
Scott	4	1,953	3,739	4	1,090	2,653
Wabasha	8	267	454	8	182	408
Washington	4	1,247	2,736	5	1,192	2,766
Winona	16	405	886	14	398	912
Wright	1	22	W	--	--	--
Undistributed[1]	r16	2,021	4,715	19	804	2,351
Total	76	7,068	15,330	85	5,797	[2]14,314

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes Dodge, Houston, and Steele Counties and data indicated by symbol W.
[2]Data do not add to total shown because of independent rounding.

Vermiculite.—Crude vermiculite mined out of State was exfoliated by two companies at plants in Hennepin County. Approximately 86% of the expanded product was used for loose fill and block insulation; the remainder was used for concrete and plaster aggregate and horticultural purposes. Sales increased in both quantity and value over those of 1979.

[1]State mineral specialist, Bureau of Mines, Minneapolis, Minn.

[2]Christianson, M., D. L. Peterson, and C. M. St. John. Evaluation of Mine Parameters for Copper-Nickel Deposits of Northern Minnesota. BuMines Open File Rept. 10-80, 1980, 112 pp.

[3]Marsden, R. W. Estimation and Evaluation of the Iron Ore Reserves of the United States—A Partial Survey 1974-75. Iron Ore Reserves of the Mesabi Range, Minn. BuMines Open File Rept. 109-80, 1980, 81 pp.

[4]Colombo, A. F., and H. D. Jacobs. Selective Flocculation and Flotation of a Mesabi Range Hematitic-Goethitic Taconite. BuMines RI 8482, 1980, 11 pp.

[5]Eng, M. T., and M. J. Costello. Industrial Minerals in Minnesota: A Status Report on Sand, Gravel, and Crushed Rock. Minnesota Dept. of Natural Resources, Div. of Minerals, Sept. 1979, 75 pp.

Table 14.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasive stone:			
Jasper Stone Co	14575 Garden Rd. Golden, CO 80401	Quarry and plant	Rock.
Clay and shale:			
Aglite, Inc	4901 West Medicine Lake Dr. Minneapolis, MN 55442	Pit and plant	Hennepin.
Ochs Brick & Tile Co	Box 106 Springfield, MN 56087	do	Brown.
Iron ore:			
Cleveland-Cliffs Iron Co.:			
Canisteo.	1460 Union Commerce Bldg. Cleveland, OH 44115	Mine and concentrator.	Itasca.
The Hanna Mining Co.:	100 Erieview Plaza Cleveland, OH 44114		
Butler Taconite Project		Mine, concentrator, agglomerator.	Do.
National Steel Pellet Project		do	Itasca and St. Louis.
Whitney		Stockpile shipments	St. Louis.
Inland Steel Mining Co.: Minorca	30 West Monroe St. Chicago, IL 60603	Mine, concentrator, agglomerator.	Do.
Jones & Laughlin Steel Corp. Northwest Ore Div.:	Virginia, MN 55792		
McKinley		Mine and concentrator.	Do.
Oglebay-Norton Co.:	1200 Hanna Bldg. Cleveland, OH 44115		
Thunderbird		Mine	Do.
Fairlane plant		Concentrator and agglomerator.	Do.
Pickands Mather & Co.:	1100 Superior Ave. Cleveland, OH 44114		
Erie Commercial		Mine, concentrator, agglomerator.	Do.
Hibbing Taconite		do	Do.
Pittsburgh Pacific Co.:	2521 1st Ave. Hibbing, MN 55746		
Connie, Embarrass, Rouchleau, Wyoming.		Stockpile shipments	Do.
Reserve Mining Co.:	Silver Bay, MN 55614		
Peter Mitchell		Mine and primary crusher.	Do.
Silver Bay plant		Concentrator and agglomerator.	Lake.
Rhude & Fryberger, Inc.:	Box 66 Hibbing, MN 55746		
Rana		Mine and concentrator.	St. Louis.
Gross-Nelson, Leonidas, Sharon-Culver.		Stockpile shipments	Do.
United States Steel Corp. Minnesota Ore Operations:	Box 417 Mountain Iron, MN 55768		
Minntac		Mine, concentrator, agglomerator.	Do.
Plummer Group		Mine and concentrator.	Itasca.
Sherman Group		Stockpile shipments	St. Louis.
Lime:			
American Crystal Sugar Co	101 North 3d St. Moorhead, MN 56560	Quicklime, shaft kilns.	Clay, Polk, Renville.
Southern Minnesota Sugar Coop	Box 500 Renville, MN 56560	do	Renville.
Manganiferous ore:			
Pittsburgh Pacific Co.:	2521 1st Ave. Hibbing, MN 55746		
Algoma-Zeno		Mine and concentrator.	Crow Wing.
Peat:			
Michigan Peat	Box 3006 Houston, TX 77001	Bog, processing plant.	Carlton.
Northern Peat Co	Box 416 Grand Rapids, MN 55744	do	Aitkin.
Power-O-Peat Co	Box 956 Gilbert, MN 55741	do	St. Louis.
Perlite, expanded:			
Conwed Corp	332 Minnesota St. St. Paul, MN 55110	Plant	Carlton.
Sand and gravel:			
Ames Sand & Gravel, Inc	Box 2702 Fargo, ND 58102	Pits and plants	Clay.
Arsenal Sand & Gravel Co	Box 2707 New Brighton, MN 55112	Pit and plant	Ramsey.
Barton Contracting Co	10300 89th Ave. North Osseo, MN 55369	Pits and plants	Dakota, Hennepin, Sherburne, Washington, Wright.

Table 14.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel —Continued			
Cemstone Products Co	1520 Minnehaha Ave. St. Paul, MN 55106	Pit and plant	Washington.
Duininck Bros. & Gilchrist	Prinsburg, MN 56281	Pits and plants	Kandiyohi and Renville.
Fischer Sand & Aggregate, Inc	6801 West 150th St. Apple Valley, MN 55124	do	Dakota.
H & S Asphalt Co	700 Industry Ave. NW. Anoka, MN 55303	do	Anoka and Sherburne.
Komatz Construction, Inc	Box 498 St. Peter, MN 56082	Pit and plant	Le Sueur.
Kost Bros, Inc	Box 499 Moorhead, MN 56560	Pits and plants	Clay and Otter Tail.
C. S. McCrossan, Inc	Box 322 Osseo, MN 55369	Pit and plant	Hennepin.
William Mueller & Sons Co	Hamburg, MN 55339	Pits and plants	Carver, McLeod, Sibley.
North Star Concrete Co	Box 167 Mankato, MN 56001	do	Le Sueur and Nicollet.
Northwestern Aggregates, Inc., a division of Model Stone Co.	Box 1248 Burnsville, MN 55337	Pit and plant	Dakota.
J. L. Shiely Co	1101 North Snelling Ave. St. Paul, MN 55108	do	Washington.
UNIMIN Corp	Greenwich Office Park 4 Greenwich, CT 06830	Pit and plant; industrial sand.	Le Sueur.
Stone:			
Granite:			
Cold Spring Granite Co	Cold Spring, MN 56320	Quarries	Big Stone, Mille Lacs, Renville.
Do		Quarries and plant	Stearns.
The Green Co., Inc	200 14th Ave. Granite Falls, MN 56241	Quarry and plant	Yellow Medicine.
Ortonville Stone Co., a subsidiary of L. G. Everist.	Box 829 Sioux Falls, SD 57102	do	Big Stone.
J. L. Shiely Co	1101 North Snelling Ave. St. Paul, MN 55108	do	Stearns.
Limestone:			
Bryan Rock Products, Inc	Box 215 Shakopee, MN 55379	Quarries and plants	Scott and Washington.
Hector Construction Co	Box 410 Caledonia, MN 55921	do	Houston and Winona.
Edward Kraemer & Sons, Inc	1000 West 122d St. Burnsville, MN 55378	Quarry and plant	Dakota.
Lundin Construction Co., Inc	1905 3d Ave. Mankato, MN 56001	Quarries and plants	Blue Earth and Steele.
Mankato Aglime & Rock Co	Box 254 Mankato, MN 56001	Quarry and plant	Blue Earth.
Mankato Stone Center, a division of the Babcock Co.	Box 3088 Mankato, MN 56001	do	Do.
Mathy Construction Co., Patterson Quarries Div.	Route 3, Box 15 St. Charles, MN 55972	Quarries and plants	Olmsted, Wabasha, Winona.
Midwest Asphalt Corp., River Warren Aggregates, Inc.	Box 122 Chaska, MN 55318	Quarry and plant	Scott.
Quarve & Anderson Co	2430 Marion Rd. SE. Rochester, MN 55901	Quarries and plants	Dodge, Fillmore, Goodhue, Olmsted, Wabasha, Winona.
Roverud Construction, Inc	159 West Main St. Spring Grove, MN 55974	do	Fillmore and Houston.
J. L. Shiely Co	1101 North Snelling Ave. St. Paul, MN 55108	do	Scott and Washington.
Stussy Construction, Inc	Box 187 Mantorville, MN 55955	do	Dodge.
Vetter Stone Co	Route 5 Mankato, MN 56001	do	Blue Earth and Le Sueur.
Quartzite:			
New Ulm Quartzite Quarries, Inc.	Route 3, Box 21 New Ulm, MN 56073	Quarry and plant	Nicollet.
Traprock (basalt):			
Arrowhead Blacktop Co	Box 6568 Duluth, MN 55806	do	St. Louis.
Sulfur, recovered elemental:			
Koch Refining Co., a division of Koch Industries, Inc.	Box 2302 Wichita, KS 67201	Elemental sulfur recovered as a by-product of oil refining.	Dakota.
Northwestern Refining Co., a division of Ashland Oil, Inc.	Drawer 9 St. Paul Park, MN 55071	do	Washington.

Table 14.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Vermiculite, exfoliated:			
W. R. Grace & Co., Construction Products Div.	62 Whittemore Ave. Cambridge, MA 02140	Processing plant	Hennepin.
P & H, Inc	459 Harding St. NE. Minneapolis, MN 55413	do	Do.

The Mineral Industry of Mississippi

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Bureau of Geology and Energy Resources, Mississippi Department of Natural Resources, for collecting information on all nonfuel minerals.

By James R. Boyle[1] and Alvin R. Bicker[2]

The value of Mississippi's nonfuel mineral production in 1980 was $104 million, a decrease of 3.5% from that of 1979. In 1980, Mississippi ranked second nationally in the production of recovered sulfur; third in bentonite and fuller's earth; and fifth in the recovery of magnesium compounds from seawater. Most of the nonfuel minerals produced in Mississippi are utilized in the construction and automotive industries, and the economic slowdown, which continued from 1979, adversely affected the demand for much of the State's mineral output. A higher unit price for all commodities caused the total value to approach that of 1979; however, this rise did not keep pace with inflation. The overall inflationary trend of the seventies was evident by comparison of 1980 mineral production and value with that of 1970. Tonnages of the various commodities in 1980 increased from 5% to 30%, while the total value increased 251%.

Trends and Developments.—During the year, titanium dioxide pigment capacity at Kerr-McGee Chemical Corp.'s Hamilton plant, which uses the chloride process, increased from 50,000 to 56,000 short tons per year. Improved processing techniques and equipment modifications led to this higher capacity.

Crushed stone producers in northeast Mississippi were operating at capacity to meet the demands of the Tennessee-Tombigbee Waterway. Construction on the 232-mile waterway, which is over 50% complete, began in 1972. During 1980, navigation opened on the southern portion; full

Table 1.—Nonfuel mineral production in Mississippi[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	1,820	$21,841	1,596	$21,714
Lime	do	70	1,571	31	707
Sand and gravel[2]	do	16,940	37,797	11,710	31,606
Combined value of cement, magnesium compounds, sand and gravel (industrial), and stone (crushed)		XX	46,480	XX	49,913
Total		XX	107,689	XX	103,940

XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Mississippi, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Adams	W	W	Sand and gravel.
Benton	W	W	Clays.
Bolivar	$230	$229	Sand and gravel.
Carroll	W	W	Sand and gravel, clays.
Chickasaw	73	119	Stone.
Clay	W	W	Stone, sand and gravel.
Copiah	5,407	6,403	Sand and gravel.
De Soto	1,826	2,445	Do.
Forrest	W	W	Do.
George	61	60	Do.
Grenada	W	W	Do.
Hancock	569	W	Do.
Harrison	180	134	Do.
Hinds	W	W	Clays, sand and gravel.
Holmes	2,305	2,065	Sand and gravel.
Itawamba	W	W	Sand and gravel, clays.
Jackson	W	W	Magnesium compounds, lime.
Jefferson Davis	40	W	Sand and gravel.
Jones	W	W	Clays.
Kemper	W	W	Do.
Lauderdale	W	--	
Lee	W	W	Sand and gravel.
Lincoln	W	W	Sand and gravel, clays.
Lowndes	22,614	26,614	Cement, sand and gravel, stone, clays.
Marion	579	1,034	Sand and gravel.
Marshall	W	W	Clays.
Monroe	W	9,937	Clays, sand and gravel.
Newton	W	W	Sand and gravel.
Noxubee	W	W	Clays, stone.
Panola	W	W	Clays, sand and gravel.
Pearl River	--	504	Sand and gravel.
Perry	498	W	Do.
Pike	875	W	Do.
Prentiss	W	W	Clays.
Quitman	W	W	Do.
Rankin	W	W	Cement, stone, clays.
Smith	W	W	Clays.
Stone	805	876	Sand and gravel.
Sunflower	17	18	Clays.
Tate	W	W	Sand and gravel.
Tippah	W	W	Clays.
Tishomingo	W	1,889	Stone, sand and gravel.
Walthall	10	195	Sand and gravel.
Warren	W	W	Do.
Washington	W	W	Do.
Wayne	343	W	Stone.
Winston	W	W	Clays.
Yalobusha	794	879	Sand and gravel.
Yazoo	3,133	2,472	Do.
Undistributed[2]	56,460	51,814	
Total[3]	96,824	107,689	

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

[1]The following counties were not listed because no nonfuel mineral production was reported: Alcorn, Amite, Attala, Calhoun, Choctaw, Claiborne, Clarke, Coahoma, Covington, Franklin, Greene, Humphreys, Issaquena, Jasper, Jefferson, Lafayette, Lamar, Lawrence, Leake, Leflore, Madison, Montgomery, Neshoba, Oktibbeha, Pontotoc, Scott, Sharkey, Simpson, Tallahatchie, Tunica, Union, Webster, and Wilkinson.

[2]Includes 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.

operation is scheduled for 1986.

Litton Industries' Ingalls Shipbuilding Division, on the gulf at Pascagoula, reported that its 1980 steel purchases were considerably above those of 1979. Most of the increase was for oil rig fabrication. The yard had contracts for nine jack-up and four submersible rigs; each rig requires from 4,000 to 5,000 tons of steel.

Imports of ilmenite from Australia, through the Port of Gulfport, increased from 33,000 tons in fiscal year (FY) 1979 to 115,000 tons in FY 1980. The ilmenite is stored in silos at Gulfport and then shipped to E.I. du Pont de Nemours & Co. Inc.'s titanium dioxide pigment plant at nearby Pass Christian. Titanium concentrates were also received from the company's mining operations in north Florida. The plant, which uses the chloride process, has a capacity of 150,000 tons per year.

In a $14.4 million Federal suit, Tupelo Concrete Products Co. and the Tennessee Valley Authority (TVA) were charged with negligence in allowing concrete cinderblocks made with radioactive materials to be used in the construction of buildings in Mississippi. An investigation began in 1979

Table 3.—Indicators of Mississippi business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	986.0	1,023.0	+3.8
Unemployment	do	57.0	76.0	+33.3
Employment (nonagricultural):				
Mining[1]	do	9.3	10.7	+15.0
Manufacturing	do	235.2	221.4	-5.9
Contract construction	do	46.7	43.7	-6.4
Transportation and public utilities	do	41.1	41.1	--
Wholesale and retail trade	do	163.0	164.6	+1.0
Finance, insurance, real estate	do	32.6	32.8	+.6
Services	do	118.1	121.4	+2.8
Government	do	192.2	194.9	+1.4
Total nonagricultural employment[1]	do	[2]838.1	830.6	-.9
Personal income:				
Total	millions	$15,060	$16,347	+8.6
Per capita		$6,200	$6,508	+5.0
Construction activity:				
Number of private and public residential units authorized		8,860	10,407	+17.5
Value of nonresidential construction	millions	$113.8	$158.0	+38.8
Value of State road contract awards	do	$108.0	$69.5	-35.6
Shipments of portland and masonry cement to and within the State	thousand short tons	1,023	926	-9.5
Nonfuel mineral production value:				
Total crude mineral value	millions	$107.7	$103.9	-3.5
Value per capita, resident population		$44	$41	-6.8
Value per square mile		$2,257	$2,178	-3.5

[p]Preliminary.
[1]Includes oil and gas extraction.
[2]Data do not add to total shown because of independent rounding.

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

in Mississippi, Alabama, Tennessee, and Georgia, after TVA officials announced that millions of concrete blocks had been manufactured using radioactive slag from its Muscle Shoals, Ala., fertilizer plant.

Legislation and Government Programs.—The Mississippi Mineral Resources Institute, at the University of Mississippi in Oxford, added James Robert Woolsey, Ph.D., to its scientific research staff. The Institute plans to work more closely with the mineral community and will investigate new methods of upgrading the State's mining technology in excavating, processing, materials handling, and byproduct recoveries. Other nonenergy areas of involvement by the Institute include investigation of oyster reefs off the Mississippi gulf coast for use as aggregate in construction and of aluminum-bearing clays for use as a future supply of aluminum.

During the year, the Mississippi Bureau of Geology and Energy Resources was divided into five technical sections: Environmental geology, ground water, surface geology, subsurface geology, and mining and reclamation. The environmental geology section conducted environmental studies in northern and central Mississippi and continued to provide geological assessments for sanitary landfills for the State Board of Health. The ground water section completed reports on the ground water resources of Clarke County and for several quadrangles. The surface geology section published a report on the geology and mineral resources of Clarke County and continued geologic mapping in Simpson County. The subsurface geology section completed a study of the deep bituminous coal resources of northeastern Mississippi and initiated preliminary work on the geothermal potential of an area in southern Mississippi. The mining and reclamation section continued to administer surface mining regulations concerning clays, limestone, and sand and gravel.

The U.S. Bureau of Mines had contracts with the Department of the Army, Vicksburg, to study the feasibility of using large tractor dozers in surface mining and to test centrifugal models of waste embankments.

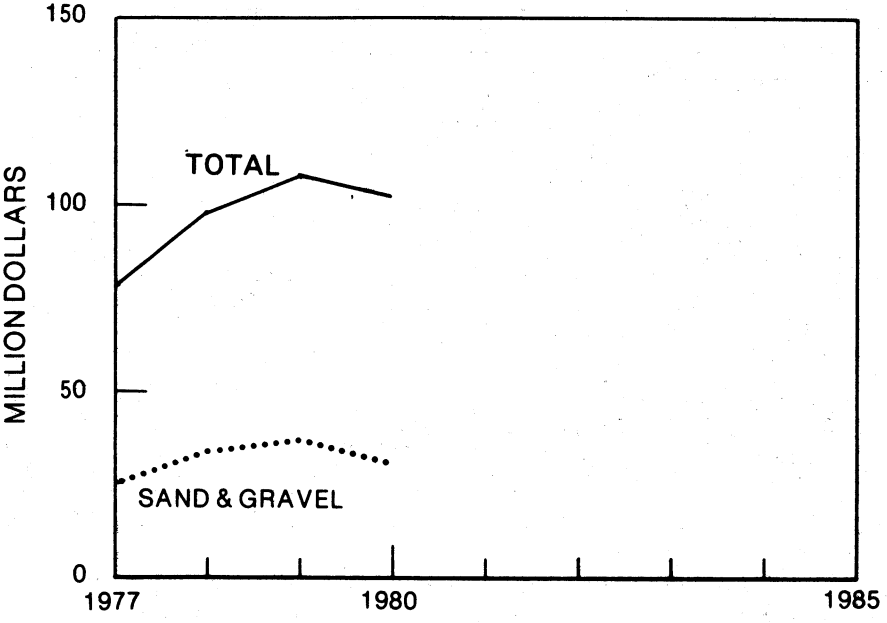

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Mississippi.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Mississippi's cement industry, composed of two companies, is located in the central and eastern parts of the State. Marquette Cement Manufacturing Co., in Rankin County, produced portland and masonry cement, and United Cement Co., in Lowndes County, produced only portland cement. Principal consumers of portland cement included ready-mix companies, building materials dealers, concrete products manufacturers, highway contractors, and other contractors. Raw materials used by cement producers were limestone, marl, chalk, sand, clay, gypsum, and iron ore; nearly all raw materials resources were adjacent to the plant sites. Cement is shipped to Louisiana and Tennessee, and one company plans to expand into the Georgia market. Portland cement shipments increased, while masonry shipments decreased, indicating a slowdown in local construction activity. Unit values for both portland and masonry cement increased.

First Mississippi Corp., which started as a chemical concern and diversified into petroleum exploration, began a new venture into cement manufacturing. The new venture, First Delta Cement Corp., tested a new production process conceived by the founders of a Memphis, Tenn., company, Delta Minerals Corp. Tests on the cement-manufacturing process were underway at a pilot plant near Memphis. If the results prove feasible, First Mississippi will help finance a full-sized demonstration plant. First Delta Cement Corp. will be headquartered in Jackson, Miss., but research on the cementmaking process will continue in Memphis.

Clays.—Mississippi's clay industry consisted of 21 companies operating 29 mines in 20 counties in the north and northeastern part of the State. Common clay, ball clay, bentonite, and fuller's earth were produced in Mississippi; the State ranked third nationally in the production of the latter three clays. Clays produced in the State were used in the automotive, construction, and

Table 4.—Mississippi: 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
1976	373	6,740	W	W	1,114	2,110	1,487	8,849
1977	340	6,389	W	W	1,143	2,452	1,483	8,841
1978	358	7,742	W	W	1,356	3,034	1,960	19,623
1979	318	7,128	W	W	1,221	3,162	1,820	21,841
1980	275	6,234	W	W	1,054	3,292	1,596	21,714

W Withheld to avoid disclosing company proprietary data, included with "Total" (1978-80).
[1]Data may not add to totals shown because of independent rounding.

agricultural-animal feed industries. Because of the depressed ecomony, sales for all clay types fell below the 1979 level.

Common clay was mined by 14 companies operating 18 pits in 12 counties, centering in Hinds, Lowndes, and Noxubee Counties. Major uses were brick, concrete, and concrete block manufacture. High interest rates and a shortage of mortgage money resulted in a decrease in new home construction which in turn severely depressed the demand for common clay products.

One company, Ky.-Tenn. Clay Co., produced ball clay from a surface mine in Panola County. Clay was trucked approximately 10 miles to a plant where it was processed for use in animal feed, wallboard, and ceiling tile.

Mississippi's bentonite producers, Filtrol Corp., American Colloid Co., and International Minerals & Chemical Corp. (IMC), operated three surface mines in three counties. The companies removed up to 130 feet of overburden to recover 6 to 8 feet of clay. Bentonite was trucked to nearby plants, where it was processed for sale to the automotive industry as a foundry binder and to the agriculture industry for use in fertilizer manufacture.

Two companies, IMC and Oil-Dri Production Co., mined fuller's earth from open pits in Tippah County. Fuller's earth deposits, generally less than 20 feet below the surface, averaged up to 25 feet thick. The clay was processed at nearby plants for sale to the agriculture industry. Although market conditions were depressed during most of the year, sales improved during the fourth quarter.

Lime.—Corning Glass Works, Ceramic Products Division, produced dolomitic quicklime from stone mined in Alabama. The company's plant is at Pascagoula in Jackson County on the gulf. The lime was used in the production of magnesia from seawater. Production and value declined more than 50% from those of 1979.

Magnesium Compounds.—Corning Glass Works, Ceramic Products Division, recovered magnesium compounds from seawater at Pascagoula. The plant, with a capacity of 40,000 short tons of MgO equivalent, produced magnesium compounds used in the manufacture of fused refractories. Mississippi ranked fifth nationally in recovery of magnesium compounds from seawater.

Peat.—Mississippi Peat Co. mined peat from the Powell Pit at Preston, about 50 miles north of Meridian. The peat was solar dried, bagged, and shipped for use as potting soil and in general soil improvement. Production in 1980 dropped from that of 1979 because of reduced local demand.

Perlite.—Johns-Manville Corp., Natchez, and United States Gypsum Co., Greenville, expanded perlite shipped in from out of State. The product was used in roof insulation and for formed products. Although depressed construction activity affected sales, inflation increased unit prices.

Sand and Gravel.—Sand and gravel continued as the second leading commodity in value among the nonfuel minerals produced in Mississippi, although output declined. Production of sand and gravel in 1980 was reported by 66 companies from 84 pits located in 31 counties. Leading producing counties were Copiah, Monroe, Lowndes, and Forrest. These four counties produced 46.4% of the State's output of sand and gravel. The top 29 companies, with 46 pits, produced 90% of the total sand and gravel in the State. Of the total production, 92.9% was shipped by truck.

Table 5.—Mississippi: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	6,187	$14,992	$2.42	4,898	$12,867	$2.63
Plaster and gunite sands	W	W	W	W	W	W
Concrete products	467	1,345	2.88	713	2,443	3.43
Asphaltic concrete	3,780	8,872	2.35	3,280	10,269	3.13
Roadbase and covering	5,472	10,772	1.97	2,289	5,057	2.21
Fill	932	1,561	1.68	449	738	1.65
Snow and ice control	1	1	1.00	1	1	1.19
Railroad ballast	2	4	2.20	--	--	--
Other uses	100	250	2.49	81	231	2.85
Total[1] or average	16,940	37,797	2.23	11,710	31,606	2.70

W Withheld to avoid disclosing company proprietary data; included in "Other uses."
[1]Data may not add to totals shown because of independent rounding.

Table 6.—Mississippi: Sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	5,888	$11,066	$1.88	4,421	$10,379	$2.35
Gravel	11,051	26,731	2.42	7,289	21,227	2.91
Total or average	[1]16,940	37,797	2.23	11,710	31,606	2.70
Industrial sand	W	W	W	W	W	8.00
Grand total or average	W	W	W	W	W	2.71

W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.

Stone.—In 1980, 9 companies crushed limestone and marl at 11 quarries in 9 counties. Although crushed stone production decreased, local market demand influenced individual operations. Stone production in the northeastern part of the State increased because of the demand for aggregate for the construction of the Tennessee-Tombigbee Waterway. One operation leased nearly a hundred trucks to haul stone for the waterway. Operations supplying crushed limestone for agricultural use experienced reduced sales. Although no one quarry produced in excess of 700,000 tons of stone, the leading three producers mined nearly 75% of the stone produced in the State.

Sulfur.—Four companies recovered sulfur from refinery and natural gases. Production was reported by Shell Oil Co. in Clarke and Rankin Counties; by Chevron, USA, Inc., in Jackson County; by Amerada Hess Corp. in Lamar County; and by Tonkawa Gas Processing Co. in Clarke County. Sulfur sold or used in 1980 totaled 569,000 metric tons, valued at $57.3 million, an increase of 1.1% in shipments and 60.8% in value from the 1979 figures.

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[1]State mineral specialist, Bureau of Mines, Tuscaloosa, Ala.
[2]State geologist, Bureau of Geology and Energy Resources, Jackson, Miss.

Table 7.—Mississippi: Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Marquette Cement Manufacturing Co	20 North Wacker Dr. Chicago, IL 60606	Plant	Rankin.
United Cement Co	Box 185 Artesia, MS 39736	do	Lowndes.
Clays:			
Delta-Macon Brick and Tile Co., Inc	RFD 3, Box 2 Macon, MS 39341	Mine and plant	Noxubee.
International Minerals & Chemical Corp	Box 346A Aberdeen, MS 39730	Mine	Monroe.
Jackson Ready Mix Concrete, a division of Delta Industries, Inc.	Box 1292 Jackson, MS 39205	do	Hinds.
Oil-Dri Production Co	Box 476 Ripley, MS 38663	Mine and plant	Tippah.
Tri-State Brick and Tile Co., Inc	Box 9787 Jackson, MS 39206	do	Hinds.
Lime:			
Corning Glass Works, Ceramic Products Div.	Box 1707 Pascagoula, MS 39567	Plant	Jackson.
Magnesium compounds:			
Corning Glass Works, Ceramic Products Div.	do	do	Do.
Sand and gravel:			
American Sand & Gravel Co	Box 272 Hattiesburg, MS 39401	Stationary plant	Forrest.
Blain Gravel Co	Box 268 Crystal Springs, MS 39059	Stationary plants	Copiah, Marion, Jefferson Davis.
Green Bros. Gravel Co., Inc	Route 4, Box 17 Franklinton, LA 70438	Stationary plant	Copiah.
Hammett Gravel Co	Box 207 Lexington, MS 39095	Mine and plant	Holmes and Pike
Stone:			
Marquette Cement Manufacturing Co	20 North Wacker Dr. Chicago, IL 60606	Quarry	Rankin.
Mississippi Stone Products	Box 338 Iuka, MS 38852	do	Tishomingo.
State Dept. of Agriculture and Commerce	Box 352 West Point, MS 39773	Quarries	Clay, Noxubee, Wayne.
United Cement Co	Box 185 Artesia, MS 39736	Quarry	Lowndes.

The Mineral Industry of Missouri

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Missouri Department of Natural Resources, Division of Geology and Land Survey, for collecting information on all nonfuel minerals.

By Jane P. Ohl,[1] Heyward M. Wharton,[2] and Ardel W. Rueff[2]

Nonfuel mineral production in Missouri in 1980 was valued at $1.06 billion, an 8.9% decrease from the record high value of the previous year. Two-thirds of this decline resulted from a net decrease in value from the nonmetallic sector. Among the nonmetallics, only barite increased in value as well as in output. Among the metallic minerals, only lead values were down, in spite of a 5.3% increase in output. New mines were being developed in southeast Missouri during 1980 by St. Joe Minerals Corp., Anschutz Mining Corp., Cominco American Incorporated, ASARCO Incorporated, and Ozark Lead Co. The new mine and mill complex at West Fork will be Asarco's first mining development in the State. St. Joe Minerals also began to expand its mill at Viburnum to handle the expected increase in output when the new mine,

Table 1.—Nonfuel mineral production in Missouri[1]

Mineral		1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
Barite	thousand short tons	89	$3,679	117	$5,570
Cement:					
Masonry	do	82	4,159	62	3,117
Portland	do	4,430	194,285	3,515	156,368
Clays	do	2,351	20,522	1,817	16,798
Copper (recoverable content of ores, etc.)	metric tons	13,021	26,705	13,576	30,655
Gem stones		NA	10	NA	15
Gold (recoverable content of ores, etc.)	troy ounces	32	10	W	W
Lead (recoverable content of ores, etc.)	metric tons	472,054	547,824	497,170	465,393
Lime	thousand short tons	1,790	70,187	1,667	63,733
Sand and gravel	do	12,558	31,310	8,900	26,753
Silver (recoverable content of ores, etc.)	thousand troy ounces	2,201	24,410	2,357	48,653
Stone:					
Crushed	thousand short tons	56,380	139,944	48,296	130,254
Dimension	do	(2)	85	W	W
Zinc (recoverable content of ores, etc.)	metric tons	61,682	50,723	65,214	53,814
Combined value of asphalt (native), iron ore, iron oxide pigments (crude), and values indicated by symbol W		XX	r46,706	XX	55,633
Total		XX	r1,160,559	XX	1,056,756

rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

[2]Less than 1/2 unit.

Table 2.—Value of nonfuel mineral production in Missouri, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Andrew	W	W	Stone.
Atchison	W	W	Sand and gravel.
Audrain	$2,485	$2,931	Clays.
Barry	548	672	Stone.
Barton	W	W	Stone, asphalt.
Bates	W	W	Stone.
Benton	698	W	Stone, sand and gravel.
Bollinger	40	38	Sand and gravel.
Boone	W	W	Stone, sand and gravel, clays.
Buchanan	W	W	Stone.
Butler	W	W	Sand and gravel, stone, clays.
Caldwell	748	W	Stone.
Callaway	7,043	W	Stone, clays, sand and gravel.
Camden	294	W	Sand and gravel, stone.
Cape Girardeau	W	W	Cement, stone, sand and gravel, clays.
Cass	1,212	1,600	Stone.
Cedar	W	W	Do.
Chariton	W	--	
Christian	806	1,176	Stone.
Clark	W	W	Stone, sand and gravel.
Clay	5,764	7,384	Do.
Clinton	460	509	Stone.
Cole	W	W	Stone, sand and gravel.
Cooper	W	W	Do.
Crawford	W	1,606	Stone, sand and gravel, clays.
Dade	W	79	Stone.
Dallas	W	W	Stone, sand and gravel.
Daviess	W	W	Do.
De Kalb	399	449	Stone.
Dent	W	W	Do.
Douglas	976	W	Sand and gravel, stone.
Franklin	1,613	W	Sand and gravel, stone, clays.
Gasconade	W	W	Clays, stone, sand and gravel.
Gentry	W	W	Stone.
Greene	W	W	Lime, stone.
Grundy	W	W	Stone, sand and gravel.
Harrison	W	W	Do.
Henry	W	W	Stone.
Hickory	W	W	Do.
Holt	W	W	Stone.
Howard	W	W	Stone, sand and gravel.
Howell	997	W	Do.
Iron	W	W	Lead, zinc, iron ore, silver, copper, stone, gold.
Jackson	W	W	Cement, stone, sand and gravel, clays.
Jasper	W	W	Stone, sand and gravel.
Jefferson	W	W	Cement, stone, sand and gravel, clays.
Johnson	406	491	Stone.
Knox	W	W	Do.
Laclede	542	1,031	Stone, sand and gravel.
LaFayette	W	415	Do.
Lawrence	W	--	
Lewis	W	W	Sand and gravel.
Lincoln	W	W	Stone, sand and gravel.
Livingston	W	W	Stone, clays, sand and gravel.
McDonald	W	W	Sand and gravel, stone.
Macon	263	--	
Madison	W	W	Stone, sand and gravel.
Maries	--	W	Clays.
Marion	131	W	Do.
Mercer	847	655	Stone.
Miller	797	W	Stone, sand and gravel.
Moniteau	W	W	Stone.
Monroe	W	W	Stone, clays.
Montgomery	W	W	Clays, stone, sand and gravel.
Morgan	123	W	Stone.
Newton	506	W	Stone, sand and gravel.
Nodaway	W	W	Stone.
Oregon	W	W	Sand and gravel, stone.
Osage	W	W	Stone, sand and gravel, clays.
Ozark	W	W	Sand and gravel.
Pemiscot	297	W	Do.
Perry	W	W	Stone.
Pettis	W	W	Do.
Phelps	1,046	1,253	Stone, sand and gravel.
Pike	W	W	Cement, stone, clays, sand and gravel.
Platte	W	W	Clays, stone.
Polk	217	W	Stone.
Pulaski	1,055	W	Stone, sand and gravel.
Putnam	W	W	Stone.
Ralls	W	W	Cement, stone, clays.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Missouri, by county[1] —Continued

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Randolph	W	W	Stone.
Ray	$1,298	$490	Do.
Reynolds	163,554	234,505	Lead, zinc, copper, silver, gold, sand and gravel.
Ripley	306	W	Stone, sand and gravel.
St. Charles	W	W	Stone, sand and gravel, clays.
St. Clair	W	W	Stone.
St. Francois	W	W	Lime, stone, sand and gravel.
St. Louis	W	W	Cement, stone, sand and gravel, clays.
St. Louis City	711	W	Sand and gravel.
Ste. Genevieve	W	W	Lime, stone, sand and gravel.
Saline	2,176	2,118	Stone.
Scotland	W	W	Do.
Scott	W	W	Stone, sand and gravel.
Shannon	384	136	Stone.
Shelby	809	1,001	Do.
Stoddard	1,121	628	Sand and gravel.
Stone	W	W	Stone.
Sullivan	286	370	Do.
Taney	W	W	Stone, sand and gravel.
Texas	285	W	Do.
Vernon	1,132	W	Stone.
Warren	W	W	Clays, stone.
Washington	r48,459	89,886	Lead, iron ore, copper, barite, zinc, silver, crude iron oxide pigments, sand and gravel.
Wayne	3,219	3,613	Stone.
Webster	W	W	Stone, sand and gravel.
Worth	489	333	Stone.
Wright	W	W	Do.
Undistributed[2]	612,954	807,190	
Total	r [3]867,497	1,160,559	

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1]The following counties are not listed because no nonfuel mineral production was reported: Adair, Carroll, Carter, Dunklin, Linn, Mississippi, New Madrid, and Schuyler.

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

[3]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Missouri business activity

		1979	1980p	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,293.0	2,295.0	+0.1
Unemployment	do	104.0	161.0	+54.8
Employment (nonagricultural):				
Mining[1]	do	8.2	7.7	-6.1
Manufacturing	do	464.4	435.9	-6.1
Contract construction	do	92.4	79.8	-13.6
Transportation and public utilities	do	142.3	138.9	-2.4
Wholesale and retail trade	do	474.3	464.3	-2.1
Finance, insurance, real estate	do	107.8	108.3	+.5
Services	do	383.2	395.8	+3.3
Government	do	338.5	338.7	+.1
Total nonagricultural employment[1]	do	2,011.1	1,969.4	-2.1
Personal income:				
Total	millions	$40,055	$43,402	+8.4
Per capita		$8,248	$8,846	+7.3
Construction activity:				
Number of private and public residential units authorized		19,384	13,074	-32.6
Value of nonresidential construction	millions	$512.1	$593.5	+15.9
Value of State road contract awards	do	$281.0	$135.0	-52.0
Shipments of portland and masonry cement to and within the State	thousand short tons	1,914	1,468	-23.3
Nonfuel mineral production value:				
Total crude mineral value	millions	$1,160.6	$1,056.8	-8.9
Value per capita, resident population		$238	$215	-9.7
Value per square mile		$16,654	$15,165	-8.9

pPreliminary.

[1]Includes bituminous coal and oil and gas extraction.

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

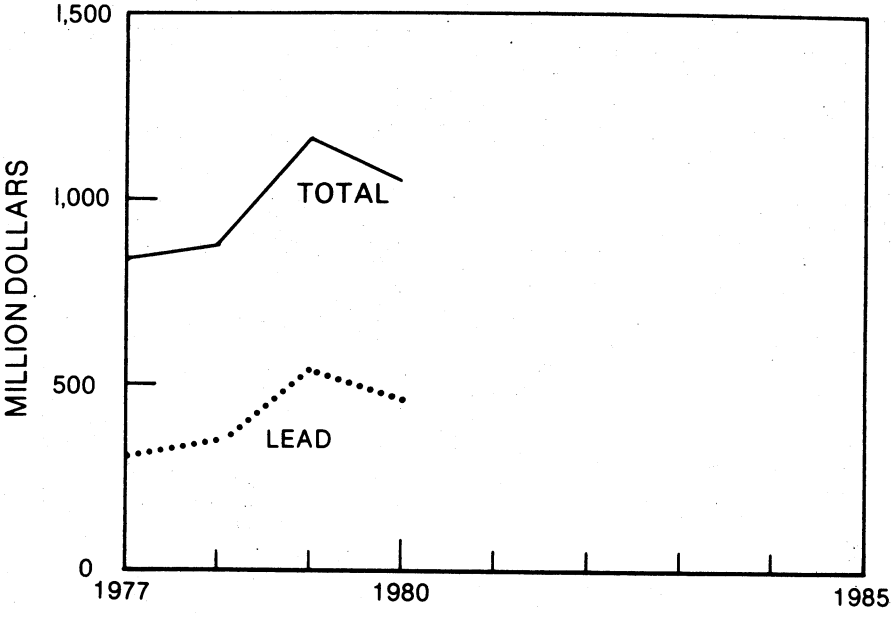

Figure 1.—Value of lead and total value of nonfuel mineral production in Missouri.

Viburnum No. 35, is completed. Homestake Mining Co. of San Francisco continued investigating the magnetic anomaly northwest of Sullivan. Some lead-mining companies appealed to the courts to reduce the burden of environmental controls imposed by Federal and State governments, and Kennecott Corp. contested on the administrative level some citations from Occupational Safety and Health Administration (OSHA) and Mine Safety and Health Administration (MSHA) for various alleged violations.

Trends and Developments.—Exploration activity for lead and zinc continued at a high level during 1980. About 15 mining companies had land positions or interests in southeast Missouri. Prospecting permits have been filed on some 200,000 acres of Federal lands in the Mark Twain National Forest and on about 40,000 acres in State forests. Interest was intensified by the release of many new maps and reports by the U.S. Geological Survey and Missouri Division of Geology and Land Survey as part of a cooperative mineral resources study of the Rolla 1° by 2° quadrangle. (See section on Legislation and Government Programs.)

Missouri was host for the 16th Annual Forum on Geology of Industrial Minerals held in St. Louis, April 9-11, 1980. The Missouri Department of Natural Resources, Division of Geology and Land Survey, and the Geology Department, University of Missouri-Rolla, were sponsors. Among the 120 registrants, 26 States and 2 Canadian Provinces were represented. Fourteen papers were presented at four technical sessions which addressed the following topics: (1) Geology of Barite Deposits; (2) Origin of Trace Elements in Fire Clay; (3) Planning for Industrial Development and Extraction; and (4) Stone—Exploration, Evaluation, and Use. Abstracts and Guidebooks were issued at the meeting, and the Proceedings will be published later by the Missouri Division of Geology and Land Survey. In a full-day field trip, the forum attendees inspected outcrops of the St. Peter Sandstone, then toured the PPG Industries, Inc., floatglass plant in Crystal City, Mo. In the afternoon, the field trip members visited the Dresser Minerals No. 10 barite mine near Blackwell, Jefferson County, and IMCO Services' new barite washer at Mineral Point in Washington County.

Anschutz continued developing the old Madison Mine east of Fredericktown to produce cobalt, nickel, and copper. The

company plans to restore the decline shaft to working status and to use a railroad track lift for moving materials and equipment from the opening to the mine floor. A new decline shaft will have its opening near the present reservoir dam. The mine may go into operation in 1984.

Asarco's chairman, Charles F. Barber, said that although lead-zinc battery sales were down during the 1979-80 mild winter and lower automobile production was discouraging to the lead industry, the outlook was bright for the larger batteries used in diesel engines. He also noted the probability of more electric vehicles and the use of load-leveling batteries for electric utilitics. Barber also forecast a greater role for lead in gasoline if the United States is to be "pragmatic" about meeting its energy needs.[3]

In June 1980, Asarco began building a mill to concentrate the 3,800 tons per day of lead-zinc ore that its new West Fork Mine is expected to produce by 1984. The company is to spend $77 million on the new mill and mine. The West Fork Mine and mill complex, located in sec. 1, T32N, R2W, within the boundaries of the Mark Twain National Forest in Reynolds County, about 5 miles northeast of Bunker, is mostly on private land. Work on sinking three shafts began in the spring of 1980, and the mine is to begin producing ore early in 1983 and to reach full operation in mid-1984. It will have an annual ore-mining capacity of 1,350,000 tons and will join the ranks of the largest underground mines in the New Lead Belt. Annually, for the next 16 years, West Fork will produce 51,000 tons of lead, 7,500 tons of zinc, and 125,000 ounces of silver, as well as some copper and cadmium. The West Fork deposit contains 15 million tons of ore reserves, averaging 5.5% lead, 1.2% zinc, and 0.3 troy ounce of silver per ton. Mining the ore body, at a depth of 840 feet, will be by the high-productivity room-and-pillar method at a planned daily rate of 3,800 tons of ore. The operation, designed to meet applicable regulations, will not appreciably disturb the surface environment. Surface plants will be built, beginning in the summer of 1981, and the mill is scheduled to process development ore in mid-1983. When in full operation, West Fork will employ about 170 people and have an annual payroll of $3.1 million. Ore from West Fork will be shipped to Asarco's lead smelter and refining plant at Glover, in southern Iron County, 23 miles east of the mine. The new mining development is Asarco's first in Missouri; Asarco had been exploring the area since 1959 and acquired the West Fork property in the early 1960's but did not build earlier because either prices for lead were too low to justify development or the company did not have the necessary capital. When lead prices increased 50% to 50 cents per pound and the company's profits from other operations reached $259 million, Asarco decided to invest in developing West Fork. Site development work was done by David Warner Construction Co. of Salem. Cementation Construction Co. of Canada grouted the mine shaft to place concrete guard shields parallel to the main shaft to reinforce the shaft and help keep out water.

Cominco American and Dresser Industries, Inc., began driving a drift westward from Magmont Mine to a satellite ore body (called the Getty ore body) in 1980. The plan is to use the development drift as the production drift for the proposed Magmont West Mine. Magmont West ore has 5.0% lead, 2.3% zinc, and 0.3% silver.

Homestake drilled two diamond drill holes northwest of Sullivan, Franklin County, in the area of a pronounced magnetic anomaly. The first core-drilling operation was completed in mid-March 1980, and a second drill hole was begun about March 17. The test holes are from 1,500-to 2,000-feet deep, and 2-inch core samples, taken at various levels, were being analyzed for their mineral content. Through the end of 1980, the company still considered the area as an exploration target and continued to pay on its leases.

In a program to diversify its mineral base, Kennecott expected to complete, early in 1981, a $25 million expansion to increase capacity 30%, from 73,000 to 100,000 tons of lead per year, from its Milliken Mine, formerly Ozark's Sweetwater Mine. A new 2,900-foot-long overland conveyor was installed which will move more than 400 tons of ore per hour to the crushing and concentrating facilities. Principal products and markets from Ozark's zinc output are bearing metals, brass and other alloys, diecastings, dies and pigments, and galvanized steel housing and automotive components.

St. Joe Minerals concentrated a part of its research program on searching for a commercial electric-vehicle battery system. The lead-acid battery has been refined in recent years to deliver 42% more energy and weigh 23% less than older models. Because of St. Joe Minerals' involvement in lead-acid and nickel-oxide-acid technology, the

company foresees a good market potential for the new battery system.

In May 1980, St. Joe Minerals announced that the St. Joe Lead Co., headquartered at Clayton, would be developing a new lead mine, to be known as Viburnum No. 35, although Viburnum Nos. 28 and 29 continued to be mined. St. Joe will develop Viburnum No. 35 on the Bixby ore reserves, about 4 miles south of Viburnum. A 1,193-foot shaft (in a 40-acre area in NE 1/4 sec. 11, T34N, R2W, Iron County) is to be excavated beginning in the early fall of 1981. When operations begin in late 1983, the mine will feed 4,000 short tons per day of ore containing lead and small amounts of zinc and copper to the mill complex. This anticipated additional feed requires that the company also modernize and expand the Viburnum mill to handle as much as 12,000 short tons per day. The new mine and mill expansion are to cost $25 million. This move will increase the company's yearly lead ore output by some 20%, to nearly 6 million short tons; mill capacity will be expanded by some 50%. The mill produces lead concentrate feed for St. Joe Minerals' lead smelter at Herculaneum, which has an annual refined-lead capacity of 225,000 tons; the smelter capacity will not have to be increased. The Viburnum No. 35 Mine is the first such project for St. Joe Minerals in the New Lead Belt in more than 7 years. It is, however, the third major new development or expansion project in the Viburnum Trend in the 1979-80 period. The Viburnum mill expansion and the development of the Bixby ore reserves will allow St. Joe Minerals to continue to produce 100% of its lead-concentrate requirements for many years. The minimum life of the new mine is to be 16 years, and it is hoped that additional exploration of the Bixby deposit will yield even greater tonnages.[4]

Mining high-grade refractory clay near Mexico, Audrain County, was the subject of an article in Pit and Quarry.[5] The fire clay deposit, containing interlayered seams of green waste clay, is covered by as much as 80 feet of overburden. A converted Caterpillar 225 hydraulic excavator enables one operator to economically remove the overburden and to selectively mine the high-grade fire clay, leaving the green waste clay behind. The front-shovel excavator, converted from a backhoe, was modified to solve the unique problems of mining the fire clay. Shortening the bucket and stick cylinders and placing slugs in the boom cylinders have reduced stress on the stick and boom when digging clay. In addition, the excavator was equipped with a new 2-cubic-yard bucket that is narrower and deeper than a standard bucket. This bucket, which permits the operator to bottom-dump wet clay, is capable of greater breakout force along the cutting edge. The narrowness of the bucket also allows greater precision in separating the valuable fire clay from the waste clay.

Legislation and Government Programs.—A 5-year Federal and State cooperative study of the metallic mineral-resource potential of the Rolla 1° by 2° quadrangle in Missouri was completed in September 1980. The project was conducted by the U.S. Geological Survey, Denver, in cooperation with the Missouri Division of Geology and Land Survey, Rolla, as part of the Federal Survey's Conterminous United States Mineral Appraisal Program. Important contributions also were made by private mining companies and the U.S. Bureau of Mines. The Rolla quadrangle covers a 7,600-square-mile region in southeastern Missouri, extending from Rolla to Ste. Genevieve on the north, and from Willow Springs to near Poplar Bluff on the south. Included are all the important lead mining districts, most of the Precambrian iron ore deposits, and the south half of the Washington County barite district. The Rolla project was a multidisciplinary study employing aerial geologic and subsurface mapping and geochemical and geophysical surveys. Seventeen types of metallic mineral deposits were identified, but the main emphasis was on the possibility of discovering new lead-zinc-copper-silver-cobalt-nickel deposits in the Bonneterre Formation. Current models and recognition criteria were developed for each type of deposit, and areas of high and low favorability were plotted on appropriate base maps. A public meeting was to be held in Rolla in May 1981 to report on the results of the project, coincident with the release of the final report.

A limestone deposit in Jackson County, about 25 miles east of Kansas City near Lake Lotawana, was the subject of a Jackson County Planning and Zoning Commission hearing that lasted for 17 hours, a record for a commission hearing. The planned $4.5 million limestone operation was opposed by nearby residents who objected to the approval of a special-use permit, which presumably had been transferred with the real estate at the time of sale, and to the

placement of a necessary access road to the deposit. The Jackson County Board of Zoning Adjustment was expected to grant the necessary permits but had not acted before the end of 1980.

AMAX Lead Co. of Missouri and Homestake Lead Co. of Missouri, subsidiaries of AMAX Inc. and Homestake Mining Co., are equal participants in a joint venture for mining lead-zinc deposits in southeastern Missouri. In their 10K annual reports for 1980 to the Securities and Exchange Commission, the two parent companies made similar observations about the effects of environmental controls at their Buick Mine and smelter, effects that result from the Clean Air Act, OSHA, and the Environmental Protection Agency (EPA). In October 1978, the EPA promulgated national standards for lead in the atmosphere and at plant boundaries of 1.5 micrograms of lead per cubic meter of air, averaged over a calendar quarter. In November 1978, OSHA adopted stringent standards for blood lead content and occupational exposure to lead in the atmosphere at a workplace.

The standards would require plants to reduce the average air lead exposure to employees to 50 micrograms per cubic meter of air by 1989 and to grant employees medical-removal protection on the basis of blood lead content. The Lead Industries Association, Inc. (LIA), and several companies filed with the U.S. Supreme Court a petition for a writ of certiorari seeking a review of a U.S. Court of Appeals decision in August 1980 that sustained the standard. Also in August 1980, the Buick lead smelter entered into a stipulation with the Missouri Air Conservation Commission that required certain changes in crushing, conveyor, dust control, and other facilities by specified times. Some of the changes had been completed at the time of submittal of the companies' 10K reports (December 31, 1980); others are not scheduled to be completed until 1984. In December 1980, the Supreme Court granted a temporary stay of certain parts of the OSHA lead standard, pending review of the LIA petition. On April 1, 1981, new regulations were to effect a reduction in the permitted lead levels in the blood of employees. To meet all the OSHA and EPA requirements, significant additional emission controls would be required at the Buick lead smelter. Such controls and required personnel policy changes may adversely affect the smelter profitability, according to Homestake's and AMAX Inc.'s statements in their 10K reports. Capital expenditures for environmental controls planned during 1981 and during 1982-84 are to total approximately $3 million and $13.7 million, respectively. In 1980, to minimize any adverse effects from its operations on the surrounding environment, the company made capital expenditures of $44 million at all its operations; Buick's share was not specified. Homestake does not expect that either the capital expenditures or the additional operating costs can produce any significant increase in productive capacity, efficiency, or revenues. Increased costs generally cannot be passed on to customers, Homestake stated in its 10K report.

Meanwhile, AMAX Lead continued installing systems to reduce in-plant air and external air lead concentrations from the present lead-smelting process. AMAX Lead also is examining alternative lead-smelting technology that would include improved environmental control. If all the OSHA lead standards, parts of which are being challenged in the courts, must be met, and the national ambient-air-quality standard is not changed, significant additional controls will be required at the Buick lead smelter.

In 1980, St. Joe Lead Co.'s Brushy Creek Mine received the Sentinels of Safety Award for 1979. This award is made annually by MSHA of the U.S. Department of Labor and the American Mining Congress and honors the best safety record of all U.S. underground metal-mining operations.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Aluminum.—After protracted negotiations with the EPA and with the cooperation of the Missouri Department of Natural Resources, Noranda Aluminum Inc. was to embark on constructing an 85,000-ton-per-year expansion of its reduction facilities at New Madrid. The expansion will bring total rated production capacity to 225,000 tons per year. The new potline is to begin operations in the second half of 1982, at a cost of $267 million. The supply of both alumina and power for the expanded operation has been arranged at cost-competitive rates, according to Noranda's 1980 annual report.

Copper.—Copper minerals from Missouri

lead-zinc ores provided a significant quantity of copper recovered as a main concentrate and as a coproduct from smelting lead and zinc concentrates. Eight producing mines along the Viburnum Trend (New Lead Belt) were, from north to south, the Indian Creek Mine and Viburnum No. 29 in Washington County; Viburnum No. 28, Magmont Mine, and Buick Mine, Iron County; and Brushy Creek Mine, Fletcher Mine, and Milliken Mine, Reynolds County. In terms of gross metal content of crude ore taken from the mines, the ratio of copper to lead was 1:27. The quantity of copper recovered in 1980 from the milling and smelting process increased 4% over that of 1979; value increased 15%. Copper was at an alltime high for the State in both quantity and value. The Comex (New York Commodity Exchange) price was $1.10 per pound at the first of the year and declined to 84 cents by yearend. On February 12, 1980, the price of copper reached its Comex high for the year of $1.41; the average annual price was 97 cents, an increase of 4 cents over the 1979 average annual price.

Iron Ore.—Two companies mined iron ore from underground mines in adjacent Washington and Iron Counties in eastern Missouri. By the end of 1980, however, Pilot Knob Mine had closed, leaving Pea Ridge Mine as the sole iron ore producer in the State and one of only two underground iron mines still active in the United States. The Pilot Knob Pellet Co., an iron ore pellet facility owned jointly by the Hanna Mining Co. and National Steel Corp., suspended operations in June 1980, and, without resuming operations, the facility was closed permanently in November 1980. More than 400 employees were affected by the closing. Production of pellets through June amounted to 421,000 long tons, down from about 750,000 tons produced at Pilot Knob in 1979, according to Hanna's 1980 annual report. The capacity of the plant was rated at 900,000 tons per year. The iron was mined from a southwestward-dipping Precambrian volcanic rock sequence that extended from about 400 feet to more than 1,700 feet below the surface. The magnetite ore body is capped by hematite on the updip edge. At the time of closing in November, the ore reserves were deemed to be nearly exhausted, but the economic recession in the U.S. steel industry accelerated the permanent shutdown by about 2 years. An evaluation of reserves made in the mid-seventies would indicate that about 4 million tons of ore remained in 1980.

Hanna's 1980 earnings, as reported in its annual report, were down from the 1979 alltime high, principally because of the lower level of iron ore operations in the United States and Canada, including a one-time $4.7 million pretax writeoff related to the closing of Pilot Knob.

Pea Ridge Iron Ore Co., a subsidiary of St. Joe Minerals, recovered magnetite, iron oxide powder, hematite, pyrite, and phosphate (apatite) concentrates from its Pea Ridge Mine and milling operation in Washington County, 10 miles southeast of Sullivan. St. Joe Minerals (in its 10K report) estimated that as of December 31, 1980, the proven ore reserves of the Pea Ridge Mine were approximately 102 million long tons, assaying 56% magnetic iron. Crude ore processed during 1980 at Pea Ridge amounted to 1.2 million tons, containing about 580,000 tons of iron. Approximately 42,000 tons of concentrate, containing about 29,000 tons of iron, and 788,000 tons of pellets, containing about 527,000 tons of iron, were produced. The concentrator has a feed capacity of 10,000 tons per day; during the year, 700,000 tons of ore concentrates were recovered by magnetic separation and flotation.[6] Equipped with a vertical-shaft indurating-furnace system, the agglomerating plant is capable of processing 1.6 million long tons annually. St. Joe Minerals believes that the iron ore produced at the Pea Ridge Mine is of suitable quality for direct-reduction ironmaking processes. During 1981, St. Joe Minerals intends to test the feasibility of constructing a direct-reduction iron plant within the next 5 years (St. Joe Minerals' 10K report).

Lead.—Quantity of lead produced from the Nation's foremost lead-producing State continued its upward trend, accounting for an even greater share (90.5%) of the domestic output than in 1979 (89.8%). The output in 1980 was 2.5% below the alltime high achieved in 1974. Missouri's lead mines supplied about 68% of the total U.S. demand for primary lead during 1980; nearly 25% of domestic need was met by imports of concentrates and metal.

The continuing development of new lead-ore deposits in Missouri has resulted in augmenting domestic reserves of recoverable lead metal to about 27 metric tons, representing about 72% of the total identified U.S. reserves; exploration will likely contribute to the discovery of additional lead resources. Lower lead-metal prices,

however, influence calculations of ore reserves.[7]

Asarco's lead smelter at Glover produced 74,000 tons of lead bullion in 1980, 23% less than in 1979, owing to abnormal downtime for maintenance. Nevertheless, Glover continued to be Asarco's greatest producer of lead bullion, according to the company's 10K report. Lead metal production from Glover amounted to 68,500 tons in 1980, a 22% decrease from that of 1979 (ASARCO Incorporated, 1980 Annual Report).

Cominco American, a wholly owned subsidiary of Cominco Ltd., mined about 1 million tons of lead-zinc-silver ore from its Magmont Mine in Iron County during 1980. The ore had 8.1% lead, 1.1% zinc, and 0.3% silver, according to the company's 1980 annual report. Cominco American is operator for a joint venture with Dresser Industries at the Magmont.

The Buick operations, including the Buick mill, provided employment to 943 people during 1980. Total tons of ore mined at the Buick Mine and processed at the mill in 1980 was the highest ever achieved. Sales were down, however, owing to lagging new car sales and a mild winter that slowed lead-battery production and sales. Homestake's 10K report for 1980 described production at the mine and mill as 2,107,505 tons of ore, a 4.5% increase over that of 1979, from which 226,068 tons of lead concentrate and 69,379 tons of zinc concentrate were produced. In 1979 the lead concentrate amounted to 197,243 tons and the zinc concentrates amounted to 73,030 tons. Refined lead metal production at the smelter for 1980 from concentrate drawn from the Buick Mine was 63,396 tons, compared with 64,284 tons in 1979. Ore reserves, proven and probable, at the mine were 46,898,000 tons; the grade of the ore was 5.9% lead and 1.6% zinc. Homestake's operating earnings before taxes from lead and zinc operations were $38.0 million in 1980, compared with $51.7 million in 1979. Revenues from sales of lead and zinc in 1980 were $67.4 million, an 11.7% decrease from the $76.3 million in sales in 1979. The decline in income and revenues in 1980 was due to lower lead prices. A 3-year labor contract was to expire on May 31, 1981.

Ozark, a division of Kennecott Minerals, mined 1,630,224 tons of ore containing 72,632 tons of lead, 5,947 tons of zinc, and 216,628 ounces of silver in 1980, according to the 1980 annual report of Kennecott Corp., the parent company. At the Milliken Mine, the estimated ore reserves amount to 27 million tons containing 1.3 million tons of lead metal and 0.1 million tons of zinc metal. During 1980, Ozark's revenues from lead and zinc concentrates increased only slightly from those of 1979. Operating profits were lower in 1980, as lead prices were 26% lower than in 1979; prices for refined zinc averaged 37 cents per pound, the same as in 1979.

By the beginning of January 1980, the value of refined lead had reached 54 cents per pound f.o.b., but price fluctuations were noted frequently during the following months. Price f.o.b. Herculaneum, Mo., with full freight allowed for carload quantities, decreased from that January high to a low of 34 cents in June-July. The price had risen to 45 cents by the end of September but fell by yearend to slightly less than 40 cents. On December 19, 1980, St. Joe Lead announced that it would sell lead only on the Metals Week monthly average at the time of shipment, partly because of the slowdown in market activities during the holiday season.

In 1980, St. Joe Lead sold 202,000 tons of lead metal, a 9% decrease from that of 1979; the average price during 1980 was 39 cents per pound, a 9-cent decrease from the 1979 average price (St. Joe Minerals Corp., News Release, Jan. 28, 1981). St. Joe Lead sells lead metal for four principal end uses: Batteries, accounting for nearly two-thirds of total consumption; pigments, used in industrial applications; gasoline additives, which are being phased out by the Federal Government; and exports and miscellaneous applications, including such products as ammunition and solder (St. Joe Annual Report, 1980).

Union miners from St. Joe Lead's southeast Missouri lead mines were to negotiate a new work contract in early 1981.

Table 4.—Missouri: Tenor of lead ore milled and concentrates produced in 1980

Total material	metric tons	9,091,559
Metal content of ore:[1]		
Copper	percent	0.16
Lead	do.	5.66
Zinc	do.	0.78
Concentrates produced and average content:		
Copper	metric tons	23,717
Recovery ratio	percent	0.26
Average copper content	do.	27.58
Lead	metric tons	682,257
Recovery ratio	percent	7.50
Average lead content	do.	74.88
Zinc	metric tons	117,646
Recovery ratio	percent	1.29
Average zinc content	do.	56.73

[1]Figures represent metal content of crude ore only as contained in the concentrate.

Table 5.—Production and value of lead in Missouri and the United States

Year	Missouri			United States	
	Quantity (metric tons)	Value (thousands)	Percent of U.S. production	Quantity (metric tons)	Value (thousands)
1976	454,492	$231,458	82.2	552,971	$281,610
1977	453,824	307,156	84.4	537,499	363,789
1978	461,762	343,070	87.2	529,662	393,516
1979	472,054	547,824	89.8	525,569	609,929
1980	497,170	465,393	90.5	549,484	514,363

Table 6.—Missouri: Mine production (recoverable) of gold, silver, copper, lead, and zinc

	1978	1979	1980
Mines producing: Lode	9	8	8
Material sold or treated: Lead ore thousand metric tons	7,962	8,263	9,092
Production:			
Quantity:			
Gold troy ounces	--	32	W
Silver do.	2,056,053	2,201,112	2,357,236
Copper metric tons	10,818	13,021	13,576
Lead do.	461,762	472,054	497,170
Zinc do.	59,038	61,682	65,214
Value:			
Gold thousands	--	$10	W
Silver do.	$11,103	$24,410	$48,653
Copper do.	$15,861	$26,705	$30,655
Lead do.	$343,070	$547,824	$465,393
Zinc do.	$40,349	$50,723	$53,814
Total do.	[1]$410,382	$649,672	W

W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.

Silver.—Missouri, fourth among the States in silver production in 1980, produced 2,357,236 troy ounces recovered in the smelting of Missouri lead and zinc concentrates, an increase of about 7% over 1979 silver production. Four companies recovered silver-bearing concentrates from eight mines in Iron, Reynolds, and Washington Counties during the year. The largest producer was AMAX Lead's Buick Mine in Iron County. AMAX Lead's annual report stated that silver production at the mine amounted to 1,058,000 troy ounces of refined-equivalent metal. The spectacular rise on January 17, 1980, to a historic high Comex spot price of $48.70 per troy ounce did not directly affect production of Missouri silver because the silver is a byproduct of lead and zinc smelting. The average annual unit price increased 85% from $11.09 per troy ounce in 1979 to $20.64 in 1980. By December 31, the price of silver had declined to $15.65, as quoted by Handy & Harman.

Zinc.—Among the 13 zinc-producing States in 1980, Missouri's output of coproduct zinc was exceeded nationally only by

that of Tennessee. All but one of the eight operating lead mines in Iron, Reynolds, and Washington Counties recorded coproduct zinc from their ores. AMAX Lead's Buick Mine produced 46% of the total zinc recovered from the State's mines. Other zinc producers were Brushy Creek, Fletcher, Magmont, Milliken, Viburnum No. 28, and Viburnum No. 29. Unit prices for zinc during the year averaged 37.43 cents per pound, or $748.60 per ton, only slightly higher than 1979 prices. On May 12, 1980, St. Joe Minerals merged its St. Joe Zinc Div. into its lead division, following the closing of its electrothermic zinc smelter at Monaca, Pa., which the company had determined to be unprofitable, obsolete, and energy intensive. By late summer 1980, the parent company had plans to reopen about one-fourth the capacity of the Monaca smelter in 1981 and had postponed plans to build a new zinc refinery.

Other Metals.—Anschutz continued developing its Madison cobalt mine near Fredericktown. A feasibility study was completed and environmental permits obtained. Production is projected at 2 million pounds per year; the mine is expected to open in 1984. Drilling to delineate and extend reserves, which also contain nickel, copper, and lead, will continue at the mine and on the 25,000 acres of adjacent properties within the area Anschutz leased.

A paper on cobalt and nickel recovery from Missouri lead ores was presented at the 7th Mineral Waste Utilization Symposium in Chicago, Ill.[8] Detailed in this paper are the Bureau of Mines' efforts to develop procedures for recovering as much as 2.5 million pounds of cobalt and 3.5 million pounds of nickel now lost annually in processing Missouri lead ores. The procedures are (1) a physical separation process for making a cobalt-nickel-enriched product from a commercial lead mill's lead-copper flotation rougher concentrate and (2) a hydrometallurgical process for treating the enriched product and/or the cobalt-nickel-bearing lead-smelter mattes and drosses.

NONMETALS

Barite.—Missouri's barite production was the second largest of the nine barite-producing States, 5% of the national total. Missouri ranked after Nevada, which accounted for more than 85% of the 1980 domestic production of this widely used mineral resource. The 1980 production of primary barite from Missouri's 12 mines increased 31% over that of 1979 to 117,000 short tons worth $5.6 million. Leading producers were Dresser Industries, operating in Washington and Jefferson Counties, and NL Industries, Inc., in Washington County. Agers Bros., Inc., Plants A and B, also in Washington County, sold concentrates for barium chemicals manufacture. The companies produced mainly well-drilling-grade barite and a few thousand short tons of filler-grade barite. IMCO Services, a division of Halliburton Co. of Houston, a new producer in Washington County, was operating at nearly full capacity, having completed initial development of its Apex Mine and a heavily automated washing plant, 3 miles east of Mineral Point. The barite is hauled by truck to a railhead for shipment to Louisiana. IMCO plans to add a flotation operation for recovering fine barite in 1981. The land disturbed by the strip mining activities will be restored, and precautions are being taken to design equipment that will meet safety and environmental regulations. IMCO postponed plans for developing operations at Blackwell, 15 miles northeast of the Apex Mine. DeSoto Mining Co., a subsidiary of G. H. Fluid Services, completed its twin jigging plants, capable of processing 60,000 short tons per year, at Richwoods in Washington County. DeSoto also reconditioned the Pfizer Inc.'s nearby Kingston plant and began constructing an additional plant on the same site to double capacity.

Cement.—Among nonmetallic nonfuel minerals produced in the State, cement manufacture again generated the largest value. Portland and masonry cement values decreased, however, at an even faster rate (19.5% and 25%, respectively) than the 8.9% decline for the total value of all nonfuel minerals. Cement was manufactured at seven plants by six firms, two of which—Alpha Portland Cement Co. in St. Louis County and Dundee Cement Co., the State's largest cement producer, in Pike County—did not record masonry production. Of the four firms that produced both types of cement, River Cement Co., a subsidiary of IFI International, S.A. of Italy, with a plant in Jefferson County, ranked first in value. Ranked second in value was Missouri Portland Cement Co., whose plants in Jackson and St. Louis Counties are in heavily populated areas on opposite sides of the State.

The industry's 5 wet-process plants and 2 dry-process plants contain 8 wet-process kilns and 4 dry-process kilns equipped with

3 glass-bag dust collectors and 12 electrostatic precipitators for air-pollution control. Four of the plants consumed a total of 682,111 million cubic feet of natural gas in 1980, a 70% decrease from consumption in 1979. Also consumed were about 23,000 barrels of oil (a 60% decrease); there was a less significant decrease (15%) in the tons of coal. The seven plants required 590 million kilowatt-hours of electric energy in 1980, a 12.5% decrease from that of 1979. Conservation efforts and decreased production resulted in lower energy requirements.

Raw materials used for manufacturing cement amounted to about 5.4 million tons of limestone and 910,000 tons of argillaceous material (clay and shale), as well as siliceous material (sandstone and sand), ferriferous material (iron ore and mill scale), and almost 175,000 tons of gypsum. Clinker, fly ash, and slag also were used.

Products were gray portland cements of the following kinds: Types I and II, general use and moderate-heat; type III, high-early-strength; type V, high-sulfate-resisting; and portland pozzolan cement.

In 1980, 85% of prepared masonry cement was shipped. By yearend, stocks of prepared masonry cement were nearly 2.5 times as large as those of 1979.

Portland cement was shipped to users in the following proportions in 1980: Ready-mix companies, 78.5%; concrete products manufacturers, 9.4%; highway contractors, 6.6%; other contractors, 2.9%; and building materials dealers, 2.4%. This distribution of shipments was similar to that of 1979, except for the category of building materials dealers, which fell from fourth to fifth rank. About 88.5% of the portland cement was shipped in bulk from plants to terminals by barge on the Missouri and Mississippi Rivers. From terminals to the consumers, shipments were transported either by truck in bulk (98.1%), by truck in containers (0.62%), or by rail in bulk (1.23%). Other shipments were transported from plants to consumers by truck or rail, in bulk, or in containers.

As 1980 drew to a close, Marquette Co., a subsidiary of Gulf + Western Natural Resources Group, neared completion of its new 1-million-ton dry-process cement plant at Cape Girardeau. The new plant, scheduled to go onstream in the first quarter of 1981, was to replace the 300,000-ton-per-year wet-process facility that had been in production at the site since 1957. The plant incorporates an Allis Chalmers four-stage preheater/flash calcining system, which has a 14.5- by 235-foot rotary kiln section. The indirect coal-firing system includes two C-E Raymond bowl mills; the overall design anticipates consuming about 3 million British thermal units per ton of cement produced. Among the major, high-efficiency electric motors installed throughout the facility are the 3,000- and 4,500-horsepower source motors used, respectively, for the C-E Raymond raw roller mill and the two Allis Chalmers 13- by 52-foot Compeb finish mills. Three microprocessors and CRT's to monitor operating data, energy consumption, and the performance of pollution-control equipment will be parts of central control. Owing to the degree of advanced technology in the processing system design and components, only about 120 employees will be required to operate the enlarged facility, the same number that run the existing plant, which has one-third the capacity of the new. Some 50,000 tons of finished cement will be stored in silos that will accommodate truck, rail, and barge shipment loading. Much of the output will be transported about half a mile from the plant to silos at the dock on the Mississippi River. To boost its competitive capability and to help transport the output of the new plant, the company acquired four 3,200-ton self-unloading barges.

Table 7.—Missouri: Portland cement salient statistics

(Short tons)

	1979	1980
Number of active plants	7	7
Production	4,367,519	3,606,186
Shipments from mills:		
Quantity	4,430,370	3,515,362
Value	$194,284,865	$156,367,824
Stocks at mills, Dec. 31	374,573	495,763

Table 8.—Missouri: Masonry cement salient statistics

(Short tons)

	1979	1980
Number of active plants	4	3
Production	83,042	71,591
Shipments from mills:		
Quantity	81,987	61,507
Value	$4,158,852	$3,117,448
Stocks at mills, Dec. 31	8,766	19,429

Clays.—Missouri ranked 10th in the Nation in clay production, a drop from 9th in

1979 and a 22.7% decrease from the 1979 output. The largest tonnages were from common clay deposits, followed by fire clay and kaolin. Common clays were recovered from 16 mines near the larger cities and towns in well-populated counties such as Jackson and Platte (west-central Missouri); Livingston (north-central); Boone (central); Crawford (south-central); Jefferson, Pike, Ralls, and St. Louis (east-central); and Butler and Cape Girardeau (southeast). Fire clays were recovered from 53 mines in 9 counties, all within an 85-mile radius of St. Louis. Kaolinite, the principal mineral in fire clays, was mined by Allied Chemical Corp. in Gasconade County for the manufacture of aluminum sulfate (alum)—commonly used in petroleum refinery processing, as a waterproofing agent for concrete, and for chemical manufactures. Common clays and shale are a short-haul, low-priced mineral resource; in 1980, Missouri common clays averaged $2.44 per unit. Fire clays and kaolin have the necessary physical characteristics to be used in ever-widening industrial applications; fire clays averaged $18.30 per unit; unprocessed kaolin brought $18.81.

About 68% of all clay output in Missouri during the year came from the mines of five firms. The combined output from Audrain, Gasconade, Montgomery, and Pike, the leading counties, exceeded 66% of the State's total clay production. About 75% of the common clay and shale was used in portland cement production, 14% was used in manufacturing common and face brick, and the rest was used for flower pots and kindred products. Nearly 82% of the fire clay was used to manufacture fire brick, blocks, and shapes; other items manufactured from fire clay were high-alumina refractories, refractory grogs, and refractory mortar and cement. Nonswelling bentonitic clays were mined in Scott and Stoddard Counties, extreme southeastern Missouri. According to the 1980 Statistical Report of the Missouri Department of Labor and Industrial Relations, 145,658 tons of this material was produced at two mines operated by Southern Clay Co. Production was used for pet-waste absorbents, oil absorbents, antiskid material, and fertilizer and pesticide carriers.

Table 9.—Missouri: Clays sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Year	Fire clay		Common clay		Kaolin		Total[1]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1976	809	11,723	1,256	2,124	68	1,068	2,133	14,915
1977	872	12,529	1,432	3,190	69	1,173	2,373	16,892
1978	773	12,190	1,434	3,817	51	873	2,258	16,880
1979	799	15,194	1,497	4,350	55	978	2,351	20,522
1980	700	12,808	1,041	2,540	77	1,451	1,817	16,798

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

Iodine.—Although crude iodine was not produced in Missouri, four companies in the State imported more than 1 million pounds of domestic and foreign crude iodine to produce various organic and inorganic compounds. The four companies, in decreasing order of consumption, were Mallinckrodt, Inc., St. Louis County; West Argo-Chemical, Inc., of Shawnee Mission, Kans., in Jackson County; Syntex Agribusiness, Inc., Springfield area, Greene County; and Chemical Products, St. Joseph area, Buchanan County. Resublimed iodine and potassium and sodium iodide were the principal inorganic compounds produced.

Lime.—Missouri ranked third in the Nation as a producer of chemical and industrial lime. The lime was calcined from limestones and dolomites mined in Greene, St. Francois, and Ste. Genevieve Counties. Three firms had a combined limestone output amounting to 2.9 million short tons valued at $5.6 million; calcining resulted in 1.7 million short tons of lime valued at $63.7 million.

Perlite.—J. J. Brouk & Co., in St. Louis, and Georgia Pacific Corp., at Cuba in Crawford County, expanded perlite obtained from out-of-State sources in 1980. J. J. Brouk, the larger of the two producers, received an average of $204.56 per ton for the expanded perlite. The principal product uses were in preparing concrete and plaster aggregates, high- and low-temperature insulation and cavity-fill insulation, horticultural aggregates, fillers, and filter aids.

Sand and Gravel.—Construction and industrial sand and gravel production in 1980

was 8.9 million short tons, valued at $26.8 million. The quantity decreased 29% from that of 1979 and the value decreased 15%; nevertheless, sand and gravel ranked fourth in value of nonmetallic minerals in the State for both 1979 and 1980. Forty-seven of the 97 operations from which sand and gravel was quarried yielded less than 50,000 short tons. St. Louis County production (all construction sand and gravel) from nine operations was 2,819,000 short tons, valued at $10,285,000. Jefferson County, with six operations (both construction and industrial sand and gravel), ranked second in number of operations and second in value, $2,832,000. Clay County ranked second in quantity (all construction sand and gravel), 994,000 short tons, quarried from two operations. All three counties encompass heavily populated urban areas near St. Louis or Kansas City; more than 50 other counties also recorded sand and gravel production. In decreasing order of quantity, construction sand and gravel was used for concrete aggregate, asphaltic concrete aggregate, roadbases, fill, and miscellaneous products. Industrial sand and gravel was used for glass containers, foundry sand for molds and cores for casting common metals, and glass sand for windows and other products. Pennsylvania Glass Sand Corp., with quarries in St. Charles and St. Louis Counties, was the State's largest producer of industrial sand and gravel. The several operations of Riverside Sand & Dredging, all in St. Louis County, combined to make it the main source of construction sand and gravel in Missouri. Most of the sand and gravel from the site was processed into ready-mixed concrete by Winters Bros. Materials Co.'s wholly owned subsidiary, General Materials Co. The company transformed its dredging area into the George A. Winter Recreational Park, an attractive wooded area and a 600-acre lake, where aggregate production continued.

Table 10.—Missouri: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	6,949	$15,304	$2.20	4,715	$11,603	$2.46
Plaster and gunite sands	18	52	2.88	4	20	5.02
Concrete products	225	467	2.08	175	443	2.54
Asphaltic concrete	2,051	4,265	2.08	1,434	3,553	2.48
Road base and coverings	1,392	2,353	1.69	1,032	2,161	2.09
Fill	726	1,078	1.48	613	1,018	1.66
Snow and ice control	108	238	2.22	66	157	2.38
Other uses	231	445	1.92	140	300	2.15
Total[1] or average	11,699	24,201	2.07	8,178	19,255	2.35

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

Table 11.—Missouri: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	7,871	$15,977	$2.03	5,456	$12,549	$2.30
Gravel	3,828	8,224	2.15	2,722	6,706	2.46
Total or average	11,699	24,201	2.07	8,178	19,255	2.35
Industrial sand	859	7,109	8.28	722	7,498	10.39
Grand total or average	12,558	31,310	2.49	8,900	26,753	3.01

Stone.—Missouri ranked fifth in the Nation in output of crushed and dimension stone and seventh in value in 1980. Tonnages and dollars both decreased from 1979 output. In decreasing order of quantity used, crushed stone was produced from limestone, granite, marble, and sandstone. In decreasing order of output, St. Louis, Ste. Genevieve, Jefferson, Jackson, Ralls, Wayne, and Cape Girardeau Counties were

the leading sources of stone, each yielding more than 1.8 million tons. Output from these seven counties was about 41% of the State's crushed stone for the year. Stone was quarried for crushing in 93 of Missouri's 114 counties by 148 firms and 3 county highway departments. Unit values ranged from $1.88 for crushed stone used for railroad ballast to $72.50 for some dimension stone. Dimension stone cut from marble and sandstone constituted a small fraction of the total value and output.

Output of stone from individual quarries ranged from about 100 short tons to more than 1 million short tons. During the year, 138 quarries individually yielded less than 100,000 tons, accounting for 12.7% of the output; 98 quarries yielded between 100,000 and 500,000 tons, accounting for about 44.5% of the production; and 19 quarries each yielded more than 500,000 tons, accounting for about 42.7% of the stone production.

Ten stone quarries each yielded from 500,000 to 900,000 short tons, and nine quarries exceeded the 900,000-ton production level. The largest quantities of stone were produced in counties bordering the Mississippi River, just north and south of St. Louis and in the vicinity of Cape Girardeau. Large quantities also were quarried in counties near Columbia, Jefferson City, Kansas City, and Springfield, and in northern Wayne County. These cities and their home counties contain 52% of the State's population. No quarries were operated in 21 counties, some of which lack the mineral resource and some of which lack the demand; except for Butler and Dunklin, these counties have populations of less than 30,000 people.

Limestone quarries yielded 95.8% of Missouri's 1980 stone production. The stone was used for other construction aggregate and roadstone (16.9% of total limestone production), dense-graded roadbase (14.6%), cement manufacture (11.9%), and concrete aggregate (9.8%). In continuing decreasing order of volume, limestone also was used for bituminous aggregate, agricultural limestone, riprap and jetty stone, lime manufacture, surface treatment aggregate, etc. A minor but growing use, ranking 18th out of 24 uses of limestone during 1980, is in the removal of sulfur oxides from stack gases, mainly from coal burning.

According to Rock Products,[9] Missouri Limestone Producers Association members noted that business was down about 35% from the 1979 level; small operators in rural areas were the hardest hit, and several quarries reduced operating hours or closed temporarily.

In 1980, the University of Missouri-Columbia, Agricultural Experiment Station, issued a collection of physical-property sampling statistics: Missouri Agricultural Liming Materials Report, January 1 to June 30, 1980. Tabulated in this 27-page report are the effective magnesium contained in each limestone sample, the effective neutralizing material, and the percent passing U.S. No. 40 sieve.

The Agrock Div. of Ash Grove Cement Co., Kansas City, acquired the assets of Morgans Materials, Inc.,[10] Buffalo; Ash Grove operates numerous limestone quarries in western and southwestern Missouri.

Howard Quarries, Inc., of Sedalia, a high-volume aggregate producer, relied on portable crushing equipment in each of its four quarries, according to Pit & Quarry.[11] The firm was among the largest (upper 10%, by volume) stone producers in the State. Of its limestone aggregates, about 90% to 95% were trucked to the company's five ready-mix plants, a block plant, and a road construction company. About 5% to 10% was sold to competing ready-mix operations. Howard served central Missouri by means of its fleet of 28 International Loadstar 1800 material haulers. The firm's main quarry was a 1,000-acre site in Pettis County, central Missouri; other quarries and pits were in Pulaski and Saline Counties. Howard has been reclaiming quarried land since about 1977; the landfill project near Sedalia in 1980 was the second such operation at that quarry. The first landfill program created a park and a lake.

Granite (dark-colored rhyolite) was produced by Missouri Pacific Corp. at Gads Hill Quarry, Wayne County, and by GAF Corp. at Annapolis Quarry, Iron County. The Annapolis Quarry, opened in 1965, is a multiple-bench open-pit operation capable of producing annually 500,000 to 1,000,000 tons of usable rock, with 100,000 to 500,000 tons of waste, according to the E/MJ International Directory of Mining and Mineral Processing Operations.[12] In the St. Francois Mountain area of Iron and Wayne Counties, Cambrian quartzose rocks are in contact with exposed knobs and ridges of Precambrian granite intrusives and rhyolite extrusives. Both the granite (dimension stone) and rhyolite have been quarried by local operators, though the term in general use is

"granite." Rock quarried in 1980 was crushed and sold for use as dense-graded roadbase, railroad ballast, riprap and jetty stone, and roofing granules; unit values ranged from $1.61 to $2.45.

Marble was quarried in Jefferson County by The Georgia Marble Co. for use as terrazzo and exposed aggregate, and in Ste. Genevieve County by Weiler Marble Co., Inc., for use as rough-block dimension stone. The crushed marble was sold for $48.00 per unit, and the dimension stone was sold for $72.50.

Sandstone was recovered in Jefferson County by River Cement and used for cement manufacture. In Camden County, Beavers Natural Stone Co. quarried sandstone for use as flagging and cut stone. Unit values ranged from $1.84 for crushed sandstone to $62.50 for dimension stone.

More than 85% of all types of crushed stone was transported by truck, 5% by rail, and the remainder by water or miscellaneous methods.

Table 12.—Missouri: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	4,401	11,879	4,009	11,679
Concrete aggregate	8,658	22,079	4,529	14,823
Bituminous aggregate	4,629	13,287	4,514	13,126
Macadam aggregate	3,482	6,649	2,329	4,569
Dense-graded roadbase stone	7,092	18,263	7,104	18,432
Surface treatment aggregate	3,775	12,056	2,680	8,933
Other construction aggregate and roadstone	6,790	18,967	7,799	22,850
Riprap and jetty stone	4,871	8,725	3,826	9,125
Railroad ballast	1,134	2,105	1,288	2,425
Filter stone	47	115	201	537
Manufactured fine aggregate (stone sand)	131	447	93	330
Terrazzo and exposed aggregate	5	240	4	197
Cement manufacture	6,120	12,062	5,604	11,802
Lime manufacture	3,230	6,116	2,902	5,635
Asphalt filler	75	229	75	246
Other[2]	1,941	6,723	1,339	5,544
Total[3]	56,380	139,944	48,296	130,254

[1]Includes limestone, granite, marble, and sandstone.
[2]Includes stone used for poultry grit and mineral food, dead-burned dolomite, flux stone, mine dusting, whiting or whiting substitute, chemicals, glass manufacture, roofing granules, sulfur removal from stack gases, and unspecified uses.
[3]Data may not add to totals shown because of independent rounding.

Sulfur.—The Sugar Creek Refinery of Standard Oil Co. (Indiana) and Amoco Oil Co., in Jackson County, reported recovering elemental sulfur during the year. Sulfuric acid was recovered by the updraft sinter method from lead-zinc ores at AMAX Lead and Zinc Div.'s plant in Iron County; the year's output from this sulfuric acid facility was reportedly 55,854 tons. Elemental sulfur and sulfuric acid were not included in table 1 because they are considered secondary products.

Vermiculite.—W. R. Grace & Co.'s and J. J. Brouk & Co.'s plants in St. Louis County produced exfoliated vermiculite from out-of-State sources of crude vermiculite, a hydrated mineral of the mica group. The product was sold for use as concrete aggregate, soil conditioner, loose fill insulation, block insulation, fertilizer, and other similar products. J. J. Brouk & Co. produced 3,684 short tons of exfoliated vermiculite, which had an average value of $266.67 per ton.

[1]State mineral specialist, Bureau of Mines, Denver, Colo.

[2]Geologist, Missouri Department of Natural Resources, Division of Geology and Land Survey, Rolla, Mo.

[3]Mining Engineering. Asarco's West Fork Lead Mine Sets 1983 Startup Date. April 1980, p. 377.

[4]Engineering and Mining Journal. St. Joe Will Develop New Mine and Expand Mill at Viburnum, Mo. June 1980, p. 43.

World Mining. St. Joe to Develop New 4,000-ton-per-day Lead Mine. July 1980, p. 69.

[5]Pit & Quarry. Excavator Solves Overburden, Waste Removal Problem at High-Grade Clay Deposit. September 1980, pp. 70-72.

[6]E/MJ International Directory of Mining and Mineral Processing Operations, 1980, p. 200.

[7]U.S. Geological Survey. Principles of the Mineral Resource Classification System of the U.S. Bureau of Mines and U.S. Geological Survey. U.S. Geol. Survey Bull. 1450-A, 1976, 5 pp.

[8]Paulson, D. L., W. M. Dressel, and R. M. Doerr. Cobalt and Nickel Recovery From Missouri Lead Ores. Proc. 7th Mineral Waste Utilization Symposium, Chicago, Ill., Oct. 20-21, 1980, pp. 127-134.

[9]Rock Products, December 1980, pp. 48-49.

[10]Pit & Quarry. Ash Grove Cement Acquires Morgans Materials, Inc. June 1980, p. 24.

[11]Steele, C. Portable Crushers Meet Million Ton Aggregate Demand. Pit & Quarry. September 1980, pp. 76-80.

[12]E/MJ International Directory of Mining and Mineral Processing Operations, 1980, p. 199.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Barite:			
Agers Bros., Inc	402 South 2d St. De Sota, MO 63020	Plants	Washington.
Dresser Industries, Inc	Box 8 Potosi, MO 63664	Mine and mill	Jefferson and Washington.
NL Industries, Inc	Box 2808 St. Louis, MO 63111	do	Washington.
Cement:			
Alpha Portland Cement Co.[1]	Box 20140 St. Louis, MO 63123	Plant and quarry	St. Louis.
Dundee Cement Co.[1 2]	Box 67 Clarksville, MO 63336	do	Pike.
Marquette Co. of Gulf + Western Natural Resources Group.[1 2]	Foot of Haven St. St. Louis, MO 63111	do	Cape Girardeau, Jackson, St. Louis.
Missouri Portland Cement Co.[2]	7711 Carondelet Ave. St. Louis, MO 63105	Plants and quarries	Jackson and St. Louis.
River Cement Co.[2]	Box 14545 Festus, MO 63028	Plant and quarry	Jefferson.
Clays:			
Allied Chemical Corp., Industrial Chemicals Div.	Box 517 Owensville, MO 65066	Mine and plant	Gasconade.
Dresser Industries, Inc., Harbison-Walker Refractories Co.	2 Gateway Center Pittsburgh, PA 15222	do	Callaway, Gasconade, Maries, Montgomery, Warren.
A. P. Green Refractories Co., U.S. Gypsum Co.	1018 East Breckenridge St. Mexico, MO 65265	Mines	Audrain, Franklin, Gasconade.
Kaiser Aluminum & Chemical Corp	Box 499 Mexico, MO 65265	Mine and plant	Audrain, Callaway, Gasconade, Montgomery, Osage.
Midland Brick & Tile Co	Box 428 Chillicothe, MO 64601	Pit and plant	Livingston.
Industrial sand:			
Martin Marietta Aggregates[2]	110 East Main St. Rockton, IL 61072	do	Jefferson.
Master Bros. Silica Sand Co	Route 1, Box 204 Pevely, MO 63070	do	Do.
Pennsylvania Glass Sand Corp	Box 187 Berkley Springs, WV 25411	do	St. Charles and St. Louis.
Iron:			
Hanna Mining Co.-National Steel Corp., Pilot Knob Pellet Co.	Box 26 Ironton, MO 63650	Underground mine and plant.	Iron.
St. Joe Minerals Corp., Pea Ridge Iron Ore Co.	Route 4 Sullivan, MO 63080	do	Washington.
Lead:			
AMAX Lead Co. of Missouri & Homestake Mining Co.[3]	Boss, MO 65440	do	Iron.
Cominco American, Incorporated[3]	Bixby, MO 65439	do	Do.
Kennecott Copper Corp., Ozark Lead Co.[3]	Sweetwater, CPO Ellington, MO 63680	do	Reynolds.
St. Joe Minerals Corp., St. Joe Lead Co.[3]	Box 500 Viburnum, MO 65566	do	Iron, Reynolds, Washington.
Lime:			
Ash Grove Cement Co.[2]	920 Main St., Suite 1000 Kansas City, MO 64105	Plant	Greene.
Mississippi Lime Co.[2]	7 Alby St. Alton, IL 62002	Plant and quarry	Ste. Genevieve.
Valley Mineral Products Corp.[2]	915 Olive St. St. Louis, MO 63101	Plant	St. Francois.
Perlite, expanded:			
J. J. Brouk & Co	1367 South Kingshighway Blvd. St. Louis, MO 63110	do	St. Louis.
Sand and gravel:			
Barnhart, Leonard, Construction Co	1921 East McCarty St. Jefferson City, MO 65101	Pit and plant	Crawford, Franklin, Jefferson.
Capitol Sand Co., Inc	Box 156 Cedar City, MO 65022	do	Callaway.
Eureka Sand & Gravel Co., Inc	Box 260 Eureka, MO 63025	Dredge and plant	St. Louis.
Holliday Sand & Gravel Co	6811 West 63rd St. Overland Park, KS 66204	Pit and plant	Clay.
Riverside Sand & Dredging	5000 Bussen Rd. St. Louis, MO 63129	Dredge	St. Louis.

See footnotes at end of table.

Table 13.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel —Continued			
Simpson Materials Co	1245 Marshall Rd. Valley Park, MO 63088	Pit and plant	Jefferson.
West Lake Ready Mix Co	Route 1, Box 206 Bridgeton, MO 63044	Dredge and plant	St. Louis.
Williamsville Stone Co	Box 234 Poplar Bluff, MO 63901	Pit and plant	Butler.
Winter Bros. Material Co	13098 Gravois Rd. St. Louis, MO 63127	Dredge and plant	St. Louis.
Stone:			
Gordon Bros. Quarries, Inc	Box 127 Forest City, MO 64451	Quarries	Andrew, Gentry, Holt.
Missouri Pacific Corp	210 North 13th St. St. Louis, MO 63103	Quarry	Wayne.
Moline Consumers Co.[4]	313 16th St. Moline, IL 61265	Quarries	Jefferson, Knox, Marion, Monroe, Pike, Ralls, St. Louis, Shelby.
Tower Rock Stone Co	Box 69 Columbia, IL 62236	Quarry	Ste. Genevieve.
Fred Weber, Inc	7929 Alabama Ave. St. Louis, MO 63111	Quarries	Jefferson, St. Charles, St. Louis.
West Lake Quarry & Material Co	13570 St. Charles Rock Rd. Bridgeton, MO 63044	____do	Cape Girardeau, Cole, St. Louis, Scott.
Vermiculite, exfoliated:			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	St. Louis.

[1]Also clays.
[2]Also stone.
[3]Also silver, copper, and zinc.
[4]Also sand and gravel in Lewis County.

The Mineral Industry of Montana

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Montana Bureau of Mines and Geology for collecting information on all nonfuel minerals.

By G. T. Krempasky,[1] E. C. Bingler,[2] and D. C. Lawson[3]

The value of nonfuel mineral production in Montana was $280 million in 1980. The total value of produced metals—antimony, copper, gold, lead, silver, tungsten, and zinc—accounted for 57% of the State's total nonfuel mineral production in 1980. The total value of the State's production of nonmetals—barite, cement, clays, gem stones, gypsum, lime, peat, phosphate rock, sand and gravel, stone, talc, and vermiculite—accounted for the remainder.

Compared with other States, the value of Montana's production ranked in the top five in 1980 for the following commodities: Antimony, barite, copper, gold, talc, and vermiculite.

Trends and Developments.—In January 1980, The Anaconda Copper Co. dismissed 360 workers at its Montana operations. The people dismissed constituted about 10% of the company's Montana work force. This reduction included 200 employees in Butte, 100 at the company's smelter in Anaconda, 45 at its Great Falls refinery, and 15 employees of the company-owned railroad. In addition, the smelter manager in Anaconda informed the Montana State Board of Health and Environmental Science that the smelter's future may be in jeopardy because of the high cost of installing air pollution control equipment. In February 1980, the Montana Board of Health granted The Anaconda Copper Co. a variance from sulfur dioxide emission standards for its smelter at Anaconda; this was effective until June 30, 1980. In its findings, the Board took into account the economic impact of smelter closure. Closure, the board indicated, would result in cessation of Anaconda's operations in Butte, a lime quarry west of Anaconda, and the Butte, Anaconda, and Pacific Railway. Since 1973, the company has obtained seven variances from the standards and was expected to seek an eighth one that would have been effective from June 30, 1980, to June 30, 1981.

The Board of Health also granted ASARCO Incorporated's East Helena smelter a 1-year renewal of a variance that expired July 1, 1980. Asarco has been operating under State exemptions to air pollution regulations since 1973. Company officials believe that the additional time to complete physical improvements can result in the smelter meeting all governmental air quality standards, even the more stringent new State standards.

The Montana Board of Health adopted new air quality standards on July 18, 1980. The rules are at least as strict as Federal standards; many are more stringent.

A labor-management dispute of 5 months'

duration resulted in the closure of Anaconda's operations in Montana, commencing on July 1, 1980. Subsequently, the dispute was settled. However, during the interim, Atlantic Richfield Co. (ARCO) announced that its wholly owned subsidiary, The Anaconda Copper Co., was closing its smelter at Anaconda and its refinery at Great Falls. According to company officials, closures were the result of the costs of retrofitting the smelter to comply with clean air standards. Losses of 1,000 jobs in Anaconda and 500 in Great Falls were the direct results of these closures. The Great Falls refinery contributed approximately 10% of the Nation's refined copper production.

The Black Pine Mine, near Philipsburg, increased production from 6,000 to 17,000 short tons per month. Montana Barite Co., near Missoula, was operating its plant on the basis of two 9-hour shifts per day, 7 days per week. U.S. Antimony Corp., of Thompson Falls, planned to erect a flotation mill in the Lolo National Forest to process silver ore from the Big Chief Mine in the Eddy Creek drainage. Placer Amex Inc. was seeking necessary permits to bring a 5,000-ton-per-day mine onstream near Whitehall. Activities in the Little Rocky Mountains, near the towns of Zortman and Landusky, pointed to an increase in Montana gold production. The Anaconda Copper Co. announced plans to build a $20 million addition to its Weed Concentrator in Butte, to include a $6 to $8 million molybdenum recovery facility. The new plant is expected to recover from 5 to 6 million pounds of molybdenum per year.

The Mining and Mineral Resources and Research Institute, at Montana College of Mineral Science and Technology, Butte, which was created under Title III of Public Law 95-87, received a total of $238,260 in grants for research endeavors from the Office of Surface Mining, U.S. Department of the Interior.

Mineral exploration continued at a high level, extending the trend of the past few years. In the State, 38 companies or individuals were active in exploration, 12 for the first time. They were engaged in 61 separate projects. During the year, the Montana Department of State Lands issued 250 small mine operator permits.

Table 1.—Nonfuel mineral production in Montana[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony ---------- short tons	W	W	260	W
Clays ---------- thousand short tons	424	$11,508	626	$22,200
Copper (recoverable content of ores, etc.) ---------- metric tons	69,854	143,268	37,749	85,236
Gem stones ----------	NA	100	NA	90
Gold (recoverable content of ores, etc.) ---------- troy ounces	24,050	7,395	48,366	29,627
Lead (recoverable content of ores, etc.) ---------- metric tons	258	299	295	276
Lime ---------- thousand short tons	216	8,965	223	9,001
Sand and gravel ---------- do	7,012	15,106	[2]6,639	[2]16,057
Silver (recoverable content of ores, etc.) ---- thousand troy ounces	3,302	36,618	2,024	41,773
Stone (crushed) ---------- thousand short tons	2,527	7,806	1,962	6,302
Talc ---------- do	343	5,940	312	11,310
Zinc (recoverable content of ores, etc.) ---------- metric tons	104	86	71	59
Combined value of barite, cement, gypsum, iron ore (1979), peat, phosphate rock, industrial sand (1980), stone (dimension), tungsten, vermiculite, and values indicated by symbol W ----------	XX	54,196	XX	57,619
Total ----------	XX	291,287	XX	279,550

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

[2]Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Montana, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Beaverhead	$917	$964	Stone, silver, sand and gravel, zinc, gold, lead, copper.
Big Horn	53	W	Sand and gravel, stone.
Broadwater	W	W	Gold, silver, lead, copper.
Carbon	W	4,061	Clays, stone, sand and gravel.
Carter	W	W	Clays.
Cascade	1,131	W	Sand and gravel, stone.
Chouteau	172	162	Sand and gravel.
Custer	25	111	Do.
Daniels	38	8	Do.
Dawson	694	449	Sand and gravel, stone.
Deer Lodge	6,893	8,178	Lime, stone, sand and gravel, tungsten, clays.
Fergus	1,136	1,123	Gypsum, sand and gravel, clays, lead, silver, copper, stone.
Flathead	2,217	3,997	Sand and gravel, stone.
Gallatin	W	20,681	Cement, stone, sand and gravel, clays.
Garfield	--	2	Stone.
Glacier	7	W	Gold, silver, zinc, lead, copper.
Golden Valley	56	1	Stone.
Granite	W	7,625	Silver, copper, stone, gold, sand and gravel, lead, zinc.
Hill	19	19	Sand and gravel.
Jefferson	16,564	15,024	Cement, stone, sand and gravel, silver, gold, lead, clays, copper, zinc.
Judith Basin	W	W	Gypsum, lead, silver.
Lake	W	W	Sand and gravel, peat, gold, silver, lead, zinc, stone, copper.
Lewis and Clark	W	1,077	Sand and gravel, lead, silver, gold, zinc, copper, stone.
Liberty	46	W	Sand and gravel.
Lincoln	W	W	Vermiculite, sand and gravel.
McCone	2	9	Stone.
Madison	W	6,883	Talc, gold, silver, copper, lead, zinc, sand and gravel, stone.
Meagher	W	W	Iron ore, gold.
Mineral	81	612	Silver, lead, sand and gravel, copper, stone, gold.
Missoula	W	W	Barite, sand and gravel, stone.
Musselshell	84	42	Sand and gravel.
Park	W	W	Stone, sand and gravel.
Petroleum	11	31	Sand and gravel.
Phillips	--	3	Stone.
Pondera	W	W	Sand and gravel.
Powell	W	W	Phosphate rock, sand and gravel.
Ravalli	W	765	Sand and gravel, stone, peat, silver, lead, zinc, copper.
Richland	W	W	Lime, sand and gravel.
Rosebud	147	W	Sand and gravel, stone.
Sanders	W	W	Antimony, gold, lead, silver, zinc, copper.
Sheridan	W	57	Sand and gravel.
Silver Bow	W	178,215	Copper, silver, gold, sand and gravel, stone.
Stillwater	15	W	Sand and gravel, stone.
Sweet Grass	17	123	Stone, sand and gravel.
Toole	100	146	Sand and gravel, stone.
Treasure	W	--	
Valley	W	W	Clays, sand and gravel.
Wibaux	--	8	Sand and gravel.
Yellowstone	W	W	Sand and gravel, lime, clays.
Undistributed[2]	175,379	40,915	
Total[3]	205,800	291,287	

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

[1]Blaine, Fallon, Powder River, Prairie, Roosevelt, Teton, Wheatland Counties, and Yellowstone National Park are not listed because no nonfuel mineral production was reported.

[2]Includes gem stones and stone 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.

Table 3.—Indicators of Montana business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	370.0	374.0	+1.1
Unemployment	do	19.0	22.0	+15.8
Employment (nonagricultural):				
Mining[1]	do	7.7	7.6	-1.3
Manufacturing	do	27.0	23.6	-12.6
Contract construction	do	15.6	14.7	-5.8
Transportation and public utilities	do	23.1	23.0	-.4
Wholesale and retail trade	do	73.5	72.3	-1.6
Finance, insurance, real estate	do	12.7	12.9	+1.6
Services	do	54.2	56.0	+3.3
Government	do	70.1	70.6	+.7
Total nonagricultural employment[1 2]	do	283.8	280.6	-1.1
Personal income:				
Total	millions	$5,917	$6,619	+11.9
Per capita		$7,528	$8,445	+12.2
Construction activity:				
Number of private and public residential units authorized		3,122	2,084	-33.2
Value of nonresidential construction	millions	$80.4	$58.9	-26.7
Value of State road contract awards	do	$105.0	$64.0	-39.0
Shipments of portland and masonry cement to and within the State	thousand short tons	339	294	-13.3
Nonfuel mineral production value:				
Total crude mineral value	millions	$291.3	$279.6	-4.0
Value per capita, resident population		$371	$355	-4.3
Value per square mile		$1,980	$1,900	-4.0

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.
[2]Data may not add to totals shown because of independent rounding.

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

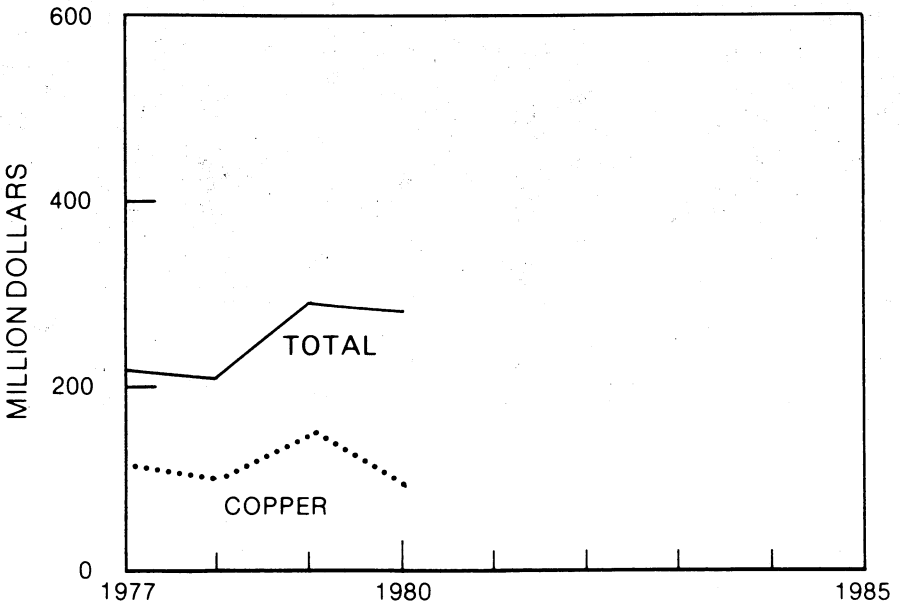

Figure 1.—Value of copper and total value of nonfuel mineral production in Montana.

Employment.—Mining-related employment in Montana during 1980 was about 7,600 people, or approximately 3% of total nonfarm employment in the State. However, the metal processing segment of the mineral industry lost about 1,500 jobs as a result of the closure of Anaconda's smelter and refinery. The average wage earned by mining workers was $434 per week, compared with $237 per week for all State nonfarm employees.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Major news of the year for Montanans was the decision by The Anaconda Copper Co. to close its copper smelter in Anaconda and its refinery in Great Falls. The company was negotiating with a Japanese firm to process its concentrates.

Metals accounted for 57% of the total value of nonfuel mineral production in Montana in 1980, compared with 65% in 1979.

Exploration and development activities continued at high rates, following trends of the past few years. Anaconda and Stillwater PGM Resources continued exploring and developing the platinum-palladium resources in the Stillwater Complex. Anaconda completed its development adit near Mouat, and PGM began work on a new portal at the west end of the complex. Ranchers Exploration and Development Corp. announced plans to develop an open pit mine near Cooke City on a half-million-ton deposit averaging 0.2 ounce of gold per ton. At the Nancy Lee Mine near Superior, the lessee, Western Silver Development Co., continued to develop the mine containing a vein reported to average more than 10 ounces of silver per ton. Anaconda's Flathead Mine was the site of additional work that has proceeded to a point where application for an operating permit is under consideration. Black Pine Mining Co. increased its output from 6,000 to 17,000 short tons per month. At the Polaris Mine, Beaverhead County, evaluation was undertaken to determine the feasibility of constructing a mill that can utilize a combination of cyanide leaching and electrolysis.

Several gold heap-leaching operations came onstream during 1980, notably operations in the Little Rocky Mountains by Zortman Mining, Inc., and by Landusky Mining, Inc., where reported gold production for the year was approximately 34,000 ounces. At the Mammoth Mine in the Tobacco Root Mountains, the first bullion from a heap-leaching operation was produced. At the Gregory Mine south of Helena, favorable tests indicated that most gold and silver from stockpiled ore can be recovered by heap-leaching techniques. In the Elkhorn district, at the Tourmaline Queen property, research related to a heap-leach operation was underway. Initial reports indicated that the operation would come onstream in 1981. Noranda Exploration was reported to have staked claims in the Rochester Basin area in Beaverhead County. Gold has been produced in the area. The Rochester mill in the same area was being evaluated for incorporation of a cyanide circuit. Goldsil-Ranchers mill near Marysville, a cyanide-leaching mill, was damaged by fire in July 1980. The mill is expected to be rebuilt. At Jardine, Homestake Mining Co. was active and completed extensive surface work and some underground activity, including long hole drilling.

Placer Amex Inc. announced plans to obtain necessary permits to bring a 5,000-ton-per-day mine and mill complex onstream. Based on present-day prices, its Golden Sunlight property, near Whitehall, is considered to have gold reserves capable of sustaining a long-term operation.

Placer mining activities, stimulated by high gold prices, were on the increase. Major companies, small operators, and individuals were evaluating former producing areas, with some areas reportedly producing. However, quantities of gold produced were not reported. International Nickel Co. (INCO) was evaluating the Ruby Placer in Beaverhead County. INCO drilled 30 holes to bedrock and removed about 1,000 cubic yards of gravel for testing. Playgo Mining Co. was evaluating the placer potential south of Virginia City.

Exploration and development activities for molybdenum continued at a high level. The most significant announcement during the year was by Anaconda, which concerned a $6 to $8 million addition to the Weed Concentrator to process copper-molybdenum ore mined from the Berkeley pit in Butte. AMAX Inc. continued its efforts in the Niehart-Hughesville area, and Cyprus Exploration Co. and Molycorp Inc.

continued their efforts in the East Pioneers. In addition, the U.S. Geological Survey announced the discovery of zones in the Pioneer Mountains likely to contain molybdenum.

Evaluation of a former tungsten-producing mine, Brown's Lake deposit, was underway by Union Carbide Corp. The company reportedly found additional tungsten resources after extensive drilling. U.S. Antimony Corp. discovered tungsten in one of the three veins in its Thompson Falls antimony mine. Initial tests indicated a tungsten content of 6 to 7 pounds per ton.

Other places with more than average activity include the Chicago Peak region of the Cabinet Mountain Wilderness Area, where Asarco drilled 35 core holes on claims held. Mascot Silver-Lead Mines Inc. was developing a lead-silver-gold vein, averaging 11.2% lead, 11.6 ounces of silver, and 0.1 ounce of gold per ton, at the Argentine Mine near Wickes. The company also was planning to open its Meadow Mine near Helena, where assays reportedly indicate over 200 ounces of silver per ton. Summit Silver Inc. was exploring the Baltimore Mine northwest of Boulder, a past producer of gold. In the Judith Mountains, Viking Exploration Co. reopened the Spotted Horse Mine where gold was produced in the late 1880's and early 1900's.

Antimony.—U.S. Antimony mined and processed ore in Sanders County and continued to be one of only two domestic sources of antimony. The plant produced a variety of products.

Copper.—Copper was recovered from the ores of eight mines in seven counties and from a leach operation in Silver Bow County in 1980; this compares with production from 29 mines in 13 counties, and the leach operation in 1979. Approximately 99% of the copper produced was from Anaconda's operations in Silver Bow County. However, production in that county during 1980 was only about 56% of the yearly average of the 5-year period (1976-80). Production in 1980 declined 46%, and the value of the product produced declined 41% when compared with 1979 statistics. Montana ranked fourth in copper production value compared with other producing States; it supplied about 3% of new copper production in the United States in 1980 and 5% in 1979.

Major 1980 issues affecting the copper industry were the labor-management dispute, closure of Anaconda's smelter and refinery, addition to the Weed Concentrator in Butte, and the exploration efforts in the Butte area. The latter are related to copper resources that may be feasibly extracted by large-volume underground mining.

Gold.—Gold was recovered from the ores of 20 mines in 9 counties and from 1 placer mine in Meagher County, compared with production from 31 mines, including 1 placer, in 1979. Production increased 101%, and value increased 301% compared with 1979 statistics. Montana ranked sixth in 1979 and fifth in 1980 among the gold-producing States. Production in 1980 was approximately 5% of new gold produced in the Nation, compared with about 2.5% in 1979.

Silver Bow County, where gold is recovered as a byproduct from copper mining, has been the leading area of production during the recent past. In 1980, approximately 24% of newly mined gold in the State was produced from that county, compared with about 89% in 1979. The 5-year production average (1976-80) from Silver Bow County was 18,170 troy ounces; in 1980, about 64% of that average was produced.

Heap-leaching activities by Zortman Mining, Inc., and Landusky Mining, Inc., placed Phillips County first in production in 1980. These two companies contributed about 71% of new gold production in Montana.

Silver.—The principal source of silver, accounting for approximately 79% of total State output in 1980 and 80% in 1979, was ore from Anaconda's operations in Butte. A total of 26 mines in 10 counties produced silver-bearing ores, compared with 31 mines in 14 counties in 1979. Silver Bow County continued to be the principal producing county; however, production in 1980 was about 64% of the average (2,510,000 troy ounces) for the period 1976-80. Production of silver outside the Butte area amounted to 646,000 troy ounces in 1979, and 428,000 troy ounces in 1980. Montana ranked sixth among the producing States in 1980, and third in 1979. About 6% of newly mined silver in the Nation during 1980 came from Montana mines; in 1979, Montana's share was approximately 9%.

Table 4.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1980, by class of ore or other source material

Source	Number of mines[1]	Material sold or treated (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:							
Dry gold[2] and gold-silver[3]	14	476,040	36,366	102,392	10	88	--
Silver	5	50,285	219	295,490	246	29	[4]
Total[5]	19	526,325	36,585	397,882	255	117	[4]
Copper	2	8,217,395	11,541	1,612,034	32,825	[6]	--
Lead	5	9,140	240	13,977	--	178	[7]71
Total	26	8,752,860	48,366	2,023,893	33,080	295	71
Other lode material:							
Copper precipitates	1	7,494	--	--	4,669	--	--
Total lode material[5]	26	8,760,354	48,366	2,023,893	37,749	295	71
Placer	1	--	[6]	--	--	--	--
Grand total	27	8,760,354	48,366	2,023,893	37,749	295	71

[1]Details may not add to total because some mines produce more than one class of material.
[2]Includes material that was leached.
[3]Combined to avoid disclosing company proprietary data. Also includes gold recovered from placers and lead recovered from copper ore.
[4]Included with recovery from lead ore to avoid disclosing company proprietary data.
[5]Data may not add to totals shown because of independent rounding.
[6]Included with recovery from gold and gold-silver ores to avoid disclosing company proprietary data.
[7]Includes recovery from silver ore.

Table 5.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing		Material sold or treated[1] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1978, total	25	3	16,349,088	19,967	$3,864,614	2,918,317	$15,758,911
1979, total	33	1	15,631,139	24,050	7,395,381	3,301,928	36,618,378
1980:							
Beaverhead	2	--	630	16	9,801	24,330	502,171
Broadwater	2	--	54	62	37,978	146	3,014
Granite	3	--	38,905	839	513,938	268,110	5,533,790
Jefferson	7	--	14,359	707	433,080	38,522	795,094
Madison	6	--	1,854	830	508,426	17,444	360,043
Mineral	1	--	12,159	30	18,377	23,741	490,014
Powell	1	--	363	5	3,063	10	206
Silver Bow	1	--	8,223,813	11,541	7,069,555	1,595,597	32,933,122
Undistributed[2]	3	1	468,218	34,336	21,032,861	55,993	1,155,696
Total	26	1	[3]8,760,354	48,366	29,627,079	2,023,893	41,773,150

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1978, total	67,326	$98,704,712	132	$97,625	79	$53,790	$118,479,652
1979, total	69,854	143,268,088	258	298,790	104	86,112	187,666,749
1980:							
Beaverhead	1	3,305	10	9,724	W	W	[4]525,001
Broadwater	--	--	--	--	--	--	40,992
Granite	238	538,486	3	2,443	--	--	6,588,657
Jefferson	8	17,952	261	244,253	W	W	[4]1,490,379
Madison	--	--	3	2,968	--	--	871,437
Mineral	6	12,730	16	15,227	--	--	536,348
Powell	2	3,896	--	--	--	--	7,165
Silver Bow	37,467	84,599,773	--	--	--	--	124,602,450
Undistributed[2]	27	60,157	2	1,826	71	58,758	22,309,298
Total	37,749	85,236,299	295	276,441	71	58,758	156,971,727

W Withheld to avoid disclosing company proprietary data; included in "Undistributed."
[1]Does not include gravel washed.
[2]Meagher, Park, and Phillips Counties and items indicated by symbol W are combined to avoid disclosing company proprietary data.
[3]Data do not add to total shown because of independent rounding.
[4]Excludes value of zinc content.

Table 6.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1980, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode:					
Cyanidation and smelting of concentrates from ore[1]	46,802	1,682,614	32,805	193	71
Direct smelting of:					
Ore	1,564	341,279	275	102	(2)
Precipitates	--	--	4,669	--	--
Total[1]	1,564	341,279	4,944	102	(2)
Total lode	48,366	2,023,893	37,749	295	71
Placer	(2)	--	--	--	--
Grand total	48,366	2,023,893	37,749	295	71

[1]Combined to avoid disclosing company proprietary data.
[2]Included with recovery by cyanidation and by smelting of concentrates to avoid disclosing company proprietary data.

Table 7.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in Silver Bow County

Year	Mines producing	Material sold or treated (thousand metric tons)	Gold (troy ounces)	Silver (thousand troy ounces)
1976	2	15,244	19,845	2,937
1977	1	14,054	21,181	3,081
1978	1	16,233	16,949	2,281
1979	1	15,545	21,336	2,655
1980	1	8,244	11,541	1,596
1882-1980	--	[1]509,153	2,666,484	680,270

Year	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)	Total value (thousands)
1976	82,471	3	1	$141,810
1977	77,942	--	--	132,163
1978	66,741	--	--	113,446
1979	69,133	--	--	177,800
1980	37,467	--	--	124,602
1882-1980	8,576,515	415,442	2,406,823	5,771,468

[1]Complete data not available for 1882-1904.

NONMETALS

Nonmetals accounted for 43% of the total value of nonfuel mineral production in Montana in 1980, compared with 35% in 1979. Construction materials production was negatively affected by the national economic downturn. However, production of gypsum, phosphate rock, and vermiculite continued strong. Because domestic steel production was down, the demand for bentonite was reduced. Gypsum production for use in wallboard and cement manufacturing was not adversely affected by the national recession. Established producers and new interests continued to explore for new talc deposits. Cominco's Warm Springs Mine in Powell County remained a steady producer of phosphate rock. Pacific Silica Co. continued to produce metallurgical-grade silica from its mine near Basin.

Cement.—Two plants, one at Trident and the other at Montana City, produced cement in 1980. Portland cement sales in 1980 were about 6% less than those in 1979; however, 1980 value decreased by only 1%. Masonry cement was also produced. Cement was used primarily by ready-mix companies, concrete product manufacturers, and highway contractors. The product was transported to users by truck and rail.

Clays.—The State's output of clay and shale in 1980 was from 16 mines in 8 counties, compared with 16 mines in 9 counties in 1979. Production increased 48%, and value increased 93% compared with

1979 statistics. The material produced was used for animal feed, drill mud, foundry sand, insulation, iron pellets, waterproofing, face brick, fertilizer, chemical manufacturing, portland cement, concrete block, and pottery. There were nine individuals and/or companies producing clay and shale.

Gypsum.—The United States Gypsum Co.'s mine at Heath continued steady operation. This mine and plant complex is the single largest taxpayer in Fergus County. Two open pit gypsum mines near Raynesford were reported operating and shipping gypsum to cement plants in Montana. Crude gypsum production in the State during 1980 decreased about 21% compared with that of 1979; however, the value of production remained the same.

Lime.—The Anaconda Company, Holly Sugar Corp., and Great Western Sugar Co. produced lime for use in metallurgical processes, sewage treatment, and sugar refining. Lime production increased about 3%; value remained about the same as that reported for 1979.

Phosphate Rock.—Phosphate rock was mined for the 51st continuous year in Powell County. The product was shipped to Canada for further processing. The Stauffer Chemical Co., Silver Bow County, continued to produce elemental phosphorous at its plant, with phosphate rock shipped in from Idaho.

Sand and Gravel.—Sand and gravel was produced by 80 operators from 91 pits in 36 of Montana's 56 counties. Production declined about 5% when compared with the 1979 production level. A total of 83 pits, mining less than 200,000 tons per pit, produced approximately 57% of the sand and gravel. Approximately 95% of the material used was transported by truck.

Table 8.—Montana: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,657	$4,592	$2.77	1,297	$4,039	$3.11
Plaster and gunite sands	9	35	3.89	7	37	5.29
Concrete products	85	256	3.01	265	593	2.24
Asphaltic concrete	1,073	2,559	2.38	1,495	4,187	2.80
Road base and coverings	3,358	6,218	1.85	2,980	5,846	1.96
Fill	739	1,273	1.72	500	1,028	2.06
Snow and ice control	61	116	1.90	74	236	3.19
Railroad ballast	15	42	2.80	W	W	W
Other	15	15	1.00	W	W	W
Total or average	7,012	15,106	2.15	6,639	16,057	2.42

W Withheld to avoid disclosing company proprietary data; included in "Total."

Table 9.—Montana: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	1,697	$4,371	$2.58	1,364	$3,767	$2.76
Gravel	5,315	10,735	2.02	5,275	12,290	2.33
Total or average	7,012	15,106	2.15	6,639	16,057	2.42
Industrial sand	--	--	--	W	W	32.32
Grand total or average	7,012	15,106	2.15	W	W	2.53

W Withheld to avoid disclosing company proprietary data.

Stone.—Stone was produced from 33 quarries in 19 Montana counties. Quarry production ranged from less than 25,000 short tons per year to more than 500,000. More than 80% of the State's production came from quarries producing more than 100,000 short tons.

Table 10.—Montana: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Dense-graded roadbase stone	59	140	--	--
Surface treatment aggregate	W	491	--	--
Other construction aggregate and roadstone	184	425	423	1,281
Riprap and jetty stone	84	195	34	81
Railroad ballast	W	W	242	565
Cement manufacture	W	W	955	3,030
Lime manufacture	319	833	37	W
Flux stone	160	563	90	354
Fill	18	62	--	--
Sugar refining	W	W	138	651
Other[2]	1,703	5,097	43	341
Total	2,527	7,806	1,962	[3]6,302

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes limestone, granite, sandstone, and traprock.
[2]Includes manufactured fine aggregate (stone sand) and ferrosilicon.
[3]Data do not add to total shown because of independent rounding.

Sulfur.—Two companies in Yellowstone County recovered sulfur as a byproduct from petroleum operations.

Talc.—Talc production continued at Cyprus' (AMOCO Minerals Co.) Beaverhead, Yellowstone, and Willow Creek Mines, and from Pfizer Inc.'s Treasure and Regal Mines, all in Madison County. Talc production decreased 9%; however, the value of production increased 90% when compared with 1979 data. Montana talc was used in ceramics, cosmetics, insecticides, paint, paper, plastics, rubber, and for other uses.

Vermiculite.—W. R. Grace & Co. produced crude vermiculite from its Rainy Creek Mine in Lincoln County. The mine was the largest source of crude vermiculite in the Nation. Production in 1980 was about 4% less than that for 1979; however, the value of the product increased 4%.

[1]State mineral specialist, Bureau of Mines, Spokane, Wash.
[2]Deputy director, Montana Bureau of Mines and Geology, Butte, Mont.
[3]Staff field agent, Montana Bureau of Mines and Geology, Butte, Mont.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum:			
Anaconda Aluminum Co	Columbia Falls, MT 59912	Reduction plant	Flathead.
Antimony:			
U.S. Antimony Corp	Box 643 Thompson Falls, MT 59873	Mine and plant	Sanders.
Barite:			
Montana Barite Co	Box 3296 Missoula, MT 59801	do	Lincoln and Missoula.
Cement:			
Ideal Basic Industries, Inc.[1]	Box 8789 Denver, CO 80201	Plant	Gallatin.
Kaiser Cement Corp.[1]	300 Lakeside Dr. Oakland, CA 94612	do	Jefferson.
Clays:			
American Colloid Co	Box 815 Glasgow, MT 59230	Pit and plant	Carbon and Phillips.
Federal Bentonite Div., Aurora Industries, Inc.	1002 Greenfield Rd. Montgomery, IL 60538	do	Valley.
International Minerals & Chemical Corp.	Box 460 Belle Fourche, SD 57717	Pit	Carter.
Copper:			
The Anaconda Company[2]	Box 689 Butte, MT 59701	Smelter, refinery, mine, plant.	Silver Bow.

See footnotes at end of table.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Gold:			
Landusky Mining, Inc.[3]	Box 57 Zortman, MT 59546	Open pit mine and leach pad.	Phillips.
Zortman Mining, Inc.[3]	Zortman, MT 59546	Open pit mine	Do.
Gypsum:			
Maronick Construction Co.[4]	East Helena, MT 59635	do	Judith Basin.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	Underground mine and plant.	Fergus.
Lime:			
Great Western Sugar Co	1530 16th St. Denver, CO 80217	Surface mine and plant	Yellowstone.
Holly Sugar Corp	Sidney, MT 59270	do	Richland.
Peat:			
Farmer's Plant Aid Corp	Hamilton, MT 59840	Surface mine	Ravalli.
Martins Peat, Inc	Swan Lake, MT 59911	do	Lake.
Phosphate rock:			
Cominco American, Inc	Garrison, MT 59731	Underground mine	Powell.
Sand and gravel:			
Gilman Excavating, Inc	3105 Kossuth Butte, MT 59701	Pit	Silver Bow.
Hilde Construction Co., Inc	Box 2287 Great Falls, MT 59403	Pits	Various.
McElroy & Wilken Inc	Box 35 Kalispell, MT 59901	Pit	Flathead.
McIntyre Construction Co	Box 2167 Great Falls, MT 59403	Pit	Jefferson.
Barry O'Leary, Inc	Box 1102 Billings, MT 59101	Pit	Yellowstone.
Ready Mix Concrete	Box 458, Route 1 Polson, MT 59860	Pit	Lake.
Schellinger Construction Co	Box 517 Columbia Falls, MT 59912	Pits	Flathead.
R. J. Studer & Sons	Box 20204 Billings, MT 59104	Pit	Yellowstone.
Washington Construction Co	Box 8989 Missoula, MT 59807	Pits	Mineral and Missoula.
Yellowstone County Highway Dept	Billings, MT 59101	do	Yellowstone.
Silver:			
Black Pine Mining Co.[5]	Box 724 Philipsburg, MT 59858	Underground mine	Granite.
Harold J. Giulio[6]	305 South Cleveland Boulder, MT 59632	Surface mine	Jefferson.
Midnite Mines, Inc.[7]	14044 NE. 8th St. Bellevue, WA 98007	Underground mine	Beaverhead.
Northwest Gold, Inc.[8]	Philipsburg, MT 59859	do	Granite.
Sparrow Resources, Inc.[9]	Box 6566, Station D Calgary, Alberta, Canada	Underground mine and mill.	Jefferson.
Western Silver Development Co.[6]	Box 67 Kellogg, ID 83837	do	Mineral.
Stone:			
Janney Construction Co., Inc	Box 517 Deer Lodge, MT 59723	Quarry	Missoula.
Montana State Highway Dept	Helena, MT 59601	Quarries	Various.
Stanco-General	Butte, MT 59701	Quarry	Deer Lodge.
Weaver Construction Co	Drummond, MT 59832	Quarries	Carbon and Granite.
Sulfur:			
Montana Sulphur & Chemical Co	Box 31118 Billings, MT 59107	Plant	Yellowstone.
Talc:			
AMOCO Minerals Co.-Cyprus	555 South Flower St. Los Angeles, CA 90017	Open pit mine and plant	Madison.
Pfizer, Inc	Box 1147 Dillon, MT 59725	do	Do.
Vermiculite, (crude):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	do	Lincoln.

[1]Also clays and stone.
[2]Also aluminum, gold, lime, and silver.
[3]Also silver.
[4]Also stone.
[5]Also copper and gold.
[6]Also copper, gold, and lead.
[7]Also copper, gold, lead, and zinc.
[8]Also gold.
[9]Also gold, lead, and zinc.

The Mineral Industry of Nebraska

This chapter has been prepared under a Memorandum of Understanding 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 nonfuel minerals.

By Jane P. Ohl[1]

The value of nonfuel minerals produced in Nebraska in 1980 was $80.5 million, nearly a 19% decrease from that of 1979. Only lime and clays increased in value. Lime, used exclusively in processing sugar, was the only commodity that increased in production, more than doubling its 1979 output.

According to the latest available figures from the Nebraska Bureau of Business Research, the gross State product (GSP) in 1979 was $16,404 million, an 11.8% increase over the 1978 GSP of $14,670 million.

Table 1.—Nonfuel mineral production in Nebraska[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	156	$454	154	$456
Sand and gravel.[2]	do.	16,197	33,001	10,538	22,981
Stone (crushed)	do.	4,995	19,362	3,775	16,301
Combined value of cement, gem stones, and lime		XX	46,364	XX	40,736
Total		XX	99,181	XX	80,474

XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Includes industrial sand in 1980.

Table 2.—Value of nonfuel mineral production in Nebraska, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Antelope	$434	$437	Sand and gravel.
Banner	126	126	Do.
Brown	W	W	Do.
Buffalo	1,053	995	Do.
Burt	W	2	Do.
Butler	519	605	Do.
Cass	W	W	Cement, stone, sand and gravel, clays.
Cedar	605	368	Sand and gravel.
Chase	166	126	Do.
Cherry	W	W	Do.
Cheyenne	35	55	Do.
Clay	W	W	Do.
Colfax	262	231	Do.
Cuming	1,216	1,268	Do.
Custer	785	836	Do.
Dawson	1,156	656	Do.
Deuel	92	W	Do.
Dixon	W	W	Sand and gravel, stone.
Dodge	1,050	2,403	Sand and gravel.
Douglas	W	W	Sand and gravel, clays.
Dundy	267	5	Sand and gravel.
Fillmore	W	W	Do.
Franklin	1,066	318	Do.
Frontier	W	W	Do.
Furnas	135	92	Do.
Gage	1,239	1,368	Sand and gravel, stone.
Garden	W	W	Sand and gravel.
Garfield	24	24	Do.
Grant	--	1	Do.
Greeley	W	W	Do.
Hall	1,516	1,426	Do.
Hamilton	W	W	Do.
Hayes	W	W	Do.
Hitchcock	W	W	Do.
Holt	914	745	Do.
Hooker	8	--	
Howard	235	235	Sand and gravel.
Jefferson	W	W	Sand and gravel, clays.
Kearney	59	62	Sand and gravel.
Keith	110	105	Do.
Kimball	5	5	Do.
Knox	281	265	Do.
Lancaster	W	478	Stone, clays, sand and gravel.
Lincoln	819	703	Sand and gravel.
Loup	97	80	Do.
Madison	1,249	786	Do.
Merrick	471	554	Do.
Morrill	W	W	Sand and gravel, lime.
Nance	515	320	Do.
Nemaha	W	W	Stone, sand and gravel.
Nuckolls	W	W	Cement, sand and gravel, stone.
Otoe	W	W	Stone.
Pawnee	W	W	Do.
Perkins	17	7	Sand and gravel.
Phelps	W	W	Do.
Pierce	448	98	Do.
Platte	1,178	1,201	Do.
Polk	189	245	Do.
Red Willow	299	256	Do.
Richardson	W	1	Do.
Rock	W	W	Do.
Saline	52	3	Do.
Sarpy	W	977	Sand and gravel, stone, clays.
Saunders	W	W	Sand and gravel, stone.
Scotts Bluff	W	W	Lime, sand and gravel.
Seward	35	46	Stone.
Sheridan	265	221	Sand and gravel.
Stanton	263	W	Do.
Thayer	966	W	Do.
Thomas	W	W	Do.
Valley	35	722	Do.
Washington	W	W	Stone.
Webster	318	W	Sand and gravel.
York	199	W	Do.
Undistributed[2]	62,594	79,726	
Total[3]	83,373	99,181	

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

[1]The following counties are not listed because no nonfuel mineral production was reported: Adams, Arthur, Blaine, Boone, Box Butte, Boyd, Dakota, Dawes, Gosper, Harlan, Johnson, Keya Paha, Logan, McPherson, Sherman, Sioux, Thurston, Wayne, and Wheeler.

[2]Includes gem stones, 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 Nebraska business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	772.0	777.0	+0.7
Unemployment	do	25.0	31.0	+24.0
Employment (nonagricultural):				
Mining[1]	do	1.8	1.7	-5.6
Manufacturing	do	99.6	96.1	-3.5
Contract construction	do	32.5	28.9	-11.1
Transportation and public utilities	do	47.8	47.6	-.4
Wholesale and retail trade	do	164.1	164.9	+.5
Finance, insurance, real estate	do	41.0	42.6	+3.9
Services	do	114.0	117.6	+3.2
Government	do	130.6	131.3	+.5
Total nonagricultural employment[1 2]	do	631.2	630.5	-.1
Personal income:				
Total	millions	$13,050	$13,951	+6.9
Per capita		$8,291	$8,914	+7.5
Construction activity:				
Number of private and public residential units authorized		8,835	7,144	-19.1
Value of nonresidential construction	millions	$169.4	$153.2	-9.6
Value of State road contract awards	do	$85.0	$97.5	+14.7
Shipments of portland and masonry cement to and within the State	thousand short tons	1,072	842	-21.5
Nonfuel mineral production value:				
Total crude mineral value	millions	$99.2	$80.5	-18.8
Value per capita, resident population		$63	$51	-19.0
Value per square mile		$1,284	$1,042	-18.8

[p]Preliminary.
[1]Includes oil and gas extraction.
[2]Data may not add to totals shown because of independent rounding.

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

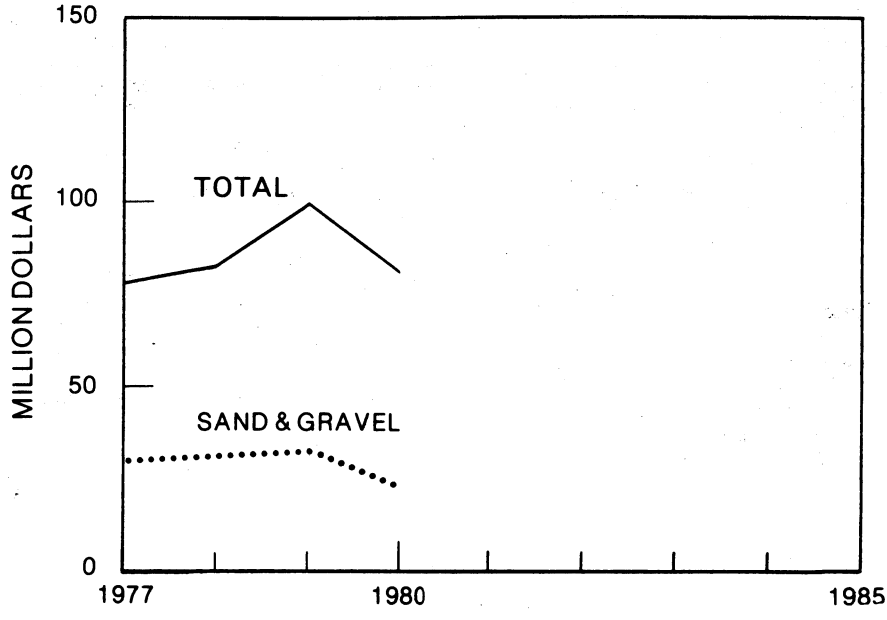

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Nebraska.

The mining industry employed an average of 1,790 workers each month of 1980. Workers in the nonfuel mineral sector constituted 57% of the total mining employment; oil and gas workers made up the remaining 43%. These statistics differed substantially from those of 1979, when the mining community employed an average of 1,767 workers: 65% mined nonfuel minerals, and 35% drilled for oil and gas.

Cass County, ranked first in value of nonfuel minerals produced during 1980, was followed, in order of decreasing value of production, by Saunders, Washington, and Douglas Counties. Cass County also ranked first in 1979, but was trailed, in decreasing order, by Douglas, Saunders, and Washington—Douglas County having a much larger share of the sand and gravel industry during that year.

Trends and Developments.—In the fall of 1980, a crew from Molycorp, Inc., a wholly owned subsidiary of Union Oil Co. of California, was drilling and coring a carbonatite deposit in the Elk Creek-Steinaur area, Johnson County, southeastern Nebraska. Since 1973, yttrium and the rare-earth elements columbium, europium, and lanthanum have been sought in the area by Molycorp, Cominco American, and others. The Nebraska Geological Survey analyzed the samples of carbonatite obtained from its own drilling project, which had been supported by a modest contribution from the U.S. Bureau of Mines.

Legislation and Government Programs.—Because the Nebraska legislature meets in alternate, odd-numbered years, no bills were introduced or enacted in 1980.

The Nebraska Supreme Court, on March 24, 1980, upheld a Keith County District Court decision ordering that a mineral interest "when severed from the surface ownership, must be separately listed on the tax rolls in the name of the owner." In effect, the State Supreme Court said that mineral interests are real estate that henceforth must be taxed separately.

County assessors are required to list for taxation all tangible and real property not expressly exempted. Mineral interests have never been so exempted. In most Nebraska situations, the person who owns the real estate also owns the mineral interests, then both the land and the minerals are combined in the assessed valuation. In areas where minerals are thought to exist, however, mineral rights commonly are severed from surface ownership and sold to mineral-resource developers. The original suit was filed by a Keith County landowner who contended that persons who own mineral rights under his property should be required to pay a share of the real estate tax.

The Nebraska Geological Survey published, in 1980, an updated Mineral Resource Map of Nebraska. The map, on a 1:1,000,000 base, shows localities of clay or shale pits, gasfields, limestone quarries, oilfields, sand and gravel pits, sandstone quarries, and siltstone quarries. In May 1980, the State Survey published "Nebraska Mineral Operations Review, 1979," by R. R. Burchett and D. A. Eversoll.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Ash Grove Cement Co. and Ideal Basic Industries, Inc., produced finished portland cement and masonry cement at plants in Cass and Nuckolls Counties. Only gray portland cement types I and II (general moderate heat) and type III (high early strength) were produced by the two firms. Finished portland cement was sold to building-material dealers, concrete-product manufacturers, highway contractors, and ready-mix companies.

Ash Grove announced plans to build a 500,000-ton-per-year production line, consisting of a four-stage precalcining preheater, a 12 1/2- by 165-foot kiln, a grate clinker cooler, and electrostatic precipitators. The unit will replace three older wet-process kilns. Startup is scheduled for late 1982. Although natural gas was the preferred fuel at Ash Grove's Louisville plant and at Ideal's Superior plant, some fuel oil and bituminous coal also were burned for energy to make cement.

Clays.—Four companies mined common clay from five pits in Cass, Douglas, Jefferson, Lancaster, and Sarpy Counties in the State's most densely populated southeastern area. In decreasing order of short tons mined, the Nebraska firms were Endicott Clay Products Co., Jefferson County; Yankee Hill Brick Manufacturing Co., Lancaster County; Ash Grove Cement Co., Cass County; and Omaha Brick Works, Inc., Douglas and Sarpy Counties. Quantity decreased 1.3% from that of 1979, and value increased less than half of 1 percent. Unit

values for common clays ranged from $2.40 to $3.64 and averaged $2.97. More than three-quarters of the clay was used to make common and face brick; the remainder was used in manufacturing portland cement. Nebraska Geological Survey reported that from the beginning of the 20th century through January 1, 1981, 137 acres (0.0003% of the area of the State) have been disturbed by clay- and shale-mining operations. More than 18% of this land has been reclaimed.

Sand and Gravel.—In 1980, sand and gravel again led all nonfuel mineral commodities produced in Nebraska. The quantity of construction and industrial sand and gravel was 10.5 million short tons, or 35% less than in the previous year; the value was $23 million, or 30% less. More than 60 of the State's 93 counties had from 1 to 10 active operations, for a total of 193; more than 120 private companies quarried sand and gravel from them during the year. Several county highway departments also supported their own needs by operating 17 sites across the State. Buffalo County Highway Department, the largest county operation, produced sand and gravel from deposits in Buffalo and Phelps Counties. The sand and gravel, valued at $66,675, was used in highway maintenance and construction (U.S. Highway 30 and Interstate 80 parallel the Platte River, which separates the two counties). Saunders County, 20 miles west of Omaha and 20 miles north of Lincoln, had the largest reported sand and gravel production in the State. Six operations in the county produced more than 1 million short tons, valued at $2.8 million. Ranking second in both quantity and value was Douglas County, whose four operations are even nearer to consumers in Omaha, the Douglas County seat. Construction sand and gravel accounted for 99% of total production. Average values per ton were as follows: Construction sand $1.92, construction gravel $2.32, and industrial sand $7.77. In decreasing order of quantity used or sold, construction sand and gravel was used in road bases and covering, concrete aggregate, asphaltic concrete, fill, and other uses. Most production was shipped by truck, but the railroads and other means of transportation also were used.

Table 4.—Nebraska: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,814	$7,526	$1.97	3,480	$7,304	$2.10
Plaster and gunite sands	117	208	1.78	95	185	1.93
Concrete products	1,005	2,189	2.18	263	578	2.20
Asphaltic concrete	2,697	5,492	2.04	1,567	3,721	2.37
Roadbase and coverings	7,010	15,404	2.20	3,981	9,234	2.32
Fill	1,452	1,921	1.32	1,052	1,544	1.47
Snow and ice control	24	44	1.83	34	60	1.78
Railroad ballast	40	149	3.74	W	W	7.86
Other uses	38	67	1.78	42	172	4.06
Total or average	16,197	[1]33,001	2.04	10,514	22,798	2.17

W Withheld to avoid disclosing company proprietary data; included in "Other uses."
[1]Data do not add to total shown because of independent rounding.

Table 5.—Nebraska: Construction sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	5,459	$10,070	$1.84	4,000	$7,675	$1.92
Gravel	10,738	22,931	2.14	6,515	15,123	2.32
Total or average	16,197	33,001	2.04	[1]10,514	22,798	2.17

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

Stone.—Crushed limestone was produced from 20 quarries in 11 eastern Nebraska counties. In August 1980, Martin Marietta Aggregates, the operating company of Martin Marietta Corp., acquired the properties of Hopper Bros. Quarries, Ltd., for approximately $7 million. The acquisition included two permanent plants at Weeping Water and Ashland and five portable plants. Martin Marietta became the leading producer from its seven quarries, followed by Kerford Limestone Co., Ash Grove Cement Co., and Fort Calhoun Stone Co. Each of the four leading producers quarried more than 500,000 short tons of limestone. Quantity and value decreased 24% and 16%, respectively, from 1979 levels. Average unit value was $4.31. The product was used for agricultural limestone, bituminous aggregate, cement manufacture, concrete aggregate, other construction aggregate and roadstone, poultry grit and mineral food, surface-treatment aggregate, and other miscellaneous uses. About 90% of the crushed stone was shipped by truck, nearly 9% was shipped by rail, and the remainder was shipped by waterways and miscellaneous methods. Cass County, midway between Omaha and Lincoln, was the source of more than two-thirds of the shipped stone.

Table 6.—Nebraska: Crushed limestone sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	167	589	204	808
Poultry grit and mineral food	257	2,867	221	2,636
Concrete aggregate	1,154	4,696	883	3,900
Surface treatment aggregate	829	3,408	654	2,961
Other construction aggregate and roadstone	910	3,594	447	2,211
Riprap and jetty stone	189	871	77	388
Filter stone	--	--	88	425
Lime manufacture	--	--	11	41
Flux stone	4	17	3	16
Roofing granules	--	--	20	97
Other uses[1]	1,486	3,321	1,168	2,818
Total[2]	4,995	19,362	3,775	16,301

[1]Includes stone used in bituminous aggregate, dense-graded road base stone, railroad ballast, cement manufacture, and asphalt filler.
[2]Data may not add to totals shown because of independent rounding.

Talc.—Crude talc is not produced in Nebraska; however, unground talc, obtained from outside the State, is milled at Cyprus Industrial Minerals Co.'s plant near Grand Island, Hall County. Cyprus—a wholly owned company of Amoco Minerals Co., headquartered in Denver, Colo.—is, in turn, a wholly owned subsidiary of Standard Oil Co. (Indiana). The ground talc is used in ceramics, insecticides, paint, paper, rubber, textiles, and toilet articles.

Vermiculite.—W. R. Grace & Co. produced exfoliated vermiculite at its plant in Douglas County, near Omaha. Crude vermiculite, a hydrated mineral of the mica group, was imported from Grace's mining and beneficiating operations at Libby, Mont. The exfoliated product was sold to the construction community for use as block insulation, loose-fill insulation, concrete aggregate, fireproofing, and plaster aggregate; and to the horticultural community as aggregate. Although production and total value declined from 1979 levels, the average price per ton rose about 10% in 1980.

[1]State mineral specialist, Bureau of Mines, Denver, Colo.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ash Grove Cement Co.[1]	920 Main St., Suite 1000 Kansas City, MO 64105	Plant	Cass.
Ideal Basic Industries, Inc., Ideal Cement Co.	Box 8789 Denver, CO 80201	do	Nuckolls.
Clays:			
Endicott Clay Products Co	Box 17 Fairbury, NE 68352	Open pit and plant.	Jefferson.
Yankee Hill Brick Manufacturing Co	Route 1 Lincoln, NE 68502	do	Lancaster.
Lead, refined:			
ASARCO, Inc	5th and Douglas Sts. Omaha, NE 68102	Refinery	Douglas.
Sand and gravel:			
Behrens Construction Co.[2]	Box 188 Beatrice, NE 68310	Pits and plants	Gage and Saline.
Bergt Bros., Inc	Davenport, NE 68335	do	Nuckolls and Thayer.
Bladen Sand & Gravel	Bladen, NE 68928	Pits	Franklin and Webster.
Central Sand & Gravel Co	Box 626 Columbus, NE 68601	Pits and plants	Butler, Madison, Platte.
Elkhorn Construction Co	Box 168 Norfolk, NE 68701	do	Madison.
Hartford Sand & Gravel Co	Box Z Valley, NE 68064	Dredges and pits	Dodge and Douglas.
Husker Concrete & Gravel Co	Route 2, Box 29 Wisner, NE 68791	Dredge and pits	Cuming, Madison, Pierce, Stanton.
Kirkpatrick Sand & Gravel Co	Box 6 Lexington, NE 68850	Pit and plant	Dawson.
Luther & Maddox Gravel Co	2819 South Locust St. Grand Island, NE 68801	Pits and plants	Hall.
Lyman-Richey Sand & Gravel Corp	4315 Cuming St. Omaha, NE 68131	do	Cass, Dodge, Douglas, Morrill, Platte, Saunders.
Midwest Bridge and Construction Co	Box 787 Norfolk, NE 68701	do	Holt, Pierce, Stanton.
Overland Sand & Gravel Co	Box 307 Stromsberg, NE, 68666	do	Hamilton, Merrick, Polk.
Stalp Gravel Co	Route 3 West Point, NE 68788	Pit and plant	Cuming.
Western Sand & Gravel Co	Box 80268 Lincoln, NE 68501	Pits and plants	Cass, Dodge, Saunders.
Will Sand & Gravel Co	308 Adams Schuyler, NE 68661	Pit and plant	Colfax.
Stone:			
Fort Calhoun Stone Co	1255 South St. Blair, NE 68008	Quarries and plants.	Washington.
Kerford Limestone Co	Box 449 Weeping Water, NE 68463	Quarry and plant	Cass.
Martin Marietta Aggregates, Central Div.	Box 789 Cedar Rapids, IA 52406	Quarries and plants.	Cass, Nemaha, Nuckolls, Pawnee, Saunders.

[1]Also produces limestone and clay in Cass County.
[2]Also produces limestone in Gage County.

The Mineral Industry of Nevada

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Nevada Bureau of Mines and Geology, for collecting information on all nonfuel minerals.

By D. W. Lockard[1] and John H. Schilling[2]

The nonfuel mineral production value for Nevada in 1980 was $386 million, an increase of 48% over that reported in 1979. Metals, led by gold and silver, accounted for more than half of the State's output value. Nevada again lead the Nation in barite and mercury production.

In terms of value, gold was the leading commodity produced; value was more than double that reported in 1979. Escalating precious metals prices increased the State's mineral production value, reversing the trend precipitated by the 1977 shutdown of the copper industry.

Table 1.—Nonfuel mineral production in Nevada[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite thousand short tons	r1,804	r$35,707	1,918	$47,800
Clays do.	76	1,163	64	2,082
Gem stones	NA	1,000	NA	900
Gold (recoverable content of ores, etc.) troy ounces	r250,097	r76,905	274,382	168,075
Gypsum thousand short tons	1,075	6,771	852	8,276
Lead (recoverable content of ores, etc.) metric tons	24	28	26	24
Mercury 76-pound flasks	29,368	8,256	30,431	11,851
Molybdenum pounds	39,826	242	--	--
Perlite thousand short tons	5	71	6	92
Sand and gravel[2] do.	10,498	21,387	8,439	18,360
Silver (recoverable content of ores, etc.) thousand troy ounces	r560	r6,215	671	13,842
Stone (crushed) thousand short tons	1,602	6,439	1,809	7,407
Zinc (recoverable content of ores, etc.) metric tons	W	W	2	2
Combined value of cement (portland), copper, diatomite, fluorspar, iron ore, lime, lithium compounds, magnesite, pumice, salt, sand and gravel (industrial), talc, tungsten, and value indicated by symbol W	XX	r96,062	XX	107,438
Total	XX	r260,246	XX	386,149

rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Combined value" figure. XX Not applicable.

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

[2]Excludes industrial sand and gravel; value included in "Combined value" figure.

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

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Carson City	$252	W	Pumice, sand and gravel, stone.
Churchill	W	$1,903	Diatomite, sand and gravel, salt, tungsten, silver, gold, lead, copper.
Clark	38,199	36,779	Sand and gravel, lime, gypsum, stone.
Douglas	W	1,488	Sand and gravel, stone.
Elko	W	6,427	Barite, gold, tungsten, sand and gravel, silver, lead, copper, zinc.
Esmeralda	15,836	17,917	Lithium, diatomite, sand and gravel, talc, clays, tungsten.
Eureka	30,674	40,864	Gold, iron ore, barite, sand and gravel, silver, stone, mercury.
Humboldt	4,075	8,526	Mercury, stone, sand and gravel, clays, gold.
Lander	30,423	49,082	Barite, gold, copper, silver, sand and gravel.
Lincoln	8,969	12,131	Tungsten, gold, lime, silver, sand and gravel, perlite, clays.
Lyon	37,538	25,254	Cement, stone, sand and gravel, diatomite, copper, lead.
Mineral	W	40	Sand and gravel, stone.
Nye	20,259	22,492	Gold, barite, magnesite, clays, sand and gravel, silver, fluorspar, pumice, iron ore, tungsten, lead.
Pershing	14,295	17,731	Diatomite, gypsum, iron ore, tungsten, sand and gravel, perlite, clays, gold, silver, lead, copper.
Storey	7,924	12,389	Diatomite, silver, gold, sand and gravel.
Washoe	W	4,659	Sand and gravel, pumice, clays, silver, gold, lead, copper, zinc.
White Pine	W	W	Tungsten, molybdenum, sand and gravel.
Undistributed[1]	28,965	2,567	
Total	237,409	[2]260,246	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes some gem stones and values indicated by symbol W.
[2]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Nevada business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	358.0	376.0	+5.0
Unemployment	do	18.0	23.0	+27.8
Employment (nonagricultural):				
Mining[1]	do	4.7	6.3	+34.0
Manufacturing	do	19.4	19.4	--
Contract construction	do	27.3	25.8	-5.5
Transportation and public utilities	do	23.1	24.1	+4.3
Wholesale and retail trade	do	77.4	79.7	+3.0
Finance, insurance, real estate	do	16.9	17.8	+5.3
Services	do	160.2	169.3	+5.7
Government	do	54.7	57.2	+4.6
Total nonagricultural employment	do	383.7	399.6	+4.1
Personal income:				
Total	millions	$7,367	$8,374	+13.7
Per capita		$10,500	$10,458	-.4
Construction activity:				
Number of private and public residential units authorized		19,038	11,864	-37.7
Value of nonresidential construction	millions	$350.1	$459.3	+31.2
Value of State road contract awards	do	$43.7	$66.2	+51.5
Shipments of portland and masonry cement to and within the State	thousand short tons	610	565	-7.4
Nonfuel mineral production value:				
Total crude mineral value	millions	$260.2	$386.1	+48.4
Value per capita, resident population		$371	$483	+30.2
Value per square mile		$2,354	$3,493	+48.4

[p]Preliminary.
[1]Includes oil extraction.

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

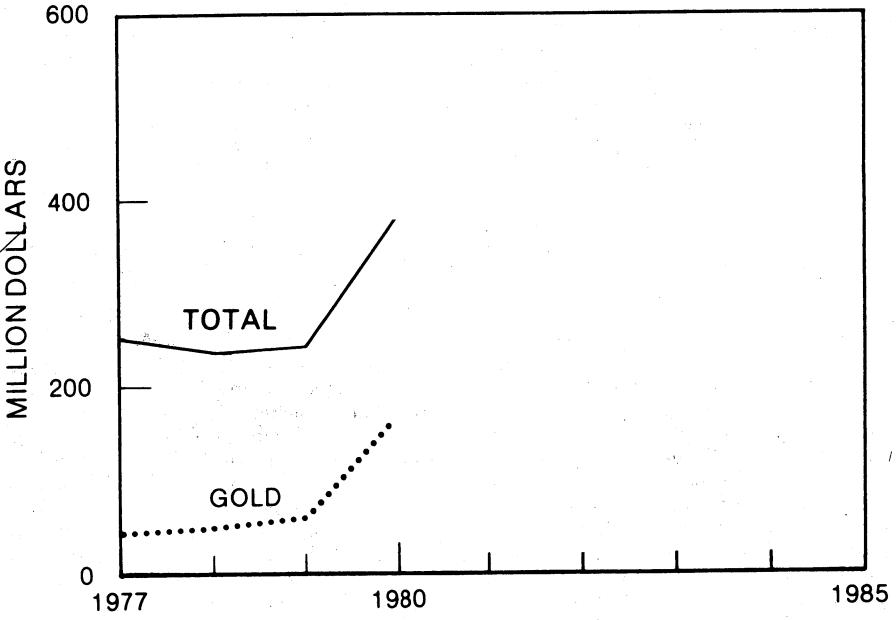

Figure 1.—Value of gold and total value of nonfuel mineral production in Nevada.

Trends and Developments.—Capital expansion of the State's mineral industry continued to surge throughout 1980. Higher metal prices and projected strong demands for mineral products resulted in many development projects being expedited to the construction stage. The Nevada Mining Association estimated that more than $1 billion will be invested in new mining projects in the State during the next few years.

In November, Candelaria Partners (Occidental Minerals Corp. and Congdon and Carey, Ltd.) dedicated and began production from its new silver mine-mill complex south of Hawthorne (Mineral County). Occidental invested more than $30 million in the property; reserves should last in excess of 7 years. The open pit produces approximately 28,000 short tons per day (8,000 short tons per day of ore); the company poured its first 10,000-troy-ounce bar before yearend.

During the year, construction began on four significant gold mine-mill and/or leaching operations: Bell Mine, Pinson-Preble, Northumberland, and Alligator Ridge. In June, the Bell Mine, owned and operated by Freeport Gold Co. (70% Freeport Minerals Co. - 30% FMC Inc.), broke ground on what could be one of the Nation's largest gold producers. Construction of the $115 million mine and plant is expected to be completed in 1981; the rated production of 200,000 troy ounces per year should be reached by mid-1982. During 1980, the company announced a doubling of reserves to nearly 12 million short tons and revised the mill design to treat 2,750 short tons per day. At full production, 200 people will be employed at an estimated annual payroll of $6 million.

Pinson Mining Co., a syndicate of four Canadian mining firms, nearly completed construction of an $18 million gold mining and milling operation north of Golconda in Humboldt County; the first gold bars were expected to be poured in January 1981. The present mining plan proposes that 300,000 short tons per year can be mined during the next 10 years.

Cyprus Mines Corp. finished feasibility studies and began construction on its Northumberland gold mine near Round Mountain, Nye County. Ore reserves at the two gold deposits in Northumberland Canyon are estimated at 8 million short tons. Daily production of 3,000 short tons is planned; the ore will be crushed and screened at the mine site and hauled to the valley floor where leach pads are to be constructed. Production is scheduled for early 1981.

Construction was almost complete by yearend at Amselco Minerals Inc.'s Alligator Ridge property. Amselco, a joint venture between Occidental Minerals Corp. and Se-

lection Trust Ltd. (Great Britain), has invested approximately $26 million in the property; reserves are estimated at 5 million short tons grading 0.12 ounce of gold per ton. Becon Construction Co. (a Houston-based firm) is the contractor for building the leach pads, crushing facilities, and the gold recovery facilities; Bechtel Corp. won the mine construction contract. Limited mining and leaching operations began in the latter quarter of 1980; the full-scale production rate of 750,000 short tons per year should be attained by the summer of 1981.

Other notable gold developments include Carlin Mining Co.'s newly discovered Maggie Creek and Gold Quarry deposits, and the increased reserves announced at the Round Mountain Mine by Smokey Valley Mining Co. Early in 1980, Carlin announced discovery of the Maggie Creek ore body, which lies about 12 miles southeast of the Carlin Mine. Drilling delineated about 4.8 million short tons of ore containing about 440,000 ounces of gold, treatable at the Carlin Mill, with an additional 3.1 million short tons of lower grade rock. Production from this deposit commenced in late fall. The Maggie Creek deposit will be developed for about $10 million— mostly for construction of heap leach facilities. This discovery was followed in December 1980 by another announcement concerning an adjacent ore body at the Gold Quarry Prospect. Preliminary drilling shows that the deposit may contain 10 million short tons of low-grade ore and another 2.5 million short tons of higher grade material that will be processed at the Carlin Mill.

Smokey Valley Mining Co. announced expansion of reserves at its Round Mountain Mine, Nye County, and anticipates spending $8 million during the next 18 months for new equipment. The increased reserves are expected to add about 6 to 8 years of operating life to the open pit operation. The company expects to recover nearly 600,000 ounces of gold and 300,000 ounces of silver from the deposit; production is expected to start in 1983.

Houston International Minerals Corp. began milling in May from stockpiled ore at its Gold Hill operations; the first doré button was poured on May 14. Mining operations at the Con-Imperial Mine were shut down from June until December as the company altered its mining plan. Houston also applied to Storey County for a special-use permit to haul mineralized waste dump material over State Highway 342 from the dormant Lucerne open pit mine. The company plans to process 300,000 short tons of this material in its mill on American Flats. The company announced it would begin a small gold-silver open pit mine in Lyon County if necessary approval can be obtained. Late in the year, Houston stated that exploration at its Borealis Prospect, near Hawthorne (Mineral County), revealed a gold-silver deposit containing 2.5 million short tons grading 0.08 ounce of gold per ton and 0.62 ounce of silver per ton. A feasibility study commenced, and a low-cost surface mining operation is planned for late 1981 or early 1982.

Other major mine construction projects include the Anaconda Copper Co.'s Nevada Moly Project, Utah International Inc.'s Springer Tungsten Mine, and Silver King Mines Inc.'s Taylor mining district project. Construction began in 1979 on what will be the largest mine in Nevada, the Nevada Moly property, Nye County. Capital investment will approach $220 million, with projected year-round employment of 400 people. The deposit is estimated to contain nearly 150 million short tons of molybdenum ore that will be processed in a 20,000-ton-per-day flotation mill; byproduct copper also will be produced. At full production, the mine will produce 15 million pounds of molybdenum annually, an estimated 5% of the Western World's yearly production. Completion of the Springer Tungsten Mine (Humboldt County) is scheduled for 1982; it is expected to produce 1,400 short tons of ore per day. Utah International Inc., a wholly owned subsidiary of General Electric Co., estimates the project cost at $50 million. Ore will be processed onsite into ammonium paratungstate and sold only to General Electric; Springer production is expected to meet one-third of annual company requirements for the next 15 years. Employment at rated production is estimated at 200. A new vertical shaft was sunk during the year; projected depth is 1,400 feet. Silver King Mines nearly completed its new 1,200-ton-per-day mill during the year and plans full production in mid-1981. The company estimates 10 years of ore reserves at the Taylor site, 15 miles south of Ely.

Sunshine Mining Co. plans to expend $18 million to place the "16 to 1" Mine, near Silver Peak (Esmeralda County), into production. The ore body is estimated to contain 500,000 short tons grading 13 ounces of silver per ton. T.R.V. Minerals Corp. announced that the Geddes Bertrand property near Eureka, Eureka County, should be

in production in 1981; an initial milling rate of 200 short tons per day is planned. The ore runs about 5 ounces of silver per ton.

Kennecott Minerals Co., Nevada Mines Div., reopened its mill and smelter at McGill for treatment of custom ores. Day Mines shipped copper concentrates to the smelter from its newly reactivated Victoria Mine in Elko County.

Exploration for metallics continued a significant upswing begun in 1978. Areas in Humboldt, Eureka, Elko, Lander, White Pine, and Nye Counties received the most attention, and targets were mostly precious metals. Numerous companies, both domestic and foreign, were involved. Molycorp Inc. is planning a 6-year molybdenum exploration project in the Sixshooter Canyon area, Lucin mining district, Elko County. Ruskin Development Ltd. did exploratory drilling on the Silver Center property, Sand Springs mining district, Churchill County; the drilling identified five silver-bearing zones. Brican Resources Ltd., acquired a large land position in the Santa Fe mining district, Mineral County. The company has done extensive drilling on the Atchison, Topeka, and Calvada properties. The Anaconda Copper Co. completed geological mapping and limited drilling on property owned by Flowery Gold Mines Co. east of Virginia City, in Storey County. Precious metals were found along a structure that parallels the Comstock Lode. Landmark Resources Ltd. explored the Nevada Spanish Silver property, San Antone mining district, Nye County. Hawthorne Gold Corp. began percussion drilling at the Mindora property in Mineral County. Inspiration Development Co. is reported to be working at the dormant Sanger Mine near Silver Peak.

Pacific Gold and Uranium Inc. reported that 151 shallow holes were drilled in the Goldfield district, Esmeralda County, as part of a joint venture with Noranda Exploration, Inc. About 500,000 short tons of 0.07 ounce of gold per ton are indicated. Klondex Gold and Silver Mining Co. (Vancouver, British Columbia, Canada) has optioned the Fire Creek property, Hilltop mining district, Lander County, from Bullion Monarch; nearly 5,000 feet of percussion drilling was scheduled in 1980. Argus Resources, Inc. was undertaking rehabilitation work at the White Caps Mine, Manhatten district, Nye County. The company also was involved in reopening dormant silver mines near Austin; a recently reconstructed mill near the properties will be able to process 150 tons of ore per day.

Most developments in the nonmetallic sector centered on the State's growing barite industry. A minimum of 40 companies was estimated to be actively engaged in exploration and development of barite deposits, primarily in Lander and Elko Counties. Barite is known to occur in bedded deposits of Cambrian to Devonian rocks.

Companies planning new barite mines in northern Elko County included Chemical and Petroleum Corp. of America, Unichem Minerals, Petro-chem Inc., and Zane Hunt Mining Co. Three small operations were reactivated in Humboldt County by Milchem Inc., Mineral Unlimited, and Couger Enterprises Inc.. The Edgar and Morgan Mining Co. started a small operation below the Greystone Mine and planned to upgrade material in a heavy-media plant in Crescent Valley, Eureka County.

The magnesite operation at Gabbs, Nye County, was acquired by Combustion Engineering Inc. of Cleveland, Ohio, and now operates as C-E Basic, Inc. Plant expansion and modification continued and should be completed in 1981. Work costing $5 million will result in an additional 35,000 short tons of magnesium oxide output annually.

Legislation and Government Programs.—The Nevada State Legislature did not meet in 1980, but will reconvene in 1981. A proposed legislative change, almost certain to be addressed, concerns imposition of a statewide mineral severance tax.

The Lyon County commissioners enacted a new mining ordinance in June that requires mining companies to obtain a special use permit to mine in designated areas within the county. The action resulted from efforts by opponents of Houston International Minerals Corp.'s expansion of its open pit mine near Silver City in the Comstock Historic District. Designated areas include the historic area and such others categorized as "sensitive" within the county.

The Nevada Bureau of Mines and Geology published 20 reports and maps on State mineral resources during the year. Fieldwork was completed on an additional 12 mineral-resource-oriented projects, which include geochemistry of the Tonopah area, molybdenum deposits of Nevada, geology and mineral resources of northern Nye and Elko Counties, and gravity maps of the Tonopah and Caliente areas. Twenty-three mineral projects were in progress at yearend, including three sheets of the gravity map of the State, geology maps of the Reno and Walker Lake AMS sheets, mercury in

Nevada, tungsten in Nevada, barite in Nevada, geologic maps of five quadrangles, geology of the Round Mountain (Nye County) gold deposits, bibliography of Nevada geology and mineral resources, and a claim staking manual. In addition, among several grants were the following studies: Mineral potential of five plutons (U.S. Geological Survey), and a study to compile information on ore deposits in northeastern and east central Nevada (Bureau of Land Management).

Employment.—Nevada's mineral industry employment at yearend was estimated at nearly 12,000 people including construction workers involved in building new mine facilities. Mining employment was placed at 6,300 with 4,600 of those involved in metal mining. Total mining employment rose 34% over that of 1979. In nine of the State's counties, mining employment was responsible for 10% and 12% of the total employment and payroll, respectively. In six of the counties, mining's contribution to the local payroll was 25% or more.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Antimony.—There was no recorded output of antimony from Nevada in 1980.

Copper.—Reactivation of the Victoria Mine in Elko County resulted in Nevada production more than doubling in 1980 compared with that reported in 1979. Output, however, remained below that reported in years prior to 1978. Day Mines, Inc. purchased the Victoria Mine and began shipments in May. Five mines recorded production in 1980, although the bulk of production came from the Copper Canyon (Lander County) and Victoria Mines. Nevada ranked eighth in the Nation in 1980 in produced copper.

Copper production appears likely to show a significant increase when Anaconda brings its Nevada Moly Project onstream; copper will be produced as a byproduct.

Gold.—In 1980, Nevada became the Nation's largest gold producer, accounting for nearly 29% of the country's newly mined metal. Operations coming onstream should ensure that the State retains its leadership in gold production. Nineteen mines recorded production in 1980; in terms of ounces produced, leading were Newmont's Carlin Mine, Duval's Copper Canyon Mine, and Smokey Valley Mining Co.'s Round Mountain Mine. They accounted for 85% of the State's total production.

Most of the mining news in the State centered on three new gold mines currently under construction: Freeport Gold Co.'s Bell Mine, Amselco's Alligator Ridge Mine, and Pinson Mining Co.'s Pinson Mine; nearly $200 million will be invested in these operations.

Iron Ore.—In 1980, both output and value fell from the levels reported in 1979. There were two producers, the Nevada Barth Corp. (Eureka County) and Cooney Mining Co. (Pershing County). All ore produced was direct-shipping material to consumers.

Lead.—Two mines reported lead production for 1980: Pyramid (Churchill County) and Mt. Hope (Eureka County). Output and value remained about the same as that reported in 1979. It is anticipated that lead production, as a silver byproduct, may increase as proposed new silver mines become operational.

Mercury.—Nevada accounted for nearly all of the Nation's mercury output in 1980. Placer Amex Inc.'s McDermitt Mine accounted for all of the primary production, while Carlin Mining Co. produced mercury as a byproduct from its gold operation. Quantity produced increased only slightly over that of 1979, while value received increased substantially.

Molybdenum.—In 1980, no Nevada molybdenum production was reported. Kennecott Minerals Co.'s operations near Ely were shut down, and all available stocks were shipped in 1979.

The Anaconda Copper Co. continued construction begun in 1979 on its new open pit mining and milling complex 25 miles north of Tonopah. Nearly 700 construction workers were at the property during the year. When completed in 1981, the operation will employ 400 and have an annual payroll of $8 million. The deposit contains 150 million short tons of reserves, and it is anticipated that 15 million pounds of molybdenum may be produced yearly.

Silver.—Silver was produced from 17 mines in the State during 1980. The largest producers, in descending order, were the

Table 4.—Nevada: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing		Material sold or treated[1] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1978, total	20	1	6,457,067	260,895	$50,496,227	803,887	$4,340,989
1979, total	16	2	4,971,644	r250,097	r76,904,831	r560,435	r6,215,225
1980:							
Churchill	1	--	95	67	41,042	977	20,165
Clark	1	--	12,247	46	28,178	31,544	651,068
Douglas	1	--	250	8	4,900	6,954	143,531
Esmeralda	2	--	18,027	145	88,821	5,433	112,137
Eureka	5	--	1,037,979	(2)	(2)	34,825	718,788
Lyon	1	--	6,684	--	--	168	3,468
Mineral	1	--	3,266	3	1,838	4,704	97,091
Pershing	1	1	1	14	8,576	77	1,589
Storey	1	--	64,007	9,761	5,979,198	478,090	9,867,778
Washoe	1	--	204	2	1,225	402	8,297
Undistributed[3]	7	--	5,440,488	264,336	161,921,661	107,461	2,217,996
Total	22	1	[4]6,583,249	274,382	168,075,439	670,635	13,841,908

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1978, total	20,453	$29,985,913	653	$485,423	1,371	$936,927	$86,245,479
1979, total	W	W	24	r27,863	W	W	88,340,263
1980:							
Churchill	(5)	14	(5)	179	(5)	216	61,616
Clark	14	30,515	--	--	--	--	709,761
Douglas	--	--	--	--	--	--	148,431
Esmeralda	--	--	--	--	--	--	200,958
Eureka	1	3,259	25	23,837	2	1,632	W
Lyon	--	--	--	--	--	--	3,468
Mineral	--	--	--	--	--	--	98,929
Pershing	--	--	--	--	--	--	10,165
Storey	--	--	--	--	--	--	15,846,976
Washoe	--	--	--	--	--	--	9,522
Undistributed[3]	W	W	--	--	--	--	W
Total	W	W	[4]26	24,016	2	1,848	W

rRevised. W Withheld to avoid disclosing company proprietary data.
[1]Does not include gravel washed.
[2]Included in "Undistributed" to avoid disclosing company proprietary data.
[3]Includes Elko, Lander, Lincoln, and Nye Counties, and gold in Eureka County, combined to avoid disclosing company proprietary data.
[4]Data may not add to total shown because of independent rounding.
[5]Less than 1/2 unit.

West Coast Oil & Gas Corp.'s Gooseberry Mine (Storey County), Mt. Hope Mining Co.'s Mt. Hope Mine (Eureka County), and Standard Slag Co.'s Atlanta Mine (Lincoln County); the Gooseberry Mine accounted for almost 70% of the State's total output.

A significant upswing in silver production can be forecast for 1981. New mines expected to be onstream or entering a full production cycle include the Candelaria Mine (Candelaria Partners), the Taylor Mine (Silver King Mines), and the Geddes Bertrand property (T.R.V. Minerals Corp.)

Tungsten.—Output and value both declined in 1980 compared with that recorded in 1979. The bulk of production came from Union Carbide's Emerson Mine at Tempiute, Lincoln County. The only other significant producer was the Nevada Scheelite Mine, operated by National Resources Development, Inc., Mineral County, where the 200 level is being extended and the mill is being reconditioned at a cost of nearly $1.5 million.

Shaft sinking and construction of surface facilities continued at Utah International's Springer Tungsten Mine in Pershing County; mining is expected to begin in 1981 at a rate of 1,270 short tons per day.

Zinc.—All reported production was from the Pyramid Mine and Mt. Hope Mine. Output was small and changed little from that reported in 1979.

Table 5.—Nevada: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1980, by class of ore or other source material

Source	Number of mines	Material sold or treated[1] (thousand metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:							
Dry gold[2]	12	6,428	274,157	562,721	W	--	--
Silver[2]	6	11	80	13,282	(3)	(3)	(3)
Copper and lead[4]	3	126	50	89,223	W	25	2
Total	21	6,565	274,287	665,226	W	[5]26	2
Other lode material:							
Silver tailings	1	18	81	5,409	--	--	--
Total lode material	22	6,583	274,368	670,635	W	26	2
Placer	1	--	14	--	--	--	--
Grand total	23	6,583	274,382	670,635	W	26	2

W Withheld to avoid disclosing company proprietary data.
[1]Does not include gravel washed.
[2]Includes material that was leached.
[3]Less than 1/2 unit.
[4]Combined to avoid disclosing company proprietary data.
[5]Data do not add to total shown because of independent rounding.

Table 6.—Nevada: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1980, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode:					
Cyanidation	274,174	568,274	--	--	--
Smelting of concentrates	130	102,260	W	26	2
Leaching	--	--	W	--	--
Direct smelting of ore	64	101	--	--	--
Total lode material	274,368	670,635	W	26	2
Placer	14	--	--	--	--
Grand total	274,382	670,635	W	26	2

W Withheld to avoid disclosing company proprietary data.

NONMETALS

Barite.—Nevada continued to be the leading barite producer in the Nation. Barite was reportedly produced at 27 mines, and shipments of processed material (mostly jig plant products) exceeded shipments of raw material. The bulk of production came from operations in Lander County, followed by that from Elko and Nye Counties.

IMCO Services Division of Halliburton Co., Dresser Minerals Division of Dresser Industries, Inc., and Minerals Division of Milchem, Inc., were the leading producers.

Cement.—Output declined slightly while reported value increased nearly 5%. Entire production came from the Centex Corp. plant at Fernley in Lyon County. The bulk of finished portland cement was shipped to ready-mix companies.

Clays.—Output fell slightly in 1980, compared with that reported in 1979, while value received nearly doubled. Industrial Mineral Ventures Inc.'s Armagosa facility in Nye County was the largest clay producer in the State. Other clay production occurred in Esmeralda, Humboldt, Lincoln, Pershing, and Washoe Counties.

Diatomite.—Production fell about 3% in 1980, although value increased nearly 10% over that reported in 1979. Eagle-Picher Industries, Inc., from pits and plants in Pershing and Storey Counties, was the State's leading producer; the company accounted for nearly 80% of total output. Construction at the Clark plant of Eagle-Picher was completed during the year. Production came from Churchill, Esmeralda, Lyon, Pershing, and Storey Counties.

Fluorspar.—The Daisy Mine in Nye County, owned and operated by J. Irving Crowell, Jr., & Son, was the State's only producer in 1980. Output increased slightly, although value received in 1980 was less

than that reported in 1979.

Gem Stones.—Turquoise, opals, and jasperoid were the most collected gem stones.

Gypsum.—Production decreased while value received in 1980 increased, compared with those reported in 1979. Output was reported from Clark, Lyon, and Pershing Counties. Pacific Coast Building Products, Inc., was the State's leading producer. Pacific Coast and the Flintkote Co. accounted for the bulk of State output of calcined gypsum. Producers in Nevada supplied nearly 7% of the Nation's crude gypsum in 1980.

Lime.—The Flintkote Lime Co. (Clark County) and Sierra Chemical Co. (Lincoln County) accounted for the State's total lime output for 1980. Total production was down 23% compared with that recorded in 1979. Output was evenly split between quicklime and hydrated.

Lithium Compounds.—The State's entire output came from Foote Mineral Co.'s Silver Peak operation in Esmeralda County. Production of lithium compounds decreased slightly from that produced in 1979, while value received increased nearly 19%.

Magnesite and Brucite.—C-E Basic, Inc., was the only producer of magnesite in the Nation in 1980. Output and value both decreased in 1980 compared with that reported in 1979. All production came from the company's operations at Gabbs, Nye County.

Perlite.—The State had but a single producer in 1980, the Delamar Perlite Co. in Lincoln County. Production remained about the same as reported in 1979, although value received increased. United States Gypsum did not produce from its Lovelock operation in Pershing County, but did ship from stockpiled material.

Expanded perlite was produced by United States Gypsum Co. at its Empire plant; this entire output was used as plaster aggregate.

Pumice and Volcanic Cinders.—Production decreased dramatically in 1980 compared with that reported in 1979. The State's largest 1979 producer, Rilite Aggregate Co., Reno, was inactive in 1980. Output from Savage Construction Co., Carson City, was half of that reported in 1979. Production from the only other producer, the Cind-R-Lite Block Co. at Beatty, remained stable both years. The State's total pumice value decreased to only a third of that received in 1979.

Salt.—Leslie Salt Co. was the only reporting salt producer in 1980. Production and reported value decreased from those of 1979.

Sand and Gravel.—Output and value both decreased in 1980 from the 1979 level because of the general decline in construction activity. Sixty quarries were reported to be in operation during the year; most of these were in Clark and Washoe Counties. The leading four producers in Clark County accounted for 56% of the State's total production.

There were two producers of industrial sand and gravel, both in Clark County. Production rose slightly, and value more than doubled for 1980 compared with that reported in 1979. Simplot Silica Products was the largest producer.

Table 7.—Nevada: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	4,377	$10,002	$2.29	4,330	$9,438	$2.18
Plaster and gunite sands	W	W	W	24	91	3.71
Concrete products	W	W	W	W	W	2.32
Asphaltic concrete	1,803	4,248	2.36	1,025	2,441	2.38
Road base and coverings	2,813	4,467	1.59	1,870	3,732	2.00
Fill	1,041	1,671	1.61	870	1,743	2.00
Snow and ice control	46	111	2.40	52	153	2.93
Other	--	--	--	268	762	2.98
Total or average	10,498	21,387	2.04	8,439	18,360	2.18

W Withheld to avoid disclosing company proprietary data; included in "Total" and "Other."

Table 8.—Nevada: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	3,229	$7,735	$2.40	3,646	$7,795	$2.14
Gravel	7,269	13,651	1.88	4,793	10,565	2.20
Total or average	10,498	[1]21,387	2.04	8,439	18,360	2.18
Industrial:						
Sand	W	W	6.54	W	W	12.65
Gravel	--	--	--	W	W	11.87
Total or average	W	W	6.54	W	W	12.53
Grand total	W	W	2.20	W	W	2.66

W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.

Table 9.—Nevada: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Concrete aggregate (coarse)	W	W	258	1,037
Dense-graded roadbase stone	--	--	102	211
Surface treatment aggregate	--	--	2	10
Riprap and jetty stone	2	8	3	5
Manufactured fine aggregate (stone sand)	--	--	25	W
Terrazzo and exposed aggregate	8	30	W	W
Chemicals	1	3	--	--
Fill	--	--	62	124
Sugar refining	51	230	W	W
Other[2]	1,540	6,167	1,357	6,020
Total	1,602	[3]6,439	1,809	7,407

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes limestone, granite, traprock, and miscellaneous stone.
[2]Includes stone used for poultry grit and mineral food, other construction aggregate and roadstone, railroad ballast, cement manufacture, lime manufacture, flux stone, glass manufacture, roofing granules (1980), and unspecified uses.
[3]Data do not add to total shown because of independent rounding.

Stone.—Eleven companies reported stone production from 20 quarries in 1980. Nearly 80% of the total stone produced was limestone for cement and lime output. Production was greatest from Clark and Lyon Counties.

Talc.—Reported production was off significantly in 1980. Only one producer, a small operator in Esmeralda County, reported production for the year.

[1]State mineral specialist, Bureau of Mines, Spokane, Wash.
[2]Director and state geologist, Nevada Bureau of Mines and Geology, Reno, Nev.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Barite:			
All Minerals, Inc	5510 South 300 West Murray, UT 84107	Surface mine and mill	Nye.
Dresser Industries, Inc., Dresser Minerals Div.	Box 375 Battle Mountain, NV 89820	----do----	Lander.
Halliburton Co., IMCO Services Div	Box 861 Battle Mountain, NV 89820	Surface mine	Do.
Milchem, Inc	Box 272 Battle Mountain, NV 89820	Surface mine and mill	Do.
NL Industries, Inc	Box 414 Battle Mountain, NV 89820	----do----	Eureka.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Cement:			
Centex Corp./Nevada Cement Co.[1]	Box 895 Fernley, NV 89408	Plant	Lyon.
Clays:			
Industrial Mineral Ventures, Inc	Box 549 Lathrop Wells, NV 89020	Surface mine and mill	Nye.
Copper:			
Day Mines, Inc.[2]	Box 65 Wendover, UT 84083	Underground mine and mill.	Elko.
Duval Corp.[3]	Box 451 Battle Mountain, NV 89820	Surface mine	Lander.
Diatomite:			
Cyprus Diatomite Co	Box 455 Fernley, NV 89408	do	Churchill.
Eagle-Picher Industries, Inc	Box 959 Lovelock, NV 89419	Surface mine and plants.	Pershing and Storey.
Fluorspar:			
J. Irving Crowell, Jr., & Son	Box 96 Beatty, NV 89003	Underground mine	Nye.
Gold:			
Carlin Gold Mining Co.[4]	Box 979 Carlin, NV 89822	Surface mines and mill.	Elko and Eureka.
Smokey Valley Mining Co.[2]	Box 480 Round Mountain, NV 89045	Surface mine and mill	Nye.
Gypsum:			
The Flintkote Co., Gypsum Products Div.	Star Route 89031 Box 2900 Las Vegas, NV 89101	do	Clark.
Pacific Coast Building Products, Inc	Box 43327 Las Vegas, NV 89104	do	Do.
United States Gypsum Co	Empire, NV 89405	do	Pershing.
Iron ore:			
Cooney Mining Co	Box 568 Lovelock, NV 89419	do	Do.
Nevada Barth Corp	Box 425 Carlin, NV 89822	do	Eureka.
Lead:			
Mt. Hope Mines[5]	Box 218 Eureka, NV 89316	Open pit mine and mill	Do.
Lime:			
The Flintkote Lime Co.[6]	107 Water St., Suite C Henderson, NV 89015	Surface mine and plant	Clark.
Sierra Chemical Co	Box 67 Pioche, NV 89043	do	Lincoln.
Lithium:			
Foote Minerals Co	Silverpeak, NV 89047	Dry lake brines	Esmeralda.
Magnesite:			
C-E Basic, Inc	Box 177 Gabbs, NV 89409	Surface mine and mill	Nye.
Mercury:			
Placer Amex, Inc	Box 497 McDermitt, NV 89421	Open pit mine and mill.	Humboldt.
Perlite:			
Delamar Perlite Co	Box 217 Pioche, NV 89043	Underground mine	Lincoln.
Pumice:			
Cind-R-Lite Block Co	3333 Cinder Lane Las Vegas, NV 89103	Open pit mine	Nye.
Savage Construction	Box 970 Carson City, NV 89701	do	Carson City.
U.S. Bureau of Land Management	1050 East William Carson City, NV 89701	Surface mines	Washoe.
Salt:			
Leslie Salt Co	Fallon, NV 89406	Solar evaporation plant.	Churchill.
Sand and gravel:			
Robert L. Helms Construction Co	Drawer 608 Sparks, NV 89431	Pits and mill	Lyon and Washoe.
Stewart Brothers Co	Box 42755 Las Vegas, NV 89104	Pit and mill	Clark.
Stocks Mill & Supply Co	3336 Cinder Lane Las Vegas, NV 89103	do	Do.
Wells Cargo, Inc	Box 14037 Las Vegas, NV 89101	do	Do.
W.M.K. Transit Mix, Inc	Box 14697 Las Vegas, NV 89114	do	Do.
Silver:			
Standard Slag Co.[7]	Box 97 Pioche, NV 89043	Open pit mine and mill.	Lincoln.
West Coast Oil & Gas Corp.[7]	395 Freeport Blvd. Sparks, NV 89431	Underground mine and mill.	Storey.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone:			
Las Vegas Building Materials, Inc	Box 530 Las Vegas, NV 89101	Surface mine and plant.	Clark.
Talc:			
Lloyd D. Rosenburg	Box 127 Olancha, CA 93549	Surface mine	Esmeralda.
Tungsten:			
Union Carbide Corp., Metals Div	Box 307 Alamo, NV 89001	Underground mine and mill.	Lincoln.

[1]Also clays and stone.
[2]Also silver.
[3]Also gold and silver.
[4]Also mercury.
[5]Also copper, gold, silver, and zinc.
[6]Also stone.
[7]Also gold.

The Mineral Industry of New Hampshire

This chapter has been prepared under a Memorandum of Understanding 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 nonfuel minerals.

By L. J. Prosser, Jr.,[1] and Robert I. Davis[2]

The value of nonfuel mineral production in New Hampshire was $25.4 million in 1980. Mining of sand and gravel and stone accounted for nearly $25.3 million of the total. Production of both commodities dropped in 1980, but higher unit prices increased the State's total value of output by $2.1 million over that of 1979. Clays were also mined in New Hampshire, and minor amounts of gem stones were recovered by collectors. Gypsum was imported into the State and processed into a higher value product.

New Hampshire, the Granite State, ranked fourth nationally in output of dimension stone, and was one of four States that produced over 100,000 short tons in 1980. In New England, New Hampshire ranked second in dimension stone production, fourth in sand and gravel and clays, and fifth in crushed stone. The State continued as the area's largest processor of imported gypsum.

Table 1.—Nonfuel mineral production in New Hampshire[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Sand and gravel	thousand short tons	7,086	$15,301	6,334	$15,837
Stone:					
Crushed	do.	866	2,172	590	2,281
Dimension	do.	86	5,774	103	7,167
Combined value of other nonmetals		XX	11	XX	121
Total		XX	23,258	XX	25,406

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

Table 2.—Value of nonfuel mineral production in New Hampshire, by county

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Belknap	$1,572	$977	Sand and gravel.
Carroll	2,279	2,279	Do.
Cheshire	1,173	1,249	Do.
Coos	1,030	1,435	Sand and gravel, stone.
Grafton	W	W	Do.
Hillsborough	6,588	8,363	Stone, sand and gravel.
Merrimack	W	W	Sand and gravel, stone.
Rockingham	2,542	W	Do.
Strafford	W	W	Sand and gravel, clays.
Sullivan	631	595	Sand and gravel.
Undistributed[1]	7,355	8,361	
Total[2]	23,167	23,258	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes gem stones and values indicated by symbol W.
[2]Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of New Hampshire business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	445.0	461.0	+3.6
Unemployment	do	14.0	22.0	+57.1
Employment and labor force, annual average:				
Mining	do	.4	.4	--
Manufacturing	do	116.6	116.8	+.2
Contract construction	do	20.7	19.3	-6.8
Transportation and public utilities	do	13.6	13.8	+1.5
Wholesale and retail trade	do	83.9	85.4	+1.8
Finance, insurance, real estate	do	18.9	19.6	+3.7
Services	do	69.2	72.6	+4.9
Government	do	55.1	57.0	+3.4
Total nonagricultural employment	do	[1]378.5	384.9	+1.7
Personal income:				
Total	millions	$7,422	$8,326	+12.2
Per capita		$8,370	$8,980	+7.3
Construction activity:				
Number of private and public residential units authorized		6,769	5,308	-21.6
Value of nonresidential construction	millions	$80.2	$60.7	-24.3
Value of State road contract awards	do	$30.0	$44.0	+46.7
Shipments of portland and masonry cement to and within the State	thousand short tons	318	231	-27.4
Nonfuel mineral production value:				
Total crude mineral value	millions	$23.3	$25.4	+9.0
Value per capita, resident population		$26	$28	+7.7
Value per square mile		$2,500	$2,731	+9.2

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

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

Trends and Developments.—For 10 of the past 20 years, New Hampshire's mineral industry produced the same commodities—clays, gem stones, sand and gravel, and stone. For that period, value of production totaled about $175 million, of which sand and gravel output accounted for over three-fifths.

From 1961 through 1970, the State's mineral industry also produced beryllium concentrate (1961-62), feldspar (1961-69), mica (1961-62, 1967, 1969-70) and peat (1961, 1966-67). Value of mineral output for this period totaled $74 million. Sand and gravel, again the dominant mineral commodity mined, contributed about two-thirds of the value.

Beryl was the last metallic mineral mined in New Hampshire. Mining ceased in 1962 when a Federal program to purchase strategic minerals ended. During the pro-

gram, hand-cobbed beryl was recovered from mines in Cheshire, Grafton, Merrimack, Rockingham, and Sullivan Counties.

A 36-million-short-ton copper-zinc deposit discovered in northern Maine in 1977 helped renew interest in New Hampshire's mineral resources. That discovery attracted several exploration companies to northern New England including Al Aquitaine Co., Ltd., Exxon Corp., Damascus Resources, Phelps Dodge Exploration East, Inc., and Texas Instruments.[3] Areas were investigated in Coos and Grafton Counties in the north and northwestern parts of the State. The area around the Mount Gardner Range, Grafton County, was one place where copper, lead, and zinc mineralization was indicated according to press reports. However, specific information on locations, findings, or plans were not disclosed because of the proprietary nature of exploration activity.

Legislation and Government Programs.—Mining and reclamation rules were adopted at yearend by the New Hampshire Department of Resources and Economic Development. The rules were formulated to interpret and implement the Mining and Reclamation Act of 1979 and to encourage environmentally safe development in the mining and minerals industry. Permit application procedures were outlined for exploration, prospecting, and mining. Exploration activity was defined as geological, geochemical, and geophysical surveys—boreholes, trial pits, and underground excavations—sampling, assaying, and testing.

A bill on coastal zone management drafted in 1980 was expected to be introduced in the 1981 legislative session. Coastal policies contained in the bill would provide guidelines for existing local, State, and Federal agencies to implement the program. Coastal resource areas identified for regulation in the proposed legislation included sand dunes, onshore sand and gravel deposits, tidal wetlands, harbors, and the Port of Portsmouth. Previous attempts to enact coastal zone management legislation were rejected by the Governor in 1978 and by the house in 1979.

Mining activity in New Hampshire was limited, but manufacturing required a broad base of industrial and metallic minerals. Efforts to attract new industries and expand existing operations continued in 1980 under the guidance of the State Office of Industrial Development. In the past decade, over 1,000 businesses either opened new facilities or enlarged operations in the State.

New Hampshire's Office of the State Geologist completed an inventory of construction minerals for Manchester and Suncook quadrangles in 1980. A lack of funding prevented continuation of the work into other parts of the State. In cooperation with the U.S. Geological Survey and the University of New Hampshire, a stream sediment sampling program was completed in the north-central part of the State. Also during the year the Office provided assistance in preparation of regulations pertaining to the Mining and Reclamation Act of 1979.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Clays.—New Hampshire was one of four New England States that produced clay in 1980. Kane-Gonic Brick Corp., the State's only operator, mined common clay in Strafford County in the southeastern part of the State and manufactured brick.

Q Ten, Inc., requested a zoning ordinance exemption to construct a synthetic gas plant at Kane-Gonic's brickyard. The plant, if approved, would, according to the company, provide a less expensive energy source for Kane-Gonic for use in the manufacture of brick. The process used to produce the gas involves heating of hydrocarbon materials such as rubber byproducts and automobile tires. A decision on the zoning ordinance exemption remained pending at yearend.

Gem Stones.—Mineral collectors and hobbyists recovered semiprecious gem stones and other mineral specimens from various sites within the State. Areas of interest included pegmatites in Cheshire, Carroll, and Grafton Counties. Some of the specimens collected were amazonite, fluorite, smoky quartz, and topaz.

The State's new mining and reclamation rules that require permits for exploration, prospecting, and mining exempted "rockhounding." Collecting mineral specimens was considered a recreational use of State lands for which neither permit nor fee would be necessary.

Gypsum.—National Gypsum Co. operated a manufacturing plant for gypsum wall-

board products at Portsmouth, Rockingham County. The crude gypsum was shipped from the company's subsidiary in Canada and entered into the State through the Port of Portsmouth. National Gypsum was one of two gypsum calciners in New England. United States Gypsum Co. operates a facility in Massachusetts.

Mica.—The United States' first commercial mica production started in 1803 at the Ruggles Mines in Grafton County. Scrap mica was mined intermittently in the 1960's in Cheshire and Grafton Counties; operations ceased in 1970. In 1980, two firms processed and marketed imported mica in Merrimack and Rockingham Counties.

Sand and Gravel.—Output of sand and gravel from 1971 through 1980 totaled about 68 million short tons and added nearly $111 million to the State's value of mineral production. During that period, the unit value of the commodity tripled.

Table 4.—New Hampshire: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	2,473	$5,985	$2.42	2,030	$5,683	$2.80
Plaster and gunite sands	43	114	2.66	44	110	2.50
Concrete products	133	388	2.93	228	588	2.57
Asphaltic concrete	1,580	3,699	2.34	1,231	3,535	2.87
Road base and coverings	1,292	2,563	1.98	1,889	4,132	2.19
Fill	731	968	1.32	566	1,016	1.79
Snow and ice control	206	277	1.34	187	280	1.50
Other	629	1,307	2.08	158	492	3.11
Total[1] or average	7,086	15,301	2.16	6,334	15,837	2.50

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

Table 5.—New Hampshire: Construction sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	3,129	$6,015	$1.92	3,143	$6,995	$2.23
Gravel	3,957	9,286	2.35	3,192	8,842	2.77
Total or average	7,086	15,301	2.16	[1]6,334	15,837	2.50

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

In 1980, production dropped for the second consecutive year. Extracted from surface mines in all of the State's 10 counties, sand and gravel remained the major mineral commodity produced in New Hampshire in terms of tonnage and value. Leading counties in output were Carroll, Hillsborough, and Merrimack.

Stone.—Crushed and dimension stone ranked second to sand and gravel in the State, in both quantity and value. Stone was quarried in four counties; Merrimack County led in output with Grafton County second.

Traprock was crushed in Grafton and Rockingham Counties and used extensively as aggregate and a roadbase material. In New England, the State ranked third in traprock production behind Connecticut and Massachusetts. Crushed granite produced in Grafton and Merrimack Counties was mostly marketed for the same uses as traprock.

In 1980, New Hampshire ranked second nationally in dimension granite output; Georgia ranked first. During the year, increased use of granite curbstone continued and accounted for about one-half of the State's production. Granite dimension stone was quarried in Hillsborough and Merrimack Counties in the south-central part of the State.

Production from individual quarries in 1980 ranged from less than 5,000 short tons to more than 200,000 short tons. Over two-thirds of the stone produced was shipped by truck.

[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.
[2]State geologist, New Hampshire Department of Resources and Economic Development, Durham, N.H.
[3]Foster's Daily Democrat. May 1979, p. 14.
Skillings' Mining Review. October 1980, p. 18.
———. November 1980, p. 15.

Table 6.—New Hampshire: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Concrete aggregate (coarse)	153	419	116	460
Bituminous aggregate	240	660	173	817
Dense-graded roadbase stone	W	W	104	130
Other construction aggregate and roadstone	330	859	166	793
Riprap and jetty stone	27	71	11	25
Other[2]	116	163	20	55
Total	866	2,172	590	[3]2,281

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes granite and traprock.
[2]Includes stone used in surface treatment aggregate, manufactured fine aggregate (stone sand), and unspecified uses.
[3]Data do not add to total shown because of independent rounding.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Kane-Gonic Brick Corp	Gonic, NH 03867	Pit	Strafford.
Gypsum (calcined):			
National Gypsum Co	4100 First International Bldg. Dallas, TX 75270	Plant	Rockingham.
Sand and gravel:			
Campton Sand & Gravel Inc	Box 1 West Campton, NH 03228	Pit	Grafton.
J. J. Cronin Co	Box 176 North Reading, MA 01864	Pit	Hillsborough.
Granite State Concrete Co., Inc	Box 185 Milford, NH 03055	Pit	Do.
Hudson Sand & Gravel Co	85 Greeley St. Hudson, NH 03051	Pit	Do.
Manchester Sand, Gravel & Cement Co	Box 415 Hookset, NH 03106	Pits	Merrimack and Strafford.
Newport Sand & Gravel Co	Box 368 Newport, NH 03773	Pit	Sullivan.
Ossipee Aggregates Corp	Ossipee, NH 03864	Pit	Carroll.
James Pike Sand Co	Packers Falls Rd. Durham, NH 03824	Pit	Strafford.
F. W. Whitcomb Construction Corp	Box 429 Bellows Falls, VT 05101	Pit	Cheshire.
Stone:			
Boston S&G Cook Concrete Co	Hookset, NH 03106	Quarry	Merrimack.
Iafolla Industries, Inc	Peverly Hill Rd. Portsmouth, NH 03801	do	Rockingham.
Kitledge Granite Corp	Armory Rd. Milford, NH 03055	do	Hillsborough.
Lebanon Crushed Stone Inc	Plainfield Rd. West Lebanon, NH 03784	do	Grafton.

The Mineral Industry of New Jersey

This chapter has been prepared under a Memorandum of Understanding 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 nonfuel minerals.

By William Kebblish[1] and Robert J. Tuchman[2]

The value of nonfuel mineral production in New Jersey was $149.4 million, a decrease of $2.2 million from that of 1979. The three main mineral commodities produced, in terms of value, were stone, sand and gravel, and zinc, accounting for nearly 88% of the State's mineral value in 1980. Nationally, New Jersey ranked third in production of selenium, fourth in magnesium compounds and zinc, and ninth in peat; it was the only State that produced greensand marl. Leading counties, in value of mineral production, were Camden, Cumberland, Morris, Passaic, Somerset, and Sussex.

Table 1.—Nonfuel mineral production in New Jersey[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	67	$559	63	$525
Gem stones	NA	1	NA	1
Lime thousand short tons	W	W	--	--
Peat do.	23	549	20	564
Sand and gravel do.	10,781	44,682	8,596	45,535
Stone, crushed[2] do.	13,950	63,174	11,830	61,886
Zinc (recoverable content of ores, etc.) metric tons	31,118	25,589	28,859	23,814
Combined value of magnesium compounds, marl (greensand), stone (dimension), titanium concentrate (ilmenite), and values indicated by symbol W	XX	17,135	XX	17,123
Total	XX	151,689	XX	149,448

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

[2]Excludes dimension stone; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in New Jersey, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Atlantic	$594	$714	Sand and gravel.
Bergen	W	W	Do.
Burlington	757	706	Do.
Camden	2,841	2,381	Do.
Cape May	W	W	Magnesium compounds, sand and gravel.
Cumberland	W	W	Sand and gravel, clays.
Essex	W	W	Stone.
Gloucester	W	W	Greensand marl, sand and gravel.
Hudson	W	W	Stone.
Hunterdon	W	W	Do.
Mercer	W	W	Do.
Middlesex	W	W	Sand and gravel, clays.
Monmouth	472	590	Sand and gravel.
Morris	W	6,218	Sand and gravel, stone.
Ocean	W	W	Ilmenite, sand and gravel.
Passaic	7,173	7,826	Stone, sand and gravel.
Somerset	20,826	26,325	Stone, clays.
Sussex	W	40,680	Zinc, stone, sand and gravel, peat, lime.
Union	1,527	—	
Warren	W	W	Sand and gravel, stone, peat.
Undistributed[2]	93,664	66,248	
Total[3]	127,856	151,689	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Salem County is not listed because no nonfuel mineral production was reported.
[2]Includes 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

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	3,538.0	3,582.0	+1.2
Unemployment	do	245.0	258.0	+5.3
Employment (nonagricultural):				
Mining	do	2.6	2.4	-7.7
Manufacturing	do	799.1	783.4	-2.0
Contract construction	do	113.7	110.7	-2.6
Transportation and public utilities	do	190.4	192.1	+.9
Wholesale and retail trade	do	678.6	677.1	-.2
Finance, insurance, real estate	do	153.6	157.1	+2.3
Services	do	572.5	606.6	+6.0
Government	do	516.7	524.5	+1.5
Total nonagricultural employment	do	[1]3,027.4	3,053.9	+.9
Personal income:				
Total	millions	$71,454	$79,051	+10.6
Per capita		$9,746	$10,755	+10.4
Construction activity:				
Number of private and public residential units authorized		34,551	23,136	-33.0
Value of nonresidential construction	millions	$656.2	$718.1	+9.4
Value of State road contract awards	do	$133.4	$128.3	-3.8
Shipments of portland and masonry cement to and within the State	thousand short tons	1,796	1,543	-14.1
Nonfuel mineral production value:				
Total crude mineral value	millions	$151.7	$149.4	-1.5
Value per capita, resident population		$21	$20	-4.8
Value per square mile		$19,358	$19,072	-1.5

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

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

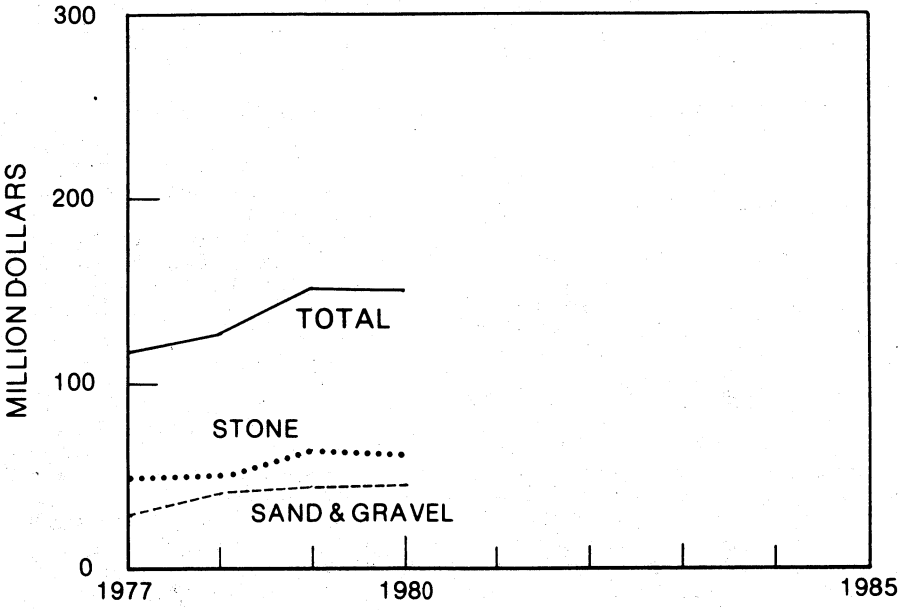

Figure 1.—Value of sand and gravel and stone, and total value of nonfuel mineral production in New Jersey.

Trends and Developments.—The Coastal Resource and Development Policies section of the State's Coastal Zone Management Program proposed guidelines that will affect the sand and gravel industry. Dredging operations would be conditionally acceptable in large rivers, certain streams, and ocean waters exceeding 18 feet in depth. Areas where dredging would be discouraged include open bays, semienclosed and back bays, and ocean water less than 18 feet in depth. Sand and gravel dredging operations would be banned in lakes, ponds and reservoirs, and man-modified harbors.

At yearend, the Governor approved a preservation plan enabling the Pinelands Commission to make land use decisions concerning the Pinelands National Reserve. The reserve, established by U.S. Congress in 1978, safeguards approximately 970,000 acres located in Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, and Ocean Counties. The plan is divided into two parts, the first of which establishes a 360,000-acre core area called the Preservation Area, where development is restricted. The second creates an outer Protection Area; municipalities within this area will be required to revise their zoning codes, possibly affecting future mining operations. At present, the plan allows extraction of minerals to any depth to reduce the amount of surface land disturbed by shallower mining.

Legislation and Government Programs.—In late 1980, the Governor signed a bill amending the Spill Compensation and Control Act reducing tax on minor metals considered hazardous substances. Taxes are paid into a spill fund by petroleum and chemical producers and funds used to protect against environmental degradation. Rates are adjusted upward when funds are depleted.

During fiscal year 1980, the U.S. Bureau of Mines awarded 12 contracts and grants valued in excess of $730,000 to New Jersey researchers. Princeton Gamma-Tech, Inc., Princeton, received over $318,000 to develop and evaluate in situ neutron activation analysis of boreholes. A $161,000 contract was awarded to Ingersoll-Rand Research Institute, Princeton, for development of au-

tomatic drill positioning for jumbo-mounted blasthole drills. Other contracts pertained to control of diesel emissions in underground mines, improved overburden handling techniques, wet venturi scrubbers, a belt elevator, a dryer-blender, a magnetic separator, a drum filter, cables, connectors and couplings, and a zeta reader.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Shipments of portland and masonry cement into New Jersey totaled 1.5 million tons in 1980, a slight decrease compared with 1979 figures. Most of the cement was manufactured in Pennsylvania and New York. Distribution terminals were located in Jersey City, Bayonne, Elizabeth, and Newark.

A new, polymer-modified concrete was developed by Rutgers University's College of Engineering. Resin and a chemical hardener are added to regular concrete to attain added compressive strength. Although more expensive than regular concrete, the modified concrete has much greater durability and strength and can be bonded with older concrete, thus providing an excellent filler for potholes. Other applications include bridge decks, highways, and runways.

A 16-ton special reinforced concrete structure resembling a large anchor, called a dolo, is being used on New Jersey's shoreline to prevent erosion caused by waves and tides. Dolos were developed in England nearly 20 years ago. A total of 684 dolos are to be used on the south jetty of Manasquan Inlet, approximately 65 miles north of Atlantic City. The dolos will be manufactured in Lakewood, Ocean County, about 14 miles from the erosion-control project.

Clays.—Both quantity and value of clays produced in New Jersey declined slightly from 1979 to 1980. Over 63,000 tons of clay, valued at $525,000, was produced in three counties by three companies. Somerset County, in central New Jersey, was the leading county with nearly 79% of the State's total production. Cumberland and Middlesex Counties, each with one producer, supplied the remainder. Common clay and shale were used for face brick and sewer pipe; fire clay, produced in Cumberland and Middlesex Counties, was used for firebrick and block, cement, refractory mortar, and sealing.

Gem Stones.—A small amount of gem stones, with an estimated value of $1,000, was collected by rockhounds and mineral dealers. Collection sites included the New Street Quarry area and road cuts on Route 80 near West Paterson, where fine green prehnite and silky white pectolite have been found. Other areas were the First Watchung Mountains near Paterson, Braens Quarry near Hawthorne, and quarries near Great Notch. At Cape May, quartz pebbles referred to as Cape May diamonds were collected.

Graphite.—Celanese Research Co., a subsidiary of Celanese Corp., produced high-modulus, synthetic graphite fiber at its Summit plant, Union County. High-modulus fiber was used for lightweight, high-strength products, such as airplane and automobile components.

Greensand Marl.—New Jersey was the sole producer of greensand marl in the Nation. Production and value remained essentially the same from 1979 to 1980. Inversand Co., a subsidiary of Hungerford & Terry, Inc., mined glauconite, commonly known as greensand, near Clayton, Gloucester County. Glauconite is a hydrous iron potassium silicate containing various amounts of aluminum, magnesium, sodium, and trace elements. Most greensand beds are unconsolidated sediments mined by open pit methods. Greensand was sold for agricultural use as a soil conditioner and for water treatment.

Gypsum.—Crude gypsum, imported from Canada, was calcined by National Gypsum Co., Burlington County, and The Flintkote Co., Camden County. Production decreased 13% in quantity and more than 26% in value compared with 1979 figures. Calcined gypsum was used mainly in the manufacture of wallboard and sheeting.

Iodine.—Crude iodine, mined primarily in other countries, was shipped into New Jersey and used by nine chemical and pharmaceutical companies to manufacture various iodine-containing compounds. Iodine compounds produced were used as catalysts, food supplements, stabilizers, in inks and colorants, in pharmaceuticals, and for sanitary purposes. Leading consumers of iodine were J. T. Baker Chemical Co., Warren County; Cooper Chemical Co., Morris County; Merck & Co., Inc., Union County; and S. B. Penick & Co., Essex County.

Magnesium Compounds.—New Jersey

ranked fourth, behind Michigan, California, and Florida, in production of magnesium compounds. Production and value declined from 1979 to 1980. Harbison-Walker Refractories, the sole producer, extracted magnesium compounds from seawater in Cape May County in southern New Jersey. Uses were mainly in refractories, fertilizers, and pharmaceuticals.

Peat.—New Jersey ranked ninth among the States in 1980, producing 20,000 tons of peat valued at $564,000. This reflected a slight decrease in quantity but a small increase in value, compared with those of 1979. Six plants operated in 1980, producing reed sedge and humus—four in Sussex County and one each in Warren and Passaic Counties. Uses included soil improvement and as a medium for packing flowers.

Perlite.—Crude perlite, mined in other States, was shipped into New Jersey and expanded by Grefco, Inc., Jamesburg, and Schundler Co., Edison, both in Middlesex County, in the central part of the State. From 1979 to 1980, production decreased nearly 14%, but total value decreased only slightly. Expanded perlite was used in roof insulation, plaster, masonry products, and as a soil conditioner.

Sand and Gravel.—Production of sand and gravel totaled 8.6 million tons valued at $45.5 million, a decline of more than 2 million tons, but a slight increase in value, compared with 1979 levels. Construction of private and public residential units dropped 33%; value of State road contract awards declined nearly 4%, while value of nonresidential construction awards increased more than 9%. Sand and gravel output used in home and commercial construction was affected by high interest rates and double-digit inflation, which persisted throughout the year, discouraging potential buyers.

Production of construction sand and gravel in 1980 was approximately 6 million tons, accounting for nearly 68% of total sand and gravel output in New Jersey. Morris County, with six operators, led in production, followed by Camden, Ocean, and Cape May Counties. Principal producers were New Jersey Pulverizing Co., Ocean County; Saxon Falls Sand & Gravel Co., Inc., Morris County; Rite Dun Sand & Gravel Co., Camden County; and Tuckahoe Sand & Gravel Co., Cape May County. Construction sand and gravel was used mainly for concrete aggregate.

Table 4.—New Jersey: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	2,922	$8,544	$2.92	2,551	$9,306	$3.65
Plaster and gunite sands	232	702	3.02	177	735	4.14
Concrete products	293	805	2.75	390	1,226	3.15
Asphaltic concrete	1,155	3,030	2.62	577	1,810	3.13
Roadbase and coverings	1,265	2,998	2.37	669	2,353	3.51
Fill	1,958	3,364	1.72	1,314	2,323	1.77
Snow and ice control	284	1,301	4.58	82	336	4.09
Other uses	168	845	5.04	68	489	7.16
Total[1] or average	8,277	21,590	2.61	5,829	18,578	3.19

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

Table 5.—New Jersey: Sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	5,249	$12,555	$2.39	4,064	$11,705	$2.88
Gravel	3,027	9,036	2.98	1,765	6,873	3.89
Total[1] or average	8,277	21,590	2.61	5,829	18,578	3.19
Industrial sand	2,504	23,092	9.22	2,766	26,957	9.75
Grand total[1] or average	10,781	44,682	4.14	8,596	45,535	5.30

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

Table 6.—New Jersey: Sand and gravel sold or used, by county

(Thousand short tons and thousand dollars)

County	1979			1980		
	Quantity	Value	Number of companies	Quantity	Value	Number of companies
Atlantic	178	714	4	150	626	3
Bergen	W	W	1	W	W	1
Burlington	341	706	1	10	25	1
Camden	954	2,381	4	1,218	3,121	5
Cape May	587	1,402	6	611	1,776	6
Cumberland	3,580	24,999	6	2,719	26,235	5
Gloucester	70	134	3	25	112	3
Middlesex	W	W	2	W	W	3
Monmouth	271	590	3	179	527	3
Morris	1,230	3,955	4	1,366	5,695	6
Ocean	1,161	2,396	7	674	1,472	6
Passaic	515	1,778	6	426	1,870	6
Sussex	526	1,282	7	373	950	7
Warren	585	2,354	2	285	1,320	2
Total	10,781	44,682	56	8,596	45,535	57

W Withheld to avoid disclosing company proprietary data; included in "Total."

Industrial sand was produced by 7 companies with 10 operations in 5 counties. Cumberland County, in southern New Jersey, was the leading producing county, accounting for over 93% of the State's industrial sand output. Major producers, in descending order of production, were Pennsylvania Glass Sand Corp., New Jersey Silica Sand Co., J. S. Morie & Son, Inc., and Whitehead Bros. Co. Principal uses of industrial sand were in the manufacture of glass products, molds and cores, refractories, and in sandblasting and filtration.

Of the total sand and gravel produced, 78% was shipped to market by truck, 12% was moved by rail, and the remainder was used at the plant site.

Tri-County Asphalt Corp. began development of a $3 million, 275-acre sand and gravel pit in Hardystown Township, near Hamburg, Sussex County. The pit is expected to provide approximately 1.5 million tons of sand and gravel annually to five asphalt plants over a 20-year period.

New Jersey Silica Sand Co., a subsidiary of Wagner Co., expanded its Millville plant in Cumberland County. The plant will produce eight grades of industrial sand and various grades of washed gravel and concrete sand.

Stone.—New Jersey ranked 25th nationally in crushed stone production with 11.8 million tons valued at $61.9 million. Crushed stone was produced in 8 of the State's 21 counties, all in the northern part of the State. Somerset was the leading producing county with seven quarries. Seventeen quarries produced crushed traprock; eight, crushed granite; two, crushed limestone; and one, dimension sandstone. Over 98% of the stone was transported to market by truck; the remainder, by rail and other methods.

Of the total stone produced, traprock accounted for more than 75%, granite and sandstone, 20%; and limestone, 5%. Major uses of crushed stone were for concrete aggregate, roadbase, and bituminous aggregate.

Leading producers of traprock were Stavola Construction Materials, Inc., Trap Rock Industries, Inc., and Union Building & Construction Corp. Crushed granite was produced by Tri-County Asphalt Corp., Anthony Ferrante & Sons, Inc., and Lentine Aggregates Corp. Crushed limestone was produced by Limestone Products Corp., subsidiary of Penn Virginia Corp.

Dimension sandstone was produced by Delaware Quarries, Hunterdon County, in western New Jersey. Output was sold for stone and house veneer.

Erosion of New Jersey's shoreline presented a continual problem throughout the year. To prevent further erosion, municipalities continued repair of seawalls and jetties using core stone and capstone. Core stone averages 1 to 35 pounds each, while capstone ranges from 2 to 18 tons each. Both core stone and capstone are diabase traprocks formed long ago by cooling of molten material, which produced a hard, dense, and durable stone withstanding disintegration by seawater or severe changes in temperature. All stone used was produced by quarries within the State.

Table 7.—New Jersey: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Poultry grit and mineral food	25	413	20	403
Concrete aggregate	1,168	4,568	2,402	11,854
Bituminous aggregate	2,228	9,770	2,272	13,072
Macadam aggregate	591	2,328	579	2,885
Dense-graded roadbase stone	3,758	15,756	2,277	10,332
Surface treatment aggregate	296	1,096	274	1,295
Other construction aggregate and roadstone	4,673	21,162	2,972	14,076
Riprap and jetty stone	284	1,310	223	1,097
Railroad ballast	59	173	71	331
Filter stone	W	W	10	56
Manufactured fine aggregate (stone sand)	98	535	110	651
Terrazzo and exposed aggregate	37	679	37	768
Asphalt filler	W	W	48	371
Other uses[2]	733	5,386	533	4,697
Total[3]	13,950	63,174	11,830	61,886

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

[1]Includes limestone, granite, and traprock.

[2]Includes stone used for agricultural limestone, flux stone, other filler, acid neutralization (1980), roofing granules, other uses, and uses indicated by symbol W.

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

Sulfur.—Sulfur was recovered as a byproduct at four oil refining operations. Production amounted to 120,000 metric tons valued at $7.3 million, reflecting an increase of 11% in quantity and 28% in value, compared with those of 1979. Gloucester County had two refineries; Middlesex and Union Counties, one each. Sulfur was used in the manufacture of sulfuric acid, fertilizers, plastics, and other products.

Talc.—Talc, mined in other States, was shipped into New Jersey and processed by Amoco Minerals Co. at a plant in South Plainfield, Middlesex County. Talc was used mainly in the production of ceramics.

Vermiculite.—Production of exfoliated vermiculite increased slightly both in quantity and value, compared with 1979 figures. Crude vermiculite was shipped into New Jersey and exfoliated by W. R. Grace & Co., Trenton, Mercer County, and Schundler Co., Edison, Middlesex County. Major uses were for agricultural purposes, loosefill insulation, fireproofing, and lightweight aggregate.

METALS

Ferroalloys.—Production of ferroalloys in New Jersey increased slightly from 1979 to 1980. Shieldalloy Corp., Newfield, Gloucester County, a subsidiary of Metallurg, Inc., produced ferroalloys of columbium, titanium, and vanadium. Ferroalloys were used in the manufacture of cast iron products, bolts, metal brake shoes, automobile mufflers, tool steel, and other products.

Iron Oxide Pigments.—Production of finished iron oxide pigments totaled over 8,800 tons valued at about $9 million, a decrease of 22% in quantity and 10% in value, compared with 1979 data. Producers were Combustion Engineering Corp., Camden County; E. I. du Pont de Nemours & Co., Inc., Essex County; and Columbian Chemicals Co., Mercer and Middlesex Counties. Iron oxide pigments were used mainly in paint manufacture.

Iron and Steel.—John A. Roebling Steel Corp. (Jarsco) reopened the previously closed steel mill in Roebling, Burlington County. Jarsco began operating an electric furnace in 1979 and recently started up a second 45-ton electric furnace. Plans include a third furnace, which will boost production of quality steel billets to 240,000 tons annually.

United States Steel Corp. planned to modernize and expand its Trenton wire plant. Facilities will include new equipment for wire drawing and for stranding and closing wire rope up to 5 inches in diameter.

Selenium.—New Jersey ranked third, behind Utah and Texas, in primary selenium production. AMAX Inc., at Carteret, Middlesex County, produced selenium as a byproduct of the electrolytic copper-refining

process. Selenium was sold for use in glass manufacturing, pigments, specialty steels, and electronic components.

Tellurium.—AMAX, at Carteret, decreased its production of tellurium from 1979 to 1980. Tellurium was recovered from metal anode slimes obtained from electrolytic refining of copper. Major sales were for mold dressing and cast iron products, for improvement of steel machinability, and in various chemicals.

Titanium.—From 1979 to 1980, production of the titanium mineral ilmenite remained constant, but value increased nearly 18%. Ilmenite, the chief source of titanium for titanium dioxide pigments, is found in sand deposits near the seashore. The deposits are dredged and the product processed, yielding concentrate of approximately 63% titanium dioxide. Ilmenite was mined by ASARCO Incorporated, Lakehurst, Ocean County. Titanium dioxide pigments for use in the manufacture of paints, paper, rubber, and plastic products were produced by NL Industries, Inc., Sayreville, Middlesex County, and by Gulf + Western Natural Resources Group, Chemicals Div., Gloucester City, Camden County.

Zinc.—New Jersey ranked fourth, behind Tennessee, Missouri, and New York, in zinc output. Production totaled nearly 29,000 metric tons valued at almost $24 million, representing a decrease in both quantity and value of 7%, compared with those of 1979. Zinc was produced only in Sussex County, with the crushed ore shipped to a company-owned smelter in Pennsylvania. New Jersey Zinc Co. reportedly reduced production of zinc ore from its underground Sterling Mine in Ogdensburg by 37% owing to economic factors. Zinc was used mainly for galvanizing, brass products, and zinc-base alloys.

[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.
[2]Program assistant, Bureau of Mines, Pittsburgh, Pa.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Almasi Clay Co	Metuchen Ave. Woodbridge, NJ 07095	Pit	Middlesex.
J. S. Morie & Son, Inc.[1]	Box 35 Mauricetown, NJ 08329	Pit	Cumberland.
New Jersey Shale Brick & Tile Corp	Box 490 Somerville, NJ 08876	Plant	Somerset.
Greensand marl:			
Inversand Co., a subsidiary of Hungerford & Terry, Inc.	226 Atlantic Ave. Clayton, NJ 08312	Pit	Gloucester.
Gypsum, calcined:			
The Flintkote Co	1101 South Front St. Camden, NJ 08103	Plant	Camden.
National Gypsum Co	4100 First Intl. Bldg. Dallas, TX 75270	do	Burlington.
Ilmenite:			
ASARCO, Incorporated	Route 70, Mile 41 Lakehurst, NJ 08733	Dredge and plant.	Ocean.
Iron oxide pigments:			
Columbian Chemicals Co	Box 300 Tulsa, OK 74102	Plants	Mercer and Middlesex.
Combustion Engineering Corp	901 East 8th Ave. King of Prussia, PA 19406	Plant	Camden.
E. I. du Pont de Nemours & Co., Inc	Pigments Dept. Wilmington, DE 19898	do	Essex.
Magnesium compounds:			
Harbison-Walker Refractories	2 Gateway Center Pittsburgh, PA 15222	do	Cape May.
Peat:			
Hyper-Humus Co	Lafayette Rd., Box 267 Newton, NJ 07860	Bog	Sussex.
Kelsey Humus & Partac Co	Kelsey Park Great Meadows, NJ 07838	Bog	Warren.
Mt. Bethel Humus Co., Inc	315 West 57th St. New York, NY 10019	Bog	Sussex.
Netcong Natural Products	738 Route 10 Randolph, NJ 07801	Bog	Do.
Perlite, expanded:			
Grefco, Inc	3450 Wilshire Blvd. Los Angeles, CA 90010	Plant	Middlesex.
Schundler Co.[2]	Box 251 Metuchen, NJ 08840	do	Do.

See footnotes at end of table.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel:			
Construction:			
New Jersey Pulverizing Co	115 Hickory Ln. Bayville, NJ 08721	Pit	Ocean.
Rite Dun Sand & Gravel Co	Sticklerville, NJ 08329	Pit	Camden.
Saxon Falls Sand & Gravel Co., Inc	R.D. 3 Stanhope, NJ 07874	Pit	Morris.
Tuckahoe Sand & Gravel Co	Box 101 Tuckahoe, NJ 08250	Dredge	Cape May.
Industrial:			
New Jersey Silica Sand Co	Millville, NJ 08332	do	Cumberland.
Pennsylvania Glass Sand Corp	Berkeley Springs, WV 25411	Pit	Do.
Whitehead Bros. Co	60 Hanover Rd. Florham Park, NJ 07932	Pit and dredge.	Do.
Stone:			
Granite, crushed and broken:			
Anthony Ferrante & Sons, Inc	Route 202, Mine Brook Rd. Bernardsville, NJ 07924	Quarries	Hunterdon and Somerset.
Tri-County Asphalt Corp	Route 15 Hopatcong, NJ 07843	Quarry	Sussex.
Traprock (basalt), crushed and broken:			
Stavola Construction Materials, Inc	Hamilton Rd. Red Bank, NJ 07701	do	Somerset.
Trap Rock Industries, Inc	Laurel Ave. Kingston, NJ 08528	Quarries	Hunterdon, Mercer, Somerset.
Union Building & Construction Corp	1111 Clifton Ave. Clifton, NJ 07013	Quarry	Passaic.
Sulfur:			
Chevron Oil Co	1200 State St. Perth Amboy, NJ 08861	Refinery	Middlesex.
Exxon Co., U.S.A	Box 23 Linden, NJ 07036	do	Union.
Mobil Oil Corp	Paulsboro, NJ 08066	do	Gloucester.
Texaco, Inc	Eagle Point, Box 52332 Houston, TX 77052	do	Do.
Vermiculite, exfoliated:			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	Mercer.

[1]Also industrial sand and gravel.
[2]Also exfoliated vermiculite.

The Mineral Industry of New Mexico

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the New Mexico Department of Energy and Minerals for collecting information on all nonfuel minerals.

By Lorraine B. Burgin[1]

The value of nonfuel minerals produced in New Mexico rose to a record $765 million in 1980. The two most valuable commodities in the State, copper and potassium salts, accounted for 82% of nonfuel mineral value, followed by molybdenum, silver, sand and gravel, portland cement, perlite, and gold.

Table 1.—Nonfuel mineral production in New Mexico[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2] thousand short tons	74	$124	60	$114
Copper (recoverable content of ores, etc.) metric tons	164,281	336,934	149,394	337,328
Gem stones	NA	180	NA	150
Gold (recoverable content of ores, etc.) troy ounces	22,976	7,065	15,787	9,670
Gypsum thousand short tons	251	3,244	182	1,688
Lead (recoverable content of ores, etc.) metric tons	43	49	--	--
Manganiferous ore (5% to 35% Mn) short tons	33,152	W	35,198	W
Mica, scrap thousand short tons	17	W	W	W
Peat do.	2	40	2	40
Perlite do.	588	14,874	539	14,404
Potassium salts thousand metric tons	2,005	228,776	1,869	289,011
Pumice thousand short tons	r603	3,550	448	3,028
Sand and gravel do.	7,141	18,245	7,050	17,676
Stone:				
Crushed do.	2,589	6,743	2,217	7,259
Dimension do.	20	117	18	91
Combined value of barite, carbon dioxide, cement, clays (fire clay), helium (high-purity, 1980), lime, molybdenum, salt, silver, vanadium, zinc, and values indicated by symbol W	XX	74,507	XX	84,752
Total	XX	694,448	XX	765,211

rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

[2]Excludes fire clay; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in New Mexico, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Bernalillo	$29,744	$26,660	Cement, sand and gravel, stone, clays.
Catron	W	W	Salt.
Chaves	712	705	Sand and gravel.
Colfax	W	--	
Curry	W	W	Sand and gravel, stone.
De Baca	175	248	Sand and gravel.
Dona Ana	W	W	Sand and gravel, pumice, stone, clays.
Eddy	W	W	Potassium salts, salt, sand and gravel, stone.
Grant	202,682	365,228	Copper, silver, gold, lime, molybdenum, manganiferous ore, stone, sand and gravel, zinc, lead.
Guadalupe	W	W	Stone, sand and gravel.
Harding	W	W	Carbon dioxide.
Hidalgo	W	529	Stone, clays, lead, silver, copper, zinc, clays.
Lea	W	W	Potassium salts, stone, sand and gravel, salt.
Lincoln	68	W	Sand and gravel, stone.
Luna	W	328	Sand and gravel, clays.
McKinley	W	W	Stone, molybdenum, vanadium, sand and gravel.
Mora	3	3	Sand and gravel.
Otero	412	358	Sand and gravel, stone.
Quay	W	292	Sand and gravel.
Rio Arriba	W	W	Pumice, sand and gravel, stone.
Roosevelt	W	33	Stone.
Sandoval	W	3,227	Gypsum, sand and gravel, peat, pumice.
San Juan	W	W	Sand and gravel, stone, pumice, clays.
San Miguel	201	84	Sand and gravel.
Santa Fe	W	W	Sand and gravel, pumice, gypsum, stone.
Sierra	W	W	Sand and gravel, silver, gold, copper, lead.
Socorro	W	W	Perlite, barite, sand and gravel, stone, copper, pumice.
Taos	36,442	45,522	Molybdenum, perlite, mica, sand and gravel, stone.
Torrance	124	124	Sand and gravel.
Union	W	W	Pumice.
Valencia	715	W	Stone, perlite, sand and gravel.
Undistributed[2]	206,278	251,105	
Total[3]	477,559	694,448	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Los Alamos County is not listed because no nonfuel mineral production was reported.
[2]Includes some gem stones that cannot be assigned to specific counties and values indicated by symbol W.
[3]Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of New Mexico business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	538.0	543.0	+0.9
Unemployment	do	35.0	40.0	+14.3
Employment (nonagricultural):				
Mining[1]	do	27.1	29.5	+8.9
Manufacturing	do	34.8	34.3	-1.4
Contract construction	do	35.6	30.2	-15.2
Transportation and public utilities	do	28.1	28.4	+1.1
Wholesale and retail trade	do	104.1	103.1	-1.0
Finance, insurance, real estate	do	21.2	21.0	-.9
Services	do	89.6	91.3	+1.9
Government	do	120.5	124.5	+3.3
Total nonagricultural employment	do	461.0	462.3	+.3
Personal income:				
Total	millions	$9,287	$10,309	+11.0
Per capita		$7,482	$7,956	+6.3
Construction activity:				
Number of private and public residential units authorized		13,097	8,664	-33.8
Value of nonresidential construction	millions	$174.4	$251.6	+44.3

See footnotes at end of table.

Table 3.—Indicators of New Mexico business activity —Continued

	1979	1980[p]	Change, percent
Construction activity —Continued			
Value of State road contract awards ---------- millions	$89.3	$78.0	-12.6
Shipments of portland and masonry cement to and within the State thousand short tons	593	611	+3.0
Nonfuel mineral production value:			
Total crude mineral value ---------- millions	$694.4	$765.2	+10.2
Value per capita, resident population ----------	$560	$589	+5.2
Value per square mile ----------	$5,708	$6,289	+10.2

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.

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

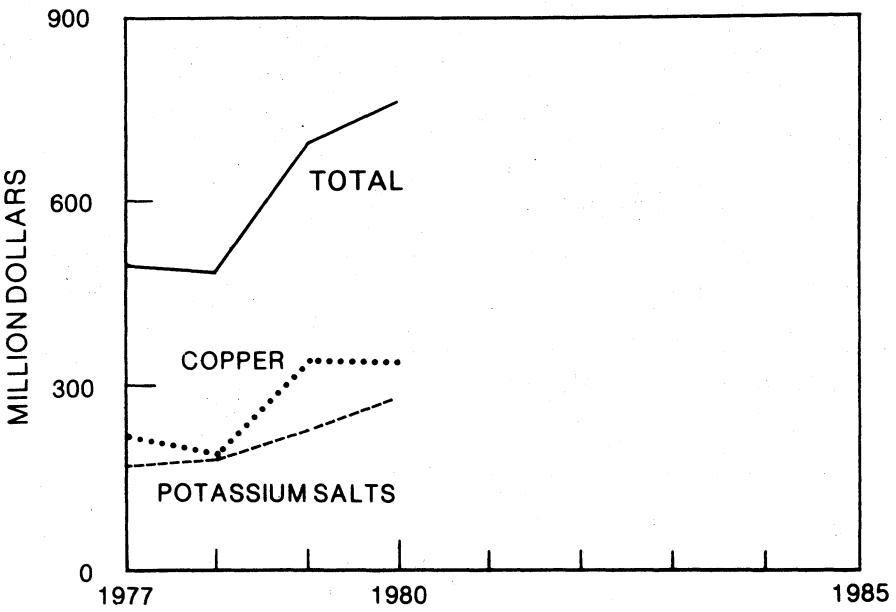

Figure 1.—Value of potassium salts, copper, and total value of nonfuel mineral production in New Mexico.

Metals contributed over half the value of nonfuel mineral production, and copper accounted for just over 44% of that total. A strike against one copper company was a major cause for the decline in output of copper in the State. However, the increase in the prices of copper and byproduct silver, as well as the rise in the price of molybdenum, led to the gain in value of metal production. The decline in molybdenum shipments was attributed not only to a slack in demand, but also to a drop in production occasioned by new construction and modification of existing facilities of two major producers of the metal.

In the nonmetals group, the following commodities, in order of production, increased in value: Potassium salts, portland

and masonry cement, stone, lime, and fire clay. Depressed conditions in the construction industry contributed to a drop in tonnages of clay, portland cement, gypsum, perlite, pumice, scrap mica, sand and gravel, and stone. New Mexico accounted for over 84% of all potassium salts produced in the United States. In perlite production sold, the State was again ranked first in the Nation with 84% of the total output. In 1980, natural carbon dioxide production in New Mexico dropped to second place in the Nation after Colorado.

Legislation and Government Programs.—The 1976 Federal Land Policy and Management Act required that the Bureau of Land Management (BLM) recommend to Congress those public lands to be designated as wilderness areas. Between October 1978 and September 1979, the initial inventory of the proposed areas was accomplished, and certain areas were identified as nonwilderness. From September 1979 to November 1980, an intensive inventory of the remaining areas was conducted. In this phase, lands were examined for wilderness qualities. In the third phase, November 1980 to October 1991, lands established as Wilderness Study Areas will be studied to determine their suitability for wilderness designation.

The U.S. Bureau of Mines and U.S. Geological Survey were actively assessing the mineral resources in the proposed areas.

In 1980, BLM Wilderness Study Areas in New Mexico that the Bureau of Mines was investigating totaled 61,500 acres, and included the Ah-Shi-Sle-Pah (6,000 acres), Bisti (3,500 acres), and Denazin (19,000 acres)—a total of 28,500 acres in San Juan County; and El Malapais (33,000 acres) in Valencia County.

Concurrently, the U.S. Forest Service Second Roadless Area Review and Evaluation (RARE II) Further Planning Areas studied by the Bureau of Mines during the year totaled 213,000 acres, and included Caballo (8,800 acres) in Los Alamos County; Chama Wilderness Contiguous (4,800 acres), and Polvadera (15,480 acres)—a total of 20,280 acres in Rio Arriba County; Columbine-Hondo (45,890 acres) in Taos County; White Mountain Wilderness Contiguous (990 acres) in Lincoln County; Little Dog-Pup Canyon (25,920 acres), and West Face Sacramento Mountains (41,650 acres)—a total of 67,570 acres in Otero County; Ryan Hill (36,640 acres) in Socorro County; Bunk Robinson Peak (15,850 acres including 740 acres in Arizona), and Whitmire Canyon (12,740 acres, including 5,080 acres in Arizona)—a total of 22,770 acres in Hidalgo County; and Hell's Hole (34,330 acres including 15,470 acres in Arizona)—a total of 18,860 acres in Grant County.

Forest Service Wilderness Areas studied by the Bureau of Mines during 1980 totaled 124,259 acres, and included the Chama River Canyon (50,300 acres) in Rio Arriba County, Manzano (37,000 acres) in Torrance and Valencia Counties, Sandia (30,930 acres) in Bernalillo and Sandoval Counties, and Wheeler Peak (6,029 acres) in Taos County.

On December 19, 1980, Public Law 96-550 designated the following National Forest System lands in New Mexico as wilderness and components of the National Wilderness Preservation System: Aldo Leopold Wilderness (211,300 acres) in Gila National Forest, Apache Kid Wilderness (45,000 acres) in Cibola National Forest, Blue Range Wilderness (30,000 acres) in Apache and Gila National Forests, Capitan Mountains Wilderness (34,000 acres) in Lincoln National Forest, Cruces Basin Wilderness (18,000 acres) in Carson National Forest, Dome Wilderness (5,200 acres) in Santa Fe National Forest, Gila Wilderness Additions (140,000 acres) to become part of Gila Wilderness in Gila National Forest, Latir Peak Wilderness (20,000 acres) in Carson National Forest, Pecos Wilderness Additions (55,000 acres) to become part of Pecos Wilderness in Carson and Santa Fe National Forests, Wheeler Peak Addition (14,700 acres) to become part of Wheeler Peak Wilderness in Carson National Forest, White Mountain Wilderness Addition (16,860 acres) to become part of White Mountain Wilderness in Lincoln National Forest, and Withington Wilderness (19,000 acres) in Cibola National Forest. A total of 609,060 acres was designated as wilderness in the National Wilderness Preservation System. Abolished were the previous classifications of Black Range Primitive Area, Blue Range Primitive Area, and Gila Primitive Area.

The following open file report was published: "Mineral Resources of the Pecos Wilderness and Adjacent Areas, Santa Fe, San Miguel, Mora, Rio Arriba, and Taos Counties, New Mexico," by R. H. Moench, J. M. Robertson, and M. E. Lane. U.S. Geological Survey, Open File Report 80-382, 1980.

From January 1 to December 31, 1980, the Bureau of Mines awarded research

contracts and grants and modified existing contracts totaling $1,995,557 to three private companies and two Federal agencies in the State. Two contracts were cooperative working agreements. The projects were on such subjects as a wireless microseismic system, design criteria of waste embankments, hardware for a mine wireless system using geophysics to delineate cased drill holes and abandoned workings in channel sands, and coal mine bit development.

The "Sagebrush Rebellion" bill of the 34th New Mexico Legislature expressed dissatisfaction with present Federal landmanagment policies. Claiming Federal land within the State, the bill was intended principally to affect lands the BLM manages and, perhaps, other lands. The lands were to be managed by a Public Lands Review Board, chaired by the commissioner of public lands. The attorney general was required to effect the provisions of the bill. Governor Bruce King signed the bill on March 6, 1980.

The New Mexico Legislature also passed the Mine Dewatering Act to promote developing mineral resources while protecting existing water rights. The bill required the State engineer to issue a permit to engage in mine dewatering in a declared underground water basin. It also granted the right of replacement to all water appropriators and mine dewaterers; the right overcomes an objection of impairment by providing a substitute water supply. In support of exercising the right of replacement, the bill granted the power of eminent domain but did not give authority to condemn water rights.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Copper.—Production of copper in New Mexico declined 9% in 1980, and value of that output increased less than 1%. The decrease was attributed to the copper strike lasting from July 1 to September 8 at the Kennecott Minerals Co., Chino operation, and also to the break in the tailings dam at Phelps Dodge Corp.'s Tyrone Mine. Employees of the Phelps Dodge Tyrone Mine and Hidalgo smelter, and of the Sharon Steel Corp. (formerly UV Industries, Inc.) Continental Mine were not on strike in 1980. Consequently, the decline in output was not as severe in New Mexico as in Arizona where more companies were shut down because of the strike. The value of production was sustained by the higher average unit price of $1.02 per pound paid for copper in 1980.

Copper was produced in Grant County at the Chino property of Kennecott, the Tyrone Branch of Phelps Dodge, the Continental Mine of Sharon Steel, and the Summit Mountain Mine and Center Mine of Summit Minerals, Inc. In Hidalgo County, the Carbonate Hill Mine had some copper production; the three small mines with output in 1979 reported no production in 1980.

Kennecott's Chino Mines Div., a subsidiary of Kennecott Corp., owns and operates the property at Santa Rita 12 miles east-northeast of Silver City, Grant County. Ores from the porphyry copper mine are trucked to the Santa Fe Railway and then transported by rail 9 miles to the 23,000-short-ton-per-day concentrator and the smelter at Hurley.

On January 21, 1980, the company announced a $280 million expansion and modernization of facilities at the Chino Mines Div. operations. Improvements were to include additional shovels, trucks, and bulldozers, as well as a truck-maintenance shop and warehouse buildings at the mine, and construction of a 37,000-ton-per-day concentrator near the Santa Rita Mine. A primary crusher designed for direct-haulage dumping would be connected by a 3,000-foot conveyor to the mill. At the concentrator, two semiautogenous mills and four ball mill grinding systems are to replace the 31 grinding mills and crushing plant now in use. The recently installed 1,000-cubic-foot flotation machines and regrind mills at the Hurley concentrator will be transferred to the new plant. Plans were to keep the old mill operational while the new mill was under construction. The concentrates would go to the smelter in slurry pipelines.

The original mill was constructed about 1910, reconditioned about 1923, and revamped again in 1937, when, among other changes, a molybdenum circuit was added. A smelter was erected adjacent to the mill in 1937-38 at a cost of $3.5 million and the fire refinery was constructed in 1942.[2] Since approximately 1938, precipitate copper has been recovered from solutions percolating over low-grade material in waste dumps and old stopes.

On June 10, 1980, officials of Kennecott and Mitsubishi Corp. signed a memorandum of intent to form a joint venture implementing a modernization program of Kennecott's facilities at Chino. The agreement, including a modified smelting plant, noted that Mitsubishi would contribute to the joint venture. According to the Kennecott April 9, 1981, proxy statement to shareholders, subsidiaries of the two companies signed a partnership agreement on December 19, 1980. At that time, Kennecott agreed to transfer the assets of its Chino Mines Div. to the newly formed Chino Mines Co. At the closing on March 2, 1981, a wholly owned subsidiary of Mitsubishi is scheduled to transfer $116 million to Chino Mines Co. and to pay one-third of the cost of a modernization program (in excess of its initial contribution for modernizing the Chino Mine and related facilities), and one-third of the partnership's operating costs. Plans are for the Mitsubishi subsidiary to receive one-third ownership interest in Chino Mines Co. and to take one-third of the partnership's production. Kennecott is to manage operations of Chino Mines Co. The 3-year modernization program, estimated to cost $365 million, is expected to increase copper production by 70% to 110,000 short tons per year. The increased cost estimate of the modernization project included constructing a new smelter.

According to the Kennecott 1980 annual report, ore mined, milled, and treated at the Chino Mines Div. declined from 7,162,000 net tons in 1979, to 5,432,000 net tons in 1980; total copper recovered dropped from 61,998 net tons in 1979, to 50,705 net tons in 1980. The average grade of ore decreased from 0.830% copper in 1979, to 0.815% in 1980. Principal cause of the decline in production was attributed to the copper strike which lasted from July 1 to September 8, when production resumed. Byproduct silver was also recovered.

As part of an application for a nonferrous smelter order to allow Kennecott to operate its Hurley smelter up to 1988 without certain pollution-abatement controls, the company proposed research of five smelter processes: The Mitsubishi process from Japan; the Noranda process used by Kennecott, Utah Copper Div.; the Outokumpu process used at the Phelps Dodge Hidalgo smelter; the Inco flash smelter process in use at Sudbury, Ontario; and a concentrate roast process in use at Kennecott's Ray Mines Div.

Phelps Dodge owns and operates the Tyrone open pit mine and concentrator 5 miles south of Silver City, Grant County. The low-grade copper sulfide ores are processed through a concentrator at the mine, and other low-grade copper material is leached and precipitated at facilities on the property. Concentrates and precipitates are shipped to the Phelps Dodge Hidalgo smelter at Playas, Hidalgo County, 40 miles south of Lordsburg.

According to the Phelps Dodge 1980 annual report, 84,824,000 short tons of ore and waste were mined in 1980 compared with 80,118,100 short tons mined in 1979. However, the amount of ore mined decreased from 17,771,000 short tons in 1979 to 16,499,000 short tons in 1980. Total copper recovered from ores, concentrates, and precipitates also dropped from 100,600 short tons in 1979 to 91,300 short tons in 1980. Although the total copper production figure included precipitates, the report noted precipitate copper recovered increased from 4,900 to 5,900 short tons in 1980. Byproduct silver and gold in the Tyrone ores are recovered from slimes shipped from Phelps Dodge's electrolytic refinery at El Paso, Tex., to the AMAX Inc., precious metals refinery in New Jersey.

Production at Tyrone was not affected by the copper strike; union contracts at the Tyrone Branch were scheduled to expire June 30, 1981; the Hidalgo smelter is not unionized. The decline in copper production was attributed to the tailings dam failure that curtailed operations at Tyrone for approximately 3 weeks in October and November. On October 13, 1980, a break in a pipeline that carried mill tailings to the pond on the No. 3 dam eroded about 1,000 feet from the face of the dam. Covering between 200 and 300 acres, the spill down the Mangus Draw below the dam was stopped by a check dam about 4.5 miles downstream. The mishap also took out a powerline and a pipeline used to move water from the Gila River to the Tyrone mill. The 50,000-ton-per-day concentrator resumed production at 40% of capacity on October 29.[3]

Phelps Dodge installed a computer-based truck-dispatching system at the mine. The first shift to be dispatched entirely by computer at Tyrone was accomplished on March 5, 1980. The project began in June 1978, with simulation studies of the Tyrone Mine. By January 1980, software development and field-hardware fabrication were completed; and, in February, operator

training and field testing were accomplished. In a 2-month test period, the new system ranged from a 2% to 22% increase in production, with an average 11% increase.[4]

The Hidalgo smelter established new records in 1980 for annual tonnage smelted and for copper produced. The company reported that changes in operating procedures substantially reduced the number and duration of shutdowns of the flash furnace for removing dust accretions from waste-heat boilers. Crushed coal added to the flash-furnace feed improved the furnace performance and substantially reduced fuel consumption.

An article[5] described the Hidalgo smelter that was constructed in 1976 at a cost of over $300 million and now processes 2,000 tons per day about 310 days per year. Air-pollution equipment, accounting for one-third of the capital cost of the smelter, consumes approximately 40% of all energy used at the property. The flash furnace has the capability of recovering sulfur either in an acid plant or in an elemental sulfur plant; however, as long as fuel is in short supply, the elemental sulfur plant will not be operated. Fuel oil is the primary fuel for the smelter. In addition, sulfuric acid plants constructed to reduce sulfur dioxide emissions from the Ajo, Hidalgo, and Morenci smelters produced 908,300 tons of sulfuric acid; 165,000 tons of this output, produced at Morenci, was used in their tailings leach plant.

Sharon Steel operates the Continental underground and open pit mine near Fierro about 19 miles northeast of Silver City, Grant County. The facilities include two concentrators, with a total capacity of 8,000 tons per day. According to the Sharon Steel 1980 10K annual report to the Securities and Exchange Commission, the Continental Mine estimated underground minable copper ore reserves were 11.4 million net tons with an average copper assay of 1.95%; the open pit reserves were an estimated 13.2 million net tons with an average copper assay of 0.85%. Exploration in 1979 defined an additional potential resource of 9.9 million tons of minable material with an average copper assay of 0.63%. The copper strike had an adverse effect on the company in 1980 in that ores continued to be mined and stockpiled awaiting shipment to the ASARCO Incorporated smelter. During the year, an expansion of the pit was under study.

In June 1980, the Copper Flats partnership of Quintana Minerals Corp. of Tucson, Ariz., and Philbro Mineral Enterprises, Inc., of New York, a Philipp Bros. Div. of Englehard Minerals & Chemicals Corp., announced plans for constructing an open pit copper mine and concentrator at Gold Dust, 4 miles northeast of Hillsboro, Sierra County. Quintana will be the operator on the property and Philipp Bros. will be sales agent for the copper and molybdenum produced.

The property was acquired on a long-term lease from Inspiration Development Co. in 1974, and exploration, feasibility studies, and mine and concentrator designs were conducted and developed during the remainder of the decade. Previous exploration efforts included Bear Creek Mining Co. and Inspiration; however, the depressed copper market held back development until 1980.

The porphyry copper deposit reportedly has reserves of about 55 to 60 million tons of sulfide ore with a cutoff grade of 0.25% copper. The average grade of the ore ranges from 0.43% to 0.45% copper, about 0.012% molybdenum, and additional gold and silver values.[6]

Construction of the $98 million, 15,000-ton-per-day operation was announced in June, and the initial excavation for the pit commenced later in the third quarter of the year. The mine will cover 600 acres. The entire operation, including mill and tailings, will comprise about 1,500 acres. The ore body is within 5 to 35 feet of the surface.

Annual production of the mine is expected to be 40 million pounds of copper, 1 million pounds of molybdenum, plus by-product gold and silver. Predicted life of the mine is 12 to 15 years, at which time the pit depth may reach 700 feet. About 200 workers will be employed during the construction phase; later, under full production, about 250 workers will be employed.

Exxon Minerals Co. continued work in the Pinos Altos mining district north of Silver City and 1.5 miles northwest of Pinos Altos, Grant County. Exploration in the area since 1971 revealed an ore body estimated to be 7 million metric tons containing 2% copper and 3% zinc, plus recoverable silver and gold. The irregularly zoned deposit, ranging in depth from 400 feet to over 1,500 feet, is about 2,500 feet long by 1,000 feet wide. The company tentatively plans to make an underground evaluation of the site. The project was estimated to cost about $13 million and take 2.5 years to complete. Surface facilities including roads, offices, compressor installation, water-management system, power transmission lines, and 100 feet of decline would constitute

the first phase. The next phase would be 2,100 feet of decline to be driven at minus 15% grade, and about 3,000 feet of drifting and crosscutting to intersect the ore zones. About 30,000 feet of borehole would then be drilled into the adjacent ore zones for bulk sampling and determining mining conditions. Feasibility studies are to be completed by late 1983. Conventional room and pillar mining was planned, with annual production at about 700,000 metric tons of ore and a mine life of 10 to 12 years.[7]

During the year, the company acquired full ownership of 1,433 acre-feet of water rights from the Mimbres Water Basin. Silver City would provide Exxon with 700 acre-feet of effluent from the sewer system, and would also have first option to purchase the mill if the company decided not to go into production. Other activities consisted of obtaining the necessary permits for the underground test mine.

In an operation separate from the Pinos Altos project, Exxon Exploration Co. staked 221 new claims on more than 4,000 acres around Signal Peak in the Gila National Forest.

Table 4.—New Mexico: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing		Material sold or treated (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1978, total	11	--	19,885,689	9,879	$1,912,082	W	W
1979, total	9	1	24,640,160	22,976	7,065,122	W	W
1980:							
Grant	5	--	22,236,330	15,775	9,663,134	W	W
Undistributed[1]	1	1	238	12	7,351	W	W
Total	6	1	22,236,568	15,787	9,670,485	W	W

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1978, total	127,828	$187,404,950	W	W	W	W	$198,171,301
1979, total	164,281	336,934,074	43	$48,998	W	W	359,210,261
1980:							
Grant	149,394	337,328,102	--	--	W	W	372,559,783
Undistributed[1]	--	--	--	--	W	W	53,254
Total	149,394	337,328,102	--	--	W	W	372,612,987

W Withheld to avoid disclosing company proprietary data.
[1]Includes Hidalgo and Sierra Counties, combined to avoid disclosing company proprietary data.

Table 5.—New Mexico: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1980, by class of ore or other source material

Source	Number of mines[1]	Material sold or treated[2] (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:							
Gold-silver, silver, and copper[3]	6	22,216,735	[4]15,787	W	129,683	--	W
Other lode material:							
Copper precipitates	1	19,833	--	--	19,711	--	--
Total lode material	6	22,236,568	15,787	W	149,394	--	W
Placer	1	--	W	--	--	--	--
Grand total	7	22,236,568	15,787	W	149,394	--	W

W Withheld to avoid disclosing company proprietary data.
[1]Detail will not add to totals shown because some mines produce more than one class of material.
[2]Does not include gravel washed.
[3]Combined to avoid disclosing company proprietary data.
[4]Includes placer gold to avoid disclosing company proprietary data.

Table 6.—New Mexico: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1980, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode:					
Smelting of concentrates	[1]15,787	W	129,673	--	W
Direct smelting of:					
Ore	W	W	11	--	--
Precipitates	--	--	19,711	--	--
Total lode material	15,787	W	[2]149,394	--	W
Placer	W	--	--	--	--
Grand total	15,787	W	149,394	--	W

W Withheld to avoid disclosing company proprietary data.
[1]Includes recovery from direct smelting of ore and from a placer operation, combined to avoid disclosing company proprietary data.
[2]Data do not add to total shown because of independent rounding.

Gold.—Gold is recovered principally as a byproduct from copper production; however, gold is also recovered from gold-silver ores. The rise in value of gold production was directly related to the rise in the average unit price of gold from $307.50 per troy ounce in 1979 to $612.56 per troy ounce in 1980. Leading producers of lode gold include the Continental, Tyrone, Center, and Summit Mines in Grant County, and a small mine in Hidalgo County. A placer operation in Sierra County continued to recover gold.

Gold Fields Mining Corp., a subsidiary of Consolidated Gold Fields, Ltd., of London, continued mining preparations at its open pit gold property 7 miles from Cerrillos in the Ortiz Mountains, Santa Fe County. The new operation is in the Old Placers (Ortiz, Dolores) mining district where the first gold in New Mexico was found and where placer deposits were discovered in 1828. On the Gold Fields property, the low-grade gold ore was being leached with an alkaline and cyanide solution which, following recovery of the dissolved gold, was then recycled through the leaching system. Newspaper accounts of the operation reported the company produced gold during the year. Plans were to mine the area at a 3,000-ton-per-day rate. In 1980, Gold Fields, which already owned or leased mineral rights on about 36,000 acres, planned to expand its acreage and began negotiating with county officials to relax mining regulations in the county's proposed land development plan to allow for additional mining in the area.

In other developments, The Goldfield Corp. of Florida evaluated surface and underground mineralization at its San Pedro Mine in Santa Fe County. The company mined and produced copper and gold ores and concentrates at the property from 1969 to 1976 when operations ceased because of declining metal prices. According to The Goldfield 1980 annual report, at yearend, the company granted Texas Gulf Western, Inc., a subsidiary of Texasgulf, Inc., a 2-year option to purchase the San Pedro mining property, excluding buildings, equipment, and certain real estate, for $4 million cash and a production royalty. The royalty was pegged at 1% of net smelter returns until Texasgulf recovers its investment and 3% thereafter. With payment of $250,000 per year, the royalty may be extended. Goldfield retained the right to manage and operate the mine and 250-ton-per-day flotation mill. Plans were to obtain ore from the reactivated San Pedro Mine and the St. Cloud silver mine in Sierra County, which was explored during 1980.

Iron Ore.—Sharon Steel continued to recover iron ore, concentrates as a byproduct of copper production from its Continental Mine, Grant County.

Lead.—No lead production was reported for the State in 1980. Lead was previously recovered as a coproduct in base metal operations and as a byproduct at some large copper properties. The drop in the price of lead from $0.53 per pound in 1979 to $0.42 per pound in 1980 was a major factor in the complete shutdown of five lead mines.

Manganese.—Luck Mining Co. mined, processed, and shipped a manganiferous ore to the CF&I Steel Corp. at Pueblo, Colo. Ores were obtained from the Boston Hill

deposit outside of Silver City, Grant County.

Molybdenum.—Although shipments of molybdenum concentrates declined 33%, the value of those shipments dropped only 4%. The rise in the domestic price of molybdic oxide, from an average $7.50 to $9.70 per pound, sustained the companies through the drop in demand for molybdenum. Molycorp, Inc., a wholly owned subsidiary of Union Oil of California, remained the largest producer of molybdenum in the State. In 1980, however, most of the production from its mine at Questa came from stockpiled material. The only other producer, Kerr-McGee Corp., recovered a small amount of molybdenum as a byproduct of uranium production from its Kerr-McGee Mine at Ambrosia Lake, McKinley County property. Kennecott reported no production of molybdenum at its Chino Div. in 1980.

Molycorp reported that its decline in molybdenum sales was because of a slackening demand as well as a reduction in production during the transition period between closing the old open pit mine and opening the new underground mine at Questa, Taos County. In mid-1979, with diminishing reserves at the original open pit, the company initiated development of the deep ore body in the nearby Goat Hill area. Drilling by Kennecott in the late 1970's had defined an estimated 125 million tons of 0.29% MoS_2 ore on a diluted basis.[8] The $200 million mine construction project, scheduled for completion in 1984, is expected to increase production to 18,000 tons per day and 20 million pounds of molybdenum per year for about 20 years. A gravity block-cave method of mining was selected because the molybdenite ore body is disseminated through a highly fractured and weak andesite. Construction will include a 14-foot-diameter development shaft and a 24-foot-diameter service shaft put down to a depth of 1,299 feet; and a 10°, 6,496-foot conveyor decline 19 feet wide and 15 feet high. A 48-inch conveyor belt will carry ore along the decline from inside the mine to the coarse ore stockpile on the surface. Other facilities will include two headframes, two hoist houses, maintenance shop, timber framing building, compression house, warehouse, change house, and the main office building.[9] The mill will be revamped and modernized during 1981. By the end of December 1980, the decline had been driven more than 6,300 feet, and 750 feet of drifting had been completed on the 7,120-foot haulage level. The contractor completed the ventilation shaft and turned it over to the company by the end of 1980.[10] In 1980, Molycorp reportedly sponsored a comprehensive study of the impact the mine expansion would have on the town of Questa. Although paid by the company, the consulting firm would work for the town to determine the government funds available for roads, sewers, sewage-treatment plants, and recreational facilities.

Silver.—Recovered mainly as a byproduct of copper production, silver was also recovered from the complex sulfide ores of a few base metal operations. Output in 1980 decreased substantially; however, the value of production almost doubled because of the dramatic increase in the price of silver. The average unit price of silver rose from $11.09 per troy ounce in 1979 to $20.63 per troy ounce in 1980. Grant County contributed most of the silver production in New Mexico. The leading producers of silver in the State were the Tyrone Mine of Phelps Dodge and the Continental Mine of Sharon Steel in Grant County. Other producers were the Summit and Center Mines of Summit Minerals Co. in Grant County, and the Carbonate Hill Mine in Hidalgo County. Kennecott's Chino Div. produced only a minor amount of silver in 1980. Two other small producers of silver in 1979 were closed in 1980. Of 17 silver-producing States, New Mexico was ranked 7th.

High silver prices stimulated exploration. In June 1980, according to The Goldfield Corp. 1980 annual report, Ellen Hunt Flowers, daughter of Nelson Bunker Hunt, acquired for $400,000, a 4% interest in the St. Cloud silver project of the Black Range Mining Corp., a subsidiary of The Goldfield Corp. of Florida. She also received a 1-year option to acquire an additional 16% interest for $1.6 million; if that option were exercised, she could acquire an additional 30% interest, at escalating prices, through June 1984. St. Cloud completed 33 drill holes, 18 of which, the company reported, encountered significant mineralization. The property is in the Chloride (Apache) mining district, Sierra County.

Zinc.—Output of zinc declined in tonnage and value in 1980. In 1979, four mines produced zinc, three in Grant County and one in Hidalgo County. By 1980, only one operation in Grant County recovered zinc from a complex ore. The copper strike contributed to the reduction in ores processed through smelters. The depressed automobile and construction industries and low

prices for zinc were also factors in the decline. The price of zinc continued low, rising from $0.373 per pound in 1979 to $0.374 per pound in 1980.

Vanadium.—New Mexico was ranked fifth among the five States producing vanadium. In 1980, however, vanadium production, small as it was, doubled in value and almost doubled in quantity. Vanadium was recovered as a byproduct of uranium output from uranium-vanadium ores mined in McKinley County.

NONMETALS

Barite.—Ranger Industries, Inc., shipped a small amount of barite from the Ranger Mine in Socorro County. Headquartered in Oklahoma City, the Barite Co. of America mined barite from an open pit mine near Hatch, Dona Ana County, and processed the barite through a flotation mill northwest of Deming. The company was also developing an underground mine on the east side of the Florida Mountains south of Deming. Ore from both mines was processed through its Deming mill, once known as the Peru mill. The barite is to be used in drilling mud for the petroleum industry.

A summary of the geology of the barite-fluorite-lead mines of the Hansonburg mining district in central New Mexico and a paper on barite occurrences in the White Sands Missile Range were recently published.[11]

Carbon Dioxide.—Amerigas Corp., a subsidiary of UGI Corp., of Valley Forge, Pa., produced natural carbon dioxide from wells in Harding County. The product was processed at two plants in the area; one produced a liquid carbon dioxide for use in the oil industry. The S.E.C. Corp. operation, which had produced natural carbon dioxide in the area in previous years, was acquired by Amerigas.

In August, the State Oil Conservation Div. approved the application of Amoco Production Co., a subsidiary of Standard Oil Co. (Indiana), for creating the Bravo Dome carbon dioxide gas unit. Covering about 1,174,225 acres of State, Federal, and fee lands in portions of Union, Harding, and Quay Counties in northwestern New Mexico, the unitization agreements involved more than 2,000 leases. Amoco has led the effort to develop the Bravo Dome carbon dioxide reserves since 1971. In 1980, Amoco proceeded with the $1.5 billion project, which will include drilling over 1,000 wells in the next 4 to 5 years and constructing storage facilities and a pipeline to transport the carbon dioxide from the Bravo Dome area to the west Texas and southeastern New Mexico oilfields by late 1984. The carbon dioxide gas, injected in wells for tertiary oil recovery in these Permian Basin fields, will retrieve oil previously thought unrecoverable with present methods. By yearend, approximately 75 carbon dioxide wells had been reported drilled in the Bravo Dome area.

Cement.—Ideal Basic Industries, Inc., Cement Div., manufactured cement at its Tijeras plant in eastern Bernalillo County. The company produced gray portland cement and masonry cement. Because of the depressed construction industry, the quantity of production continued to decline, although the value of cement shipped increased. Leading consumers of the cement included ready-mix companies, building material dealers, concrete product manufacturers, and highway contractors. Raw materials included limestone, gypsum, and iron ore.

A two-stage preheater was installed at the Ideal Basic Tijeras cement plant to reduce fuel requirements. The project, underway in 1979, included a 100-foot-high preheater tower and preheater vessels; and in 1980, a large duct work, installation of refractory linings, and final tie-in to the existing kiln were completed. Major repairs to other units in the plant delayed the startup of the project until late in the year when the plant achieved full operating capacity. The company rated the cement plant at 505,000 tons per year. To comply with State and Federal air-pollution regulations, Ideal planned to upgrade or replace pollution-abatement equipment installed on clinker coolers at the Tijeras plant and three plants in other States at a total cost of $13 million.

Clay and Shale.—As with most construction materials, clay and shale production decreased in quantity and value during the year. El Paso Brick Co. mined common clay and shale for face brick in Dona Ana County; Kinney Brick Co., Inc., mined common clay and shale for common brick in Bernalillo County; Phelps Dodge mined fire clay in Hidalgo County; Mathis & Mathis Mining & Exploration Co. mined fire clay in Luna County; and Garcia & Son mined common clay and shale for roof tile in San Juan County. Fire clay was used for plugs and other refractory ware in smelters.

New Mexico is the leading producer of

adobe brick in the Southwestern United States. A history of the use of adobe brick; geology and mineralogy of the adobe clays; techniques (traditional, semimechanized, and mechanized methods) of adobe production; and a list of the adobe brick producers active in 1980, were presented in the literature.[12] Materials for the adobe brick consist principally of certain clays and salts stabilized by such materials as bituminous and asphalt emulsion, lime, portland cement, sand, and straw. Commercial operations in New Mexico use an asphalt emulsion.

Gem Stones.—The Bureau of Mines estimated production of gem stones declined in 1980. Amateurs and professionals collected gem material and mineral specimens from various areas in the State, but the precise amount is not known. The second annual New Mexico Minerals Symposium was held October 25-26, 1980, at the New Mexico Institute of Mining and Technology in Socorro, and abstracts of papers presented at the meeting appeared in the literature.[13] Minerals discussed included gold, beryl, zeolites, cassiterite, manganous pickeringite, and minerals of the Magdalena and Socorro mining districts, and of several mines near Hillsboro.

Rock Hound State Park, the first of its kind in the Nation founded for rock hounds and mineral collectors, was established in the Little Florida Mountains, 12 miles southeast of Deming, Luna County. In 1980, the park and notations of rock and mineral occurrences were described.[14]

Gypsum.—Following the downward trend of the construction industry, gypsum production in the State declined in 1980. Crude gypsum was mined in Sandoval County by White Mesa Gypsum Co. at its White Mesa Mine and by Ernst Teeter at his San Felipe operation. Western Gypsum Co. mined and calcined gypsum at its Rosario deposit, Santa Fe County. White Mesa shipped its crude gypsum to American Gypsum Co.'s operation for calcining. Gypsum from the San Felipe operation was trucked to the Ideal Basic cement operation at Tijeras for use as a retarder in portland cement.

Lime.—Kennecott's Chino Mines Div. quarried limestone for conversion to lime at its Hurley plant in Grant County. Because the lime was used in its concentrator, the copper strike contributed to the decline in lime production during the year. The value of the product, however, increased because of inflation. Mathis & Mathis Mining & Exploration Co. quarried limestone and produced quicklime at its plant several miles west of Hanover, Grant County.

Mica.—Mineral Industries Commodities of America mined scrap mica near Taos, Taos County, and processed the ore at Pojoaque, Santa Fe County. Industry used mica as a hardener in cement, paint, and other products.

Peat.—Humus Organic Products at San Ysidro, Sandoval County, mined peat (humate) used for general soil improvement. Output was estimated to be 2,000 tons in 1980.

Perlite.—New Mexico continued to produce 84% of the Nation's processed perlite. Most production came from the No Aqua Mountain deposit near Tres Piedras, Taos County, where perlite was mined by Johns Manville Corp.; Grefco, Inc., of General Refractories Co.; and Silbrico Corp. Grefco also mined perlite near Socorro, Socorro County, and United States Gypsum mined perlite near Grants, Valencia County. Reflecting depressed conditions in the construction industry, production declined during the year. Expanded perlite was used principally in such construction products as fire-protective plaster, fire-resistant insulation and acoustical products, lightweight insulating concrete aggregate, paint, and texturizers. The product was also used as a filler in horticultural products and in filter aids.

Potash.—Total production of potassium salts in the Carlsbad district of Eddy and Lea Counties declined in tonnage and increased in value, along with increases in prices of each type and grade of potassium product. Seven potash producers in New Mexico produced potash from essentially flat-lying, bedded deposits in the Paradox Member of the Hermosa Formation (Pennsylvanian).[15] Listed in order of quantity of production in eastern Eddy County, producers included International Minerals and Chemicals Corp. (IMC); AMAX Chemical Corp., of AMAX Inc.; Potash Co. of America of Ideal Basic Industries, Inc.; Kerr-McGee Chemical Corp., of Kerr-McGee Corp.; Mississippi Chemical Corp.; and Duval Corp., of Pennzoil Co. National Potash Co. of Freeport Minerals Co. was the only producer in Lea County.

In industry development in Eddy County, according to the IMC 1980 annual report, the company was testing a salting out process for producing potassium sulfate at its Carlsbad plant. The new process, to be

installed at a cost of $200,000, was expected to minimize natural-gas use and particulate emissions.

AMAX reported lower sales tonnages of potash in 1980 because of reduced domestic sales resulting from poor weather in the spring planting season and because of the effect of high interest rates on the farmers. Also at the AMAX operation, output was down because of lower ore grade, startup delays with continuous miners, and an ore skip hoist breakdown that halted operations for 15 days. During the year, AMAX harvested its first 20,000 tons of potash using solar evaporation. The company was expanding its mine production by using additional continuous miners and by increased hoisting capacity. In 1980, a wet-scrubber system was completed to alleviate stack emissions, and work continued on controlling dust in the mine and mill. According to the AMAX 1980 annual report, reserves were estimated to be 77 million tons of minable ore averaging 13.5% K_2O. In the last 3 years, 36 million tons of ore was added to potash reserves, including 8 million tons in 1980.

The Potash Co. of America reported 1980 production up 5% from that of 1979 when almost a month's production was lost because ore hoisting equipment failed. According to the Ideal Basic 1980 annual report, potash reserves at its Carlsbad property should be adequate at the present rate of muriate production for about 9 years.

At the Kerr-McGee potash operation, cost savings from modernization of its mining operation, high foreign and domestic prices for potash, and strong demand for agricultural and industrial uses attributed to the nearly double earnings in 1980. Mississippi Chemical Co., owned by a Louisiana coop, mines potash at Carlsbad for the coop's own use in fertilizers.

Duval Corp. produced potassium magnesium sulfate from langbeinite ores in Eddy County for use in a premium specialty fertilizer. According to the Pennzoil Co. 1980 annual report, Duval Corp. langbeinite proved ore reserves at the end of the year were an estimated 34,241,000 tons of ore (not allowing for waste dilution) with an 8.4% average K_2O content.

Late in the year, BLM opened up additional acreage for potash prospecting in certain areas in Chaves, De Baca, Eddy, Lea, and Roosevelt Counties. East of Carlsbad, about 2.7 million acres were released. BLM had halted potash leases and prospecting permits in 1974.

The New Mexico Bureau of Mines and Mineral Resources studied the use of microorganisms to reduce the State's potash industry slime problem: For every 100 tons of potash produced, up to 14 tons are lost in slime. The U.S. Bureau of Mines Salt Lake City Research Center evaluated solar evaporation as an alternative method for recovering various process and waste brines that contain potassium.

Table 7.—New Mexico: Production and sales of potassium salts

(Thousand metric tons and thousand dollars)

Period	Crude salts[1] mine production		Marketable potassium salts				
			Production		Sold or used		
	Gross weight	K_2O equivalent	Gross weight	K_2O equivalent	Gross weight	K_2O equivalent	Value[2]
1980:							
January-June	8,985	1,232	1,872	945	1,889	952	$143,596
July-December	9,046	1,222	1,788	926	1,756	916	145,414
Total[3]	18,031	2,454	3,660	1,871	3,645	1,869	289,011

[1]Sylvinite and langbeinite.
[2]F.o.b. mine.
[3]Data may not add to totals shown because of independent rounding.

Pumice.—Following the downward trend of the construction industry, pumice, scoria, and volcanic cinder production declined in quantity and value during the year. Pumice was mined and processed by several companies: General Pumice Corp. at its Cullum operation near Espanola, Rio Arriba County; Copar Pumice Co., Inc., at its Copar Mine near Santa Fe, Santa Fe County; Utility Block Co. at its Esquire operation near Ponderosa, Sandoval County; and American Pumice Co. at its Rhodes Mine

near Sante Fe, Santa Fe County. Volcanic cinder was mined and processed by Morton Bros.' Big Chief Stone Co. at two operations near Las Cruces, Dona Ana County; and by Garcia & Son near Farmington, San Juan County. Scoria was mined by Crego Block Co. at its Lacienga Mine near Santa Fe, and by Del Norte Products Co. (formerly Associated Materials Co.) at its Black Bear operation near Anthony, Dona Ana County. Scoria was mined and processed by Colorado Aggregate Co., Inc., at its San Antone operation in Rio Arriba County near Antonito, Colo. Colony Materials Co. also mined scoria at its Red Bird deposit near Santa Fe. Pumice, scoria, and volcanic cinder was all used in concrete aggregate, and for landscaping and roofing. Pumice was also used in abrasives and insulation.

Salt.—Salt was one of the few commodities that increased in quantity and value of production during the year. United Salt Corp., Eddy County, produced salt by solar evaporation. SPN Dismantling, Inc., also in Eddy County, produced bulk rock salt. In Lea County, Williams Brine Service sold brine and a small amount of rock salt from salt recovered as a brine; Pioneer Water Co. also produced a brine.

Sand and Gravel.—Sand and gravel continued to be the most important natural building material produced in New Mexico in 1980. Sand and gravel was the second most valuable nonmetallic mineral. Production had declined since 1977; value of output, however, declined only in 1980. Listed in order of output, Bernalillo, San Juan, Otero, Dona Ana, and Santa Fe Counties accounted for 74% of the production from 22 counties. Sixty-two producers mined sand and gravel from 70 operations. Leading private producers mining construction sand and gravel included Albuquerque Gravel Products Co. and Springer Building Materials Corp., Bernalillo County; and San Juan Concrete Co. and Arco Materials, Inc., San Juan County. Thirty-four operations produced less than 50,000 tons in 1980; 18 firms produced between 50,000 and 100,000 tons per year; and 11 firms produced between 100,000 and 200,000 tons per year. State agencies produced 17% of the total output, principally for road construction.

Table 8.—New Mexico: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	2,765	$7,222	$2.61	3,067	$8,804	$2.87
Plaster and gunite sands	209	789	3.77	128	475	3.71
Concrete products	407	954	2.35	101	278	2.75
Asphaltic concrete	770	2,669	3.47	496	1,548	3.12
Road base and coverings	2,339	5,545	2.37	2,931	6,002	2.05
Fill	571	792	1.39	300	458	1.53
Other	80	274	3.42	27	111	4.17
Total or average	7,141	18,245	2.55	7,050	17,676	2.51

Table 9.—New Mexico: Construction sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	2,919	$7,495	$2.56	1,927	$5,137	$2.67
Gravel	4,222	10,760	2.55	5,123	12,539	2.45
Total or average	7,141	[1]18,245	2.55	7,050	17,676	2.51

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

Stone.—In 1980, stone production decreased in amount. The value of output, however, increased again as it had for the past 5 years. Crushed stone was produced from 30 quarries in 15 counties. Twenty-two operations quarried less than 50,000 tons of stone per year, and 12 quarries produced from 50,000 to 500,000 tons per year. Ninety-nine percent of the stone produced in the State was crushed rock.

Listed in descending order of production, 94% of the crushed rock mined in the State was obtained in McKinley, Bernalillo, San Juan, Valencia, Lea, Hidalgo, Eddy, and Grant Counties. Dimension stone was quarried in Dona Ana, Socorro, and Valencia Counties. Over half of the stone mined in the State was limestone, mostly from Bernalillo County, followed by McKinley, Valencia, Eddy, and Grant Counties. Sandstone was quarried in San Juan, Hidalgo, Valencia, and Sandoval Counties. Granite was quarried in Santa Fe and Taos Counties, traprock in Catron and McKinley Counties, and marble in Dona Ana County.

Ideal Basic Industries, Inc., and Wallach Concrete Products quarried limestone for cement. Kennecott and Mathis & Mathis quarried limestone in Grant County for manufacturing lime used in the copper industry. Kennecott also mined limestone, and Phelps Dodge mined sandstone for use as flux. Other leading producers of stone included Kent Nowlin Construction Co., which mined sandstone for aggregate, San Juan County; Concrete Sales and Equipment Rentals, which mined limestone for concrete aggregate, McKinley County; Hamilton Bros., Inc., who mined traprock for bituminous aggregate, Valencia County; and Constructors, Inc., which mined limestone for various aggregates, Eddy County.

Government agencies mined 14% of the crushed stone for local use in road construction in Sandoval, Santa Fe, Valencia, Catron, Taos, and Torrance Counties.

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[11]Kottlowski, F. S. Barite-Fluorite-Lead Mines of Hansonburg Mining District in Central New Mexico. New Mexico Geology, v. 1, No. 2, May 1979, pp. 17-20, 32 (a New Mexico Bureau of Mines & Mineral Resources publication).

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[13]New Mexico Geology. Second Annual New Mexico Minerals Symposium. V. 3, No. 1, February 1981, pp. 14-16.

[14]Weber, R. H. Rock Hound. New Mexico Geol., v. 2, No. 4, November 1980, pp. 59-60.

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Table 10.—New Mexico: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Concrete aggregate	179	525	311	873
Bituminous aggregate	285	643	196	661
Dense-graded road base stone	450	949	252	540
Surface treatment aggregate	99	307	129	553
Other construction aggregate and roadstone	351	901	600	1,736
Riprap and jetty stone	59	127	6	10
Lime manufacture	127	W	84	W
Flux stone	166	563	W	W
Fill	W	543	--	--
Other[2]	873	2,185	641	2,886
Total	2,589	6,743	[3]2,217	7,259

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

[1]Includes limestone, granite, sandstone, and traprock.

[2]Includes stone used for macadam aggregate (1980), railroad ballast, filter stone, manufactured fine aggregate (stone sand) (1979), cement manufacture, and fill (1979).

[3]Data do not add to total shown because of independent rounding.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Barite:			
Ranger Industries, Inc	Box 602 Socorro, NM 87801	Open pit mine and processing plant.	Socorro.
Carbon dioxide (natural):			
Amerigas Corp., a subsidiary of UGI Corp.	4455 LBJ Freeway Suite 1100 Dallas, TX 75234	Wells and liquefaction and solidification extraction plant.	Harding.
Cement:			
Ideal Basic Industries, Inc., Ideal Cement Co.[1]	750 17th St. Denver, CO 80202	Dry process, 2 rotary-kiln plants.	Bernalillo.
Clays:			
El Paso Brick Co	Box 12336 El Paso, TX 79912	Open pit mine	Dona Ana.
Kinney Brick Co., Inc	100 Prosperity Ave. Box 1804 Albuquerque, NM 87102	do	Bernalillo.
Copper:			
Kennecott Minerals Co., a subsidiary of Kennecott Corp., Chino Mines Div.[2]	Hurley, NM 88043	Open pit mine, flotation mill, precipitation plant, smelter.	Grant.
Phelps-Dodge Corp., Tyrone Branch[3]	Drawer B Tyrone, NM 88065	Open pit mine and mill	Do.
Sharon Steel Corp.[4]	Box 406 Hanover, NM 88041	Underground mine, open pit mine, and 2 flotation mills.	Do.
Gypsum:			
American Gypsum Co	Box 6345 Albuquerque, NM 87191	Processing and wallboard plant.	Bernalillo.
Western Gypsum Co., a subsidiary of Drywall Supply, Inc.	Box 2636 Sante Fe, NM 87501	Open pit and plant	Sante Fe.
White Mesa Gypsum Co	124 Jackson, NE Albuquerque, NM 87108	Open pit	Sandoval.
Lime:			
Mathis & Mathis Mining & Exploration Co.	1101 Santa Rita Box 452 Silver City, NM 88061	Quarry, open pit mine	Do.
Manganese:			
Luck Mining Co	Box 29 Silver City, NM 88061	Open pit mine and plant.	Grant.
Mica:			
Mineral Industries Commodities of America, Inc.	Box 2403 Santa Fe, NM 87501	Open pit mine	Taos.
Molybdenum:			
Molycorp, Inc., a division of Union Oil Co. of California.	Box 760 Los Angeles, CA 90051	Open pit mine and flotation mill.	Do.
Perlite:			
Grefco, Inc., a subsidiary of General Refractories Co.	Box 308 Antonito, CO 81120	Open pit mine; crushing, screening, and air separation.	Socorro and Taos.
Johns-Manville Sales Corp., a division of Johns-Manville Corp.	Box 338 Antonito, CO 81120	do	Taos.
Silbrico Corp	Box 367 Antonito, CO 81120	Open pit	Do.
United States Gypsum Co	Box 216 Grants, NM 87020	Open pit mine, crushing plant.	Valencia.
Potash:			
AMAX Chemical Corp	Box 279 Carlsbad, NM 88220	Underground mine and plant.	Eddy.
Duval Corp., a subsidiary of Pennzoil Co.[5]	Box 511 Carlsbad, NM 88220	do	Do.
International Minerals & Chemical Corp.	Box 71 Carlsbad, NM 88220	do	Do.
Kerr-McGee Chemical Corp., a subsidiary of Kerr-McGee Corp.	Kerr-McGee Bldg. Oklahoma City, OK 73102	do	Do.
Mississippi Chemical Co	Box 101 Carlsbad, NM 88220	do	Do.
National Potash Co., a subsidiary of Freeport Minerals Co.	Box 731 Carlsbad, NM 88220	do	Lea.
Potash Co. of America, a subsidiary of Ideal Basic Industries, Inc.[5]	Box 31 Carlsbad, NM 88220	do	Eddy.
Pumice:			
American Pumice Co., a division of Beatrice Foods Co.	Box 4305 Santa Fe, NM 87502	Processing plant	Santa Fe.
Copar Pumice Co	Box 38 Espanola, NM 87532	Open pit	Do.
General Pumice Corp	Box 449 Santa Fe, NM 87501	Open pit mine and crushing and screening plant.	Rio Arriba.
Salt:			
United Salt Corp	Box SS Carlsbad, NM 88220	Salt lake	Lea.

See footnotes at end of table.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel (commercial):			
Albuquerque Gravel Products	Box 829 Albuquerque, NM 87103	Dredge and plant	Bernalillo.
Springer Building Materials Corp.	Drawer 5 Albuquerque, NM 87103	Pit and stationary crushing and screening plant.	Do.
Stone:			
Concrete Sales and Equipment Rentals.	Box 2547 Milan, NM 87021	Open pit mine and crusher.	McKinley.
Kent Nowlin Construction, Inc	Box 14654 Albuquerque, NM 87111	Quarries and portable crushers.	Guadalupe, Lincoln, McKinley, Quay, San Juan, Santa Fe.

[1]Also clays, stone.
[2]Also silver, lime.
[3]Also silver, gold, sandstone.
[4]Also gold, silver, zinc, iron.
[5]Also salt.

The Mineral Industry of New York

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the New York Geological Survey for collecting information on all nonfuel minerals.

By William Kebblish[1] and Robert J. Tuchman[2]

The value of nonfuel mineral production in New York was $497.9 million in 1980, an increase of $40.6 million over that of 1979. Cement, lime, salt, stone, and sand and gravel contributed over 80% to the total value of mineral production. Nationally, New York ranked first in production value of garnet, third in salt and zinc, and fourth in talc; it was the only State that produced emery and wollastonite. Other commodities produced were clays, gypsum, iron ore, and peat. Silver and lead were recovered as byproducts of zinc processing; ilmenite, as a coproduct of iron ore production. Slag was produced at steelmaking operations, while byproduct sulfur was recovered during oil refining.

Table 1.—Nonfuel mineral production in New York[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2]	thousand short tons	836	$3,027	596	$2,479
Emery	short tons	e10,005	e204	7,284	153
Gem stones		NA	20	NA	20
Lead (recoverable content of ores, etc.)	metric tons	458	532	876	820
Peat	thousand short tons	38	630	43	917
Salt	do.	6,387	77,751	5,509	99,395
Sand and gravel[3]	do.	26,242	55,889	21,918	53,276
Silver (recoverable content of ores, etc.)	thousand troy ounces	11	117	21	427
Stone:					
Crushed	thousand short tons	r37,499	r114,174	34,483	120,764
Dimension	do.	27	2,626	25	2,414
Zinc (recoverable content of ores, etc.)	metric tons	12,133	9,977	33,629	27,750
Combined value of cement, clays (ball clay), garnet (abrasive), gypsum, iron ore, lime, sand and gravel (industrial), talc, titanium concentrate (ilmenite), and wollastonite		XX	r192,377	XX	189,476
Total		XX	r457,324	XX	497,891

eEstimated. rRevised. 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; value included in "Combined value" figure.
[3]Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in New York, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Albany	W	W	Cement, stone, clays, sand and gravel.
Allegany	$1,147	$1,277	Sand and gravel.
Broome	W	W	Sand and gravel, clays, peat.
Cattaraugus	W	4,896	Sand and gravel, peat.
Cayuga	W	226	Sand and gravel.
Chautauqua	882	877	Do.
Chemung	1,529	1,559	Do.
Chenango	607	695	Do.
Clinton	W	W	Stone, sand and gravel.
Columbia	W	W	Do.
Cortland	1,041	1,046	Sand and gravel.
Delaware	1,885	1,965	Stone, sand and gravel.
Dutchess	W	W	Stone, sand and gravel, peat.
Erie	W	W	Lime, stone, sand and gravel.
Essex	12,233	15,708	Ilmenite, iron ore, wollastonite, sand and gravel, stone, garnet.
Franklin	W	W	Stone, sand and gravel.
Fulton	343	438	Sand and gravel.
Genesee	W	W	Gypsum, stone, sand and gravel.
Greene	W	W	Cement, stone, sand and gravel.
Herkimer	W	W	Stone, sand and gravel.
Jefferson	3,390	3,174	Do.
Lewis	W	W	Wollastonite, sand and gravel, stone.
Livingston	W	W	Salt, stone, sand and gravel.
Madison	1,763	1,398	Stone, sand and gravel.
Monroe	W	W	Do.
Montgomery	W	W	Do.
Nassau	W	W	Sand and gravel, clays.
Niagara	W	W	Stone.
Oneida	W	W	Sand and gravel, stone.
Onondaga	44,122	58,728	Lime, stone, salt, cement, sand and gravel, clays.
Ontario	W	W	Stone, sand and gravel.
Orange	W	W	Stone, sand and gravel, clays.
Orleans	1,068	W	Stone, sand and gravel.
Oswego	1,742	1,487	Sand and gravel.
Otsego	297	285	Do.
Putnam	W	W	Stone.
Rensselaer	W	W	Sand and gravel, stone.
Rockland	W	W	Stone, sand and gravel.
St. Lawrence	27,259	15,537	Zinc, stone, talc, lead, sand and gravel, silver.
Saratoga	3,271	W	Stone, sand and gravel.
Schenectady	W	W	Sand and gravel.
Schoharie	W	W	Cement, stone, sand and gravel.
Schuyler	W	W	Salt, sand and gravel.
Seneca	W	W	Stone, peat, sand and gravel.
Steuben	W	W	Sand and gravel, stone.
Suffolk	5,100	4,977	Sand and gravel.
Sullivan	W	W	Stone, sand and gravel.
Tioga	1,563	1,561	Sand and gravel.
Tompkins	W	W	Salt, stone, sand and gravel.
Ulster	W	W	Cement, stone, clays, sand and gravel.
Warren	12,157	17,216	Cement, garnet, stone, sand and gravel.
Washington	1,799	W	Stone, sand and gravel.
Wayne	W	W	Do.
Westchester	302	390	Emery, sand and gravel, stone, peat.
Wyoming	W	W	Salt, sand and gravel.
Yates	158	146	Sand and gravel.
Undistributed[2]	294,883	323,738	
Total	[3]418,542	457,324	

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

[1]Bronx, Hamilton, Kings, New York, Queens, and Richmond Counties are not listed because no nonfuel mineral production was reported.

[2]Includes gem stones, sand and gravel, and values indicated by symbol W.

[3]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of New York business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	8,009.0	7,992.0	-0.2
Unemployment	do.	507.0	603.0	+18.9
Employment (nonagricultural):				
Mining[1]	do.	5.9	6.1	+3.4
Manufacturing	do.	1,492.8	1,451.1	-2.8
Contract construction	do.	210.3	207.3	-1.4
Transportation and public utilities	do.	433.8	431.9	-.4
Wholesale and retail trade	do.	1,476.8	1,468.3	-.6
Finance, insurance, real estate	do.	605.4	624.3	+3.1
Services	do.	1,643.2	1,701.5	+3.6
Government	do.	1,311.3	1,314.3	+.2
Total nonagricultural employment[1 2]	do.	7,179.4	7,204.7	+.4
Personal income:				
Total	millions	$160,704	$177,658	+10.5
Per capita		$9,106	$10,143	+11.4
Construction activity:				
Number of private and public residential units authorized		33,835	24,436	-27.8
Value of nonresidential construction	millions	$823.3	$1,220.5	+48.2
Value of State road contract awards	do.	$445.0	$482.0	+8.3
Shipments of portland and masonry cement to and within the State	thousand short tons	2,682	2,455	-8.5
Nonfuel mineral production value:				
Total crude mineral value	millions	$457.3	$497.9	+8.9
Value per capita, resident population		$26	$28	+7.7
Value per square mile		$9,225	$10,043	+8.9

[p]Preliminary.
[1]Includes oil and gas extraction.
[2]Data may not add to totals shown because of independent rounding.

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

Trends and Developments.—A large zinc deposit was located at Pierrepont, St. Lawrence County, by St. Joe Minerals Corp., and the company planned to develop the ore body. Reserves were estimated at 2.5 million tons of ore grading 15% zinc.

The mineral industry in New York is heavily dependent upon the State's many ports. The U.S. Army Corps of Engineers conducted a study to determine the feasibility of dredging the Port of Ogdensburg, along the St. Lawrence River, and extending the present 600-foot pier by an additional 1,100 feet. Currently, 8 acres of storage space is available for storage of minerals, including marble chips and zinc concentrate, awaiting exportation.

During the year, the New York Department of Environmental Conservation (DEC) estimated that 468 of the 2,800 Adirondack lakes possess high acidity levels. As a result, lime was added to some of the lakes to neutralize the acidic water. DEC officials are seeking additional ways to resolve the contamination problem and ameliorate water quality in the Adirondack region.

State officials proposed a plan to construct a toxic waste disposal facility to treat over 1.3 million tons of hazardous nonnuclear wastes produced annually by New York industries. An estimated 60% of these waste products is generated by the chemical and allied product industries; 8% by the primary metal industry; 4% by fabricated metal producers; 3% by the stone, clay, and glass industries; and the remaining 25% by other industries. Under the plan, private industry would build and operate the waste treatment plant as a commercial venture on State land.

Legislation and Government Programs.—In June 1980, the Governor signed a bill requiring that American-made steel products be used to fill State contracts over the next 3 years. The measure was an attempt to protect employment opportunities within the State.

In early 1980, the New York Court of Appeals reversed a lower court order directing the Commissioner of DEC to either issue a permit for proposed mining activities on privately owned wetlands or initiate condemnation proceedings. In *Spears v. Berle*, this issue was examined in regard to the State's authority in wetland protection. Decision on the case was pending at year-end.

The New York Geological Survey was involved in 12 major projects during the year—5 related to environmental and engi-

neering geology and 7 to regional geological studies. Individual project topics included nuclear waste burial sites, geochemical and petrological studies, engineering geology mapping, seismic studies, and environmental problems of drilling on the Outer Continental Shelf. Projects under consideration were an asbestos hazards study, preparation of a State geochemical map, identification of ground water resources, and earthquake activity investigations.

Under a U.S. Bureau of Mines contract, Arthur D. Little, Inc., completed a study of the slate mining industry in New York and Vermont. The study identified problems constraining industry growth and provided such recommendations as formation of a regional marketing association, assistance from State agencies, and improved exploration and quarrying techniques.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives, Manufactured.—Abrasives manufactured in New York included fused aluminum oxide, fused alumina zirconia, and silicon carbide. Pellets, Inc., manufactured cut wire abrasives in the Buffalo-Niagara Falls area.

Calcium Chloride.—Allied Chemical Corp. recovered synthetic calcium chloride as a byproduct of soda ash production at the company's plant in Syracuse, Onondaga County. Output in 1980 decreased 12%, but value increased more than 16%, compared with those of 1979. Calcium chloride was used mainly for ice and snow removal.

Cement.—New York ranked 7th among the States in shipments of portland cement and 17th in shipments of masonry cement in 1980. Portland cement shipments from eight plants in six counties decreased more than 14% in quantity, but only 3% in value, from 1979 to 1980. Most of the cement plants were located south of Albany near the Hudson River.

In 1980, ready-mix concrete companies used 71% of the portland cement produced, concrete product manufacturers used 15%, and the remainder was used by building material dealers, highway contractors, government agencies, and other customers. Portland cement was transported to market by truck (83%), rail (9%), barge (6%), and other means (2%).

Masonry cement was produced by two companies in Greene County and one company in Warren County. From 1979 to 1980, shipments of masonry cement remained constant, but value increased over 6%.

Marquette Co., affiliated with Gulf + Western Industries, Inc., placed into service a $5 million oceangoing barge to transport 6,000-ton shipments of cement from the Catskill plant along the Hudson River in Greene County to the company's terminal in Flushing Bay. The self-unloading vessel is 300 feet in length and is moved by a 2,000-horsepower tugboat.

Alpha Portland Cement Co. closed the Jamesville cement plant, Onondaga County, in late 1980 because of reduced demand for portland cement in the Northeastern States.

Lehigh Portland Cement Co. at Alsen, Greene County, planned a new 750,000-ton-per-year facility, doubling the plant's current capacity. Completion was anticipated by 1984. The company also requested a permit from the U.S. Army Corps of Engineers for dredging on the Hudson River to build a pumphouse and water intake structure.

Clays.—Clay and shale produced in 1980, excluding ball clay, totaled 596,000 tons valued at $2.5 million, a decrease of 29% in quantity and 18% in value compared with 1979 figures. Common clay and shale were produced by 11 companies in 6 counties. Leading producers were Atlantic Cement Co., General Dynamics Corp., Norlite Corp., and Northeast Solite Corp. Leading producing counties were Albany and Ulster; other counties included Broome, Nassau, Onondaga, and Orange. Clay and shale were used mainly in the manufacture of portland cement, lightweight aggregate, common brick, and pottery.

A small amount of ball clay was produced by Industrial Mineral Products, Inc., Albany County. The unit value of ball clay increased $15.19 to $79.46 from 1979 to 1980. Ball clay was used principally for bonding in ceramic ware.

Emery.—Production of emery totaled 7,284 tons valued at $153,000, a slight decline in both quantity and value compared with 1979 data. The entire U.S. production was recovered from open pit mines in Westchester County by De Luca Emery Mine, Inc., Emeri Crete, Inc., and John Leardi. Emery was used mainly as a nonslip additive for floors, pavements, and stair treads.

Garnet.—New York ranked second to Idaho in the production of garnet. Barton Mines Corp., Warren County, and NYCO, a division of Processed Minerals, Inc., Essex County, were the sole producers in the State. The Barton open pit mine is situated on Gore Mountain; reserves are nearly depleted and a new mine will be opened on Ruby Mountain, approximately 3.5 miles northwest of the present site. NYCO recovered garnet as a byproduct of wollastonite mining and processing. Garnet was used in coated abrasives, glass grinding and polishing, and metal lapping.

Gem Stones.—A small amount of gem stones, with an estimated value of $20,000, was collected by rockhounds and mineral dealers throughout the State.

Graphite, Manufactured.—New York led the Nation in 1980, producing synthetic graphite from petroleum coke and other materials. Leading producers were Great Lakes Carbon Corp., Carborundum Corp., and Union Carbide Corp. The latter planned to transfer its graphite specialities from the Niagara Falls plant to Clarksburg, W. Va. Graphite was sold principally for graphite shapes, anodes, electrodes, electric motor brushes, and crucibles. Synthetic graphite powder was used in steelmaking, as an additive in nonferrous metallurgy, for foundry facings, and in lubricants.

Gypsum.—United States Gypsum Co., Genesee County, was the State's only producer of crude gypsum. Production decreased nearly 8%, but value increased more than 5% compared with those of 1979. Crude gypsum, including foreign imports and quantities mined in other States, was calcined at five plants in Erie, Genesee, Rensselaer, Rockland, and Westchester Counties.

Calcined gypsum production totaled 768,000 tons valued at $21.6 million, a decrease of 35% in quantity and 55% in value compared with 1979 figures. This decline was caused by a drop in housing and commercial developments. Principal uses were in the manufacture of wallboard and various types of plasters.

National Gypsum Co.'s Gold Bond Building Products Div. relocated its headquarters from Buffalo to North Carolina. New buildings are also to be constructed for storage of wallboard at the company's Rensselaer, N.Y., plant. Additional plans include extension of a dock and construction of a conveyor for transporting gypsum ore from ships to the plant.

Iodine.—Crude iodine, imported from other countries and States, was used by H. Kohnstamm & Co., Kings County; Sterling Organics, Rensselaer County; and RSA Corp., Westchester County, in the manufacture of pharmaceuticals, catalysts, and sanitation products.

Lime.—Bethlehem Steel Corp., Erie County, and Allied Chemical Corp., Onondaga County, produced quicklime for use in alkalies and steelmaking. In 1980, production and value decreased nearly 7% and 3%, respectively, from 1979 figures.

Peat.—Production of peat in 1980 amounted to 43,000 tons valued at $917,000, representing an increase of 13% in quantity and 46% in value compared with the 1979 figures. Six companies produced peat in Dutchess, Cattaraugus, Westchester, Seneca, and Broome Counties. Reed sedge and humus were sold for soil improvement and as an ingredient in potting soils.

Perlite.—Crude perlite mined in other States was expanded by Buffalo Perlite Div. of Pine Hill Concrete Mix Corp., Erie County; United States Gypsum Co., Genesee County; and Scolite International Corp., Rensselaer County. United States Gypsum's other plant in Erie County remained inactive during 1980. Expanded perlite was used mainly in lightweight acoustical building plaster. Other uses included loosefill insulation, soil conditioning, and filtration.

Salt.—New York ranked third nationally in quantity of salt sold or used by producers in 1980. Production totaled 5.5 million tons valued in excess of $99 million, reflecting a decrease of 14% in quantity, but an increase of 28% in value, compared with 1979 figures. Nearly 54% of the salt sold was produced by underground mining methods; the remainder, from brines and evaporation methods. Rock salt, used primarily for snow and ice removal, was produced by Cargill, Inc., and International Salt Co. They also produced salt from brines and evaporation methods along with Allied Chemical, Inc., Hooker Chemical Corp., and Morton-Norwich Products, Inc. Most evaporated salt was used for the manufacture of soda ash, chlorine, and other chemicals.

Sand and Gravel.—Production of construction sand and gravel in 1980 amounted to 21.9 million tons valued at $53.3 million, averaging $2.43 per ton. Both tonnage and value decreased compared with 1979 figures. Construction sand and gravel was produced by 314 companies, 25 fewer than in 1979. Leading producers were Valent

Gravel, Inc. (Rensselaer and Albany Counties) and Buffalo Slag Co. (Cattaraugus and Allegany Counties). Leading producing counties, in descending order, were Dutchess, Cattaraugus, Suffolk, and Rensselaer. Construction sand and gravel was sold mainly for roadbase, concrete aggregate, and fill.

Table 4.—New York: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	6,107	$16,837	$2.76	4,737	$15,081	$3.18
Plaster and gunite sands	162	571	3.52	153	585	3.82
Concrete products	862	2,173	2.52	839	2,310	2.75
Asphaltic concrete	3,962	9,910	2.50	3,377	10,420	3.09
Road base and coverings	8,627	15,969	1.85	7,344	14,907	2.03
Fill	4,225	5,316	1.26	3,417	4,972	1.46
Snow and ice control	1,360	2,551	1.88	1,375	2,952	2.15
Railroad ballast	11	17	1.55	15	48	3.20
Other	928	2,545	2.74	661	1,999	3.02
Total[1] or average	26,242	55,889	2.13	21,918	53,276	2.43

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

Table 5.—New York: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	11,846	$25,022	$2.11	9,733	$23,666	$2.43
Gravel	14,396	30,867	2.14	12,185	29,609	2.43
Total or average	26,242	55,889	2.13	21,918	[1]53,276	2.43
Industrial sand	W	W	7.33	W	W	10.92
Grand total or average	W	W	2.15	W	W	2.45

W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.

Table 6.—New York: Construction sand and gravel sold or used, by county

(Thousand short tons and thousand dollars)

County	1979		1980	
	Quantity	Value	Quantity	Value
Albany	116	169	127	212
Allegany	571	1,277	622	1,263
Broome	461	1,299	250	893
Cattaraugus	2,157	4,766	2,102	4,939
Cayuga	93	226	W	W
Chautauqua	392	877	369	919
Chemung	594	1,559	W	W
Chenango	279	695	253	723
Clinton	263	649	209	588
Columbia	232	431	253	521
Cortland	389	1,046	233	720
Delaware	70	168	63	178
Dutchess	2,357	6,827	2,223	7,650
Erie	1,162	3,632	1,045	3,552
Essex	720	1,067	590	1,061
Franklin	14	61	13	64
Fulton	242	438	228	478
Genesee	280	537	252	506

See footnotes at end of table.

Table 6.—New York: Construction sand and gravel sold or used, by county —Continued

(Thousand short tons and thousand dollars)

County	1979		1980	
	Quantity	Value	Quantity	Value
Greene	W	W	W	W
Herkimer	563	914	466	832
Jefferson	443	869	312	737
Lewis	281	487	257	527
Livingston	732	1,464	690	1,518
Madison	152	197	58	112
Monroe	1,105	2,045	1,004	2,171
Montgomery	W	W	W	W
Nassau	W	W	W	W
Oneida	742	1,315	721	1,632
Onondaga	594	1,166	549	1,230
Ontario	1,009	1,640	528	885
Orange	560	1,373	527	1,396
Orleans	W	W	W	W
Oswego	691	1,487	570	1,501
Otsego	177	285	99	231
Rensselaer	1,920	2,824	1,710	2,709
Rockland	W	W	W	W
St. Lawrence	312	495	299	552
Saratoga	134	390	91	W
Schenectady	W	W	W	W
Schoharie	7	8	6	8
Schuyler	51	71	33	51
Seneca	6	7	5	6
Steuben	697	1,967	392	1,203
Suffolk	2,635	4,977	1,854	3,904
Sullivan	181	414	312	662
Tioga	742	1,561	504	1,156
Tompkins	147	316	162	380
Ulster	195	372	230	533
Warren	W	W	W	W
Washington	92	148	62	119
Wayne	502	757	447	770
Westchester	W	W	W	W
Wyoming	48	76	40	75
Yates	75	146	74	162
Total	26,242	55,889	21,918	53,276

W Withheld to avoid disclosing individual company proprietary data; included in "Total."

Industrial sand was produced by two companies, one each in Oneida and Saratoga Counties. Both production and value declined from 1979 to 1980. Uses were for glassmaking, moldings, and foundry purposes.

In late 1980, Gilford Instrument Laboratories of Oberlin, Ohio, merged with Corning Glass Works in Corning, Steuben County. Gilford will operate under its present name and as a subsidiary of Corning Glass Works. Also during the year, the Corning Museum of Glass opened, with over 19,000 objects on display covering 3,500 years of glassmaking history.

Slag.—New York ranked ninth among the States in the production of slag, a byproduct of iron and steelmaking operations. Buffalo Slag Co. and Harsco Corp., both in Buffalo, produced iron blast furnace slag. Uses included roadbase, asphaltic concrete aggregate, fill, and railroad ballast.

Sodium Carbonate (Synthetic).—The only producer of synthetic soda ash in the Nation during 1980 was Allied Chemical Corp., Syracuse. Other synthetic plants have closed throughout the country owing to increased energy costs, environmental constraints, and competition from nearby sources of natural materials. The Syracuse plant remained economically viable because the plant's liquid effluent containing appreciable lime values was pumped to the City of Syracuse waste water treatment plant and used in phosphate removal. Another factor was a reduction in freight rates to eastern markets. Synthetic sodium carbonate—produced by using salt, limestone, and an ammonia catalyst—was marketed to the glass and chemical industries in the region.

Stone.—Crushed stone production in 1980 totaled 34.5 million tons valued at nearly $121 million, representing an 8% decrease in quantity, but a 5.8% increase in value, compared with 1979 levels. A total of 82 quarries produced crushed stone in 37 counties. Leading producing counties, in de-

scending order, were Onondaga, Rockland, Dutchess, Albany, Erie, and Greene.

Nearly 90% of the crushed stone was limestone; other types were granite, sandstone, traprock, and slate. Main uses included bituminous aggregate, roadbase, and cement manufacture.

Table 7.—New York: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	r371	r1,817	346	2,165
Concrete aggregate	r3,439	r11,872	2,762	11,707
Bituminous aggregate	r7,714	r26,640	7,320	29,615
Macadam aggregate	625	2,015	731	2,784
Dense-graded roadbase stone	r7,438	r24,023	6,629	24,583
Surface treatment aggregate	r1,538	r5,071	1,548	5,710
Other construction aggregate and roadstone	r5,937	r17,395	6,101	20,080
Riprap and jetty stone	r765	r2,795	661	3,049
Railroad ballast	564	1,788	412	1,501
Filter stone	31	123	70	168
Manufactured fine aggregate (stone sand)	r1,121	r3,235	1,157	4,034
Cement manufacture	6,204	10,888	5,222	9,758
Lightweight aggregate (expanded slate)	W	W	11	85
Other[2]	1,750	6,513	1,512	5,525
Total[3]	r37,499	r114,174	34,483	120,764

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Other."

[1]Includes limestone, granite (1979), sandstone, traprock, and slate.

[2]Includes stone used for agricultural marl and other soil conditioners (1980), poultry grit and mineral food (1979), terrazzo and exposed aggregate, lime manufacture, flux stone, chemical stone for alkali works, abrasives, asphalt filler (1979), other fillers or extenders, drain fields, fill, roofing granules, and other uses.

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

Table 8.—New York: Dimension stone[1] sold or used by producers, by use

Use	1979			1980		
	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)
Rough stone:						
Irregular-shaped stone	780	10	$29	298	4	$18
Rubble	1,778	21	36	1,573	19	34
Flagging	11,218	128	1,106	11,652	138	1,194
Dressed stone:						
Cut stone	5,410	65	835	2,442	29	375
House stone veneer	795	9	W	725	9	29
Flagging	5,540	63	323	6,227	71	431
Structural and sanitary	W	W	W	195	2	24
Flooring slate	669	7	161	568	6	171
Other[2]	810	9	136	1,342	16	137
Total[3]	27,000	314	2,626	25,022	294	2,414

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

[1]Includes granite, sandstone, and slate.

[2]Includes stone used for rough blocks, and dressed stone for construction work (1980), curbing, roofing slate (standard), and other uses.

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

Dimension stone was produced at 22 quarries in 7 counties. Washington County led with 13 quarries, followed by Albany County with 3, Delaware County with 2, and Essex, Franklin, Tompkins, and Westchester Counties with 1 each. The largest quarries were located in Delaware County, producing over 60% of the State's output. Types of dimension stone quarried included granite, sandstone, and slate. Sales of dimension stone were for cut stone and rough and dressed flagging.

Martin Marietta Corp. sold its Tomkins Cove and Haverstraw Quarries to Hudson

River Aggregates, Inc., which then sold them to Thomas Tilling Ltd. The two quarries are situated approximately 35 miles north of Manhattan on the Hudson River in Rockland County.

Sulfur.—Elemental sulfur was recovered as a byproduct from oil refinery operations, and was used in chemicals and various synthetic products. During the year, Niagara Mohawk Power Corp., Tonawanda, was building a $50 million sulfur removal system at the Huntley Steam Station. The system will react a water solution of sodium carbonate with sulfur dioxide in the stack gases to produce elemental sulfur.

Talc.—Gouverneur Talc Co., Inc., subsidiary of R. T. Vanderbilt Co., Inc., operated two underground mines near the town of Fowler, St. Lawrence County. Production of talc decreased nearly 8%, but value increased almost 13%, compared with 1979 figures. Crude talc was ground in company-owned mills and used mainly in ceramics and as a mineral filler in paints. Lesser amounts were used as filler in floor tile, rubber, paper, and various other products.

Vermiculite.—Crude vermiculite mined in other States was exfoliated by W. R. Grace & Co. at Weedsport, Cayuga County. Uses included loosefill insulation, soil conditioning, ultralightweight concrete aggregate, and building plaster aggregate.

Wollastonite.—New York was the only State that produced wollastonite, a calcium silicate found in metamorphic rocks. The tonnage shipped in 1980 increased 22% compared with that of 1979. NYCO, a division of Processed Minerals, Inc., operated the underground Willsboro Mine and surface Lewis Mine in Essex County; R. T. Vanderbilt Co., Inc., operated the surface and underground Valentine Mine in Lewis County. Major markets for wollastonite were in ceramics, coatings, plastics, refractories, welding rod fluxes, insulating boards, and metal casting plasters.

METALS

Aluminum.—Primary aluminum was produced by Aluminum Co. of America (Alcoa) and Reynolds Metals Co., in Massena, St. Lawrence County. Alcoa operated a 220,000-ton-per-year smelter; a wire, rod, and bar plant; and an electrical products laboratory. Reynolds Metals operated a 126,000-ton-per-year primary aluminum smelter. The New York State Power Authority approved long-term electric rates for the two aluminum producers. Under the new contract, rates would increase to 16 mills per kilowatt-hour by 1987 for Reynolds Metals, while Alcoa would reach that rate in 1986. The current basic rate paid by both companies is 4 mills per kilowatt-hour. Also included in the contract were rate discounts if new jobs are created at the plants and aluminum produced is retained in the State for fabrication.

Alcoa also planned a $4 million modernization program at its Massena plant, which would include a furnace for homogenizing aluminum extrusion ingots.

Ferroalloys.—New York was one of 17 States that produced ferroalloys used by the steel industry to manufacture stainless, electrical, and carbon steels, and by foundries to manufacture iron castings. Shipments and value decreased 22% and 2%, respectively, from 1979 to 1980.

Union Carbide Corp. reached an agreement in principle to sell its Niagara Falls plant, which produced specialty manganese and chromium products, to foreign interests. Nine other ferroalloy facilities throughout the United States and overseas were included in the transaction.

Iron Ore.—Magnetite concentrate was produced from NL Industries, Inc.'s open pit MacIntyre Mine in Essex County. Concentrates were shipped to market by rail. Principal uses were in the manufacture of miscellaneous products other than iron and steel.

In 1980, Jones & Laughlin Steel Corp. turned over control of its abandoned Benson iron ore mine, together with surface facilities, to St. Lawrence County authorities. Rehabilitation of the mine and sintering plant was considered uneconomical, and auctioning of equipment took place on September 30, 1980. Permanent closure of the Benson Mine in 1978 left the MacIntyre Mine as the last iron ore producing mine in New York.

Iron and Steel.—Pig iron shipments in New York amounted to 2.2 million tons valued at $440.8 million, a decrease of about 37% in both quantity and value compared with 1979 figures. The decrease was attributed to depressed orders, slumping auto demand, and imports of both steel and automobiles.

Roblin Industries, Inc., operated its forge rolling mill in Dunkirk, Chautauqua County, at 25% capacity and on a one-shift basis because of economic conditions. The mill had been installed late in 1979. The company's finishing plant at North Tonawanda,

north of Buffalo, also operated at reduced levels throughout 1980.

Bethlehem Steel Corp.'s "F" blast furnace, which was closed in late May, remained idle at yearend. Company officials expected the furnace to be relit in early 1981. The company's 12- and 13-inch bar mills and the billet preparation department were reopened in the latter part of 1980, providing employment for idled workers.

Although pig iron production declined in 1980, some companies continued to modernize operations. Bethlehem Steel allotted $1 million for galvanizing modifications at its Lackawanna plant to improve surface characteristics of zinc-coated sheet steel used by appliance and automotive producers. Improvements were also completed or underway at the company's coke oven batteries.

Auburn Steel Co. of Auburn, Cayuga County, increased its annual capacity to 200,000 tons by replacing a 50-ton electric arc furnace with a 65-ton electric furnace. During the year, the minimill operated 7 days per week on a three-shift basis at 90% capacity. Products included merchant quality rounds, squares, and flats, in addition to rebar.

Lead and Silver.—Lead was recovered as a byproduct from zinc ore processed from three mines in St. Lawrence County. Production of lead in 1980 amounted to 876 metric tons valued at $820,000, an increase in both quantity and value compared with 1979 levels. Silver was recovered from lead concentrate; production increased to 21,000 troy ounces valued at $427,000.

Superalloys.—Guterl Special Steel Corp., Lockport, Niagara County, undertook a $15 million expansion program to include a third electroslag remelt furnace and a vacuum induction melting facility for primary melting of superalloys. Both facilities are expected to operate by early 1982. The company's superalloys have been sold mainly to the aerospace industry.

Titanium Concentrate (Ilmenite).—Ilmenite concentrate was produced by NL Industries, Inc., Essex County, as the major product from the MacIntyre titanium-iron ore mine operations. Shipments and value of shipments both decreased nearly 19% from 1979 to 1980. Ilmenite was used mainly in the manufacture of titanium dioxide pigments for use in paint, paper, plastics, rubber, and ceramics.

Zinc.—New York ranked third, behind Tennessee and Missouri, in zinc production. Output totaled 33,629 metric tons valued at $27.8 million. Zinc production returned to normal levels following the resolution of a 6-month work stoppage in 1979.

Table 9.—New York: Mine production (recoverable) of silver, lead, and zinc

		1979	1980
Mines producing: Lode		3	3
Material sold or treated: Zinc ore	thousand metric tons	144	395
Production:			
Quantity:			
Silver	troy ounces	10,538	20,702
Lead	metric tons	458	876
Zinc	do.	12,133	33,629
Value:			
Silver	thousands	$117	$427
Lead	do.	532	820
Zinc	do.	9,977	27,750
Total	do.	10,626	28,997

St. Joe Minerals Corp. announced plans in August to develop its recently discovered Pierrepont zinc deposit situated 28 miles north of the company's Balmat and Edwards zinc operations in St. Lawrence County. Reserves were estimated at 2.5 million tons of 15% zinc ore. The zinc ore will be trucked to milling operations at Balmat, and the concentrates shipped to a company smelter at Monaca in western Pennsylvania.

[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.
[2]Program assistant, Bureau of Mines, Pittsburgh, Pa.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Carborundum Co	Box 423 Niagara Falls, NY 14302	Plant	Niagara.
General Abrasives Div. of Dresser Industries, Inc.	2000 College Ave. Niagara Falls, NY 14305	do	Do.
Pellets, Inc	531 South Niagara St. Tonawanda, NY 14150	do	Do.
Aluminum smelters:			
Aluminum Co. of America	1210 Alcoa Bldg. Pittsburgh, PA 15222	do	St. Lawrence.
Reynolds Metals Co	Box 27003-2A Richmond, VA 23215	do	Do.
Cement:			
Alpha Portland Cement Co.[1]	15 South 3d St. Easton, PA 18043	Quarry and plant.	Greene.
Atlantic Cement Co., a subsidiary of Newmont Mining Corp.	Box 30 Stamford, CT 06904	do	Albany.
Glens Falls Portland Cement Co., Inc., a subsidiary of Moore McCormack Resources, Inc.[2]	Box 440 Glens Falls, NY 12801	do	Warren.
Lehigh Portland Cement Co.[2]	718 Hamilton St. Allentown, PA 18105	do	Greene.
Marquette Co., a subsidiary of Gulf + Western Industries, Inc.[1 2]	1 Commerce Plaza Nashville, TN 37239	do	Do.
Clays:			
Norlite Corp	628 South Saratoga St. Cohoes, NY 12047	Pits	Albany.
Northeast Solite Corp., a subsidiary of Solite Corp.	Box 27211 Richmond, VA 23261	Pit	Ulster.
Emery:			
De Luca Emery Mine, Inc	929 Constant Ave. Peekskill, NY 10566	Pit	Westchester.
Garnet:			
Barton Mines Corp	North Creek, NY 12853	Pit	Warren.
Gypsum, calcined:			
Georgia-Pacific Corp	Box 311 Portland, OR 97207	Plant	Erie and Westchester.
National Gypsum Co.[3]	Gold Bond Building Products 2001 Rexford Rd. Charlotte, NC 28211	do	Bronx.
United States Gypsum Co.[3]	101 South Wacker Dr. Chicago, IL 60606	Underground mine and plant.	Genesee, Richmond, Rockland.
Iron ore:			
NL Industries, Inc.[4]	Tahawus, NY 12879	Pit	Essex.
Lime:			
Allied Chemical Corp.[1 5]	Box 70 Morristown, NJ 07960	Quarry and plant.	Onondaga.
Bethlehem Steel Corp	701 East 3d St. Bethlehem, PA 18016	do	Erie.
Peat:			
Anderson Peat Co., Inc	Pleasant Hill Rd. Wingdale, NY 12594	Bog	Dutchess.
Good Earth Organics Corp	5960 Broadway Lancaster, NY 14086	Bog	Cattaraugus.
Salt:			
Cargill, Inc	1620 Northstar Ctr. Minneapolis, MN 55402	Underground mine.	Tompkins.
International Salt Co	Clarks Summit, PA 18411	do	Livingston.
Morton-Norwich Products, Inc	110 North Wacker Dr. Chicago, IL 60606	Well	Wyoming.
Sand and gravel:			
Colonial Sand & Stone Co., Inc.[1 2 6]	1740 Broadway New York, NY 10019	Pits	Dutchess and Nassau.
Roanoke Marbro Sand & Gravel Corp	Box 172 Riverhead, NY 11901	Pit	Suffolk.
Valent Gravel, Inc	Box 56, R.D. 5 Troy, NY 12180	Pits	Albany and Rensselaer.
Slag:			
Buffalo Slag Co., a subsidiary of Koppers Co., Inc.[7]	111 Great Arrow Ave. Buffalo, NY 14216	Plants	Allegany, Cattaraugus, Steuben.
Stone:			
Callanan Industries, Inc., a subsidiary of Penn-Dixie Industries., Inc.	South Bethlehem, NY 12161	Quarry	Albany and Ulster.
Dolomite Products Co.[7]	1150 Penfield Rd. Rochester, NY 14625	do	Monroe.
General Crushed Stone Co., a subsidiary of Koppers Co., Inc.	712 Drake Bldg. Easton, PA 18042	do	Genesee, Herkimer, Jefferson, Livingston, Onondaga, Ontario, Wayne.
Johnston & Rhodes Bluestone Co	East Branch, NY 13756	do	Delaware.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
New York Trap Rock Corp., a subsidiary of Lone Star Industries, Inc.	162 Old Mill Rd. West Nyock, NY 10994	Pits	Ulster.
Sulfur, elemental:			
Ashland Oil & Refining Co.[1]	Tonawanda, NY 14150	Refinery	Erie.
Talc:			
Gouverneur Talc Co., Inc., a subsidiary of R. T. Vanderbilt Co., Inc.	Gouverneur, NY 13642	Underground mine.	St. Lawrence.
Wollastonite:			
NYCO, a division of Processed Minerals, Inc.[5]	Box 368 Willsboro, NY 12996	Underground and surface mines.	Essex.
R. T. Vanderbilt Co., Inc	30 Winfield St. Norwalk, CT 06855	Surface	Lewis.
Zinc:			
St. Joe Minerals Corp.[9]	250 Park Ave. New York, NY 10017	Mine	St. Lawrence.

[1]Also stone.
[2]Also clays.
[3]Also expanded perlite.
[4]Also ilmenite.
[5]Also salt.
[6]Also cement.
[7]Also sand and gravel.
[8]Also garnet.
[9]Also lead and silver.

The Mineral Industry of North Carolina

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Division of Land Resources, North Carolina Department of Natural Resources and Community Development, for collecting information on all nonfuel minerals.

By Doss H. White, Jr.[1] and P. Albert Carpenter, III[2]

The value of mineral production in North Carolina in 1980 was $379 million, an increase of $37 million over that reported in 1979. North Carolina is a leading State in the production and value of industrial minerals, and over the past 10 years mineral production has added over $2 billion to the State's economy. The State is a world leader in the production of lithium and leads the Nation in the output and sales of feldspar, scrap mica, olivine, and pyrophyllite. North Carolina ranks second nationally in common clay and crushed granite output and sales, and third in crushed marble and phosphate rock. Many mineral commodities, ranging from boron compounds to crude vermiculite, are imported from foreign and/or domestic producers and used by the State's manufacturing industry.

Table 1.—Nonfuel mineral production in North Carolina[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2]	thousand short tons	3,308	$8,385	2,852	$7,308
Feldspar	short tons	523,663	14,531	499,600	15,062
Gem stones		NA	50	NA	40
Mica, scrap	thousand short tons	r84	r5,847	78	3,680
Sand and gravel	do.	11,203	29,733	9,309	28,735
Stone:					
Crushed	do.	39,864	125,319	34,764	125,019
Dimension	do.	49	3,932	55	4,536
Talc and pyrophyllite	do.	130	692	W	W
Combined value of cement, clays (kaolin), lithium compounds, olivine, phosphate rock, and value indicated by symbol W		XX	153,752	XX	194,986
Total		XX	r342,241	XX	379,366

rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

[2]Excludes kaolin; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in North Carolina, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Alamance	W	W	Stone, clays.
Anson	W	W	Sand and gravel, stone.
Ashe	W	$831	Stone.
Avery	W	W	Mica, clays, stone, sand and gravel.
Beaufort	W	W	Phosphate rock, sand and gravel.
Bertie	W	W	Sand and gravel.
Bladen	W	75	Do.
Brunswick	$11	42	Sand and gravel, stone.
Buncombe	W	W	Stone, sand and gravel, clays.
Burke	W	W	Stone, sand and gravel.
Cabarrus	W	W	Stone, sand and gravel, clays.
Caldwell	W	W	Stone, sand and gravel.
Camden	W	W	Sand and gravel.
Caswell	W	W	Stone.
Catawba	W	W	Stone, sand and gravel.
Chatham	1,827	W	Clays.
Cherokee	W	W	Stone, talc.
Chowan	10	W	Sand and gravel.
Cleveland	15,001	18,880	Lithium, mica, stone, feldspar, sand and gravel, clays.
Craven	W	W	Stone, sand and gravel.
Cumberland	697	711	Sand and gravel.
Currituck	W	W	Do.
Dare	W	W	Sand and gravel, clays.
Davidson	W	W	Stone, clays.
Davie	W	W	Stone, sand and gravel.
Duplin	W	W	Do.
Durham	W	W	Stone, clays.
Edgecombe	W	W	Stone, sand and gravel.
Forsyth	W	W	Do.
Franklin	W	W	Sand and gravel.
Gaston	W	14,247	Lithium, feldspar, stone, mica, sand and gravel.
Granville	W	W	Talc.
Greene	W	W	Sand and gravel.
Guilford	W	W	Stone, sand and gravel, clays.
Halifax	W	W	Clays.
Harnett	W	W	Sand and gravel, clays.
Haywood	918	W	Stone.
Henderson	W	W	Stone, clays, sand and gravel.
Hertford	W	336	Sand and gravel.
Hyde	22	4	Do.
Iredell	W	W	Stone, sand and gravel, clays.
Jackson	W	W	Olivine, stone, sand and gravel, mica.
Johnston	W	W	Stone, sand and gravel.
Jones	131	41	Stone.
Lee	W	W	Stone, clays, sand and gravel.
Lenoir	W	W	Sand and gravel.
McDowell	745	783	Do.
Macon	W	W	Stone, sand and gravel.
Martin	17	13	Sand and gravel.
Mecklenburg	W	W	Stone.
Mitchell	W	W	Feldspar, mica, sand and gravel, stone, olivine.
Montgomery	W	W	Sand and gravel, stone, clays.
Moore	W	W	Sand and gravel, talc, clays.
New Hanover	30,418	32,945	Cement, stone, clays, sand and gravel.
Northampton	W	417	Sand and gravel.
Onslow	W	W	Stone, sand and gravel.
Orange	1,594	1,450	Stone, talc, sand and gravel.
Pasquotank	W	W	Sand and gravel.
Pender	161	W	Do.
Person	--	W	Stone.
Pitt	W	W	Stone, sand and gravel.
Polk	--	418	Stone.
Randolph	W	W	Do.
Richmond	4,443	3,301	Sand and gravel, stone.
Rockingham	W	W	Stone, clays, sand and gravel.
Rowan	W	W	Do.
Rutherford	W	723	Stone.
Sampson	W	W	Clays, sand and gravel.
Scotland	6	6	Sand and gravel.
Stanly	W	1,529	Clays, stone.
Stokes	W	W	Sand and gravel, stone, clays.
Surry	W	W	Stone, sand and gravel.
Swain	W	W	Stone.
Transylvania	W	W	Stone, sand and gravel.
Tyrrell	24	7	Sand and gravel.
Union	W	W	Stone, clays.
Vance	W	W	Stone.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in North Carolina, by county[1] —Continued

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Wake	W	W	Stone, clays, sand and gravel.
Washington	$29	W	Sand and gravel.
Watauga	895	W	Stone.
Wayne	235	$188	Sand and gravel.
Wilkes	W	W	Stone, sand and gravel.
Wilson	W	W	Do.
Yadkin	W	W	Sand and gravel.
Yancey	W	W	Olivine, sand and gravel.
Undistributed[2]	237,393	265,295	
Total[3]	294,578	342,241	

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

[1]The following counties are not listed because no nonfuel mineral production was reported: Alexander, Alleghany, Carteret, Clay, Columbus, Gates, Graham, Hoke, Lincoln, Madison, Nash, Pamlico, Perquimans, Robeson, and Warren.

[2]Includes gem stones 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 North Carolina business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,692.0	2,741.0	+1.8
Unemployment	do.	129.0	180.0	+39.5
Employment (nonagricultural):				
Mining	do.	5.2	5.2	--
Manufacturing	do.	827.9	824.2	-.4
Contract construction	do.	126.1	118.2	-6.3
Transportation and public utilities	do.	115.7	116.9	+1.0
Wholesale and retail trade	do.	477.1	472.9	-.9
Finance, insurance, real estate	do.	93.0	95.1	+2.3
Services	do.	332.1	341.7	+2.9
Government	do.	397.2	411.0	+3.5
Total nonagricultural employment	do.	2,374.3	2,385.2	+.5
Personal income:				
Total	millions	$41,382	$45,919	+11.0
Per capita		$7,382	$7,852	+6.4
Construction activity:				
Number of private and public residential units authorized		41,672	32,915	-21.0
Value of nonresidential construction	millions	$559.0	$598.1	+7.0
Value of State road contract awards	do.	$238.0	$170.0	-28.6
Shipments of portland and masonry cement to and within the State	thousand short tons	1,883	1,647	-12.5
Nonfuel mineral production value:				
Total crude mineral value	millions	$342.2	$379.4	+10.9
Value per capita, resident population		$61	$65	+6.6
Value per square mile		$6,508	$7,214	+10.8

[p]Preliminary.

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

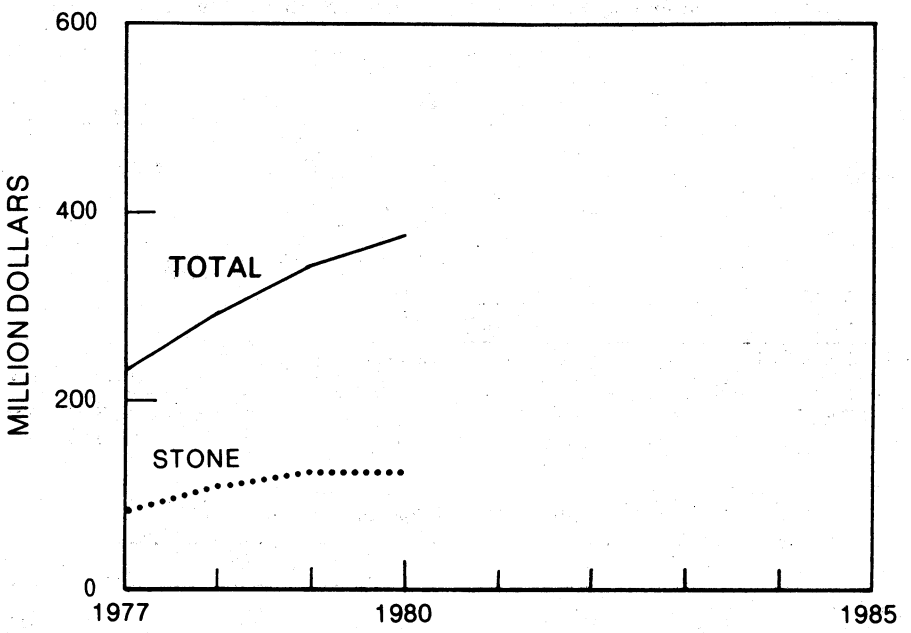

Figure 1.—Value of stone and total value of nonfuel mineral production in North Carolina.

Trends and Developments.—Although inflation increased the value of the State's mineral production above the 1979 level, production slumped for a number of mineral commodities as orders from major customers decreased. The downturn in demand, due to the effects of the recession, began in the latter part of 1979.

Most severely affected were those commodities used in construction—clay, sand and gravel, and crushed stone. Output for these three commodities decreased over 7 million tons and sales were $1.8 million below those of the previous year. In December, the prime interest rate surpassed 20%, severely depressing new construction. Housing starts were down about 27% from 1979, 40% below the 1978 level. In April, 60,000 of the State's 128,000 residential construction workers were out of work.[3]

Industrial construction was less affected by the recession than the residential sector—a number of major companies announced or continued ongoing expansion plans. Notable among these were the Aluminum Co. of America at Baden; PPG Industries, Inc., at Shelby; Lithium Corp. of America at Gastonia; Texasgulf, Inc., at Lee Creek; and North Carolina Phosphate Corp., near Aurora.

Continuing a trend of resource conservation, the State's mineral industry worked toward developing markets for materials formerly considered mining wastes. The Kings Mountain Mica Co., with the help of the North Carolina State University Laboratory in Asheville, developed beneficiation processes to recover and market silica and clay materials formerly discarded as waste. The State's two lithium companies sold amphibolite overburden to a local aggregate company for crushed stone production and marketed feldspar, mica, and silica—a by-product of spodumene processing; a pyrophyllite company recovered and sold by-product silica, sericite, and quartzite; and a feldspar producer reworked wastes from former processing operations for the silica content.

Legislation and Government Programs.—During the year, the Sunset Commission, established to review expiring State laws, recommended changes to the State Mining Law in the area of reclamation bonding. These recommendations, if adopted, would increase operating costs for

a number of firms, and were opposed by the mineral industry.

In December, a potential precedent-setting lawsuit concerning lands proposed for wilderness designation was filed in U.S. District Court in Asheville. The suit sought to prevent the U.S. Forest Service from treating lands proposed for wilderness designation as if such a designation had been approved by the U.S. Congress. The suit, filed by the North Carolina Wildlife Federation, the Southern Appalachia Multiple Use Council, and the Save America Club, names the Secretary of the U.S. Department of Agriculture as defendant. In 1979, the Forest Service had proposed 5,124 acres in the Shining Rock extension and 11,342 acres in southern Nantahala Forest as wilderness.[4]

The North Carolina Geological Survey Section of the Division of Land Resources, Department of Natural Resources and Community Development, completed a number of geologic and mineral resource studies. Five 7-1/2 minute quadrangles in the Blue Ridge province were published as part of the State's cooperative geologic mapping program with the Tennessee Valley Authority and the U.S. Geological Survey (USGS). These maps, published in black and white at a scale of 1:24,000, include a mineral resource summary. The Geological Survey Section became an affiliate of the National Cartographic Information Center of the USGS. The purpose of this program is to collect, organize, and disseminate information on the availability of cartographic data covering the United States.

The Land Quality Section of the Division of Land Resources reported a total of 525 mines under permit at the end of 1980. Acreage mined totaled 1,176 with 479 acres reclaimed. The North Carolina State University Mineral Research Laboratory at Asheville conducted a variety of studies, including beneficiation of clays; flotation of feldspar, glass sand, mica, and spodumene; evaluation of mica schist ores; and evaluation of byproduct clay from a crushed stone operation.

Geologists at the University of North Carolina at Chapel Hill, supported by a grant from the North Carolina Energy Institute, were studying North Carolina peat reserves. The State has approximately 1,000 square miles of peat land containing about 600 million tons of peat. The study includes the determination of the extent and thickness of the deposits as well as calculations of ash and water content, heating value, proximate and ultimate analyses, and bulk density. Investigations are underway to determine the effects of peat mining on environmentally sensitive coastal areas—a mining permit was issued to First Colony Farms, Inc., to conduct experimental peat mining in Washington and Hyde Counties. Projects were conducted to determine the suitability of peat as an energy source.

A study to determine the existence of a buried Triassic basin in the North Carolina Coastal Plain was completed. This program, begun in 1978 under grants from the North Carolina Energy Institute, the Coastal Plains Regional Planning Commission, and the North Carolina Department of Natural Resources and Community Development, included both comprehesive geophysical surveys and core drilling. The findings indicated that the subsurface feature, originally recognized on aeromagnetic maps, was actually a fault-block syncline in the crystalline basement.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Boron.—PPG imported boric acid from California, and colemanite, a calcium borate, produced in Turkey and processed at Kings Creek, S.C. The materials were used in fiberglass manufacture at company plants at Shelby in southwestern North Carolina and Lexington in the central part of the State.

During 1980, PPG completed plans for a $20 million expansion of the Shelby facility. The expansion, which includes an advanced glass melting furnace, is scheduled for completion in the spring of 1982.

Cement.—The State's only cement producer, Ideal Basic Industries, Inc., manufactured both portland and masonry cement near Castle Hayne, New Hanover County, on the Atlantic coast. The company operated two kilns to produce cement by the wet process. Limestone and clays for cement manufacture was mined locally, iron ore was obtained from South Carolina, and gypsum was shipped from Nova Scotia through Virginia. Most of the cement sales were to North Carolina customers with some shipments to Florida and South Carolina.

Clays.—North Carolina's clay industry

dates from the 1700's when Josiah Wedgewood shipped 5 tons of kaolin to England for jasperware manufacture. From this beginning, the State's clay industry has grown into a multimillion-dollar-per-year business, and during the past decade, over 30 million tons of clay valued at over $55 million has been produced. However, in 1980, production decreased 456,000 tons from that of 1979 as a result of the depressed state of the construction industry, the major customer for the State's clay production.

The clay industry in North Carolina consisted of 25 companies operating 50 pits. Twenty-two companies operated 47 pits for material for brick manufacture, 2 companies produced kaolin at 2 operations, and 1 company produced clay for use in cement manufacture.

The majority of the brick clay production was located in a 16-county area in the center of the State. The primary material mined was residual clay developed from weathering of the rocks of the Carolina Slate Belt; a lesser amount in Moore and Lee Counties was mined from Triassic shales. The remainder of the brick clay production was from Buncombe and Henderson Counties in southwestern North Carolina, and from Sampson, Halifax, and Dare Counties in the eastern part of the State.

Table 4.—North Carolina: Common clay and shale sold or used by producers, by county

County	1979			1980		
	Number of mines	Quantity (short tons)	Value	Number of mines	Quantity (short tons)	Value
Alamance	2	85,092	$156,399	1	53,601	$107,845
Buncombe	1	W	W	1	W	W
Cabarrus and Durham	3	225,920	549,306	3	364,141	978,741
Chatham	4	584,501	2,183,282	4	527,862	2,157,499
Davidson	1	125,000	216,563	1	52,668	100,069
Guilford	2	W	W	1	W	W
Harnett	1	W	W	1	W	W
Henderson	1	W	W	1	W	W
Iredell	1	W	W	1	29,321	57,710
Lee	3	522,301	843,622	3	741,276	1,353,310
Montgomery and New Hanover	4	173,890	514,226	4	149,558	512,878
Rockingham	5	468,247	672,984	2	W	W
Rowan	4	186,296	422,584	2	W	W
Sampson	1	W	W	1	32,500	131,625
Stanly	3	376,290	1,480,807	2	W	W
Stokes	1	20,620	23,713	1	35,538	89,911
Union	1	W	W	1	W	W
Undistributed[1]	5	540,188	1,321,665	5	865,284	1,818,015
Total	43	3,308,345	8,385,151	35	2,851,749	7,307,603

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes Halifax, Moore, and Wake Counties and data indicated by symbol W.

Harris Mining Co. in Avery County, and Kings Mountain Mica Co. in Cleveland County, produced kaolin as a coproduct of mica mining. Primary sales were for ceramic applications and specialty brick manufacturing.

One company, Ideal Basic Industries, Inc., in New Hanover County, mined clay for use in cement manufacture.

Feldspar.—North Carolina continued to lead the Nation in the production of feldspar, an anhydrous aluminum silicate used as a flux in glass and ceramics manufacture. Over the past 10 years, the State's feldspar industry has produced over 5 million tons of concentrate valued at over $100 million.

Feldspar production decreased 24,000 tons from that reported in 1979. The slump in the construction and automotive industries, which adversely affected the demand for glass, coupled with the inroads made by the 2-liter plastic beverage container on the container glass market, were major factors.

The industry consisted of six companies; three companies in the Spruce Pine district in western North Carolina produced feldspar as a primary concentrate, and three companies in the Kings Mountain district of Cleveland and Gaston Counties in the southwestern part of the State, recovered feldspar as a byproduct of lithium and mica production.

The three primary producers, The Feldspar Corp., Lawson-United Feldspar and Mineral Co., and International Minerals &

Chemical Corp., operated five mines near Spruce Pine in Mitchell County. The ore, alaskite, which contains approximately 65% feldspar, was mined by open pit methods. Broken ore was trucked to processing facilities where, after crushing and grinding, a three-step flotation process was used to remove mica, iron minerals, and silica. After drying, the feldspar concentrate was sold to the glass industry. High-intensity magnetic separation and dry grinding were used to produced a pottery-grade product.

Feldspar from the Spruce Pine district was shipped to 36 States, Canada, Puerto Rico, Mexico, Japan, the Republic of South Africa, and Middle East Nations.

The three companies sold byproduct mica to local mica grinding operations, Harris Mining Co. and United States Gypsum Co. Two of the three companies sold byproduct silica as an industrial-grade sand for glass manufacture and sandblasting, the third produced a construction grade sand.

Two lithium producers in the Kings Mountain-Gastonia area, Foote Mineral Co., Inc., and Lithium Corp. of America, produced feldspar-silica sand tailings as a byproduct of spodumene flotation. One company shipped the feldspar-silica mixture to South Carolina for processing, while the second sold the feldspathic sand, after further treatment, to glass manufacturers.

Kings Mountain Mica Co., Kings Mountain, in Cleveland County, recovered feldspar as a coproduct of mica, clay, and silica production. Flotation methods were used to produce a high potash feldspar that was sold, after drying and magnetic separation, for specialty glass or ground to specifications for pottery manufacture.

Gem Stones.—North Carolina was one of the leading States in the Nation in gem stone collecting. Dozens of mines allowed gem collecting on a fee basis. Gem collecting was centered in the western part of the State, near Franklin in Macon County, near Hiddenite in Alexander County, and near Spruce Pine in Mitchell County. Macon County is famous for rubies, sapphires, and garnets; Alexander County for emeralds and hiddenite; and Mitchell County for emeralds and aquamarine. During the year, an emerald crystal weighing 115.4 carats was discovered by an amateur collector at one of the mineral operations near Spruce Pine.[5]

At yearend, gem mine owners near Franklin faced the specter of mine closings due to a State agency denial of water discharge permit renewals. New regulations issued by the State required the mines to install water recirculation systems. Mine owners contend that the expense would close the mines.

Graphite.—Synthetic graphite was produced by Great Lakes Carbon Corp. at their facility at Morganton in Burke County in the western part of the State. Petroleum coke and pitch, a refinery byproduct, were ground, sized, heated, and extruded. Extruded material was fired at 750° C to produce "baked coke" which was then heated to 2,800° C in an electric resistance oven to produce a synthetic graphite product. The graphite was used in the manufacture of anodes, electrodes, crucibles and vessels, and specialty graphite products. During 1980, production increased slightly, compared with 1979 figures.

Gypsum.—Nova Scotian gypsum was imported by National Gypsum Co. for its wallboard manufacturing facility at Wilmington. Initial operations started in 1979, and 1980 shipments were above average. Byproduct gypsum, produced by Texasgulf during fertilizer manufacture at the Lee Creek facility in Beaufort County, was marketed as a soil additive. Sales were below the level of the previous year. Nova Scotian gypsum, imported into Virginia, also was purchased by Ideal Basic Industries, Inc., for use in cement manufacturing.

Iodine.—Crude iodine, extracted from iodine-bearing natural gas brines in Japan's Chiba Peninsula near Tokyo, was imported by Mallinkrodt Chemical Works near Raleigh in Wake County. The crude iodine, along with organic iodine obtained from the company's St. Louis, Mo., plant, was used to produce diaprizoic acid used in X-ray contrast media. Production declined because of a significant price increase for crude iodine.

Lithium.—North Carolina produced over 50% of the world's estimated lithium output in 1980. Although production increased slightly compared with that of 1979, 1980, because of the slow growth rate, was not considered a good year for the State's lithium industry. Contributing to this slow rate were a decrease in housing starts affecting lithium's ceramic market, and increased competition from mainland China, which affected overseas markets.

The State's lithium industry consisted of Foote Mineral Co., Inc., in Kings Mountain in Cleveland County, and Lithium Corp. of America in adjacent Gaston County; both in southwestern North Carolina. Mining and

processing operations of both companies were similar. Pegmatite, rich in spodumene, a lithium aluminum silicate, was mined by open pit methods. Waste rock removed in the mining process was sold to Martin Marietta Corp. for aggregate. Beneficiation steps include crushing and grinding, flotation, acid roast and leach, purification, and precipitation. Commercial amounts of feldspar, mica, and silica were recovered during beneficiation. The primary end product is lithium carbonate, used as a feedstock to produce a variety of lithium products. One principal market, the aluminum industry, uses lithium carbonate to increase the tonnage of aluminum produced per unit of energy.

Other markets included glass and ceramics, multipurpose lithium hydroxide greases, lithium bromide in air conditioning applications, and butyllithium in the synthetic rubber industry. Lithium use in storage battery applications is a small but growing market.

Lithium Corp. of America continued expansion work on its mine and chemical plant. Expansion will continue until capacity reaches 44 million pounds per year.

During the year, Foote Mineral Co. completed an expansion at its Kings Mountain plant. Lithium carbonate capacity was raised to 18 million pounds per year.

Mica.—North Carolina, the leading State in the Nation in the production of scrap, flake, and ground mica, accounted for approximately two-thirds of the country's output. Over the last decade, the State's mica production has been valued at approximately $40 million per year. However, in 1980, production dropped 6,000 tons (7.1%) and sales fell almost $2.2 million below that reported in 1979.

The State's mica industry was centered in two principal areas: The Spruce Pine district in Avery, Mitchell, and Yancey Counties; and the Kings Mountain area of Cleveland and Gaston Counties.

The Spruce Pine district in northwestern North Carolina accounted for approximately 62% of the production, over 48,000 tons valued at approximately $2.7 million. Two companies—Harris Mining Co. and Deneen Mica Co.—produced mica as a primary product, while three others—International Minerals & Chemical Corp., The Feldspar Corp., and Lawson-United Feldspar and Mineral Co., Inc.—recovered mica as a byproduct of feldspar processing. Byproduct mica from the feldspar producers was sold to Harris Mining Co. and United States Gypsum Co.

Spruce Pine area producers shipped to 19 States, Canada, Japan, Middle East Countries, and South Africa.

The two primary producers mined saprolite derived from mica-rich pegmatites with front-end loaders and dozer-mounted rippers. Both companies used similar beneficiation methods; grinding, gravity separation, and flotation. Harris Mining Co. produced mica, clay, and silica while output at Deneen was limited to mica.

During the year, Harris Mining Co. was developing plans to mine a mica schist to produce a lower grade mica product. The company was also planning to recover mica by dredging two flooded pits.

Table 5.—North Carolina: Ground mica sold or used by producers, by use

Use	1979		1980	
	Quantity (short tons)	Value	Quantity (short tons)	Value
Roofing	W	W	W	W
Paint	6,776	$1,595,259	6,678	$1,346,419
Rubber	4,197	1,177,459	2,402	626,555
Joint cement	39,236	4,470,083	28,956	3,252,157
Other[1]	31,213	4,333,441	36,787	5,022,286
Total	81,422	11,576,242	74,823	10,247,417

W Withheld to avoid disclosing company proprietary data; included in "Other."
[1]Includes plastics, textile coatings, wallpaper, well drilling, other miscellaneous uses, and uses indicated by symbol W.

In the Kings Mountain-Gastonia area, one company mined mica and two produced a mica concentrate as a byproduct of lithium processing. Area producers accounted for approximately 38% of the State's mica output. Kings Mountain Mica Co. produced mica from weathered pegmatites. The company, using a process developed at the North Carolina State University Laboratory, produced mica, feldspar, silica, and clay.

Mica recovery included grinding, gravity separating, and flotation. The company produced both dry- and wet-ground products.

Foote Mineral Co. and Lithium Corp. of America produced a byproduct mica from lithium ore processing. Part of the output was purchased by United States Gypsum for dry grinding at the company's Kings Mountain plant.

Franklin Mineral Products Co., Inc., in Franklin, ground mica imported by truck from Georgia. The company produced a wet ground product. Sericite was produced by Piedmont Minerals Co. in Orange County as a byproduct of pyrophyllite mining. Principal uses were for a filler in structural clay products and ceramics.

Olivine.—North Carolina was the leading State nationally in the production of olivine, a magnesium iron silicate. In the United States, the material is used as slag conditioner in the steel industry and as foundry sand. Output in 1980 decreased below the previous year's level, a result of the decreased demand by the steel and foundry industries.

The State's olivine industry consisted of three companies operating five open pit mines in Mitchell, Yancey, and Jackson Counties, in western North Carolina. Two companies used crushing, wet milling, and gravity separation in a wet-beneficiation process, while the third used dry processing, primarily crushing and screening.

During the year, a fourth company, Appalachian Properties, Inc., attempted to obtain mining permits for an olivine-rich deposit located in Nantahala National Forest in the Buck Creek area in Clay County. However, during an environmental study of the area, Forest Service personnel identified certain pine and grass species in the "rare and endangered" species category and denied the permit. The company appealed the decision and if the denial is overturned, the company plans to build a processing facility in Dillsboro, N.C., to produce olivine bricks for heat storage and olivine flux additive for the steel industry.

Perlite.—Carolina Perlite Co., Inc., operated an expanded perlite facility at Gold Hill, Rowan County, in central North Carolina. Raw material was obtained by rail from New Mexico producers. Crude perlite was crushed, sized, and expanded at high temperatures to produce a lightweight product used for concrete and plaster aggregate. Output decreased slightly as a result of the slump in residential and commercial construction.

Phosphate.—North Carolina again ranked third nationally in phosphate output and value. During 1980, Texasgulf was the State's only phosphate rock producer. Production increased approximately 12%, to 4.3 million tons.[6]

The Texasgulf operation included a large, open pit mining complex and a fertilizer manufacturing facility near Aurora at Lee Creek in Beaufort County on the Atlantic coast. In the mining operation, the upper portion of the 100-foot-thick overburden was stripped with dredges. After dredging, the pit was dewatered and 50 and 72 cubic yard draglines completed stripping and mined the ore. The ore was pumped as slurry to the beneficiating plant.

At yearend, the $180 million expansion of the Lee Creek operation, which started in 1978, was approximately 25% complete. Phosphate capacity was increased to 780,000 tons per year and work continued to increase production to 850,000 tons of P_2O_5 in 1981 and 1 million tons by 1982. Both mine and fertilizer complex were being expanded.

Mine expansion plans include the addition of new shipping equipment; work continued on a new, 30-inch dredge, the "Sir Walter Raleigh." The vessel was under construction at a shipyard in Maryland.

Fertilizer complex expansion included increasing sulfuric and phosphoric acid capacity by adding and/or modifying existing facilities. New diammonium phosphate and superphosphate acid plants will increase output by 620,000 tons per year. Also included in the expansion are ammonia storage facilities at Lee Creek and facilities for storing liquid sulfur at Lee Creek and Morehead City.

Texasgulf purchased the Great Gossan Lead property in southern Virginia from Freeport Minerals Co. The property, which contains large reserves of pyrrhotite, provides the company with an additional source of raw material for sulfuric acid manufacture.

During 1980, Agrico Chemical Corp. purchased full ownership of North Carolina Phosphate Corp. and will begin mining in 1983.

North Carolina Phosphate Corp. signed a contract with the North Carolina State Port Authority to construct an $18 million phosphate shipping facility at Morehead City. The company plans annual shipments of 3.7 million tons of raw phosphate through the

port after 1983. The phosphate is to be exported to overseas customers.

Premining work on the $300 million complex near Aurora was underway. Phosphate rock, mined by bucket wheel excavator and dragline, and concentrated by flotation, is to be barged from the mine to the Morehead City facility.

At yearend, Cie. Francaise de L'Azote (Cofaz), a major French fertilizer company, was investigating the feasibility of a partnership with Agrico in the North Carolina Phosphate Corp.

Geologists from East Carolina University and the University of Southern Florida continued efforts to define geographical limits and ore grade of several extensive offshore phosphate deposits. Some of the deposits, located in waters 50 to 130 feet deep, contain phosphate beds up to 26 feet thick.

Pyrophyllite.—In 1980, North Carolina was one of two States recording production of pyrophyllite, an anhydrous aluminum silicate used as an extender and filler and in refractory applications. The State's pyrophyllite industry was composed of three companies; Standard Minerals Co., Inc., and Glendon Pyrophyllite, Inc., with mines and plants in Moore County in central North Carolina, and Piedmont Minerals Co., Inc., with operations in Orange County in the north-central part of the State.

In Moore County, the pyrophyllite occurred in lenses and pods up to 80 feet wide. After stripping, the ore was broken with rippers, crushed at the mine at one operation, and trucked to the plants where it was crushed, dried, and milled to the customer's specifications. During the year, the majority of sales were for an insecticide filler and carrier and for wallboard filler. Other sales were for a filler for latex foam and paint-related products, in wall tile and other ceramic products, and refractory applications.

Piedmont Minerals Co., Inc., operated a mine and mill near Hillsborough in Orange County. The ore, an andalusite-rich pyrophyllite, occurred as lenticular pods separated by sericite. Ore was shot, loaded by shovel, and trucked to the nearby mill where heavy media separation upgraded the andalusite-pyrophyllite. After milling, granular andalusite-pyrophyllite was trucked to Greensboro where it was blended with Ohio clay and South Carolina kaolin for the manufacture of refractories. Finely ground pyrophyllite was sold to ceramic manufacturers.

Sericite, mined in conjunction with the pyrophyllite, was ground and sold to brick and quarry tile or ceramic tile manufacturers, the market dependent on the sericite purity. Quartzite, mined to allow better access to the pyrophyllite, was crushed and sold for aggregate. Silica, removed during heavy media separation, was sold locally for use in concrete block.

Sand and Gravel.—In 1980, sand and gravel was the second ranking mineral produced in North Carolina, in terms of tonnage and sales. During the past 10 years, the industry has recorded over $190 million in sales. In 1980, output declined for the second consecutive year as a result of a slowdown in highway construction and a building slump. Sand and gravel production decreased almost 2 million tons, representing a $1 million drop in value from 1979 levels.

The sand and gravel industry consisted of 81 companies which operated 134 mines in 60 counties. Leading counties were Anson, Cumberland, Harnett, and Richmond in the south-central part of the State, and Buncombe in the western section. The Anson-Richmond County area had one of the largest sand and gravel reserves in North Carolina, and sand and gravel from these counties was shipped to many areas of the State and into South Carolina. As in past years, principal sales, almost 2 million tons, were for concrete aggregate, asphaltic concrete, and road base and coverings.

North Carolina ranked among the top 10 States in the production of industrial sand and gravel. The industrial sand industry consisted of seven companies and was centered in Anson, Richmond, and Harnett Counties. These three counties produced approximately 46% of the total tonnage. Additional tonnages were produced as a byproduct of feldspar processing in Mitchell and Yancey Counties and lithium processing in Cleveland County. Production totaled 3.5 million tons; principal markets were the container and flat glass industry. Industrial gravel was produced by four companies in Anson, Richmond, and Harnett Counties. Output totaled 4.3 million tons, used mainly by the ferrosilicon industry.

Table 6.—North Carolina: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	4,799	$11,589	$2.41	3,876	$11,033	$2.85
Plaster and gunite sand	128	306	2.40	110	301	2.73
Concrete products	548	1,332	2.43	223	625	2.80
Asphaltic concrete	1,628	3,485	2.14	1,559	4,362	2.80
Road base and coverings	1,377	3,220	2.34	1,221	3,067	2.51
Fill	990	1,216	1.23	631	922	1.46
Snow and ice control	W	W	W	12	40	3.20
Railroad ballast	1	5	4.00	W	W	4.51
Other	161	466	2.90	205	560	2.72
Total[1] or average	9,634	21,618	2.24	7,837	20,910	2.67

W Withheld to avoid disclosing company proprietary data; included in "Other."
[1]Data may not add to totals shown because of independent rounding.

Table 7.—North Carolina: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	6,881	$13,443	$1.95	5,640	$12,485	$2.21
Gravel	2,753	8,175	2.97	2,197	8,425	3.84
Total or average	9,634	21,618	2.24	7,837	20,910	2.67
Industrial:						
Sand	W	W	4.13	862	3,526	4.09
Gravel	W	W	6.19	610	4,299	7.05
Total or average	1,569	8,115	5.17	1,472	7,825	5.32
Grand total or average	11,203	29,733	2.65	9,309	28,735	3.09

W Withheld to avoid disclosing company proprietary data; included in "Total."

Stone.—Over the past decade, stone has been the State's leading mineral commodity in terms of value and output. During this period, the crushed and dimension stone industry produced over 310 million tons valued at over $850 million. However, 1980 was not a favorable year for the State's stone industry. A decrease in highway construction, the principal market for crushed stone, and a slump in housing starts severely curtailed sales. Production declined 5 million tons from the previous year's output.

North Carolina's stone industry produced crushed granite, traprock, limestone, marl, and slate. The dimension stone industry quarried granite, sandstone, argillite, and marble. Both segments of the stone industry operated 97 quarries in 55 of the State's 100 counties.

North Carolina ranked second behind Georgia in crushed granite production; granite accounted for over 80% of the State's crushed stone output.

Granite and related rocks were mined and crushed by 33 companies operating 58 quarries in 40 counties, primarily in the central and western parts of the State. Production was 3.7 million tons less than in 1979. Principal uses included aggregate for road construction, concrete aggregate, and railroad ballast.

Crushed traprock output was centered in Cabarrus, Lee, and Union Counties in the south-central part of the State and in Durham, Johnston, and Orange Counties in east-central North Carolina. The traprock industry was composed of five companies operating six quarries. Primary uses were for road construction, concrete aggregate, and filter stone; production decreased 4.4 million tons compared with 1979 levels. Two companies in Cleveland and Gaston Counties produced traprock (amphobilite) from lithium mining, output was sold to a local aggregate producer.

Crushed limestone production was reported from Cleveland, Henderson, and Swain Counties in the southwestern part of the State; Person County in north-central North Carolina; and Craven, New Hanover, Onslow, and Pender Counties in the southeast. Production from 7 companies operating 10 quarries was 8.9 million tons less than in 1979. Principal applications were in highway construction and cement manufacture.

Marl was mined and crushed by four companies at four quarries in Brunswick, Craven, and Duplin Counties in southeastern North Carolina. Major sales were for aggregate and agricultural applications. Output decreased approximately 8,000 tons compared with 1979 figures.

Slate was quarried by one company in Stanly County in northern North Carolina. The material was crushed and expanded to produce a lightweight aggregate used in concrete products.

Vulcan Materials Co.'s Enka quarry and Martin Marietta Aggregates' Baker and Charlotte quarries were awarded the National Crushed Stone Association's Showplace Award. The award is the highest given by the association for quarry appearance improvement.

North Carolina ranked sixth nationally in dimension stone output. North Carolina's dimension stone producers were not as affected by the depressed state of the economy as were those in crushed stone—production increased about 6,000 tons in 1980. Most dimension stone operators market a variety of stone products and a slump in one area of sales was usually offset by increased demand in other areas.

Dimension granite was produced at 10 quarries in Avery, Mitchell, Rowan, Surry, and Watauga Counties in northwestern North Carolina. The dimension sandstone industry was located in Montgomery and Stokes Counties with five quarries reporting production. Dimension marble was quarried at three operations in Cherokee County in the extreme southwestern part of North Carolina, and dimension argillite was quarried by the Jacobs Creek Stone Co. in Davidson County in central North Carolina. Principal granite sales were for curbing, construction stone, and as rough block; all marble sales were for monumental purposes. Major uses for dimension sandstone included facing and patio walkway applications. Argillite sales were for construction and monumental purposes. New markets for argillite have developed over the past few years as hearths for prefabricated fireplaces in mobile homes and for fireplace facings.

Talc.—In 1980, the Warner Corp. produced talc from the State's operating underground mine located near Murphy in Cherokee County in the southwestern part of the State. Production was from replacement lenses in the Murphy Marble. After mining, talc was transported to the mill and ground for use in the textile industry and cut into talc crayons for use in marking metals. The crayon market encountered stiff competition from Japanese and Chinese imports.

Table 8.—North Carolina: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Poultry grit and mineral food	24	230	30	294
Concrete aggregate	4,614	16,336	5,027	20,528
Bituminous aggregate	2,771	9,108	3,883	15,042
Macadam aggregate	365	1,115	W	W
Dense-graded roadbase stone	13,684	39,322	11,020	35,720
Surface treatment aggregate	3,414	10,568	1,043	3,820
Other construction aggregate and roadstone	9,622	31,667	7,882	28,913
Riprap and jetty stone	675	2,411	512	2,139
Railroad ballast	2,676	7,927	2,544	8,228
Filter stone	205	549	551	2,026
Manufactured fine aggregate (stone sand)	688	2,110	901	2,834
Terrazzo and exposed aggregate	16	126	6	73
Fill	16	16		
Roofing granules	20	102	W	W
Other[2]	1,074	3,731	1,366	5,402
Total[3]	39,864	125,319	34,764	125,019

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

[1]Includes limestone, granite, marble (1979), marl, sandstone (1979), traprock, and slate.

[2]Includes stone used in agricultural limestone, agricultural marl and other soil conditioners, cement manufacture, and other uses.

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

Table 9.—North Carolina: Dimension stone[1] sold or used by producers, by use

Use	1979			1980		
	Quantity			Quantity		
	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)
Rough stone:						
Rough blocks	5,187	62	$213	6,800	81	$323
Irregular-shaped stone	6,083	76	203	6,090	75	274
Rubble	816	10	12	1,145	14	20
Monumental	4,754	58	274	3,947	48	229
Dressed stone:						
Cut stone	3,323	42	673	4,200	53	851
Construction stone	W	W	W	4,800	60	646
Curbing	19,937	249	1,113	25,200	315	1,407
Other[2]	8,436	98	1,445	3,183	37	786
Total[3]	48,536	594	3,932	55,365	682	4,536

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes granite, marble, sandstone, and slate.
[2]Includes dressed stone used for monumental, flagging, and structural and sanitary.
[3]Data may not add to totals shown because of independent rounding.

Vermiculite.—Exfoliated vermiculite was produced by W. R. Grace & Co. at its facility near High Point in Guilford County in north-central North Carolina. Crude vermiculite was shipped from company-owned mines in South Carolina. Output continued a 2-year decline resulting from product competition and the construction slump.

METALS

Aluminum.—Primary aluminum was produced at the Aluminum Co. of America's (Alcoa) smelting operation at Badin, Stanly County, in south-central North Carolina. Feed for the 125,000-ton-per-year smelter was shipped from Alcoa's bauxite-alumina facility in Mobile, Ala., which converts foreign bauxite into alumina.

During the year, Alcoa announced plans to add a third potline at the Badin facility, increasing the plant's capacity by 50%. The $70 million expansion was scheduled for completion in 1982.

Copper.—Construction was underway at Durham on SCM Co.'s Glidden Metals Div. powdered copper facility. The plant, scheduled for completion in May 1981, will produce copper powder from scrap for the bearing and friction products industries.

Cobalt.—Carolmet, Inc., began production of extra-fine cobalt powder at a new $15 million plant in Laurinburg in southern North Carolina. The powder was used in the production of cementing material for the manufacture of carbide cutting tools. Cobalt was obtained from the Zairian cobalt producer, Gecamines.

Lithium Metal.—Foote Mineral Co. and Lithium Corp. of America produced lithium metal from molten salt electrolysis of a lithium chloride-potassium chloride mixture. Production was in the form of ingots, rod, wire, shot, and dispersions.

Magnetite.—Cranberry Magnetite Corp. imported ground magnetite from New York. The material was dried and bagged and sold to coal preparation plants in West Virginia, Virginia, Tennessee, and Alabama.

Manganese.—Manganiferous schists mined in South Carolina were imported for use by brick producers as a coloring agent.

Steel.—Florida Steel Corp. operated the State's only steel mill in Charlotte in south-central North Carolina. The facility, which uses scrap as plant feed, operates a 32- and 36-ton electric furnace and two, 2-strand continuous billet casters.

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[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.
[2]Geologist, North Carolina Geological Survey Section, Raleigh, N.C.
[3]The News and Observer. Dec. 11, 1980.
[4]Winston-Salem Journal. Jan. 13, 1981.
[5]Lapidary Journal. May 1981, p. 598.
[6]Industrial Minerals. July 1981, p. 21.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum, smelter:			
Aluminum Co. of America	1501 Alcoa Bldg. Pittsburgh, PA 15219	Plant	Stanly.
Cement:			
Ideal Basic Industries, Inc.[1 2]	420 Ideal Cement Bldg. Denver, CO 80202	do	New Hanover.
Clays:			
Boren Clay Products Co	Box 368 Pleasant Garden, NC 27313	Open pit mines and plant.	Chatham, Guilford, Sampson.
Sanford Brick Corp	Drawer 458 Sanford, NC 27330	do	Chatham, Lee, Stanly.
Solite Corp	Box 27211 Richmond, VA 23261	do	Rockingham and Stanly.
Feldspar:			
The Feldspar Corp.[1 2 3]	Box 99 Spruce Pine, NC 28777	Open pit mines and plants.	Mitchell.
International Minerals & Chemical Corp.[3]	666 Garland Place Des Plaines, IL 60016	do	Do.
Lawson-United Feldspar and Minerals Co.[3]	Box 309 Spruce Pine, NC 28777	do	Do.
Lithium minerals:			
Foote Mineral Co.[1]	Box 792 Kings Mountain, NC 28086	Open pit mine and plant.	Cleveland.
Lithium Corp. of America, Inc	449 North Cox Rd. Gastonia, NC 28052	do	Gaston.
Mica:			
The Feldspar Corp.[4]	Box 99 Spruce Pine, NC 28777	Open pit mines	Mitchell.
Harris Mining Co.[1 2]	Box 628 Spruce Pine, NC 28777	do	Avery.
Kings Mountain Mica Co., Inc.[4]	Box 709 Kings Mountain, NC 28086	do	Cleveland.
Olivine:			
International Minerals & Chemical Corp.	Box 672 Spruce Pine, NC 28777	do	Jackson and Yancey.
Perlite, expanded:			
Carolina Perlite Co., Inc	Box 741 Hillside, NJ 07205	Plant	Rowan.
Phosphate rock:			
Texasgulf, Inc.[5]	Box 48 Aurora, NC 27806	Open pit mine and plant.	Beaufort.
Pyrophyllite:			
Glendon Pyrophyllite, Inc	Box 306 Carthage, NC 28327	Open pit mines and plant.	Alamance and Moore.
Piedmont Minerals Co., Inc.[3]	Box 566 Hillsborough, NC 27278	Open pit mine and plant.	Orange.
Standard Minerals Co., Inc	Box 278 Robbins, NC 27325	do	Moore.
Sand and gravel:			
Becker Sand & Gravel Co	Box 848 Cheraw, SC 29529	Pits	Cumberland, Harnett, Moore.
W. R. Bonsal Co	Box 38 Lilesville, NC 28091	do	Anson.
B. V. Hedrick Gravel and Sand Co.[1]	Swannanoa, NC 28778	do	Buncombe.
Stone:			
Martin Marietta Corp	Box 30013 Raleigh, NC 27612	Pits	Various.
Nello L. Teer Co	Box 1131 Durham, NC 27702	do	Do.
Vulcan Materials Co., Mideast Div.	Box 7506, Reynolds Station Winston-Salem, NC 27109	do	Do.
Talc:			
Warner Corp	Box 459 Murphy, NC 28906	Underground mine	Cherokee.
Vermiculite, exfoliated:			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	Guilford.

[1]Also stone.
[2]Also clays.
[3]Also mica.
[4]Also feldspar.
[5]Also gypsum.

The Mineral Industry of North Dakota

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the North Dakota Geological Survey for collecting information on all nonfuel minerals.

By James H. Aase[1]

The value of nonfuel mineral production in North Dakota during 1980 was $22.4 million, a 5% increase over that of 1979. Among the six nonfuel mineral commodities produced during the year, sand and gravel led in value, accounting for approximately 65% of the total value. Production of half of the nonfuel minerals declined, reflecting the general national trend of softening demand for industrial minerals. Continuing inflation resulted in higher unit values for all commodities produced, except clay.

Nationally, North Dakota was ranked 48th in value of nonfuel mineral production; output was recorded from 64 firms and government agencies, operating at 96 sites scattered throughout 33 counties.

North Dakota's State Soil Conservation Committee reported that during 1980, surface mining operations for minerals other than coal affected 380 acres of land from which 4,077,539 cubic yards of minerals was mined and 626,495 cubic yards of overburden was disturbed. Under North Dakota law, operations that remove 10,000 cubic yards or more of material, or that affect one-half acre or more of land annually, must report their activities.

According to statistics published by the North Dakota Job Service, employment in mining during 1980, excluding coal and petroleum and natural gas extraction, ranged from a low of 170 workers in January to a high of 410 workers in June, for an average of 308 workers for the year. These mining workers represented less than 1% of the total average nonagricultural work force in North Dakota during 1980, about the same percentage as in the previous year.

Table 1.—Nonfuel mineral production in North Dakota[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Gem stones	NA	$1	NA	$2
Peat thousand short tons	(2)	W	W	31
Sand and gravel do	6,648	15,128	5,173	14,457
Combined value of clays, lime, salt, and value indicated by symbol W	XX	6,105	XX	7,886
Total	XX	21,234	XX	22,376

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

[2]Less than 1/2 unit.

Table 2.—Value of nonfuel mineral production in North Dakota, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Barnes	$165	$241	Sand and gravel.
Benson	W	--	
Bottineau	W	72	Sand and gravel, peat.
Bowman	W	W	Sand and gravel.
Burke	3,073	W	Do.
Burleigh	3,357	3,694	Do.
Cass	W	W	Do.
Dickey	79	79	Do.
Divide	101	81	Do.
Dunn	--	4	Do.
Eddy	W	914	Do.
Foster	--	W	Do.
Grand Forks	220	W	Do.
Griggs	W	--	
Kidder	W	W	Sand and gravel.
McHenry	W	W	Do.
McKenzie	163	166	Do.
McLean	957	930	Do.
Morton	802	W	Sand and gravel, clays.
Mountrail	W	1,358	Sand and gravel.
Pembina	W	W	Lime, sand and gravel.
Pierce	W	W	Sand and gravel.
Ramsey	1	--	
Ransom	W	W	Sand and gravel.
Renville	4	W	Do.
Richland	W	W	Lime, sand and gravel.
Rolette	88	57	Sand and gravel.
Sheridan	W	--	
Slope	83	--	
Stark	502	W	Sand and gravel.
Steele	355	--	
Stutsman	1,725	758	Sand and gravel.
Towner	W	W	Do.
Traill	929	414	Do.
Walsh	173	478	Do.
Ward	1,376	1,647	Do.
Wells	190	--	
Williams	W	4,070	Salt, sand and gravel.
Undistributed[2]	7,791	6,268	
Total[3]	22,137	21,234	

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

[1]The following counties are not listed because no nonfuel mineral production was reported: Adams, Billings, Cavalier, Emmons, Golden Valley, Grant, Hettinger, La Moure, Logan, McIntosh, Mercer, Nelson, Oliver, Sargent, and Sioux.

[2]Includes gem stones and values indicated by symbol W.

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

Hebron Brick Co., the State's only clay brick manufacturing facility, shut down its plant at Hebron in Morton County at year-end. Company officials indicated that a slump in sales caused the closing and that production would not resume until inventory buildups were reduced or until the building industry recovers from its 1980 downturn.

Near the end of the year, Hardy Salt Co. completed a program to increase its accessibility to salt reserves by drilling a new 8,400-foot-deep salt recovery well adjacent to its plant near Williston. The company's 1980 production was obtained from two wells by solution mining methods.

Amerigas, Inc., subsidiary of UGI Corp., Valley Forge, Pa., announced plans to build a liquid nitrogen plant near Dickinson, Stark County. Plant output is intended to help supply the growing demand for liquid nitrogen in the oil and gas fields of the Williston Basin. The firm expects to complete the 35-ton-per-day plant within a year and has plans for further expansion thereafter.

Exploration for nonfuel mineral resources was at a near standstill during the year. Responsible for regulating subsurface mineral exploration, North Dakota's Geological Survey reported that only 1 of the 2,759 test holes drilled and completed in 1980 was for nonfuel minerals (salt).

The North Dakota Geological Survey was engaged in a variety of activities during 1980 aimed at a better understanding of the State's geology and mineral and water resources. Included among the projects were: Studies of the depositional systems of Paleozoic Basin rock; county ground water

Table 3.—Indicators of North Dakota business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	303.0	309.0	+2.0
Unemployment	do	11.0	15.0	+36.4
Employment (nonagricultural):				
Mining[1]	do	5.7	8.0	+40.4
Manufacturing	do	16.7	15.5	-7.2
Contract construction	do	18.7	16.2	-13.4
Transportation and public utilities	do	16.1	16.9	+5.0
Wholesale and retail trade	do	67.6	67.4	-.3
Finance, insurance, real estate	do	11.0	11.4	+3.6
Services	do	47.8	49.3	+3.1
Government	do	60.6	60.9	+.5
Total nonagricultural employment[1]	do	244.2	245.6	+.6
Personal income:				
Total	millions	$5,047	$5,583	+10.6
Per capita		$7,683	$8,556	+11.4
Construction activity:				
Number of private and public residential units authorized		4,833	2,992	-38.1
Value of nonresidential construction	millions	$107.5	$87.4	-18.7
Value of State road contract awards	do	$68.4	$64.0	-6.4
Shipments of portland and masonry cement to and within the State	thousand short tons	380	277	-27.1
Nonfuel mineral production value:				
Total crude mineral value	millions	$21.2	$22.4	+5.7
Value per capita, resident population		$32	$34	+6.2
Value per square mile		$300	$317	+5.7

[p]Preliminary.
[1]Includes coal and oil and gas extraction.

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

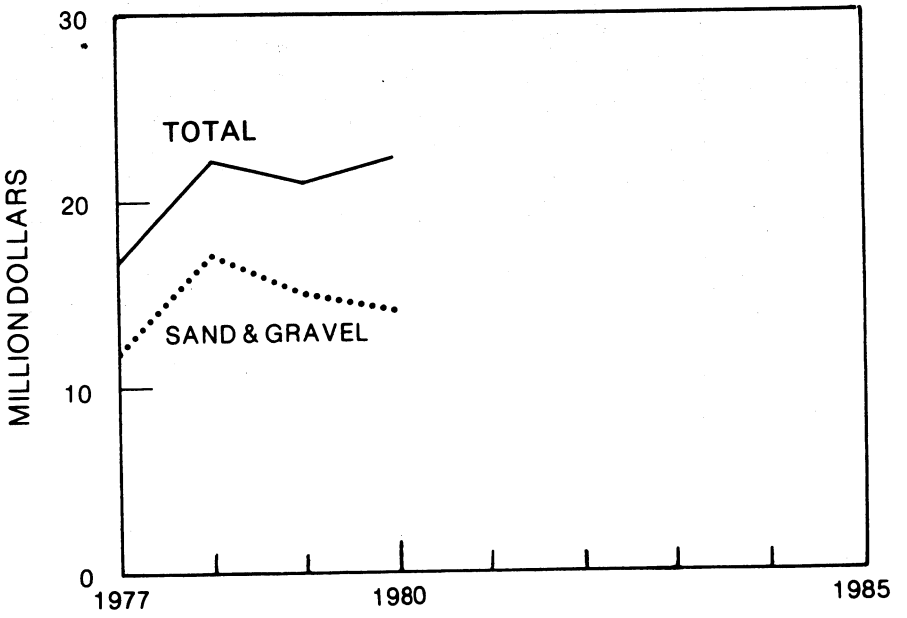

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in North Dakota.

studies; studies of the environmental effects of geologic settings on various North Dakota communities; studies of the stability of sanitary landfill systems; correlation, geochemistry, and resource potential of Cenozoic rock in North Dakota and adjacent areas; and compilation of stratigraphic correlation charts for the Committee on Correlation of Stratigraphic Units of North America.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Clays.—Clay and shale mined in the State during 1980 was consumed principally in manufacturing brick and lightweight aggregate. The quantity and attendant value of the crude clay produced decreased markedly at 25% and 44%, respectively, from those of the previous year.

The State's only brick manufacturing plant, at Hebron, Morton County, closed at yearend because of slumps in sales. Officials of Hebron Brick Co. indicated that operations would resume when large inventory buildups were reduced. In 1980, the firm manufactured approximately 18 million brick. Normally about half the plant's brick output is marketed out of State.

U.S. Noonlite, Ltd., at its plant in Mandan, Morton County, produced lightweight aggregate from local clay and shale. The principal use of the product was in concrete blocks and structural concrete products.

Gem Stones.—No commercial gem stone operations were recorded for North Dakota during 1980. All of the State's output resulted from the recreational activities of mineral collectors and other hobbyists. The value of the materials collected during the year was estimated at a modest $2,000. Included among the various minerals and fossilized materials found in the State are agatized fossil pine cones, chalcedony, moss agate, petrified wood, gypsum, and "rosettes" of marcasite crystals.

Lime.—American Crystal Sugar Co. in Pembina County and Minn-Dak Farmers Co-op in Richland County produced quicklime. All of the lime produced was used by the two companies in their sugar refining operations at these same locations. The limestone used in the manufacturing process to produce the quicklime was obtained from out-of-State sources. Approximately 117,000 tons of lime, obtained from all U.S. sources, was consumed in the State during 1980.

Peat.—The quantity of peat produced in North Dakota during 1980 increased over the previous year's output. Consisting of reed-sedge type peat, the entire production, all from a single operation in Bottineau County, was marketed in bulk quantities for general soil improvement and miscellaneous nursery applications. The Turtle Mountains in Bottineau and Rolette Counties and areas bordering the Souris River bottom in McHenry County are principal peat sources in the State.

Salt.—Compared with 1979 figures, quantity and attendant value of salt production increased in 1980. Hardy Salt Co. near Williston, Williams County, used solution mining to recover salt from a depth of 8,400 feet through two 4-inch-diameter drill holes and processed the brine at its adjoining plant. The refined salt was used in a variety of products, including special salts for baking and food processing, block salt for cattle, water-softener pellets, and as a component in drilling muds for petroleum exploration. During the year, the company completed drilling a new third well into the 8,400-foot-deep salt beds, at a cost of approximately $1.5 million. The well is not intended to increase productivity but rather to assure future access to salt reserves when needed.

During the year, Rainbow Resources, Inc., began initial production of brine from a well in McKenzie County. Output was used principally by the oil and gas industry in drilling activities.

Extensive salt resources underlie most of the western one-third of the State at depths ranging from 3,600 to 12,570 feet.

Sand and Gravel.—Construction sand and gravel was the leading nonfuel mineral commodity, in quantity and value, produced during 1980. Although output fell sharply from that of 1979, the total value decline was slight, reflecting a higher unit price attributed to general inflation.

During 1980, the industry consisted of 57 firms and government agencies operating out of 89 deposits in 33 counties. Production from individual deposits varied widely, with output from 40 operations under 25,000 tons during the year, 19 between 25,000 and 50,000 tons, 13 between 50,000 and 100,000 tons, 12 between 100,000 and 200,000 tons, and 5 in excess of 200,000 tons.

Burleigh was the leading county in production, followed in order by Ward, Stark,

Burke, and Eddy, which collectively accounted for approximately half the State's total output.

Fourteen companies and government agencies, operating from 41 pits, produced more than 100,000 tons each and accounted for more than three-fourths of the entire output during the year.

The largest usage of the 1980 production was as aggregates for roadbase and coverings.

Shipments of sand and gravel in 1980 were handled almost exclusively by truck.

Table 4.—North Dakota: Sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,446	$5,008	$3.46	976	$4,028	$4.13
Plaster and gunite sands	100	437	4.36	103	527	5.10
Concrete products	201	685	3.41	142	603	4.25
Asphaltic concrete	1,113	2,173	1.95	867	1,863	2.15
Roadbase and coverings	2,318	4,231	1.82	2,352	5,534	2.35
Fill	1,447	2,498	1.73	599	1,397	2.33
Snow and ice control	[1]	2	5.00	W	W	4.38
Railroad ballast	12	49	4.00	3	21	8.00
Other	10	45	4.54	131	484	3.69
Total or average	[2]6,648	15,128	2.28	5,173	14,457	2.79

W Withheld to avoid disclosing company proprietary data; included in "Other."
[1]Less than 1/2 unit.
[2]Data do not add to total shown because of independent rounding.

Table 5.—North Dakota: Sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	2,333	$5,247	$2.25	1,481	$4,049	$2.73
Gravel	4,315	9,881	2.29	3,692	10,408	2.82
Total or average	6,648	15,128	2.28	5,173	14,457	2.79

Table 6.—North Dakota: Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1979			1980		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Barnes	2	W	241	2	30	71
Burke	2	W	W	3	303	555
Burleigh	8	1,094	3,694	8	775	3,148
Dickey	1	53	79	--	--	--
Divide	1	48	81	1	38	79
Dunn	1	2	4	--	--	--
Eddy	3	425	914	3	298	777
Emmons	--	--	--	1	57	111
Kidder	2	W	W	3	77	94
McKenzie	1	W	166	1	160	290
McLean	5	400	930	4	278	622
Mercer	--	--	--	2	56	205
Morton	3	611	976	3	177	525
Mountrail	3	577	1,358	2	W	W
Ramsey	--	--	--	1	20	61
Richland	2	W	68	2	W	236
Rolette	1	57	57	2	53	63
Stark	3	W	W	3	465	1,585
Stutsman	8	224	758	9	254	909
Traill	4	231	414	3	72	155
Walsh	6	291	478	5	109	220
Ward	6	864	1,647	7	746	2,120
Undistributed[1]	r23	1,770	3,260	24	1,205	2,632
Total[2]	85	6,648	15,128	89	5,173	14,457

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

[1]Includes Benson (1980), Bottineau, Bowman, Cass, Foster, Grand Forks, McHenry, Pembina, Pierce, Ransom, Renville, Towner, and Williams Counties and data indicated by symbol W.

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

Stone.—No stone production was reported for 1980. In the glaciated portions of the State, boulders are often collected from agricultural lands and run through portable crushing plants to produce aggregate material.

Sulfur.—At the natural gas processing plants of Aminoil USA, Inc., at Tioga in Williams County, and Warren Petroleum Corp., at Little Knife in Billings County, elemental sulfur was recovered as a by-product.

Vermiculite.—Crude vermiculite shipped into the State was exfoliated at the plant of Robinson Insulation Co. at Minot, Ward County. The quantity of exfoliated material produced during 1980 was about one-third less than that of the previous year. The expanded product was used mainly for insulation.

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[1]State mineral specialist, Bureau of Mines, Minneapolis, Minn.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Hebron Brick Co	Hebron, ND 58638	Pit and plant	Morton.
U.S. Noonlite, Ltd	Box 117 Mandan, ND 58554	do	Do.
Lime:			
American Crystal Sugar Co	101 North 3d St. Moorhead, MN 56506	Shaft kiln at beet sugar refinery.	Pembina.
Minn-Dak Farmers Co-op	Wahpeton, ND 58075	do	Richland.
Peat:			
Peat Products Co	821 4th St. Bismarck, ND 58501	Bog	Bottineau.
Salt:			
Hardy Salt Co	Drawer 449 St. Louis, MO 63166	Brine wells and plant	Williams.
Sand and gravel:			
Ames Sand & Gravel, Inc	Box 2702 Fargo, ND 58102	Pit and plant	Burke.
Anderson Sand & Gravel, Inc	Route 1 New Rockford, ND 58356	Pits and plants	Eddy and Foster.
Border States Paving, Inc	Box 3162 Fargo, ND 58108	do	Burke and Rolette.
Cactus Concrete Products, Inc	Box 1483 Williston, ND 58801	do	Williams.
Fisher Sand & Gravel Co	Box 1034 Dickinson, ND 58601	do	Bowman, McLean, Mercer, Morton, Stark.
Minot Sand & Gravel	Box 116 Minot, ND 58701	do	Ward.
Missouri River Sand & Gravel, Inc	Box 2024 Bismarck, ND 58501	Pit and plant	Burleigh.
Northern Improvement Co	Box 1254 Bismarck, ND 58501	Pits and plants	Do.
Schriock Construction Co	Route 3, Radio City Minot, ND 58701	Pit and plant	Ward.
Sheyenne Sand & Gravel, Inc	Box 178 Sheyenne, ND 58374	do	Eddy.
Sulfur, recovered elemental:			
Aminoil USA, Inc	Box 94193 Houston, TX 77018	Plant	Williams.
Warren Petroleum Corp., a division of Gulf Oil Corp.	Box 1589 Tulsa, OK 74101	do	Billings.
Vermiculite, exfoliated:			
Robinson Insulation Co	Box 1782 Minot, ND 58702	do	Ward.

The Mineral Industry of Ohio

By Donald K. Harrison[1]

The value of Ohio's nonfuel mineral production in 1980 was $562.3 million, down from $607.3 million in 1979. Construction commodities contributed the largest portion of the value; cement, sand and gravel, and stone accounted for more than 60% of the State's total.

The State ranked first in the Nation in the production of ferroalloys and lime, second in blast furnace slag and fire clay, third in pig iron, and fourth in salt and sand and gravel. Ohio led the Nation in the manufacture of synthetic quartz crystal, producing 40% of the world's total. In addition to minerals produced in-State, imported alumina, beryllium, iron ore, perlite, rutile, vermiculite, zinc, and zircon were processed or refined into higher value finished products.

Table 1.—Nonfuel mineral production in Ohio[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	170	$10,869	126	$8,549
Portland	do.	1,921	87,483	1,625	77,696
Clays	do.	3,374	13,495	2,718	11,516
Gypsum	do.	W	W	136	1,346
Lime	do.	3,392	141,663	2,786	122,817
Peat	do.	8	191	10	166
Salt	do.	4,135	79,598	3,228	87,371
Sand and gravel	do.	45,944	121,048	36,972	114,291
Stone:					
Crushed	do.	50,717	149,819	42,441	136,929
Dimension	do.	50	1,702	35	1,558
Combined value of abrasives, gem stones, and values indicated by symbol W		XX	1,452	XX	101
Total		XX	607,320	XX	562,340

W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

Table 2.—Value of nonfuel mineral production in Ohio, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Adams	W	W	Stone.
Allen	$2,732	$3,044	Do.
Ashland	W	W	Sand and gravel, clays.
Ashtabula	W	W	Lime, sand and gravel.
Athens	W	W	Stone, sand and gravel.
Auglaize	W	1,501	Stone, sand and gravel, clays.
Belmont	W	W	Sand and gravel, stone.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Ohio, by county[1] —Continued

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Brown	$387	$235	Stone, sand and gravel.
Butler	7,051	7,743	Sand and gravel.
Carroll	580	W	Stone, sand and gravel.
Champaign	486	531	Sand and gravel, peat.
Clark	W	W	Sand and gravel, stone.
Clermont	W	309	Do.
Clinton	W	W	Stone.
Columbiana	W	910	Sand and gravel, clays, stone.
Coshocton	W	W	Sand and gravel, stone.
Crawford	W	W	Stone.
Cuyahoga	24,313	28,840	Salt, lime, clays, peat.
Darke	968	913	Sand and gravel, clays.
Delaware	3,240	W	Stone, clays.
Erie	W	W	Lime, stone, sand and gravel.
Fairfield	W	W	Sand and gravel.
Fayette	W	W	Stone, sand and gravel.
Franklin	W	W	Stone, sand and gravel, clays.
Gallia	W	W	Sand and gravel.
Geauga	W	W	Sand and gravel, stone.
Greene	29,672	35,984	Cement, sand and gravel, stone, clays.
Guernsey	W	W	Stone.
Hamilton	9,921	10,546	Sand and gravel.
Hancock	1,618	1,767	Stone.
Hardin	W	W	Do.
Harrison	W	W	Stone, clays.
Henry	W	W	Sand and gravel, clays.
Highland	1,816	W	Stone, sand and gravel.
Hocking	295	W	Sand and gravel, clays.
Holmes	W	W	Stone, sand and gravel, clays.
Huron	W	W	Sand and gravel, stone.
Jackson	W	W	Clays, stone, sand and gravel.
Jefferson	W	W	Clays.
Knox	W	W	Sand and gravel, stone.
Lake	W	W	Salt, lime, sand and gravel.
Lawrence	W	W	Cement, clays, sand and gravel.
Licking	W	W	Sand and gravel, clays.
Logan	W	1,517	Stone, sand and gravel, peat.
Lorain	17,853	17,116	Lime, sand and gravel, stone, abrasives.
Lucas	W	W	Cement, stone, sand and gravel, clays.
Mahoning	W	W	Stone, clays, peat.
Marion	W	W	Stone, sand and gravel, clays.
Medina	W	W	Sand and gravel, clays, stone.
Meigs	4,003	4,067	Sand and gravel.
Mercer	W	W	Stone.
Miami	4,990	5,994	Stone, sand and gravel.
Monroe	W	W	Stone.
Montgomery	W	W	Sand and gravel, stone.
Morgan	W	W	Do.
Morrow	214	242	Sand and gravel.
Muskingum	W	W	Cement, stone, sand and gravel, clays.
Noble	660	1,000	Stone.
Ottawa	W	W	Stone, lime, gypsum.
Paulding	W	25,837	Cement, stone, clays.
Perry	W	W	Sand and gravel, stone, clays.
Pickaway	W	W	Sand and gravel, stone.
Pike	W	W	Do.
Portage	9,746	9,747	Sand and gravel.
Preble	773	822	Sand and gravel, stone.
Putnam	W	W	Stone, clays.
Richland	W	W	Sand and gravel, clays.
Ross	W	W	Sand and gravel, stone.
Sandusky	71,964	W	Lime, stone.
Scioto	W	1,566	Sand and gravel, clays, stone.
Seneca	W	W	Lime, stone, clays.
Shelby	1,291	1,595	Stone, sand and gravel.
Stark	W	W	Sand and gravel, cement, stone, clays.
Summit	W	W	Salt, sand and gravel, stone.
Trumbull	W	W	Sand and gravel, stone.
Tuscarawas	W	W	Sand and gravel, clays, stone.
Union	W	W	Stone.
Van Wert	1,496	1,203	Do.
Vinton	W	W	Clays.
Warren	W	W	Sand and gravel, stone.
Washington	1,884	1,433	Do.
Wayne	W	W	Salt, sand and gravel, stone, clays.
Williams	W	W	Sand and gravel, peat.
Wood	4,008	3,599	Stone.
Wyandot	W	W	Stone, lime, sand and gravel, peat, clays.
Undistributed[2]	351,396	439,256	
Total[3]	553,349	607,320	

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

[1]Defiance, Fulton, and Madison Counties are not listed because no nonfuel mineral production was reported.

[2]Includes gem stones, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

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

Table 3.—Indicators of Ohio business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	5,036.0	5,086.0	+1.0
Unemployment	do.	297.0	426.0	+43.4
Employment (nonagricultural):				
Mining[1]	do.	31.6	30.8	-2.5
Manufacturing	do.	1,382.3	1,267.5	-8.3
Contract construction	do.	183.5	180.1	-1.8
Transportation and public utilities	do.	232.1	225.1	-3.0
Wholesale and retail trade	do.	975.2	969.9	-.5
Finance, insurance, real estate	do.	200.6	205.7	+2.5
Services	do.	805.6	830.2	+3.0
Government	do.	674.0	689.6	+2.3
Total nonagricultural employment[2]	do.	4,484.7	4,398.8	-1.9
Personal income:				
Total	millions	$93,495	$101,237	+8.3
Per capita		$8,713	$9,398	+7.9
Construction activity:				
Number of private and public residential units authorized		47,992	29,586	-38.4
Value of nonresidential construction	millions	$1,463.2	$1,446.3	-1.2
Value of State road contract awards	do.	$365.0	$177.0	-51.5
Shipments of portland and masonry cement to and within the State	thousand short tons	3,410	2,810	-17.6
Nonfuel mineral production value:				
Total crude mineral value	millions	$607.3	$562.3	-7.4
Value per capita, resident population		$57	$52	-8.8
Value per square mile		$14,733	$13,642	-7.4

[p]Preliminary.
[1]Includes bituminous coal and gas extraction.
[2]Data may not add to totals shown because of independent rounding.

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

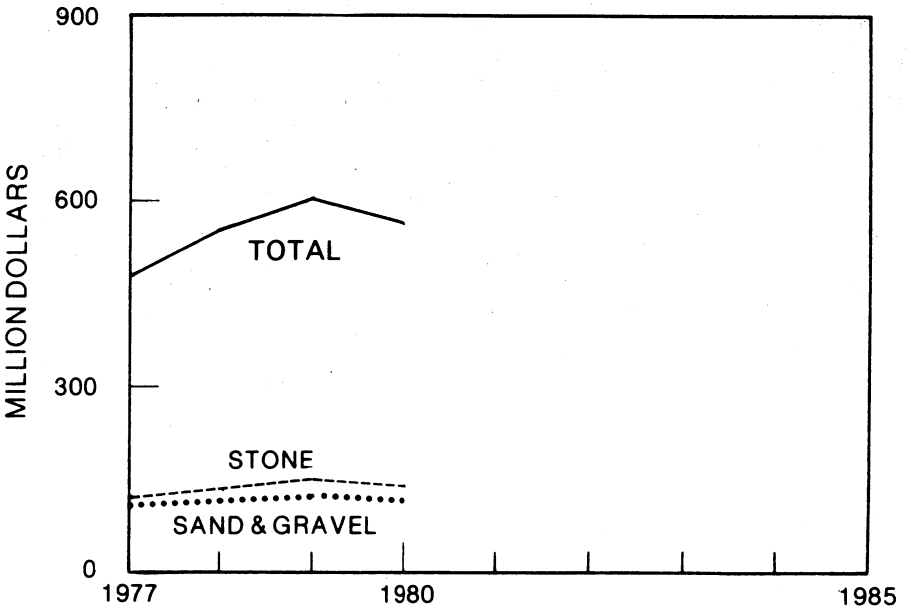

Figure 1.—Value of sand and gravel, and stone, and total value of nonfuel mineral production in Ohio.

Trends and Developments.—The economic conditions of 1980, for the most part, had a negative impact on both Ohio's steel industry and mining companies that supplied raw materials used in construction.

The sluggish steel market in 1980 prompted several companies to close or temporarily shut down their operations. Shutdowns and reductions resulted from lower demand that forced the steel industry to reduce inventories. Hardest hit were plants that supplied steel to the automotive industry. Shipments to automakers in the first 9 months were down about 43% from 1979. Although steel orders increased in the early fall, a drop was reported again in December. Increased operating costs, obsolete equipment, and pollution-control expenditures also added to the industry's problems.

During the year, United States Steel Corp. eliminated 3,500 jobs when the company closed the McDonald and nearby Ohio Works in Youngstown because of declining profits. In late 1980, the company agreed to lease a mill and other properties at the shuttered McDonald Works to Toro Enterprises, Inc., a Youngstown investment firm. Under a 5-year lease, Toro plans to form a new company, McDonald Steel Corp., and resume production by mid-1981.

Layoffs occurred as a result of decreased steel production at Armco Inc.'s Middletown Works, National Steel Corp.'s Weirton Steel Div. at Steubenville, and Republic Steel Corp.'s and Jones & Laughlin Steel Corp.'s Cleveland plants. Both Jones & Laughlin Steel and Republic Steel closed a blast furnace in Cleveland because of decreased sales.

In anticipation of an upswing in economic conditions in the 1980's, Republic Steel completed construction and began operating a new pellet receiving terminal on Lake Erie at Lorain. Ore from Reserve, Hibbing, and other sources is unloaded from 1,000-foot vessels and transferred into smaller boats for delivery to the company's Cleveland plant. Some ore was also loaded into railroad cars for shipment to the company's facilities in the Mahoning Valley district. To transport the pellets from Lorain to the Cleveland plant, Republic Steel signed a long-term contract with American Steamship Co., which used a newly acquired 630-foot, self-unloading vessel specially designed to navigate the Cuyahoga River. During 1980, a total of 2,707,005 gross tons of iron ore pellets was discharged at the Lorain pellet terminal.

The Chessie System Railroads announced plans to construct a $33 million iron ore transfer and storage facility at Toledo to handle self-unloading ore vessels carrying bulk cargo on the Great Lakes. The new facility will be owned and operated by a subsidiary of the Chesapeake and Ohio (C&O) Railroad and served jointly by the C&O, Baltimore and Ohio Railroad, and Conrail. Approximately 4 to 4.5 million tons of ore is expected to be transshipped annually by railcars loaded from dockside or from the storage facility. Limited operations are expected to begin in June 1981; full operations are scheduled for November 1981.

Another positive development in Ohio's mineral industry in 1980 was RMI Co.'s completion of a $3.5 million titanium expansion program in Ashtabula, which raised the company's titanium sponge capacity by 25%. The company also announced an additional $8 million expansion program involving installation of a second 3,000-ton press forging system. This new system will handle the increase and is expected to be able to accommodate additional sponge from a second planned expansion that the company is still considering.

Legislation and Government Programs.—The Ohio Division of Geological Survey (DGS) of the Ohio Department of Natural Resources began a project in conjunction with the Ohio Department of Energy to evaluate the State's carbonate rocks. Tests will be conducted to determine which carbonate units would best be suited for use as a desulfurization material.

DGS continued to map sand and gravel resources in several counties and developed new data on sand and gravel in Lake Erie. Glacial-drift thickness maps also were being developed for a number of counties. Detailed field work continued on the Lake Erie shore erosion and flooding program. Shore erosion reports have been published for approximately half the counties bordering on Lake Erie.

The Ohio Department of Natural Resources, Division of Reclamation, issued 62 new nonfuel mining permits and 49 amended permits during the year. The division also provided bonding for 2,420 acres and released 435 acres for regrading and 262 acres for revegetation.

Twenty-four U.S. Bureau of Mines contracts or grants were ongoing during the year. These were awarded to State and local agencies, universities, research institutes, and private industry, and were concerned with various aspects of the mineral industry.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives.—Cleveland Quarries Co. produced grindstone as a byproduct of sandstone quarrying operations at Amherst in Lorain County. Production decreased 17% compared with that of 1979. Five companies manufactured metallic abrasives (iron and steel shot and grit) in Butler, Cuyahoga, Lucas, Medina, and Richland Counties.

Cement.—Five companies operated five cement plants during the year. Portland cement was produced at all of the plants; four also produced masonry cement. The bulk 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). Both the dry- and wet-grinding processing methods were used.

In late 1979, Medusa Corp. closed its cement plant in Toledo. Since April 1, 1979, the company had operated as a subsidiary of the Crane Co., a diversified manufacturer. End stock of 1979 was either sold or used in 1980, and the plant machinery and equipment were later sold for scrap.

During 1980, Medusa renovated a cement distribution terminal on the Cuyahoga River in Cleveland permitting the company to serve the Cleveland market. Cement is shipped by boat from the Charlevoix, Mich., and Wampum, Pa., cement plants.

Table 4.—Ohio: Portland cement salient statistics

(Short tons)

	1979	1980
Number of active plants	6	5
Production	2,044,852	1,693,308
Shipments from mills:		
Quantity	1,921,136	1,624,836
Value	$87,482,881	$77,695,559
Stocks at mills, Dec. 31	210,996	130,208

Table 5.—Ohio: Masonry cement salient statistics

(Short tons)

	1979	1980
Number of active plants	4	4
Production	177,927	129,140
Shipments from mills:		
Quantity	170,285	126,315
Value	$10,868,972	$8,549,420
Stocks at mills, Dec. 31	17,784	21,422

Dundee Cement Co. was building a $1.5 million cement distribution terminal at Ashtabula. The terminal will consist of unloading facilities and two storage facilities with a total capacity of 7,500 tons. Upon completion of the terminal, the company will be able to meet additional customer needs in the Ohio, West Virginia, and Pennsylvania markets.

Columbia Cement Corp., Zanesville, was awarded $1 million in industrial development revenue bonds by county and city officials for a $3.3 million equipment modernization project for its cement plant in Newton Township. The award was made under an Ohio law encouraging the financing of projects to retain and expand existing manufacturing jobs.

Clays.—Ohio ranked fourth in the Nation in common clay and shale output. Production was down nearly 19% in 1980. Fifty-five companies operated 73 pits in 31 counties in the State. The majority of the clays produced were common clay (84.7%) and fire clay (15.1%). Only one company, the Chaney Mining Co. in Lawrence County, produced kaolin. The unprocessed kaolin accounted for less than 1% of the State's clay production, and was used in the manufacture of adhesives. Major end products of common and fire clay processing were drain tile, refractories, quarry tile, face brick, concrete block, and portland cement.

Fluorspar.—Seaforth Mineral & Ore Co. operated a fluorspar concentrate drying and processing plant in East Liverpool. The facility, opened in 1979, handles imported filter cake from Mexico and the Republic of South Africa, which is used by the ceramic industry.

Gem Stones.—Flint (the State's official gem stone), calcite, celestite, and jasper were some of the mineral specimens collected by hobbyists in the State. Value of the specimens collected was estimated at $5,000.

Graphite (Synthetic).—Union Carbide Corp. produced high modulus graphite and cloth and fibers at its Cleveland and Fostoria plants. Research and development and engineering facilities for the corporation's carbon operations are located at Parma.

Gypsum.—Crude gypsum was mined by the Celotex Corp. at an open pit mine in Ottawa County. Production was down 10% in 1980 compared with that of 1979.

Crude gypsum, including quantities mined in other States, was calcined by the Celotex Corp. and by United States Gypsum Co. at plants in Ottawa County and by the

National Gypsum Co. at a plant in Lorain County. Output of calcined gypsum continued to decline, dropping 26% from that of 1979. Demand for gypsum products used in residential construction declined in 1980 because of recessionary pressures and the slump in the housing market.

In May, United States Gypsum received the go-ahead from the U.S. Environmental Protection Agency (EPA) on proposed construction at the company's acoustical tile plant near Gypsum. New construction plans include a 54-inch, coke-fired cupola, auxiliary fiber production and handling system, a natural gas-fired drying kiln, solid waste processing and recycling system, and a tile mold cleaning system. This equipment will replace the existing 36-inch, coal-fired mineral-melting cupola, auxiliary fiber production and handling system, and 13 natural gas-fired drying kilns.

Lime.—Ohio ranked first in lime production, accounting for nearly 15% of the Nation's output. Production was down in 1980, dropping below the 3-million-ton level for the first time in over two decades. The drop can largely be attributed to the decline in demand by the steel industry, a major consumer of lime. Fifteen companies produced lime in nine counties. Leading counties were Sandusky, Lorain, Lake, Erie, and Seneca. Sandusky County, with six operating companies, accounted for 45% of the State's output. The lime was used principally in steelmaking furnaces, refractories, and glass.

Table 6.—Ohio: Lime sold or used by producers, by use

Use	1979		1980	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Steel, BOF	1,980,394	$82,697	1,589,238	$67,346
Refractory dolomite	438,030	18,291	308,977	16,638
Glass	152,540	6,370	152,878	6,516
Steel, electric	118,984	4,969	87,685	3,693
Water purification	W	W	30,840	1,396
Steel, open-hearth	34,454	1,439	27,756	1,217
Sewage treatment	23,781	993	12,077	496
Agriculture	9,130	381	9,303	565
Other[1]	635,186	26,524	566,887	24,950
Total[2]	3,392,499	141,663	2,785,646	122,817

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes acid mine water, calcium carbide, fertilizer, finishing lime, food products (1979), magnesia from seawater or brine (1980), magnesite (1979), mason's lime, other chemical and industrial uses, other construction lime, road stabilization (1980), soil stabilization (1979), sugar refining, and uses indicated by symbol W.
[2]Data may not add to totals shown because of independent rounding.

Steetley Industries Ltd. of Hamilton, Ontario, Canada, continued improvements at two lime plants purchased in 1979. The company acquired National Gypsum Co.'s dolomitic lime plant at Gibsonburg and the Ohio Lime Co. facilities at Woodville. The two plants, 3 miles apart, operate as an integrated unit and supply lime to steel manufacturers in the Great Lakes region.

Peat.—Six companies produced 10,000 tons of peat from bogs in five counties (Cuyahoga, Logan, Mahoning, Williams, and Wyandot). The peat was used as a soil conditioner and for other horticultural purposes.

Perlite.—Crude perlite, shipped from mines in the Western States, was expanded by National Gypsum Co. in Lorain County, Celotex Corp. at Lockland in Hamilton County, and Cleveland Gypsum Co. at Cleveland in Cuyahoga County. State production was down 18% in 1980 compared with 1979 levels. Principal uses of the expanded perlite were for construction and horticultural aggregate, cavity-fill insulation, plaster, and acoustical tile.

Quartz Crystal (Synthetic).—Synthetic quartz crystal was manufactured by the Bliley Electric Co. at Cortland in Trumbull County and by Sawyer Research Products, Inc., a wholly owned subsidiary of Brush Wellman, Inc., at Eastlake in Lake County. Production at the Eastlake plant represents approximately 40% of the world's output of this essential material. Applications included use in microprocessors, telecommunications systems, timepieces, navigation systems, and optical equipment.

Salt.—Ohio ranked fourth nationally in salt production. Four firms with five operations extracted rock salt and brine. Rock salt was recovered from two underground mines; International Salt Co. operated a mine at Whiskey Island, Cleveland, Cuyaho-

ga County, and Morton Salt Co. mined rock salt at Fairport Harbor, Lake County. Both companies used room-and-pillar methods to extract the rock salt from beneath Lake Erie at a depth of approximately 2,000 feet. Average value per ton in 1980 was $16.24 compared with $12.22 in 1979. The rock salt was used principally for snow and ice control.

Brine was pumped by two companies from three operations in Summit and Wayne Counties and evaporated by both the open-pan and vacuum processes. Most of the brine was used by the chemical and food processing industries.

Sand and Gravel.—Ohio ranked fourth in the Nation in sand and gravel value and output. In 1980, 237 companies operated 292 mines and 251 plants in 61 counties. Construction sand and gravel accounted for almost 96% of the production and industrial sand accounted for the remainder. Leading counties in total tonnage were Hamilton, Franklin, Butler, Portage, and Warren. Principal uses of construction sand and gravel were for concrete aggregate, roadbase and paving, and fill. Industrial sand was used primarily for mold and core, containers, specialty glass, and fiberglass.

Slag.—Ohio was the Nation's second leading producer of slag, after Pennsylvania. Both iron slag (blast furnace) and steel slag were produced. Iron slag sold or used decreased in tonnage from 5.2 million tons in 1979 to 3.7 million tons in 1980. Steel slag also decreased from 2.3 to 1.7 million tons. Decreases in consumption were caused primarily by the decrease in supply created by the depressed condition of the steel industry. Most of the slag was used in roadbuilding and railroad construction and fill. It was also used as an aggregate in the manufacture of lightweight concrete, concrete products, and masonry units.

Table 7.—Ohio: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	18,823	$44,559	$2.37	9,966	$27,038	$2.71
Plaster and gunite sands	340	884	2.60	260	736	2.84
Concrete products	1,834	4,920	2.68	2,783	8,579	3.08
Asphaltic concrete	7,915	20,412	2.58	9,569	28,117	2.94
Roadbase and coverings	7,104	17,880	2.52	6,478	19,130	2.95
Fill	6,420	10,881	1.69	4,960	9,627	1.94
Snow and ice control	574	1,225	2.13	387	995	2.57
Railroad ballast	--	--	--	W	W	2.00
Other	1,209	4,126	3.41	1,059	3,468	3.28
Total[1] or average	44,218	104,888	2.37	35,462	97,690	2.75

W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Data may not add to totals shown because of independent rounding.

Table 8.—Ohio: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	20,449	$45,070	$2.20	16,866	$42,807	$2.54
Gravel	23,769	59,819	2.52	18,596	54,884	2.95
Total[1] or average	44,218	104,888	2.37	35,462	97,690	2.75
Industrial:						
Sand	1,383	14,080	10.18	1,424	15,856	11.14
Gravel	342	2,080	6.08	85	745	8.76
Total[1] or average	1,726	16,160	9.36	1,510	16,601	11.00
Grand total or average	45,944	121,048	2.63	36,972	114,291	3.10

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

Table 9.—Ohio: Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1979		1980	
	Quantity	Value	Quantity	Value
Ashland	257	621	163	502
Ashtabula	170	480	135	447
Athens	141	379	80	204
Auglaize	W	W	216	599
Belmont	W	W	528	1,520
Brown	55	100	44	93
Butler	3,719	7,743	2,738	7,495
Carroll	W	13	67	189
Champaign	265	517	214	631
Clark	1,107	2,224	962	2,514
Clermont	81	304	65	283
Coshocton	253	663	339	994
Darke	374	909	779	2,456
Erie	118	463	101	439
Franklin	3,628	7,971	3,641	10,767
Geauga	1,827	9,174	1,028	6,920
Greene	1,190	2,778	963	2,776
Hamilton	4,382	10,546	3,974	11,072
Henry	60	W	48	W
Highland	33	50	26	47
Hocking	W	W	169	400
Holmes	162	W	115	W
Huron	172	522	137	486
Jackson	16	94	6	42
Knox	753	3,801	734	4,703
Lake	W	284	W	W
Lawrence	66	141	52	131
Licking	1,230	2,950	458	1,116
Logan	202	412	220	580
Lucas	W	W	477	1,025
Marion	167	463	141	446
Medina	1,062	2,497	910	2,309
Meigs	1,437	4,067	1,260	2,402
Miami	683	1,354	1,080	2,882
Montgomery	2,686	5,929	1,388	3,732
Morrow	96	242	85	241
Pike	657	1,382	497	1,260
Portage	3,371	9,747	2,359	7,771
Preble	326	759	339	956
Richland	677	1,458	536	1,454
Ross	753	1,653	625	2,033
Scioto	574	1,292	19	52
Shelby	328	687	288	645
Stark	1,439	4,461	981	3,509
Summit	1,087	2,673	857	2,374
Tuscarawas	1,624	4,758	1,091	3,673
Warren	2,504	5,570	2,207	4,394
Washington	442	1,332	308	1,079
Wayne	625	1,413	439	1,144
Williams	430	1,121	287	846
Wyandot	195	459	223	559
Undistributed[1]	4,526	14,592	2,570	12,095
Total[2]	45,944	121,048	36,972	114,291

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

[1]Includes Columbiana, Fairfield, Fayette, Gallia, Lorain, Morgan, Muskingum, Perry, Pickaway, and Trumbull 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.

Stone.—Ohio ranked sixth nationally in stone production in 1980. Limestone and sandstone were the two major rock types produced, with limestone accounting for nearly 99% of the State's total output. Although limestone and dolomite are present in many areas of the State, most of the production is from Silurian and Devonian Age rocks in western Ohio. Small quantities of limestone are also produced from Mississippian and Pennsylvanian rocks in the east-central and eastern part of the State. Sandstone is produced in 12 counties, primarily in the northeastern part of the State.

In 1980, there were 120 crushed limestone quarries and 1 dimension limestone quarry. Primary uses for the crushed limestone were for concrete aggregate, highway construction and paving fill, as a fluxstone, in cement manufacture, and as agricultural lime.

Sandstone of Mississippian or Pennsylvanian Age was both crushed and mined for dimension stone. Nineteen crushed sandstone quarries and 19 dimension stone quarries operated during the year. Crushed sandstone was used as foundry sand; glass, engine, fire, or furnace sand; as a refractory; and for polishing and grinding. Dimension sandstone was used as curbing, grindstones, flagging, and in rough construction and aggregate uses.

Table 10.—Ohio: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	1,647	6,038	1,838	7,103
Poultry grit and mineral food	15	43	--	--
Concrete aggregate	8,432	22,731	6,895	20,812
Bituminous aggregate	3,546	9,731	2,981	9,433
Macadam aggregate	4,304	11,287	3,795	11,470
Dense-graded roadbase stone	5,613	16,019	5,283	16,883
Surface treatment aggregate	2,044	6,548	2,086	7,096
Other construction aggregate and roadstone	9,222	25,959	8,084	24,875
Riprap and jetty stone	r510	1,454	481	1,643
Railroad ballast	1,163	2,769	1,134	3,053
Filter stone	8	30	W	W
Manufactured fine aggregate (stone sand)	993	2,634	440	1,268
Cement manufacture	3,407	11,505	2,744	10,894
Lime manufacture	3,604	8,588	3,165	7,845
Dead-burned dolomite	972	2,164	667	1,630
Flux stone	3,631	9,649	1,924	5,535
Refractory stone	361	3,723	W	W
Mine dusting	56	589	W	W
Other fillers	167	1,776	99	1,165
Glass manufacture	450	3,639	407	3,464
Other[2]	571	2,940	419	2,762
Total[3]	50,717	149,819	42,441	136,929

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Other."

[1]Includes limestone and sandstone.

[2]Includes stone used for agricultural marl and other soil conditioners, terrazzo and exposed aggregate (1979), ferrosilicon, abrasives (1979), asphalt filler, whiting or whiting substitute, roofing granules, and other uses.

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

Under a research contract with the U.S. Bureau of Mines, a portable, low-profile, hard rock crusher was developed by the Eagle Crusher Co. of Galion. Designed for use at the face of underground mines, the crusher can be fed 30-inch-diameter rock under a roof of only 11 feet.

The new crusher successfully completed surface tests at the McCarthy limestone quarry near Upper Sandusky in June. Testing in an underground hard limestone mine was scheduled for 1981. During a 6- to 12-month testing period, at least 100,000 tons of rock is expected to be crushed to provide information on performance, maintenance, and costs.

Sulfur.—Elemental sulfur was recovered as a byproduct of petroleum refining by Standard Oil Co. of Ohio at the Lima refinery in Allen County; by Gulf Oil Co. and Sun Co., Inc., at their Toledo refineries in Lucas County; by Ashland Oil, Inc., at the Canton refinery in Stark County; and by Republic Steel at the Iron & Chemical Operations in Trumbull County. Total sulfur production for the State in 1980 amounted to 21,394 metric tons valued at $1.4 million.

Vermiculite (Exfoliated).—Ohio led the Nation in output and value of exfoliated vermiculite in 1980. Cleveland Gypsum Co., Div. of Cleveland Builders Supply Co. in Cleveland, and O. M. Scott & Sons Co. in Marysville exfoliated vermiculite concentrate for use primarily as a fertilizer carrier and in loose-fill insulation, block insulation, horticulture, and soil conditioning.

METALS

Aluminum.—Primary aluminum was produced by the Ormet Corp. at its Hannibal reduction plant from alumina produced and shipped from a company-owned plant at Burnside, La. Production increased slightly in 1980.

Aluminum Co. of America (Alcoa) announced a $35 million expansion project at the company's forging division in Cleveland. The project will increase output of truck wheels and forged aluminum parts for the aerospace and defense markets. A new 8,000-ton hydraulic forging press and a

3,000-ton flat die press will be installed at the plant. Engineering work for the project was underway, with completion expected in 1982.

Magnode Corp., a Trenton, Ohio-based extruder, began operating a new aluminum extrusion billet casting facility in August. The facility, initially expected to produce 32,500 tons of secondary aluminum billet per year, will supply Magnode with the raw material needed to make extrusion products. Before starting this production, the company used outside sources to obtain secondary billet. Magnode will continue to purchase primary billet.

Beryllium.—Brush Wellman, Inc., produced beryllium alloys, beryllia, and metallic beryllium at its Elmore plant from beryllium hydroxide concentrate produced at its extraction facilities near Delta, Utah. During the past 3 years, the company has invested more than $24 million in plant development and expansion at Elmore and downstream production facilities. Expansion of beryllium copper production facilities at Elmore included installation of a $5 million arc furnace to boost production of master alloy with significant design improvements in environmental controls.

During the first half of 1980, two furnaces were installed at a cost of $1 million to increase beryllium oxide output. Production capacity for dry-pressed beryllia ceramic products at Elmore was augmented during 1980 with the completion of a new $3 million Tucson, Ariz., ceramic plant.

Ferroalloys.—Ohio, the leading producer of ferroalloys, accounted for almost one-third of the Nation's output. Six companies in Ashtabula, Guernsey, Jefferson, Monroe, Muskingum, and Washington Counties produced alloys of iron, chromium, manganese, silicon, and vanadium.

In June, Satralloy, Inc., shut down the ferrochrome furnaces in Steubenville because of weaker demand and a flood of imports. At yearend, the company had not decided whether the plant would reopen.

Globe Metallurgical Div. of Interlake, Inc., resumed production in November at its Beverly plant after a 55-day strike was settled.

Iron Oxide Pigments (Synthetic).—Synthetic iron oxide pigments were manufactured by the Ottawa Chemical Div., Ferro Corp., at its plant in Lucas County. Hilton Davis Chemical Div., Sterling Drug, Inc., produced synthetic yellow iron oxide pigment in Hamilton County. Production increased nearly 12% in 1980.

Iron and Steel.—Production of pig iron amounted to 10.7 million tons in 1980, a 24% decrease compared with 1979 output. Value also decreased 21%, from $2.8 billion in 1979 to $2.2 billion in 1980.

All major steel markets, except for "oil country" tubular products, were down significantly. Particularly depressed were the markets for flat-rolled products used by the automobile and appliance industries. However, in anticipation of an eventual return to normal operations, the steel industry used this slack period for plant repairs, maintenance, and other improvements.

At Republic Steel's Warren plant, blast furnace modifications were expected to boost output from 2,800 to 3,400 tons per day. The modifications involve retrofitting a blast furnace with a unique system called the "Paul Wurth Top." It features a new method of adding precise amounts of raw materials, improving control and distribution, and providing better control in distributing heated air inside the furnace.

At Republic Steel's Enduro Div. South plant in Canton, a new electroslag remelt facility was completed in 1980 that produces extremely high-strength, fracture-resistant steels. Also in 1980, the Union Drawn Div. at Massillon put into operation a new atmosphere-annealing furnace, boosting capacity of annealed cold finished bar by 700 tons per month. The unit increased the combined capacity of the plant's five other annealing furnaces by 30%.

United States Steel announced plans to build a continuous caster at its Lorain Works that initially will produce over 500,000 tons of semifinished steel rounds annually for conversion into seamless "oil country" and standard pipe.

In September, Ohio Steel Tube Co., a subsidiary of Copperweld Corp., started the first of four continuous-finishing lines, being built at a cost of $17 million. This is part of a $57 million expansion and modernization program begun in 1977. The company produces hot-formed seamless and cold-formed welded tubing.

A large part of capital spending went for environmental control equipment at the steel plants. At Republic Steel's central alloy district plant in Canton, a new air-control system to clean and collect particulates from the facility's No. 4 melt shop was under construction. The baghouse will be capable of cleaning 2.7 million cubic feet of air per minute from the district's melt shop, which operates four 200-ton electric-arc furnaces. At the company's Warren operation,

a desulfurization plant for the removal of sulfur from coke oven gas was completed. The desulfurization plant strips hydrogen sulfide from coke oven gas, converting it into elemental sulfur. A similar plant was expected to be completed in 1981 at Cleveland.

The Cleveland Works of Jones & Laughlin Steel spent $19 million in 1980 on the operation and maintenance of environmental systems. Of this amount, nearly $6 million was spent for energy alone.

During the year, several steelmaking firms were involved in plant transactions. Cyclops Corp. sold its Portsmouth coke-producing facilities to McLouth Steel Corp., Detroit, Mich. The 70-oven coke battery complex, with a 400,000-ton annual capacity, was closed earlier in the year, idling over 200 people. The facilities became the New Boston Coke Corp., a wholly owned subsidiary of McLouth.

Jones & Laughlin Steel, a subsidiary of the Dallas-based LTV Corp., sold its Youngstown facilities to Cold Metal Products Co., an affiliate of Aarque Management Corp. of Jamestown, N.Y. The plant produces carbon, alloy, and stainless steel products.

In October, Republic Steel purchased the former United States Steel sinter plant at Youngstown. The acquisition of the plant will permit Republic Steel to recycle iron-bearing oxides into material suitable for blast furnace use.

Titanium.—In July, RMI Co., Niles, completed a $3.5 million expansion program that increased the company's production capacity by 25%, to 19 million pounds annually. Anticipating a growing demand for titanium in the aerospace and industrial markets, the company announced an additional $8 million expansion program in 1980. The program involves installation of a second 3,000-ton, open-die press forging system that will use titanium sponge generated from the 25% increase in sponge production capacity. The new press forging system is expected to be brought onstream in late 1981. The new system is also expected to be able to accommodate sponge from a second capacity expansion that the company is still considering.

Gulf + Western Industries, Inc., announced that it is expanding the capacity of its titanium chemicals facility at Ashtabula. Titanium tetrachloride capacity will be increased from 120,000 to 145,000 tons per year, and pigment production will increase from 30,000 to 35,000 tons per year. The expansion will cost about $3.7 million and is expected to be completed in late 1981.

Zinc.—ASARCO Incorporated produced zinc oxide at its plant in Columbus. The plant, which operated at full capacity in 1980, produced zinc oxide directly from zinc concentrates shipped from other States. Zinc oxide production (metal content) in 1980 was 19,000 short tons, up from 16,000 short tons in 1979. It was used primarily in the manufacture of rubber, paints, ceramics, and in various chemical applications.

Zirconium.—Six companies produced zirconia, zirconium alloys, refractory cores and molds, and zirconium ceramics. End uses included foundry and ceramic industry applications, castings of high-temperature alloys, and zircon-based welding rod coatings.

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[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Columbia Cement Corp	Box 1531 Zanesville, OH 43701	Plant	Muskingum.
General Portland Inc.[1 2]	Box 109 Paulding, OH 45879	do	Paulding.
Marquette Cement Co.[2]	Box 8 Pedro, OH 45659	do	Lawrence.
SME Cement, Inc	Box 1187 Uniontown, PA 15401	do	Stark.
Southwestern Portland Cement Co.[1 2]	Box 191 Fairborn, OH 45324	do	Greene.
Clays:			
Belden Brick Co	Box 910 Canton, OH 44701	Pits	Tuscarawas.
Hydraulic Press Brick Co	Box 7786 Independence, OH 44131	Pit	Cuyahoga.
Swank Refractories Co	400 Rouser Rd. Coraopolis Hts., PA 15108	Pit	Jefferson.
Ferroalloys:			
Foote Mineral Co	Route 100 Exton, PA 19341	Plants	Guernsey and Jefferson.
Interlake, Inc	135th & Perry Aves. Chicago, IL 60627	do	Washington.
Union Carbide Corp.[3]	Box 176 Marietta, OH 45750	do	Ashtabula and Washington.
Graphite, synthetic:			
Union Carbide Corp	270 Park Ave. New York, NY 10017	do	Seneca.
Gypsum:			
Celotex Corp.[4]	1500 North Dale Mabry Tampa, FL 33607	Pit and plant	Ottawa.
National Gypsum Co.[4]	4100 First International Bldg. Dallas, TX 75270	Plant	Lorain.
United States Gypsum Co.[1 3]	101 South Wacker Dr. Chicago, IL 60606	do	Ottawa.
Lime:			
Basic, Inc	Maple Grove Fostoria, OH 44830	do	Seneca.
Huron Lime Co	Box 428 Huron, OH 44839	do	Erie.
Martin Marietta Chemicals[1]	Executive Plaza II Hunt Valley, MD 21030	do	Sandusky.
Republic Steel Corp	Box 6778 Cleveland, OH 44101	do	Lake.
Steetley Resources, Inc.[1]	Box E Gibsonburg, OH 43431	do	Sandusky.
United States Steel Corp	600 Grant St. Pittsburgh, PA 15230	do	Lorain.
Peat:			
Buckeye Peat Moss	R.D. 1 Bellefontaine, OH 43311	Bog	Logan.
Perlite, expanded:			
Cleveland Builders Supply Co.[5]	2100 West 3d St. Cleveland, OH 44113	Plant	Cuyahoga.
Salt:			
Diamond Crystal Salt Co	916 South Riverside St. Clair, MI 48079	do	Summit.
International Salt Co	Clarks Summit, PA 18411	Underground mine.	Cuyahoga.
Morton International, Inc	110 North Wacker Dr. Chicago, IL 60606	do	Lake and Wayne.
PPG Industries, Inc	Box 31 Barberton, OH 44203	Plant	Summit.
Sand and gravel:			
American Aggregates Corp.[1]	Garst Ave. Greenville, OH 45331	Pits	Various.
Dravo Corp	5254 Wooster Rd. Cincinnati, OH 45226	do	Butler, Hamilton, Warren.
Hilltop Basic Resources, Inc	Lane Ave. Cincinnati, OH 45214	do	Greene and Montgomery.
Twin Lakes Sand Co	2307 State Rte. 303 Streetsboro, OH 44240	do	Portage.
Stone:			
Davon, Inc	2152 Tremont Center Columbus, OH 43221	Quarries	Adams and Highland.
France Stone Co	1800 Toledo Trust Bldg. Toledo, OH 43604	do	Lucas, Sandusky, Seneca.
Maumee Stone Co	Box 369 Maumee, OH 43537	do	Lucas, Ottawa, Paulding, Wood.
National Lime & Stone Co.[3]	First National Bank Bldg. Findlay, OH 45840	do	Various.

[1]Also stone.
[2]Also clays.
[3]Also lime.
[4]Also expanded perlite.
[5]Also exfoliated vermiculite.

The Mineral Industry of Oklahoma

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Oklahoma Geological Survey, for collecting information on all nonfuel minerals.

By Albert E. Ward[1]

Total value of nonfuel minerals in Oklahoma increased 11% in 1980, up moderately from the 9% increase in 1979. Basic construction materials again represented the bulk of output value; stone, cement, and sand and gravel exceeded 80% of the total nonfuel mineral value. Economic indicators for Oklahoma, as reported by the Center for Economic and Management Research at the University of Oklahoma, the U.S. Department of Commerce, and the U.S. Department of Labor, generally were more favorable than nationwide figures. Employment in Oklahoma was up in all business sectors except for small decreases in agriculture and contract construction. Total employment was 1,264,800, up 2.5% from that of 1979, whereas U.S. employment rose 0.3%. Employment of more than 68,000 in the mineral industries, mostly in oil and gas activities, was up 12.9% over that of 1979, thereby leading the gains in all sectors of the State's economy and continuing a trend begun in 1973 when domestic energy resources development was encouraged by initial deregulation of the petroleum industry. Employment in the mining industries, other than oil and gas, was about 3,300, unchanged from that of 1979. Approximately half of this number was employed in nonfuel mines; the other half in coal mines. Estimated unemployment was 4.3%, whereas the national figure was 7.1%. Personal income of $27.3 billion, or $9,081 per capita, increased 12.3% in the State compared with 10.7% for the country. (Using the implicit price deflator for gross national product to adjust for inflation, personal income, in real terms, rose about 3.0% for the State, while the national figure registered a 1.5% increase.) Much of Oklahoma's economic strength in 1980 was rooted in the mineral fuels sector wherein crude oil production showed an upturn that reversed a long-standing downtrend. Manufacturing, an increasingly important sector in Oklahoma's economy, remained firm. Owing to drought, high interest rates, and weak prices for cattle and wheat, the agricultural sector had a poor year. Highway construction and commercial building gained for the year, but because of high interest rates, the more sensitive residential and industrial construction was off sharply. Home building was at its lowest level since 1976, off 11.3% in housing units from 1979, and down about 7% in real dollars. Value of industrial construction in real terms was off 23%. Total construction decreased about 16% in 1980 from that of 1979. Curtailed construction activity had a chilling impact upon mine output of several construction-related minerals and subsequent manufacture of such items as prestressed concrete products, brick, and tile.

Table 1.—Nonfuel mineral production in Oklahoma[1]

Mineral		1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
Clays	thousand short tons	949	$1,999	972	$2,249
Gypsum	do.	r1,480	r9,770	1,326	11,230
Helium:					
High purity	million cubic feet	r395	r9,085	349	8,027
Crude	do.	r35	r420	23	276
Pumice	thousand short tons	1	W	1	W
Sand and gravel	do.	12,101	r32,502	11,881	37,162
Stone:					
Crushed	do.	28,312	66,666	28,173	76,267
Dimension	do.	38	1,383	16	678
Combined value of cement, feldspar, iodine, lime, salt, tripoli, and values indicated by symbol W		XX	80,696	XX	88,244
Total		XX	r202,521	XX	224,133

rRevised. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure.
XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Oklahoma, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Adair	W	W	Sand and gravel.
Alfalfa	W	W	Do.
Atoka	$1,680	$1,871	Stone.
Beaver	W	W	Sand and gravel, pumice.
Blaine	W	W	Gypsum, sand and gravel.
Bryan	W	W	Stone, sand and gravel.
Caddo	1,035	W	Stone, gypsum.
Canadian	W	W	Sand and gravel, clays, gypsum.
Cherokee	W	W	Stone, sand and gravel.
Choctaw	W	3,693	Do.
Cimarron	12,593	9,505	Helium.
Cleveland	393	241	Sand and gravel.
Coal	W	W	Stone.
Comanche	W	W	Stone, gypsum.
Cotton	1,171	W	Sand and gravel.
Craig	577	W	Stone.
Creek	W	W	Stone, clays.
Custer	W	W	Sand and gravel, clays.
Garfield	W	W	Sand and gravel.
Garvin	W	W	Do.
Greer	W	W	Stone, clays, sand and gravel.
Harmon	W	W	Salt.
Haskell	--	W	Stone.
Hughes	W	W	Sand and gravel.
Jackson	W	W	Gypsum.
Johnston	W	W	Sand and gravel, stone.
Kay	W	W	Stone, sand and gravel.
Kingfisher	W	W	Sand and gravel.
Kiowa	3,786	4,491	Stone.
Latimer	1	--	
Le Flore	380	279	Sand and gravel, stone, clays.
Logan	W	W	Sand and gravel.
McClain	1,136	1,091	Do.
McCurtain	W	W	Stone, sand and gravel.
McIntosh	933	W	Stone.
Major	W	W	Stone, sand and gravel.
Mayes	W	W	Cement, stone, clays.
Murray	W	W	Stone, sand and gravel.
Muskogee	W	W	Sand and gravel, feldspar, stone.
Nowata	W	--	
Oklahoma	3,419	W	Sand and gravel, clays.
Okmulgee	W	34	Stone.
Osage	W	W	Do.
Ottawa	W	W	Stone, tripoli, sand and gravel.
Pawnee	W	W	Stone, sand and gravel.
Payne	908	W	Sand and gravel, stone.
Pittsburg	W	W	Stone, sand and gravel.
Pontotoc	W	W	Cement, stone, clays, sand and gravel.
Pottawatomie	317	W	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Oklahoma, by county[1] —Continued

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Pushmataha	$240	$223	Sand and gravel.
Rogers	W	W	Cement, stone, clays.
Seminole	W	W	Stone, sand and gravel, clays.
Sequoyah	W	W	Lime, stone, sand and gravel.
Texas	W	W	Sand and gravel.
Tillman	350	--	
Tulsa	W	W	Stone, sand and gravel, clays.
Wagoner	357	640	Sand and gravel.
Washington	680	1,127	Stone.
Woods	W	W	Salt.
Woodward	W	W	Iodine, sand and gravel.
Undistributed[2]	154,750	179,323	
Total[3]	184,707	202,521	

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

[1]Beckham, Carter, Delaware, Dewey, Ellis, Grady, Grant, Harper, Jefferson, Lincoln, Love, Marshall, Noble, Okfuskee, Roger Mills, Stephens, and Washita Counties are not listed because no nonfuel mineral production was reported.

[2]Includes some sand and gravel that cannot be assigned to specific counties and values indicated by symbol W.

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

Table 3.—Indicators of Oklahoma business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,278.0	1,325.0	+3.7
Unemployment	do	44.0	64.0	+45.4
Employment (nonagricultural):				
Mining[1]	do	60.9	71.5	+17.4
Manufacturing	do	184.1	190.1	+3.3
Contract construction	do	59.1	57.6	-2.5
Transportation and public utilities	do	66.0	68.0	+3.0
Wholesale and retail trade	do	256.4	268.6	+4.8
Finance, insurance, real estate	do	53.6	56.4	+5.2
Services	do	183.2	198.7	+8.5
Government	do	224.0	224.6	+.3
Total nonagricultural employment[1]	do	1,087.3	1,135.5	+4.4
Personal income:				
Total	millions	$24,274	$27,257	+12.3
Per capita		$8,394	$9,081	+8.2
Construction activity:				
Number of private and public residential units authorized		18,814	17,449	-7.3
Value of nonresidential construction	millions	$482.8	$584.0	+21.0
Value of State road contract awards	do	$107.0	$59.6	-44.3
Shipments of portland and masonry cement to and within the State	thousand short tons	1,768	1,682	-4.9
Nonfuel mineral production value:				
Total crude mineral value	millions	$202.5	$224.1	+10.7
Value per capita, resident population		$70	$74	+5.7
Value per square mile		$2,897	$3,206	+10.7

[p]Preliminary.

[1]Includes bituminous coal and oil and gas extraction.

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

Legislation and Government Programs.—The University of Oklahoma announced it will organize a College of Geosciences that will offer studies in geology, geophysics, geochemistry, mineral economics, and other related subjects.

Two suits were filed in courts in Oklahoma in response to the Oklahoma attorney general's recent opinion that it is illegal for a nonresident alien or foreign company to own land in Oklahoma. The opinion directly affects existing and planned commercial, industrial, and mineral activities. Hillcrest Investments, Ltd., of Calgary, Canada, has asked the State supreme court to overrule the attorney general's opinion, and two civic groups have asked the Oklahoma City Federal Court to declare the opinion in violation of the Constitution of the United States.

To forestall a takeover of Oklahoma-based Kerr-McGee Corp. by a French concern that is partly owned by the French Government, the State Legislature passed Senate Bill 640 requiring the would-be purchasers to file pertinent business and financial credentials with the State security administrator. The target firm could then request a hearing with the administrator, who is authorized to halt the takeover. Opponents of the bill contended that the bill would discourage new investment.

House Bill 1536 (amends 45 Oklahoma Statute Supplement 1979, Section 1) increases membership of the State Mining Board from seven to eight members, the added member to be a lay member appointed by the Governor. The bill also provides the board total authority over the administration of the office of Chief Mine Inspector and provides that the board file an annual written report with the State Budget Office and the State Legislative Council. House Bill 1834 (amends 45 Oklahoma Statute Supplement 1979, Sections 3 and 31) specifies that the Deputy Chief Mine Inspector shall devote all his time to the duties of his office, and assure that the mining laws of the State are faithfully executed. Senate Bill 618 (amends 68 Oklahoma Statute Supplement 1979, Sections 1001 and 1010) relating to the gross production tax on minerals, oil, and gas would eliminate the provision that the Oklahoma Tax Commission requires reports from both the producer and purchaser of oil, gas, and minerals. Section 1010 provides that a nontaxpaying producer or purchaser would no longer be required to submit the report to the Tax Commission. The section requires specific information to be included in the report and prohibits any person from purchasing from an oil, gas, or mineral lease that has not been assigned a production unit number. It also provides that any person or organization that becomes delinquent in reporting or remitting the gross production tax would be required to furnish a cash deposit or bond to the Tax Commission.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Barite.—Oklahoma's first barite grinding mill came onstream in mid-1980. Milchem, Inc., a division of Baker International, started grinding barite from the company mine at Battle Mountain, Nev., in its new 12-acre plant 3 miles south of Clinton. The 60-inch Raymond grinding mill can process 325 tons per day of barite for use in the oil well drilling industry. The firm supplies bulk and bagged ground barite, liquid drilling mud, and drilling fluids services. A second grinding plant to be operated by the Eisenman Chemical Co., was planned for location in the Clinton area also. A record number of oil and gas wells have been widely forecast for the early 1980's, leading to the strong demand for barite-base muds and for improved regional processing and shipping facilities. Economics of the industry favors ore shipment to a processing facility located in the area of final demand for the custom ground product or prepared mud.

Cement.—High interest rates during much of 1980 took its toll on the construction industry, and this was promptly reflected in cement sales, up only slightly in 1980 in contrast to the more rapid growth during the late 1970's. Output of portland cement in Oklahoma increased about 4% in 1980, masonry cement declined 18%, and total cement was up 3.5%. Unit value of portland rose 5% to an average of $46 per short ton, whereas masonry was up 12% to $57.

OKC Corp., headquartered in Dallas and undergoing corporate liquidation in 1980, sold its cement plant near Pryor to Lone Star Industries, Inc. The Pryor plant had been a bankrupt entity and through reorganization became the initial operation of OKC Corp. when it was created in 1959. The plant was enlarged in 1964 and modernized in the late 1970's to include conversion from natural gas to coal and increase annual capacity from 420,000 to 725,000 tons of cement. OKC also plans to dispose of oil refinery and real estate interests in the State, and cement, oil, and real estate properties in Louisiana and Texas. Ideal Cement Co., a division of Ideal Basic Industries, Inc., at Ada, and Martin Marietta Corp. at Tulsa, also provided portland and masonry cement. Portland cement represents more than 95% of the State's cement output.

Fuel and energy consumption by the industry was essentially unchanged in 1980 from that of the previous year; 1.2 billion cubic feet of natural gas, 289,000 tons of bituminous coal, and 224 million kilowatt-hours of electric current were used. Two-

thirds of the cement output was sold to ready-mix companies. Building material dealers and concrete product manufacturers took about 17% of the cement, and highway and other contractors bought most of the remainder.

Clays.—Output was up 2.4% in 1980, while average unit value at $2.32 per ton rose 10.0%, about in step with the 9.0% inflation rate. These production figures are indications of moderately weak construction activity throughout much of Oklahoma, owing to unusually high interest rates for most of 1980. Clay or shale output was recorded in 8 counties by 11 companies at 15 mines. Primary uses were in the manufacture of face and common brick, pipe, pottery, concrete block, structural concrete, and as an ingredient in cement. General weakness in residential construction adversely affected clay output as well as brick and tile production; brick shipments were down an estimated 20% from that of 1979. Moreover, inventories reportedly were growing in late 1980, an omen suggesting continued near-term slack in clay demand.

Owing to litigation over mineral rights and use of surface materials for making brick at a site near Mounds, Oklahoma Brick Corp. of Oklahoma City abandoned that location and selected a site 4.5 miles south of Muskogee. Fully automated, energy efficient, and essentially duplicating the firm's existing unit at Union City, the plant will have an initial annual capacity of about 55 million bricks. The facility is designed so that output could be doubled in the future at minimum cost. The operation is supported by an excellent local source of clay and well-developed ground transportation facilities. Construction costs of $7 million were to be supported in part by a local bond issue and by the Oklahoma Industrial Finance Authority. Oklahoma Brick operates two automated plants north of Union City in Canadian County, producing up to 55 million clay bricks per year in one plant and 30 million concrete blocks in the other.

Acme Brick Co. at Edmond, Oklahoma County, completed its first full year of producing king-size bricks from its large, efficient plant north of Oklahoma City. Red-burning clay, mined at the site, is deposited on a layered stockpile with up to 70,000 cubic yards of material to provide a uniform distribution of minor clay variations from the pit.

Feldspar.—Arkhola Sand and Gravel Co. recovered feldspar from sands dredged from the bed of the Arkansas River near Muskogee. The feldspar represents about one-quarter of the feldspar-silica mix recovered from the river. Glass plants in Oklahoma utilized the feldspar. Although production declined slightly from that of the past 2 years, price per ton was firm, increasing 14%, well ahead of the 1980 rate of inflation.

Gypsum.—Output of crude gypsum declined 10.4% in 1980 from revised production data of 1979. However, average unit value per short ton soared 28% from $6.60 in 1979 to $8.47 in 1980. Calcined gypsum was down in quantity and off sharply in unit value. Crude gypsum was produced by six operators in five counties; calcined gypsum output was from two operators in two counties.

Helium.—Production of high-purity helium, valued at $23 per thousand cubic feet as in 1979, declined 11.7% in quantity in 1980. Recovery of crude helium, unchanged at $12 per thousand cubic feet, fell 34.3% in 1980.

Iodine.—Production declined slightly compared with 1979 output; however, owing to strong demand, tight supplies, and resulting sharp increases in price throughout most of 1980, total value of output soared more than 50%. Based upon U.S. Bureau of Mines statistics, world surplus stocks of iodine, common in the mid-1970's, now seem insufficient to meet steadily growing demand, and as a result, worldwide exploration efforts were spurred in 1980.

The leading domestic producer, Woodward Iodine Operations, a joint project of PPG Industries, Inc., and Amoco Production Co., did not operate at full production capacity during the year. The operation was hampered by reinjection problems, concurrent production of sour natural gas, and controversy over local mineral rights. The plant recovers iodine from brine produced from 7,000- to 7,500-foot-deep Morrowan (Pennsylvanian) strata and returns stripped brine to the subsurface by reinjection.

The Oklahoma Supreme Court ruled that saltwater is a mineral under State law; therefore, brine water and any natural gas or other mineral it contains belong to the owner of the mineral rights, not the owner of the surface rights of the land overlying the saltwater deposits. Ownership of brine water had never been established in Oklahoma because it had not been considered a valuable commodity. The decision is an outgrowth of the conflict between Amoco Production Co. and landowners in Wood-

ward County, where Amoco recovers iodine from brine. Amoco had anticipated the presence of a small volume of natural gas in the brine; however, subsequent operations have yielded large amounts of gas in solution and free form. The initial suit and followup appeal by landowners in Woodward County affixed the rights of the parties to the gas produced. Value of the natural gas over the life of the project now has been estimated at $8 million. With the recovery of increasing amounts of natural gas, Amoco altered its leases to include solution gas and also acquired separate oil and gas leases over much, but not all, of the area involved. Most of the gas produced has been sold to a pipeline company, and smaller amounts have been flared or used in operating the iodine extraction plant. This legal decision adopts the theory of "ejusdem generis," holding that helium is included in the phrase "oil, gas, and other minerals."

Godoe, Inc., and United Industry Resources Co., Ltd., of Japan, constructed a pilot plant about 4 miles northeast of Dover to extract iodine from oilfield brines. The Japanese-designed plant will use about 240 metric tons of brine per day to determine economic feasibility of the system. Japan, the world's leading producer of iodine, provides about 80% of U.S. imports. Following oversupply and discounted pricing in the mid-1970's, iodine has risen in value from about $2.00 per pound in 1976 to $6.00 and more in 1980. Recent firm pricing, in turn, has led to several commitments for developing domestic iodine resources as well as pilot plant and exploratory efforts.

Lime.—Lime production decreased about 8% in Oklahoma in 1980. Average unit value per ton increased about 2.5%. Both production and value figures are clear indications of a statewide decline in total construction activity during a year of volatile and mostly upward-trending interest rates.

Pumice (Volcanic Ash).—Axtell Mining Corp. continued to mine volcanic ash at its 50-year-old pit near Gate in Beaver County. Although quantity of output declined slightly in 1980, unit value increased about 6%. The ash is trucked to Gate where it is cleaned, dried, and packaged in 50-pound bags for marketing. Ground ash is used in manufacturing soft abrasives; however, with a trend to other abrasives, the ash is increasingly used as a floor sweep and in products to absorb oil and grease. Substantial reserves of volcanic ash exist at the Axtell Mine and in other ash-laden former lakes in western and northern Oklahoma. Largely shards of volcanic glass mixed with lesser amounts of feldspar, clay, quartz, mica, and diatom fossils, these lakebed deposits are principally the result of windblown dust from volcanic activity in New Mexico or Colorado during the Pleistocene epoch.

Salt.—Recovery of salt increased 13% in 1980 compared with that of 1979; however, because of tight supplies, the average unit price increased 43%. Strong demand for deicing in the late 1970's, ice-related barge transport problems in the Midwest, and several production problems in the major domestic producing States contributed to local shortages and price volatility.

Crystal salt from brine evaporated in solar pans was recovered from natural brines that originate in shallow underground salt beds in the Permian Flowerpot Shale in Harmon and Woods Counties. Brine is recovered from natural springs and from wells drilled into brine-filled solution cavities in the salt beds. The salt is used in agriculture, to rejuvenate zeolites in water softeners, and as a deicing agent.

Sand and Gravel.—Sand and gravel was again ranked second in quantity to stone among nonfuel mineral materials produced in Oklahoma in 1980; value remained in third place behind stone and cement. Output was recorded in 42 of the 77 Oklahoma counties. Total construction and industrial sand and gravel produced was off 1.8% from that of 1979. Although sand output skidded 3.2%, gravel production rolled up a 4% gain, reflecting ongoing highway construction that was less curtailed than most other construction activities. Total industrial sand output declined 1.1%. Unit value of total sand and gravel output increased about 16%; notably more than the 9% inflation rate for the year. Sand and gravel recovered in Cleveland, Johnson, Oklahoma, and Tulsa Counties comprised 56% of the State's total production; in effect, these and other counties surrounding the Oklahoma City and Tulsa metropolitan areas accounted for considerably more than half of Oklahoma's output. The four largest sand and gravel operators each recovered more than 500,000 tons, or about 29% of the total. Another 51% of the production came from 23 operators that yielded 100,000 to 500,000 tons each. Eighty-seven operations of 100,000 tons or less accounted for 76% of the operators and 20% of the output, a clear indication of the diverse structure of the

industry. Fifty-three of the State's 123 operations produced less than 25,000 tons each, with total output of 5.2%.

Construction sand and gravel represented 86.6% of total output; industrial sand, the other 13.4%. Construction sand and gravel values ranged from $1.26 per ton for fill to more than $6 for a small quantity of high-quality material. More than 93% of the output was marketed between $1.26 and $2.57 per ton. Industrial sand values ranged from about $4 to $20 per ton; however, 92% of the sand was sold for within $2 of the $8.68 average price. Approximately 80% of construction sand and gravel was used in aggregate and as fill. Almost 40% of industrial sand was used in glass containers; the remainder was used miscellaneously. More than 75% of all sand and gravel output was shipped by truck; about 14% was used on site; and the remainder was moved mostly by rail. The top five construction sand and gravel operators recorded 33% of the State's output from 12 operations; the top 10 produced 50% from 19 deposits; and the top 22 recovered 75% from 32 operations.

Most of Oklahoma's sand and gravel was recovered from major rivers and their flood plains; principal sources were the Arkansas, Canadian, Cimarron, North Canadian, and Red Rivers. Terrace deposits also were an important source in many locations. Silica sand from the Ordovician Simpson Group yielded high-purity silica sand for glass manufacture.

An $8.6 million claim by the Cherokee Nation against the Federal Government for sand and gravel lost and dredged from the Arkansas River during construction of the McClellan-Kerr Arkansas River Navigation System remains unsettled. A 5-year Congressionally funded study determined that Indian interests included the sand and gravel, along with coal resources and other nonmineral values. Finally, the Cherokees negotiated their sand and gravel interest with the U.S. Department of the Interior, and the agency concluded that $8.6 million was a reasonable sum. A 1969 U.S. Supreme Court decision determined that the Cherokee, Choctaw, and Chickasaw Tribes are the legal owners of parts of the Arkansas River bed in Oklahoma; however, the question of a legal obligation for compensation was not determined. Congressional action to appropriate funds for the lost sand and gravel is the key to a settlement of this long-term litigation.

A 4,000-ton-per-month-capacity, resin-coated silica sand plant was under construction by Brandt Equipment and Supply Co. near Roff in Pontotoc County. The 14-acre plant will utilize abundant silica sand deposits in the Roff area. Output is to be used in the steel casting industry.

The McMichael Co., a 70-year old Tulsa construction and construction materials firm, was purchased by the Koppers Co. of Pittsburgh, Pa. The five-unit firm consists of McMichael Asphalt Sales Co., McMichael Concrete Co., Tulsa Concrete Co., Tulsa Paving Co., and Tulsa Rock Co.

Table 4.—Oklahoma: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	r5,640	$12,477	$2.21	5,779	$14,841	$2.57
Plaster and gunite sands	W	W	W	85	175	2.07
Concrete products	465	1,024	2.20	574	1,366	2.38
Asphaltic concrete	787	2,110	2.68	623	1,993	3.20
Roadbase and coverings	748	1,450	1.94	699	1,517	2.17
Fill	2,565	2,736	1.07	2,473	3,124	1.26
Snow and ice control	W	W	W	6	18	3.17
Railroad ballast	(1)	(1)	--	W	W	5.00
Other	r290	573	1.97	59	362	6.14
Total[2] or average	10,496	20,372	1.94	10,294	23,395	2.27

rRevised. W Withheld to avoid disclosing company proprietary data; included in "Other."
[1]Less than 1/2 unit.
[2]Data may not add to totals shown because of independent rounding.

Table 5.—Oklahoma: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	8,694	r$16,621	$1.91	8,421	$18,950	$2.25
Gravel	1,801	3,751	2.08	1,873	4,445	2.37
Total[1] or average	10,496	20,372	1.94	10,294	23,395	2.27
Industrial sand	1,605	12,129	7.56	1,587	13,767	8.68
Grand total[1] or average	12,101	32,502	2.69	11,881	37,162	3.13

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

Stone.—Total output and value of dolomite, granite, limestone, and sandstone was greater than that of any other raw nonfuel mineral product of Oklahoma in 1980, unchanged from those of recent years. Quantity produced was essentially unchanged, reflecting high interest rates that chilled most construction industry activities during the year. Pricing of stone products held firm, however, rising an average 15.3% per unit ton, well ahead of the estimated 9% inflation rate for 1980. The bulk of stone output came from quarries in Comanche, Kiowa, Murray, Rogers, and Tulsa Counties. Limestone continued to be the main stone quarried.

Crushed stone production was off 0.5%; whereas dimension stone, reflecting building industry contraction, tumbled 58%. Total stone output was down 0.5%. Prices of stone were firm; unit price of crushed stone averaged $2.71, up about 15% over that of 1979, and dimension stone averaged $42 per ton, up 16%.

A 50% increase in capacity of pulverized and fine ground limestone was scheduled for completion by yearend at the Marble City facility of St. Clair Lime Co. Planned expansion included additional equipment for crushing, screening, drying, and air classifying high-calcium limestone.

Table 6.—Oklahoma: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	467	942	457	995
Concrete aggregate	7,968	20,951	6,984	21,048
Bituminous aggregate	2,152	5,582	2,158	6,418
Dense-graded roadbase stone	7,846	13,907	8,428	18,276
Surface treatment aggregate	2,797	8,464	2,642	9,427
Other construction aggregate and roadstone	1,426	3,216	1,301	3,179
Riprap and jetty stone	653	1,410	1,202	3,507
Railroad ballast	2,011	5,174	1,897	5,783
Filter stone	30	91	97	382
Cement manufacture	2,303	4,275	2,352	4,248
Fill	147	298	132	W
Waste material	--	--	1	1
Other[2]	512	2,355	523	3,004
Total[3]	28,312	66,666	28,173	76,267

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes limestone, granite, sandstone, and miscellaneous stone (1980).
[2]Includes stone used for poultry grit and mineral food, macadam aggregate, manufactured fine aggregate (stone sand), lime manufacture, asphalt filler, glass manufacture, and other uses.
[3]Data may not add to totals shown because of independent rounding.

Tripoli.—American Tripoli, the Carborundum Co. and Midwestern Minerals Corp. continued to mine tripoli in 1980, but output was off about 30%. Raw tripoli was shipped to a processing plant in Seneca, Mo., and used to make fine-grained abrasives.

Vermiculite.—W. R. Grace & Co., in an Oklahoma City plant, exfoliated a small quantity of vermiculite. Output was used in loose and block insulation and in aggregates.

METALS

No metallic ore was mined in Oklahoma during 1980. A number of metals were recovered in a variety of smelting operations that used recycled materials from local and out-of-State sources and ore concentrates from out-of-State producers. National Zinc Co., a subsidiary of Engelhard Minerals & Chemical Corp., operated its electrolytic refinery and byproduct sulfuric acid plant in Bartlesville on a curtailed basis for a brief period early in the year, owing to technical difficulties. Later in the year, National Zinc was affected by a shortage of zinc concentrates.

Water pollution problems in the Picher lead-zinc mining area continued under investigation in 1980. Sampling of water and aquatic life at numerous sites in Ottawa County was completed. Water from newly discovered artesian springs in the Tar Creek watershed, encompassing over an estimated 435 abandoned lead and zinc mines, has caused red stains and encrustations on the banks and bottoms of streams in the area. Seepage of highly acidic lead-, zinc-, copper-, and cadmium-bearing water from flooded deeper mine workings or unplugged drill holes into the underlying Roubidoux Formation, an aquifer in the Tri-State district, is a potentially long-term problem. The Oklahoma Water Resources Board, concerned about these problems, has sought continued Federal assistance to analyze and deal with this regional water pollution.

[1]State mineral specialist, Bureau of Mines, Denver, Colo.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ideal Basic Industries, Inc., Ideal Cement Co.[1 2]	Box 8789 Denver, CO 80201	Quarry and plant	Pontotoc.
Lone Star Industries, Inc.[1 2]	Box 68 Pryor, OK 74361	do	Mayes.
Martin Marietta Cement Western Div.[1 2]	5350 East 46th St. Tulsa, OK 74135	do	Rogers.
Clays:			
Chandler Materials Co	Box 627 Tulsa, OK 74101	Mine and plant	Oklahoma and Rogers.
Commercial Brick Corp	Box 1382 Wewoka, OK 74884	do	Seminole.
W. S. Dickey Clay Manufacturing Co	Box 6 Pittsburg, KS 66762	Mine	Le Flore.
Frankoma Pottery, Inc	Box 789 Sapulpa, OK 74066	Mine and plant	Creek.
Justin Industries Acme Brick Co	Box 425 Fort Worth, TX 76101	do	Canadian, Custer, Oklahoma, Tulsa.
Mangum Brick Co	Box 296 Mangum, OK 73554	do	Greer.
Oklahoma Brick Corp	Box 87 Union City, OK 73090	do	Canadian.
Sapulpa Brick and Tile Co	Box 1170 Sapulpa, OK 74066	do	Creek.
Superior Clay Products, Inc	Box 1501 Ada, OK 74820	do	Pontotoc.
Feldspar:			
Ashland Oil Co.- Arkhola Sand and Gravel Co.[2 3]	Box 1627 Fort Smith, AR 72902	Dredge and plant	Muskogee.
Gypsum:			
Harrison Gypsum Co., Inc	Box 336 Lindsay, OK 73052	Quarry	Caddo.
Lehigh Portland Cement Co	Box 1882 Allentown, PA 18105	do	Do.
Republic Gypsum Co	Box 750 Dallas, TX 75221	Quarry and plant	Jackson.
Schweitzer Gypsum Co	Route 2, Box 69 Okarche, OK 73762	Quarry	Canadian.
Temple Gypsum	Box 1270 West Memphis, AR 72301	do	Comanche.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	Quarry and plant	Blaine.

See footnotes at end of table.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Iodine:			
PPG Industries, Inc., Woodward Iodine Operations.	Box 1245 Woodward, OK 73801	Brine field and plant.	Woodward.
Lime:			
St. Clair Lime Co	Box 569 Sallisaw, OK 74955	Plant and quarry	Sequoyah.
Pumice (volcanic ash):			
Axtell Mining Corp	Box 92 Gate, OK 73844	Open pit	Beaver.
Salt:			
Acme Salt Co	Box 420 Erick, OK 73645	Solar evaporation	Harmon.
Sand and gravel:			
The Dolese Co	Box 677 Oklahoma City, OK 73101	Pit and plant	Canadian, Garfield, Kingfisher, Logan, McClain.
E & A Materials	Box 365 Wichita Falls, TX 76307	do	Cotton.
McMichael Concrete Co.[2]	Box 9486 Tulsa, OK 74107	do	Tulsa.
Mohawk Rock and Sand Co	Box 640 Sand Springs, OK 74063	do	Do.
Pennsylvania Glass Sand Corp., Oklahoma Works.	Box 36 Mill Creek, OK 74856	do	Johnston.
Shoffner Sand of Oklahoma, Inc	Box 863 Edmond, OK 73034	do	Oklahoma.
Stone:			
Anchor Stone Co.[3]	Box 6130 Tulsa, OK 74106	Quarry	Tulsa.
Ashland Oil Co.-Standard Industries, Inc.	Box 15670, Admiral Station Tulsa, OK 74112	do	Kay, Osage, Tulsa.
Century Granite Co., Inc	Industrial Park Frederick, OK 73542	do	Greer and Johnston.
Delta Mining Corp	Box 85 Mill Creek, OK 74856	do	Johnston.
Dolese Bros. Co	Box 677 Oklahoma City, OK 73101	do	Atoka, Caddo, Carter, Coal, Comanche, Kiowa, Murray, Seminole.
Eagle-Picher Industries, Inc	Box 910 Miami, OK 74354	Rock waste recovery.	Ottawa.
Fairfax Granite, Inc	Box 482 Barre, VT 05641	Quarry	Comanche, Greer, Kiowa.
Hallett Construction Co	Box 13 Boone, IA 50036	do	Murray.
Isabel Stone Co	Box 934 Paris, TX 75460	do	Choctaw and McCurtain.
Lattimore Industries, Inc	Box 1186 Denison, TX 75020	do	Bryan.
Leco Materials, Inc	Drawer D, Admiral Station Tulsa, OK 74112	do	Rogers, Nowata, Washington.
The Quapaw Co.[1]	Box 72 Drumright, OK 74030	do	Creek.
Willia-Pellow Bros. Monument Co	Box 188 Granite, OK 73547	Quarry and plant	Greer.
H. D. Youngman, Contractor	Box 647 Eufaula, OK 74432	do	Choctaw and McIntosh.
Tripoli:			
The Carborundum Co	Box 489 Seneca, MO 64865	Pits	Ottawa.

[1]Also clays.
[2]Also stone.
[3]Also sand and gravel.

The Mineral Industry of Oregon

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Oregon Department of Geology and Mineral Industries for collecting information on all nonfuel minerals.

By George T. Krempasky,[1] Donald A. Hull,[2] and Jerry J. Gray[3]

Oregon's nonfuel mineral production was valued at $150 million in 1980. Nonmetals—cement, clays, diatomite, gem stones, lime, pumice, sand and gravel, stone, and talc—accounted for 94% of production value. Metals accounted for the remainder. Oregon remained the only domestic source of primary nickel.

The effect of the slowdown in the national economy during 1980, with its corresponding drop in construction, resulted in decreased need for construction materials; the mainstay of the State's mineral production.

Trends and Developments.—Exploration programs continued at high levels, extending the trend of the past few years. In the northwest portion of the State, in the Santiam mining district, an exploration project was underway to evaluate a mineralized zone containing copper. On the northeast side of the State, evaluation of former gold-producing areas was underway by individuals, companies, and State agencies. The mineral potential of the Bourne mining district was being studied by the Oregon Department of Geology and Mineral Industries (ODOGAMI). In southwestern Oregon, a massive sulfide deposit reported to contain copper-cobalt minerals was being investigated. In addition, numerous projects related to gold occurrences were underway in southwest Oregon. ODOGAMI reviewed the mineral potential of the Wild Rogue wilderness area. The interest in gold placering was reflected by the 10% growth in the number of sites that were under ODOGAMI's Mined Land Reclamation Program.

Oregon's processing of mineral commodities to usable products was also expected to increase. A Danish firm, Bergsoe Metal Corp., was building a $25 million lead recycling plant. Oregon Metallurgical Corp. announced plans to increase capacity to handle 50% more unprocessed titanium, from which titanium sponge is produced. Completion of the expansion was scheduled for mid-1981. Capacity expansion of the company's titanium mill was completed the latter part of 1980. Cascade Steel Rolling Mills, Inc., McMinnville, announced a $6 million expansion of its mill facilities, to be completed in early 1981.

Oregon Portland Cement Co. completed the first-year run of its new cement plant near Durkee. Construction was started on a $6 million brick manufacturing plant for Columbia Brick Works at Gresham.

Some sectors of the mineral processing industry were impacted by the downturn in the national economy. Teledyne Wah Chang Albany Corp., a producer of zirconium used for fuel rods in nuclear reactors, announced the layoff of about 180 workers during the year. The company anticipated no recall of employees until mid or late 1981. Gilmore Steel Corp. phased out its direct reduction division at Oregon Steel

Mills. Oregon Steel Mills laid off approximately 25% of its work force. Affected were about 150 union members, as well as 25 management employees.

Reynolds Metals Co. closed down one of its potlines from March to July because the Bonneville Power Administration (BPA) curtailed delivery of interruptible electric power. The line was restarted with power purchased outside of BPA grids. By year-end, all potlines were back in full production. Estimated production loss was about 16% of yearly capacity.

Table 1.—Nonfuel mineral production in Oregon[1]

Mineral	1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
Clays thousand short tons	139	$263	172	$321
Copper (recoverable content of ores, etc.) metric tons	2	4	--	--
Gem stones	NA	500	NA	450
Gold (recoverable content of ores, etc.) troy ounces	W	W	187	115
Lead (recoverable content of ores, etc.) metric tons	(2)	(2)	--	--
Nickel (content of ore and concentrate) short tons	15,065	W	14,653	W
Pumice thousand short tons	r722	r1,555	1,090	2,734
Sand and gravel do	17,874	45,829	16,005	47,300
Silver (recoverable content of ores, etc.) thousand troy ounces	2	17	1	17
Stone:				
Crushed thousand short tons	25,738	65,074	18,380	48,190
Dimension do	(2)	4	15	231
Combined value of cement, diatomite, lime, talc, and values indicated by symbol W	XX	51,872	XX	50,364
Total	XX	r165,118	XX	149,722

rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

[2]Less than 1/2 unit.

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

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Baker	$14,469	$14,633	Cement, stone, sand and gravel, clays, gold, silver, copper, lead.
Benton	W	W	Stone, sand and gravel, clays.
Clackamas	W	W	Cement, sand and gravel, stone, clays.
Clatsop	1,380	W	Stone, sand and gravel.
Columbia	W	W	Sand and gravel, stone.
Coos	770	W	Stone, sand and gravel.
Crook	W	W	Stone, sand and gravel, pumice.
Curry	W	385	Stone, sand and gravel.
Deschutes	W	W	Pumice, sand and gravel, stone.
Douglas	W	W	Nickel, stone, sand and gravel.
Gilliam	W	W	Sand and gravel, stone.
Grant	W	W	Do.
Harney	78	1,263	Stone.
Hood River	505	260	Do.
Jackson	W	W	Sand and gravel, stone, talc.
Jefferson	W	361	Stone, pumice.
Josephine	W	W	Sand and gravel, stone.
Klamath	W	W	Stone, sand and gravel, pumice, clays.
Lake	W	W	Diatomite, stone, pumice, sand and gravel.
Lane	8,859	15,080	Stone, sand and gravel.
Lincoln	2,024	4,061	Do.
Linn	1,428	1,737	Sand and gravel, stone.
Malheur	W	W	Stone, lime, sand and gravel.
Marion	4,829	5,523	Sand and gravel, stone.
Morrow	302	W	Do.
Multnomah	W	W	Sand and gravel, lime, stone, clays.
Polk	543	W	Stone, sand and gravel.
Sherman	69	117	Stone.
Tillamook	623	393	Stone, sand and gravel.
Umatilla	1,665	2,218	Do.
Union	607	744	Sand and gravel, stone.
Wallowa	102	W	Stone, sand and gravel.

See footnotes at end of table.

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

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Wasco	$43	$147	Stone.
Washington	8,326	11,297	Stone, sand and gravel.
Wheeler	W	W	Do.
Yamhill	1,496	2,618	Do.
Undistributed[1]	80,724	104,280	
Total[2]	128,843	165,118	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes gem stones and stone that cannot be assigned to specific counties and values indicated by symbol W.
[2]Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Oregon business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,217.0	1,271.0	+4.4
Unemployment	do	83.0	105.0	+26.5
Employment (nonagricultural):				
Mining	do	2.4	2.3	-4.2
Manufacturing	do	228.5	214.2	-6.3
Contract construction	do	53.0	45.7	-13.8
Transportation and public utilities	do	60.0	60.0	--
Wholesale and retail trade	do	256.8	255.8	-.4
Finance, insurance, real estate	do	69.1	69.4	+.4
Services	do	185.7	191.3	+3.0
Government	do	200.7	202.4	+.8
Total nonagricultural employment	do	1,056.2	1,041.1	-1.4
Personal income:				
Total	millions	$22,460	$24,613	+9.6
Per capita		$8,887	$9,400	+5.8
Construction activity:				
Number of private and public residential units authorized		28,348	19,889	-29.8
Value of nonresidential construction	millions	$467.7	$461.6	-1.3
Value of State road contract awards	do	$195.5	$148.4	-24.1
Shipments of portland and masonry cement to and within the State	thousand short tons	977	832	-14.8
Nonfuel mineral production value:				
Total crude mineral value	millions	$165.1	$149.7	-9.3
Value per capita, resident population		$65	$57	-12.3
Value per square mile		$1,703	$1,544	-9.3

[p]Preliminary.

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

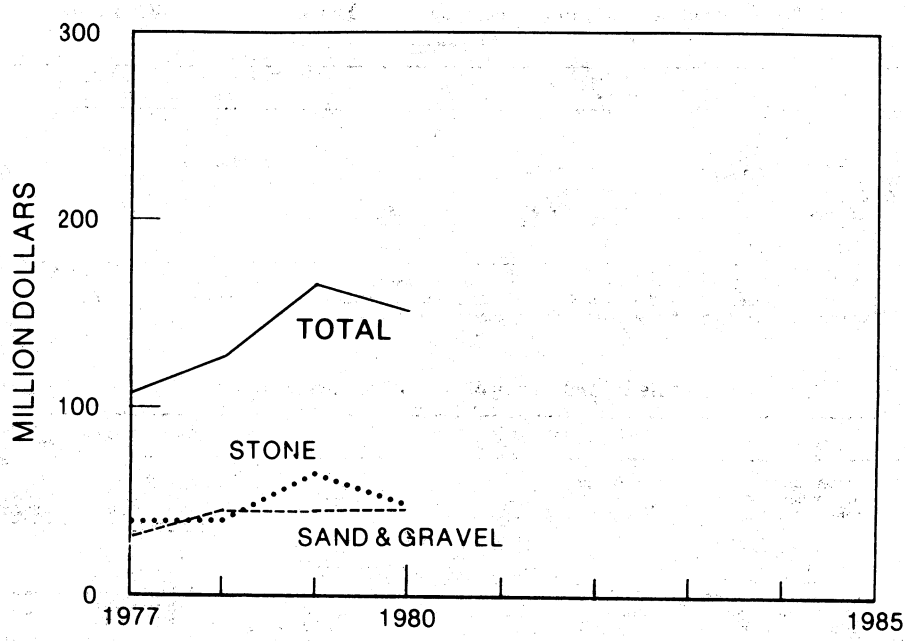

Figure 1.—Value of sand and gravel and stone, and total value of nonfuel mineral production in Oregon.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Nonmetals, especially construction materials, were impacted by the economic downturn. This was dramatically demonstrated by a decline in production of sand and gravel and stone. Nonmetals accounted for 93% of the total value of nonfuel mineral production in Oregon in 1979, and for 94% in 1980. The Pacific coastal area of Newport lacked concrete-grade aggregate and was being supplied from the Willamette Valley's Corvallis area. Studies for the coastal area were underway to determine the availability of acceptable aggregate within economic distance of users. Limestone for agricultural use and paper manufacturing was imported into the Willamette Valley, through the Port of Newport, from Texada Island, British Columbia, Canada. According to a Conditional Use Permit granted to the company by the Portland City Council, Ross Island Sand & Gravel Co. planned to remove about 1 million cubic yards of gravel each year from Ross Island and its lagoon. A study giving methods to forecast demand for sand and gravel and stone was published.[4]

Cement.—Oregon Portland Cement Co., the State's only cement producer, completed the first-year run at its Durkee plant. The new plant, which replaced the company's plant at Lime, has an annual capacity of about 500,000 tons of cement. Limestone for the plant was mined from the Durkee Quarry.

Clays.—Teague Mineral Products continued to produce bentonite from its Malheur County site. The clay, mined from pits near the head of Sucker Creek, was used as a binder in sandcasting molds and hay cubes, in pond sealants, and in fire retardants. The firm installed a Raymond grinding mill at its Adrian drying and bagging plant.

Construction was started on a $6 million brick manufacturing plant for Columbia Brick Works at Gresham, Multnomah County. Capacity of the new plant is anticipated to be 48 million bricks annually, compared with 17 million for the old plant.

Diatomite.—Oil Dri Products Corp. continued to mine and process diatomaceous earth for pet litter and floor-sweeping absorbent from its Christmas Valley site, Lake County.

Pumice and Volcanic Cinder.—Pumice and volcanic cinder were extracted in Baker, Creek, Deschutes, Jefferson, Klamath, and Lake Counties. Seven operators recovered material from 82 pits for use as concrete aggregate, in road construction, landscaping, and roofing. Of total production, 81% was used in road construction.

Sand and Gravel.—Sand and gravel was produced from 102 pits by 90 operators in 30 of Oregon's 36 counties. Reported production declined about 11% compared with that of 1979. A total of 95 pits, yielding less than 400,000 tons per pit, accounted for 65% of the output. Uses of sand and gravel are shown in table 4. The product was transported by truck (68%), water (9%), and other means (8%); 15% was used onsite.

Stone.—Crushed and/or dimension stone was produced from 245 quarries in 33 counties. The U.S. Forest Service, which mined stone in various counties, was the leading producer. Excluding Forest Service production, Washington County was the leading source with more than 3.7 million tons of crushed stone. Crushed stone production in 1980 was 29% less than that in 1979; value of production was 26% less.

Stone mined from quarries yielding more than 200,000 tons per year accounted for 72% of total production. In excess of 96% of the product was transported to users by truck. During 1980, 117 different entities produced stone.

Crushed stone sold or used by producers, by use, is shown in table 6. Principal producers, with annual production of more than 300,000 tons, are listed in table 7.

Table 4.—Oregon: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,963	$11,527	$2.91	3,016	$9,227	$3.06
Plaster and gunite sands	35	120	3.48	156	552	3.53
Concrete products	1,000	2,760	2.76	179	916	5.12
Asphaltic concrete	3,727	10,169	2.73	3,440	10,515	3.06
Roadbase and coverings	7,039	17,376	2.47	6,026	18,845	3.13
Fill	1,771	3,108	1.76	1,881	3,255	1.73
Snow and ice control	W	W	W	48	162	3.38
Railroad ballast	--	--	--	1	6	4.00
Other	339	769	2.26	1,258	3,822	3.04
Total or average	17,874	45,829	2.56	16,005	47,300	2.96

W Withheld to avoid disclosing company proprietary data; included in "Other."

Table 5.—Oregon: Construction sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	5,614	$14,127	$2.52	4,203	$11,907	$2.83
Gravel	12,260	31,702	2.59	11,802	35,392	3.00
Total or average	17,874	45,829	2.56	16,005	[1]47,300	2.96

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

Table 6.—Oregon: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Concrete aggregate	1,850	4,618	120	345
Bituminous aggregate	1,036	2,967	1,263	3,443
Macadam aggregate	775	2,221	885	2,510
Dense-graded roadbase stone	10,573	25,908	3,582	9,142
Surface treatment aggregate	1,686	4,790	1,639	4,293
Other construction aggregate and roadstone	8,004	19,307	9,312	23,461
Riprap and jetty stone	720	1,586	523	963
Railroad ballast	429	1,130	238	931
Filter stone	26	80	17	78
Manufactured fine aggregate (stone sand)	25	77	3	17
Ferrosilicon	25	W	20	W
Terrazzo and exposed aggregate	W	W	1	4
Drain fields	5	13	1	2
Other[2]	583	2,378	776	3,004
Total[3]	25,738	65,074	18,380	48,190

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

[1]Includes limestone, granite, sandstone, traprock, and other stone.

[2]Includes stone used for agricultural limestone, poultry grit and mineral food, cement manufacture, fill, sugar refining, and items indicated by symbol W.

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

Talc.—Steatite of Oregon continued to mine and market block soapstone for art carving and other specialty uses from its Jackson County deposit.

Zeolite.—Teague Mineral Products processed zeolite at its Adrian plant. Zeolite was mined from a deposit in Malheur County and was used as a hog-feed supplement.

METALS

Increased exploration activities for metals were widely prevalent. In the Santiam mining district of the northwest portion of the State, a major company was conducting geological, geochemical, and geophysical studies, and diamond drilling. Focus of attention was an area containing copper mineralization. On the northeast side of the State, corporations and individuals were evaluating former producing areas, including the Buffalo Mine, the Cougar-New York Mine, and an area near Bourne. Copper-molybdenum prospects were also under investigation near Unity and not far from the head of the North Powder River. Southwestern Oregon became a scene of increased activity, as both individuals and corporations explored for gold, chromium, nickel, copper, and cobalt. The U.S. Bureau of Mines identified a low-grade cobalt deposit, chromite deposits underwent extensive exploration, and nickel-laterites were evaluated by three major companies. Precious metals activities were noted in the following areas: Sugarloaf Hill, Black Bear, Boswell, Greenback, and Lost Flat.

Recovery of gold by placering was underway on Basin Creek in Malheur County, and in Fry Gulch and on Sucker Creek, both in Josephine County. The largest gold production reported during the year was recovered in conjunction with the construction of a rock-filled dam on the Applegate River; construction was performed under the auspices of the U.S. Army Corps of Engineers. Prospectors, weekend miners, and recreationists worked other gold-producing areas of the State.

Aluminum.—Martin Marietta Aluminum Inc., at The Dalles, and Reynolds Metals Co., at Troutdale, operated at varying capacities, depending upon availability of electric power.

Copper, Gold, and Silver.—Gold production in Oregon declined in quantity during 1980, but value of production increased compared with that reported for 1979. The Iron Dyke Mine and the Buffalo Mine were operating in 1980; however, production from these mines was not reported.

Silver production declined 50% in 1980 compared with that of 1979; the value of production remained the same.

No copper production was reported in 1980.

Nickel.—The Hanna Mining Co., the only domestic source of primary nickel, continued to produce from its Nickel Mountain deposit. Output of contained nickel from its smelter complex at Riddle declined about

3%, from 15,065 to 14,653 short tons.

Titanium.—Oregon Metallurgical Corp. announced plans to increase its production capacity for titanium sponge metal by 50%. Planned completion for the expansion was mid-1981.

Zirconium.—Teledyne Wah Chang Albany Corp., a producer of zirconium primarily used by nuclear plants, laid off workers during 1980 because of low demand for the exotic metal. The company anticipated recall of employees in mid or late 1981.

[1]State mineral specialist, Bureau of Mines, Spokane, Wash.

[2]State geologist, Oregon Department of Geology and Mineral Industries, Portland, Oreg.

[3]Economic geologist, Oregon Department of Geology and Mineral Industries, Portland, Oreg.

[4]Gray, J. J. Forecasting Rock Material Demand: An Overview of Several Techniques and Detailed Review of Two. Oreg. Dept. Geol. and Min. Ind., Oreg. Geol., v. 42, No. 1, January 1980, pp. 3-15.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum:			
Martin Marietta Aluminum, Inc	6801 Rock Ledge Dr. Bethesda, MD 20034	Smelter	Wasco.
Reynolds Metals Co	Troutdale, OR 97060	Plant	Multnomah.
Cement:			
Oregon Portland Cement Co.[1]	111 SE. Madison St. Portland, OR 97214	Plants	Baker and Clackamas.
Diatomite:			
Oil-Dri Products Corp	Box 203 Christmas Valley, OR 97638	Mine and plant	Lake.
Lime:			
Amalgamated Sugar Co	Nyssa, OR 97913	Plant	Malheur.
Ash Grove Cement Co	101 West 11th St. Kansas City, MO 64105	do	Multnomah.
Nickel:			
Hanna Mining Co	Riddle, OR 97469	Mine and plant	Douglas.
Pumice:			
Central Oregon Pumice Co	5 Greenwood Ave. Bend, OR 97701	do	Deschutes.
Graystone Corp (Cascade Pumice)	Box 1087 Bend, OR 97701	do	Do.
U.S. Forest Service, Region 6.[2]	319 SW. Pine St. Portland, OR 97208	Pits	Various.
Sand and gravel:			
Joe Bernert Towing Co	Box 37 Wilsonville, OR 97070	Surface mine	Clackamas.
Cascade Aggregates, Inc	Box 1225 Scappoose, OR 97056	do	Columbia.
Copeland Sand and Gravel Co	695 SE. J Grants Pass, OR 97526	do	Josephine.
Delta Sand & Gravel Co	999 Division Ave. Eugene, OR 97301	do	Lane.
Gresham Sand & Gravel Co	2039 SE. 195th Ave. Gresham, OR 97030	do	Multnomah.
M. C. Lininger & Sons, Inc	Box 1145 Medford, OR 97501	do	Jackson.
Northwest Sand & Gravel Co	7295 SE. King Rd. Milwaukee, OR 97222	do	Clackamas.
Ready Mix Sand & Gravel Co	Box 200 Milton-Freewater, OR 97862	do	Morrow and Umatilla.
Ross Island Sand & Gravel Co	4129 SE. McLoughlin Portland, OR 97202	do	Multnomah.
Scappoose Sand & Gravel Co	Rt. 2, Box 1 Scappoose, OR 97056	do	Columbia.
Umpqua Sand & Gravel Co	Box 2270 Roseburg, OR 97470	do	Douglas.
Walling Sand & Gravel Co	1750 McGilchrist SE. Salem, OR 97302	do	Marion.
Western Pacific Construction Materials Co.	3510 SW. Bond St. Portland, OR 97201	do	Multnomah.
Wildish Sand & Gravel Co	Box 1106 Eugene, OR 97401	do	Lane.
Willamette Western Co	Foot of North Portsmouth Ave. Portland, OR 97203	do	Multnomah.
Stone:			
Baker Rock Crushing Co	2030 East Main St. Hillsboro, OR 97123	Quarry	Washington.
L. H. Cobb	21305 SW. Koehler Rd. Beaverton, OR 97005	do	Do.
Hard Rock Quarry	Box 1030 Philomath, OR 97370	Quarries	Benton and Linn.

See footnotes at end of table.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Jackson County Department of Public Works.	200 Antelope Rd. White City, OR 97501	Quarries	Jackson.
P. Kiewit Sons Co	904 Yale Ave., North Seattle, WA 98109	Quarry	Douglas.
Oregon State Highway Div	State Highway Bldg. Salem, OR 97310	Quarries	Various.
Progress Quarry Inc	14515 Scholls Ferry Rd. Beaverton, OR 97005	Quarry	Washington.
Rogers Construction Co	Box 16537 Portland, OR 97216	do	Do.
Titanium:			
Oregon Metallurgical Corp	Box 580 Albany, OR 97321	Plant	Linn.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	do	Multnomah.
Zirconium:			
Teledyne Wah Chang Albany Corp	Box 460 Albany, OR 97321	do	Linn.

[1] Also clays and stone.
[2] Also stone.

The Mineral Industry of Pennsylvania

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Pennsylvania Bureau of Topographic and Geologic Survey, Department of Environmental Resources, for collecting information on all nonfuel minerals.

By William Kebblish[1] and Robert J. Tuchman[2]

The value of Pennsylvania's nonfuel mineral production was $667.6 million in 1980, a 7% decrease from that of 1979. The decrease was related to economic conditions that curtailed construction activities. Compared with 1979 figures, production value increased for peat, ferroalloys, and zinc, but decreased for portland and masonry cement, clays, lime, sand and gravel, slag, stone, iron oxide pigments, and pig iron.

Nationally, Pennsylvania ranked high in mineral output and led in shipments of masonry cement and blast furnace slag production. The State was second in the production of pig iron, finished iron oxide pigments, and lime; third in stone, steel slag, and portland cement; and sixth in crude mica and zinc. Leading producing counties were York (cement and stone), Butler (lime, cement, and stone), Huntingdon (stone), and Armstrong (sand and gravel, clays, and stone).

Table 1.—Nonfuel mineral production in Pennsylvania[1]

Mineral	1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
Cement:				
Masonry thousand short tons	415	$24,177	324	$20,298
Portland do.	6,508	259,756	5,570	237,684
Clays[2] do.	2,468	20,099	1,650	12,112
Lime do.	2,153	96,569	1,768	84,291
Mica (scrap) do.	4	W	3	W
Peat do.	24	531	26	552
Sand and gravel do.	20,150	71,740	15,603	68,257
Stone:				
Crushed do.	r71,432	r224,014	61,143	218,231
Dimension do.	77	5,961	65	6,397
Zinc (recoverable content of ores, etc.) metric tons	21,447	17,636	22,556	18,613
Combined value of clays (kaolin), tripoli, and values indicated by symbol W	XX	1,237	XX	1,171
Total	XX	r721,720	XX	667,606

rRevised. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

[2]Excludes kaolin; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Pennsylvania, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Adams	W	W	Stone, lime, clays, mica.
Allegheny	W	W	Cement, clays, stone, sand and gravel.
Armstrong	$10,941	W	Sand and gravel, stone, clays.
Beaver	7,777	$12,419	Sand and gravel, clays.
Bedford	2,438	2,737	Stone, sand and gravel.
Berks	W	W	Cement, stone, clays, sand and gravel.
Blair	W	W	Stone, sand and gravel.
Bradford	W	W	Sand and gravel, stone.
Bucks	W	W	Stone, sand and gravel, clays.
Butler	32,651	37,553	Lime, cement, stone, sand and gravel, clays.
Cambria	W	W	Stone.
Cameron	W	W	Sand and gravel.
Carbon	W	W	Sand and gravel, stone.
Centre	W	35,491	Lime, stone.
Chester	W	W	Stone, lime, clays.
Clarion	W	W	Stone, sand and gravel.
Clearfield	W	W	Clays, stone, sand and gravel.
Clinton	W	W	Stone, clays.
Columbia	W	W	Sand and gravel, stone.
Crawford	1,210	917	Sand and gravel.
Cumberland	W	5,523	Stone, sand and gravel, clays.
Dauphin	W	W	Stone, sand and gravel.
Delaware	W	W	Stone.
Elk	W	W	Do.
Erie	4,616	4,643	Sand and gravel, peat.
Fayette	5,545	5,868	Stone, clays.
Forest	W	W	Sand and gravel, stone.
Franklin	W	W	Stone, sand and gravel.
Fulton	W	W	Do.
Huntingdon	W	W	Sand and gravel, stone.
Jefferson	W	W	Clays, stone.
Juniata	W	W	Stone.
Lackawanna	905	831	Stone, peat, sand and gravel.
Lancaster	W	W	Stone, clays, sand and gravel.
Lawrence	W	W	Cement, stone, sand and gravel, clays, peat.
Lebanon	W	W	Lime, stone.
Lehigh	W	W	Cement, zinc, stone.
Luzerne	W	W	Stone, sand and gravel, clays, peat.
Lycoming	W	W	Stone, sand and gravel.
McKean	W	W	Clays.
Mercer	W	W	Sand and gravel, stone.
Mifflin	W	987	Stone, sand and gravel, lime.
Monroe	W	W	Stone, sand and gravel, clays.
Montgomery	W	W	Stone, lime, cement, clays.
Montour	W	W	Stone.
Northampton	W	W	Cement, stone, sand and gravel.
Northumberland	W	W	Stone, sand and gravel, clays, tripoli.
Perry	W	W	Stone.
Philadelphia	--	W	Sand and gravel.
Pike	W	1,086	Sand and gravel, stone.
Potter	W	--	
Schuylkill	1,431	W	Stone, sand and gravel.
Snyder	W	W	Stone.
Somerset	3,684	4,431	Stone, clays, sand and gravel.
Susquehanna	W	W	Stone, sand and gravel.
Tioga	1,106	995	Do.
Union	W	W	Stone, clays.
Venango	1,120	889	Sand and gravel.
Warren	1,687	1,359	Do.
Wayne	W	936	Stone, sand and gravel.
Westmoreland	W	W	Do.
Wyoming	W	W	Sand and gravel.
York	52,480	59,119	Cement, stone, lime, sand and gravel, clays.
Undistributed	501,921	545,930	
Total[2]	629,516	721,720	

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

[1]Greene, Indiana, Sullivan, and Washington Counties are not listed because no nonfuel mineral production was reported.

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

Table 3.—Indicators of Pennsylvania business activity

		1979	1980[P]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	5,296.0	5,368.0	+1.4
Unemployment	do	368.0	417.0	+13.3
Employment (nonagricultural):				
Mining[1]	do	51.7	49.5	-4.3
Manufacturing	do	1,386.7	1,328.0	-4.2
Contract construction	do	204.2	190.3	-6.8
Transportation and public utilities	do	272.3	262.7	-3.5
Wholesale and retail trade	do	992.5	988.9	-.4
Finance, insurance, real estate	do	233.7	236.7	+1.3
Services	do	945.0	969.1	+2.6
Government	do	720.7	727.7	+1.0
Total nonagricultural employment[1]	do	4,806.8	[2]4,753.0	-1.1
Personal income:				
Total	millions	$100,385	$109,942	+9.5
Per capita		$8,558	$9,294	+8.6
Construction activity:				
Number of private and public residential units authorized		42,811	29,586	-30.9
Value of nonresidential construction	millions	$686.4	$882.5	+28.6
Value of State road contract awards	do	$105.5	$616.0	+483.9
Shipments of portland and masonry cement to and within the State	thousand short tons	3,067	2,630	-14.2
Nonfuel mineral production value:				
Total crude mineral value	millions	$721.7	$667.6	-7.6
Value per capita, resident population		$62	$56	-9.7
Value per square mile		$15,920	$14,727	-7.6

[P]Preliminary.
[1]Includes coal (anthracite and bituminous), gas, and oil extraction.
[2]Data do not add to total shown because of independent rounding.

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

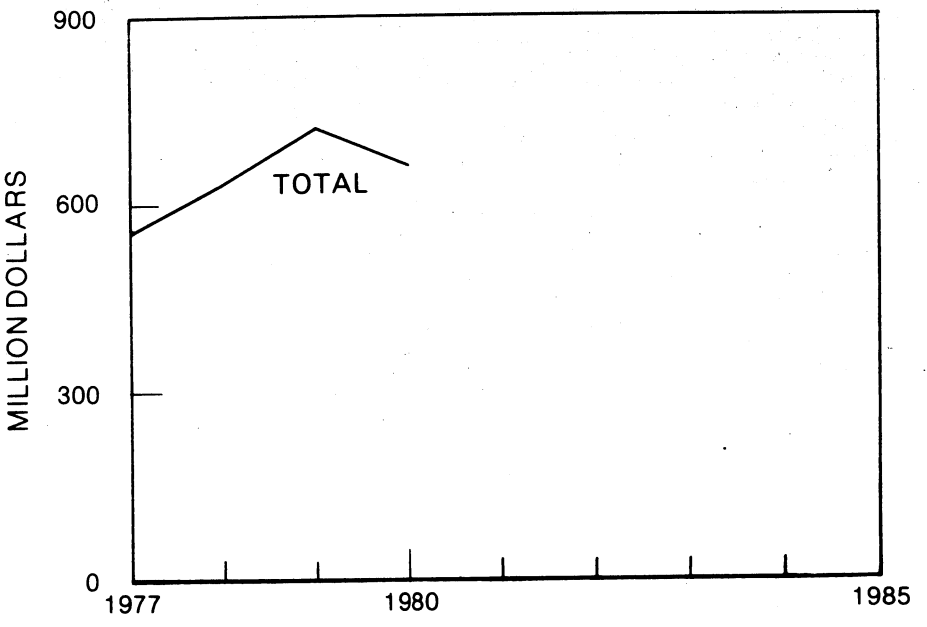

Figure 1.—Total value of nonfuel mineral production in Pennsylvania.

Trends and Developments.—Much of Pennsylvania's mineral output and manufactured mineral products are moved by rail. Clays, sand and gravel, slag, and iron and steel are among the raw materials and finished products relying on rail transportation. The State's capacity to export minerals was given a boost by a plan completed in late 1980 between the Commonwealth and Consolidated Rail Corp. (Conrail). The State agreed to finance $22.6 million of the project for modernizing the Greenwich Pier 124, Philadelphia. The handling capacity will increase from 3.5 million tons to 10.5 million tons by 1982.

A 1980 State Rail Plan was formulated by the Pennsylvania Department of Transportation (PennDot) to provide over $24 million to assist rail segments excluded from the Conrail system created in 1976. Also, 357 miles of light-density track would be added to the 55 miles of railroad already owned by the State. The State Rail Plan will aid mineral producers and manufacturers in transporting products to market. PennDot currently allocates $1 million annually for rail freight assistance programs.

On a local level, Carbon County officials arranged to purchase the Neshquehoning Branch line 109 from the Reading Co. and Conrail with assistance from the U.S. Department of Housing and Urban Development. The transaction would make the 17.8-mile railroad line, between Carbon and Schuylkill Counties, the first county-owned railroad in the State.

Industry annually moves approximately 64 million tons of bulk mineral materials and fabricated steel on the Ohio, Allegheny, and Monongahela Rivers in the Pittsburgh area. The U.S. Army Corps of Engineers, responsible for maintaining the Nation's waterways, scheduled repairs for the Emsworth locks located on the Ohio River below Pittsburgh. Repairs, for a 45-day period, are to begin in 1981, with work to be completed the following year. An adjacent, smaller lock will be used during construction.

Pennsylvania ranks third nationally in generation of industrial waste, including sulfuric acid, various metals, and sludge. A large portion of these waste products originates from mineral processing and metal manufacturing. To find markets for these wastes, a catalog was published by the Pennsylvania Chamber of Commerce featuring paid listings that detail available waste from companies identified by a code number. Potential buyers can contact the companies through the Chamber of Commerce's Pennsylvania Waste Information Exchange.

The Hillman Hall of Minerals and Gems, in Carnegie Museum of Natural History, Pittsburgh, opened in September. The new hall contains an outstanding array of 2,500 minerals and gems, including special sections featuring Pennsylvania specimens, rough and cut stones, microminerals, and luminescent and radioactive samples.

Pennsylvania State University continued work on a "Handbook for State and Local Taxation of Minerals." The booklet was designed to provide State legislators and other interested individuals with an analysis of the effects of mineral taxation on the mining industry.

Legislation and Government Programs.—On October 10, 1980, the Governor signed into law various measures affecting mineral mining operations, including a Clean Streams Law (Senate bill 992).

A Pennsylvania Commonwealth Court judge granted an injunction against the State Department of Environmental Resources (DER), preventing the agency from implementing new regulations covering surface mining in the State. The action was initiated by a group of mining companies because sections of the Federal Act pertaining to surface mining regulations were being challenged. DER's request to dismiss the court injunction was rejected by the Commonwealth Court.

During 1980, the General Assembly enacted three bills relating to the mineral industry:

(1) House bill 569 (medical technician treatment and liability),

(2) Senate bill 1262 (restoration of mined lands), and

(3) Senate bill 1263 (appropriation of monies for reclamation purposes).

The Pennsylvania Department of Agriculture proposed regulations for weighing and measuring devices used in the sale of precious metals. Interested persons were invited to provide written or oral comments on the proposed regulations.

Legislation signed by the Governor permitted the Pennsylvania Industrial Development Authority (PIDA) to lend money to businesses for nonmanufacturing purposes. PIDA can now direct money to small businesses and into high unemployment areas. New construction activity will require aggregates produced locally.

"A User's Guide to DER Permits" became available in early 1980. The publication provides information on permits required by mine operators prior to opening a mine in the State.

Of interest to the nonfuel mineral industries was the report prepared by the Committee on Surface Mining and Reclamation, as required by section 709 of the Surface Mining Control and Reclamation Act. This report covers current and developing reclamation technology for surface mines and assists in the establishment of effective and reasonable reclamation regulations. Public hearings were held on the study, and a final report is scheduled for completion in early 1981 for submission to the President and U.S. Congress.

The U.S. Army Corps of Engineers completed a Final Environmental Statement (FES) in mid-1980 on commercial sand and gravel dredging operations on the Allegheny River from Pittsburgh to Kittanning, a distance of 62.2 miles. The FES was required by section 102 of the National Environmental Policy Act of 1969. Under section 10 of the River and Harbor Act of 1899, as well as section 404 of the Clear Water Act, the Corps of Engineers issues permits to dredging companies extracting sand and gravel from navigable waters. In addition to obtaining these permits, dredging companies must comply with State and local regulations that affect and/or control use of land onshore.

The Pennsylvania Bureau of Topographic and Geologic Survey conducted a number of mineral-related projects during 1980, including geologic mapping in the areas of Altoona, Reading, Bloomsburg, Sunbury, and the Pocono Mountains. These data are to be incorporated into a revised State geologic map nearing completion. Work was also underway on a new tectonic map of the State. Other ongoing projects included investigation of landslides, sinkholes, and ground water problems, and collection of ground water data on the Susquehanna River Basin.

During 1980, the U.S. Bureau of Mines, in cooperation with the U.S. Geological Survey, conducted site-specific mineral surveys on national forest lands within Pennsylvania to develop information on mineral potential. These Roadless Area Review and Evaluation (RARE II) surveys will be used by the U.S. Congress in making wilderness classification decisions. RARE II areas investigated within Allegheny National Forest include the Allegheny Front (8,696 acres) and Hickory Creek (9,427 acres) planning areas in Warren County, and the Clarion River (4,042 acres) and Cornplanter (3,012 acres) planning areas in Elk County. Evaluation reports are scheduled for publication in early 1982.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—In spite of decreased demand for cement in 1980, Pennsylvania ranked third nationally, behind Texas and California, in shipments and sales of portland cement, and first in shipments and sales of masonry cement. Shipments of portland cement declined 14% in quantity and over 8% in value, compared with those of 1979. Portland cement was shipped from 17 plants and/or terminals in 7 counties; counties leading in tonnage shipped were Northampton and Lawrence. Principal producers of portland cement included Coplay Cement Manufacturing Co. and Crane Co.

Masonry cement shipments decreased 22% in quantity and 16% in value, compared with 1979 levels. Shipments occurred from 15 plants and/or terminals in 7 counties; counties leading in quantity shipped were Northampton, Lawrence, and Lehigh. Principal producers of masonry cement were Coplay Cement Manufacturing Co., Crane Co., and National Gypsum Co.

The drop in shipments of both portland and masonry cement was due mainly to curtailed residential, industrial, and commercial construction during the year. This, in turn, was attributed to high interest rates and double-digit inflation.

In April 1980, Penn-Dixie Industries, Inc., filed for protection under Chapter 11 of the Federal Bankruptcy Act. During the year, the company's cement division operated one plant in Nazareth, Northampton County, and one in West Winfield, Butler County. The Nazareth plant was expected to be sold to Coplay Cement Manufacturing Co.; the West Winfield plant remained unsold.

During the year, United States Steel Corp.'s Universal Atlas Cement Div., including the Universal and Northampton

plants, was sold to Allentown-based Lehigh Portland Cement Co., a subsidiary of Portland Zementwerke, A.G., of Heidelberg, Federal Republic of Germany.

Late in the year, United States Cement Co. purchased Hercules Cement Co., a subsidiary of Gifford-Hill & Co., Inc. Hercules' cement plant is located in Stockertown, Northampton County, near the New Jersey border.

Officials of Penn Virginia Corp. announced plans to acquire The Whitehall Cement Manufacturing Co. in Whitehall, Lehigh County. Shareholders of Whitehall would receive 0.98 share of Penn Virginia common stock for each share of Whitehall.[3]

Medusa Corp. continued to improve and replace outmoded equipment. At Wampum, Lawrence County, $900,000 was funded for kiln improvements during 1980. Since April 1979, Medusa has operated as a subsidiary of Crane Co., a diversified manufacturer of building products and other industrial equipment.

Clays.—Production of clay and shale, excluding kaolin, totaled 1.6 million tons in 1980. Output and value decreased 33% and 40%, respectively, compared with those of 1979.

In 1980, 32 companies operated 66 clay and shale mines (10 fewer than in 1979) in 23 counties. Leading producing counties, in descending order of output, were Berks, York, Clearfield, and Jefferson.

The average unit value of clay and shale decreased to $7.34 per ton. Clay and shale was used mainly in the manufacture of face brick, firebrick, and common brick. Glen-Gery Corp., with 12 mines, was the leading clay and shale producer in Pennsylvania.

Narvon Products, Inc., with one mine in Lancaster County, was the State's only kaolin producer. Kaolin was used mainly in the manufacture of fertilizers and paint products.

Table 4.—Pennsylvania: Clays sold or used by producers, by use[1]

(Short tons)

Use	1979	1980
Common brick	335,527	128,081
Face brick	1,091,641	981,786
Firebrick, block and shapes	581,107	272,500
Flue linings	70,673	34,735
Lightweight aggregates	W	W
Mortar and cement, refractory	81,012	17,157
Portland and other cements	159,604	153,105
Tile: Drain, quarry, and structural	51,557	47,904
Other[2]	45,897	14,037
Exports: Mortar, cement, other refractories	50,860	286
Total	2,467,878	1,649,591

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Excludes kaolin.
[2]Includes fertilizers, paint, pottery, roofing granules, sewer pipe, terra cotta, and data indicated by symbol W.

Graphite.—Synthetic graphite production in Pennsylvania increased approximately 50% in quantity and 100% in value from 1979 to 1980. Of the 17 producers of carbon and graphite products in the State, the three largest employers were Airco Speer Carbon Co., Keystone Carbon Co., and Stackpole Carbon Co., all in St. Marys, Elk County. Total number of employees at the three plants exceeded 6,000. Synthetic graphite was used in the manufacture of anodes, graphite shapes, crucibles and vessels, and electric-motor brushes.

Gypsum.—Production of calcined gypsum in Pennsylvania decreased 44% in quantity and 49% in value from 1979 to 1980. Raw gypsum mined by United States Gypsum Co. in Michigan and Nova Scotia was calcined at its Philadelphia facility; the operation employs about 150 workers. Two smaller companies producing gypsum products were H. B. Fuller Co., Bucks Co., and Insuldeck Corp., Northampton County. Calcined gypsum was used mainly in the manufacture of prefabricated products, such as regular wallboard, type-X wallboard, and lath. These products were used extensively in home and commercial construction.

Iodine.—Whitmoyer Laboratories, Inc., in Lebanon County, and West Agro-Chemical, Inc., in Washington County, imported crude iodine from other States. The iodine was used in the manufacture of pharmaceuticals, catalysts, and sanitation products.

Lime.—In 1980, Pennsylvania ranked second nationally behind Ohio in production

and sales of lime. The State produced over 1.7 million tons, or slightly more than 9% of the national total. Lime output decreased approximately 400,000 tons, compared with 1979 data, because of a 20% reduction in the State's pig iron production.

Lime was produced at 10 plants in 8 counties. Centre was the leading lime-producing county in the State, followed by Lebanon, Butler, Adams, Chester, York, Montgomery, and Mifflin Counties.

The average unit value of lime was $47.67 per ton, an increase of $2.82 over that of 1979. The steel industry was the largest consumer of lime, and lesser amounts were used for sewage treatment, water purification, abatement of acid mine water discharges, paper and pulp products, and soil stabilization.

Table 5.—Pennsylvania: Lime sold or used by producers, by use

Use	1979		1980	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Steel, BOF	900,987	$40,411	698,721	$32,060
Steel, electric	285,871	12,822	237,732	11,348
Sewage treatment	193,587	8,683	181,721	8,950
Water purification	185,710	8,329	140,805	6,979
Steel, open-hearth	80,976	3,632	124,761	6,297
Mason's lime	83,306	3,736	74,896	3,773
Acid mine water	69,606	3,122	57,782	2,853
Agriculture	23,154	1,038	34,007	1,386
Paper and pulp	20,504	920	15,607	753
Tanning	10,169	456	14,238	714
Other[1]	299,191	13,420	188,130	9,178
Total	2,153,061	96,569	1,768,400	84,291

[1]Includes alkalies, explosives, glass, oil well drilling, ore concentration, other chemical and industrial uses, other construction uses, other metallurgical uses, paint, petrochemicals, petroleum refining, refractory dolomite, rubber (1979), sand-lime brick, silica brick, soil stabilization, sugar refining, sulfur removal, and wire drawing.

Mica.—Only one company in Pennsylvania mined crude mica in 1980. Gross Minerals Corp., near Aspers, Adams County, produced scrap and flake mica by beneficiation of pegmatites. The product was used in mica paper and other electrical insulating materials.

Mullite.—The production and production values of synthetic mullite in 1980 decreased slightly, compared with those of 1979. A. P. Green Refractories, Philadelphia County, produced synthetic mullite by high-temperature processing of aluminum silicate materials. Mullite is a heat-resistant material used in furnace linings and refractories.

Peat.—In 1980, peat production in Pennsylvania increased 8% in quantity and 4% in value, compared with 1979 levels. Of the State's eight peat producers, six were situated in a three-county area in northeastern Pennsylvania: Three in Luzerne County, two in Lackawanna County, and one in Monroe County. The other two producers were located in Erie and Lawrence Counties. Approximately 76% of the peat produced was humus, and the remaining 24%, reed sedge. Uses were for agricultural and horticultural purposes.

Perlite.—Crude perlite was shipped into six counties in Pennsylvania and expanded at six plants by five companies. The total amount of expanded perlite sold or used in 1980 was nearly 39,000 tons valued in excess of $5 million, reflecting a 14% increase in production and a 33% increase in value, compared with those of 1979. Plants in western Pennsylvania were the Therm-O-Rock Div. of Allied Block Chemicals Co., located at New Eagle, Washington County, which began operating in 1978; and Perlite Manufacturing Co., located at Carnegie, Allegheny County. Producers in eastern Pennsylvania included Armstrong World Industries, United States Gypsum Co., and Pennsylvania Perlite Corp. Perlite was used in plaster and cement aggregates and for horticultural purposes. Other uses included low-temperature and cavity-fill insulation, ceiling tile, and various industrial applications.

Pyrophyllite.—Pyrophyllite, a natural hydrous aluminum silicate found in metamorphic rocks, was processed in Montgomery County for use in ceramics.

Sand and Gravel.—In 1980, sand and gravel was produced by 114 companies (11 fewer than in 1979) in 41 of the State's 67 counties. Production of sand and gravel in Pennsylvania dropped 23% from 1979 to 1980 because of inflation and high interest

rates, which curtailed residential, industrial, and commercial construction.

Most of the sand and gravel deposits in Pennsylvania were relatively small, supplying local construction needs. Of the 132 sand and gravel operations throughout the State in 1980, 115 produced less than 200,000 tons each, accounting for 45% of the State's total production.

Leading counties in output of construction sand and gravel, in descending order, were Bucks, Armstrong, and Erie, accounting for 43% of the State's production total. Construction sand and gravel was used mainly for concrete aggregate, asphaltic concrete, and roadbase.

Industrial sand was produced in Allegheny, Huntingdon, and York Counties. Major uses were in glass manufacture, ferrous foundry operations, and chemical and metallurgical processes.

Nearly 92% of all sand and gravel produced was shipped to market by truck, indicating nearby local markets. Other modes of transportation included railroad and waterway.

Table 6.—Pennsylvania: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	7,718	$26,405	$3.44	5,785	$23,433	$4.05
Plaster and gunite sands	552	1,851	3.35	423	1,479	3.49
Concrete products	1,317	5,174	3.93	696	3,042	4.37
Asphaltic concrete	2,336	7,047	3.02	2,873	13,177	4.59
Road base and coverings	4,728	14,233	3.01	2,932	9,595	3.27
Fill	1,483	2,529	1.71	1,059	2,508	2.37
Snow and ice control	245	802	3.27	158	586	3.70
Railroad ballast	45	126	2.76	W	W	2.76
Other	622	1,864	3.00	628	2,063	3.28
Total[1] or average	19,047	60,031	3.15	14,554	55,883	3.84

W Withheld to avoid disclosing company proprietary data; included in "Other."
[1]Data may not add to totals shown because of independent rounding.

Table 7.—Pennsylvania: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	9,787	$30,312	$3.10	8,293	$31,559	$3.81
Gravel	9,261	29,718	3.21	6,261	24,324	3.88
Total[1] or average	19,047	60,031	3.15	14,554	55,883	3.84
Industrial sand	1,102	11,709	10.62	1,049	12,374	11.79
Grand total[1] or average	20,150	71,740	3.57	15,603	68,257	4.37

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

Table 8.—Pennsylvania: Sand and gravel sold or used by producers, by county

County	1979[1]			1980		
	Quantity (thousand short tons)	Value (thousands)	Number of companies	Quantity (thousand short tons)	Value (thousands)	Number of companies
Allegheny	W	W	1	W	W	1
Armstrong	2,308	$8,820	3	W	W	2
Beaver	2,435	11,097	4	821	$4,146	4
Bedford	3	7	1	--	--	--
Berks	53	79	1	--	--	--
Blair	W	W	1	W	W	1

See footnotes at end of table.

Table 8.—Pennsylvania: Sand and gravel sold or used by producers, by county —Continued

County	1979[1]			1980		
	Quantity (thousand short tons)	Value (thousands)	Number of companies	Quantity (thousand short tons)	Value (thousands)	Number of companies
Bradford	373	$1,017	6	291	$889	6
Bucks	2,955	7,443	3	2,588	7,595	4
Butler	293	W	2	W	W	2
Cameron	W	W	1	W	W	1
Carbon	408	1,374	3	324	1,365	3
Clarion	W	W	1	W	W	1
Clearfield	W	W	1	W	W	1
Columbia	W	W	2	W	W	2
Crawford	335	917	8	224	667	8
Cumberland	W	470	2	265	1,064	3
Dauphin	W	W	1	W	W	1
Erie	1,907	4,584	15	1,641	4,440	14
Forest	W	W	2	W	W	1
Franklin	W	W	1	W	W	1
Fulton	W	W	1	W	W	1
Huntingdon	W	W	1	W	W	1
Lackawanna	W	W	2	W	W	1
Lancaster	98	371	1	--	--	--
Lawrence	622	2,118	9	499	1,877	8
Luzerne	949	2,578	8	683	2,442	8
Lycoming	W	W	1	W	W	1
Mercer	662	1,572	6	279	916	5
Mifflin	W	W	1	W	W	1
Monroe	223	509	4	292	861	3
Northampton	W	W	2	530	1,868	3
Northumberland	248	871	1	202	786	1
Philadelphia	W	W	1	W	W	1
Pike	248	639	4	144	545	3
Schuylkill	W	W	1	W	W	1
Somerset	12	41	1	10	39	1
Susquehanna	W	W	1	W	W	1
Tioga	182	199	3	146	417	3
Venango	436	889	5	368	1,035	4
Warren	481	1,359	10	509	1,733	9
Wayne	137	338	3	W	W	2
Westmoreland	W	W	1	W	W	1
Wyoming	W	W	2	W	W	2
York	W	W	2	W	W	2
Undistributed	3,679	12,739	--	5,787	35,572	--
Total	19,047	60,031	130	15,603	68,257	119

W Withheld to avoid disclosing individual company proprietary data; included in "Undistributed."
[1]Does not include industrial sand and gravel.

Slag-Iron and Steel.—Pennsylvania led the Nation in 1980 in the production of iron and steel slag. Total slag produced amounted to 5.7 million tons valued at $23.9 million, a decline of 22% in output and 13% in value, compared with those of 1979. The decrease in slag output reflected a drop in the State's pig iron production. Of the total slag produced, 86% was iron slag, and 14%, steel slag.

Types of iron slag produced included air-cooled, expanded, and granulated. Major uses of air-cooled slag were for asphalt and concrete aggregate and as a roadbase material; expanded slag was used in concrete products; and granulated slag was used for roadbase material, fill, and cement manufacture. Steel slag was used mainly for roadbase material. Principal slag producers included Bethlehem Mines Corp. and Warner Co.

Millcraft Industries, Inc., in Washington, Pa., announced a new licensing agreement with a West German firm permitting it to engineer, manufacture, and erect a proprietary system for the granulation of blast furnace slag.

Stone.—In 1980, Pennsylvania ranked second to Texas in the value of stone produced and third, behind Texas and Florida, in quantity. The State's 221 quarries were located in 51 of the State's 67 counties; Bucks County led with 16 such operations.

Of the 61.1 million tons of crushed stone produced during the year, limestone accounted for 78%; sandstone, 6%; traprock, 6%; and other types, 10%. Leading counties in output of crushed stone were Bucks, Lancaster, Northampton, and York, each producing over 4 million tons in 1980. Principal producers included New Enterprise Stone & Lime Co., Inc., and Warner Co.

Dimension stone was quarried at 18 operations in 9 counties. Bucks and Northampton Counties, with a total of six quarries, accounted for 56% of the State production total. Principal types of dimension stone produced were sandstone and slate.

Table 9.—Pennsylvania: Dimension stone[1] sold or used by producers, by use

Use	1979			1980		
	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)
Rough stone:						
Rough blocks	--	--	--	113	1	$16
Irregular-shaped stone	21,199	271	$535	5,805	74	179
Rubble	1,831	23	23	10,726	137	122
Monumental	W	W	W	4,007	40	581
Flagging	1,785	23	66	1,478	19	55
Dressed stone:						
Cut	16,946	13	690	17,815	228	793
Sawed	--	--	--	W	W	10
House stone veneer	--	--	--	W	W	1
Flagging	9,098	104	553	5,722	63	506
Roofing slate (standard)	2,789	31	721	2,761	30	1,267
Structural and sanitary	4,653	51	2,053	4,286	47	1,904
Blackboards	146	2	58	W	W	W
Flooring slate	641	7	133	W	W	W
Other[2]	17,558	189	1,128	12,686	140	963
Total[3]	76,646	714	5,961	65,399	780	6,397

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes granite, sandstone, slate, and other stone.
[2]Includes stone used in dressed construction, billiard table tops, and unspecified uses.
[3]Data may not add to totals shown because of independent rounding.

Table 10.—Pennsylvania: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	1,728	10,028	1,992	12,712
Agricultural marl and other soil conditioners	110	763	--	--
Poultry grit and mineral food	W	W	66	654
Concrete aggregate	5,409	17,232	4,916	18,002
Bituminous aggregate	6,057	19,520	5,588	20,334
Macadam aggregate	1,692	4,991	1,354	4,434
Dense-graded roadbase stone	13,737	40,445	11,899	39,802
Surface treatment aggregate	2,878	9,003	2,144	7,787
Other construction aggregate and roadstone	17,732	50,981	14,659	46,025
Riprap and jetty stone	922	3,005	667	2,667
Railroad ballast	1,589	5,097	1,532	5,614
Filter stone	545	2,065	488	2,059
Manufactured fine aggregate (stone sand)	1,561	5,752	1,533	6,620
Terrazzo and exposed aggregate	231	956	263	1,230
Cement manufacture	r9,187	r19,661	7,378	17,250
Lime manufacture	3,259	10,854	2,768	10,470
Dead-burned dolomite	438	1,972	W	W
Flux stone	2,955	12,199	2,307	10,846
Refractory stone	72	1,262	82	1,644
Mine dusting	131	1,683	154	2,030
Asphalt filler	108	636	101	759
Other fillers or extenders	147	2,073	107	1,969
Building products	124	334	90	262
Fill	W	W	2	6
Glass manufacture	W	W	W	681
Roofing granules	W	W	191	310
Other[2]	819	3,503	862	4,066
Total[3]	r71,432	r224,014	61,143	218,231

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes limestone, granite, sandstone, traprock, and other stone.
[2]Includes whiting or whiting substitute, abrasives, chemical stone for alkali work, and unspecified uses.
[3]Data may not add to totals shown because of independent rounding.

Sulfur.—Three petroleum refineries in Philadelphia and Delaware Counties and one steel mill near Pittsburgh recovered elemental sulfur in 1980. Production amounted to approximately 57,000 metric tons valued at more than $3.4 million, reflecting a slight drop in output and a slight increase in value, compared with those of 1979.

Elemental sulfur was recovered from refinery gases; a lesser amount was recovered in the treatment of natural gas. Principal

uses were in the manufacture of sulfuric acid for fertilizers, in the leaching of ores, and in chemicals, fibers, paints, and explosives.

Tripoli.—Keystone Filler & Manufacturing Co.'s Sheddy Mine in Northumberland County produced tripoli, which was used as an abrasive and filler.

Vermiculite.—Crude vermiculite shipped into Pennsylvania was exfoliated by J. P. Austin, Inc., Allegheny County, and W. R. Grace & Co., Lawrence County. Although the quantity exfoliated in 1980 was slightly less than that of 1979, value increased more than 6%. Major uses were for lightweight concrete aggregate, loose fill insulation, horticultural purposes, and soil conditioning.

METALS

Abrasives, Manufactured.—Manufactured abrasives, consisting of steel shot and grit, were produced by Durasteel Abrasive Co., in Westmoreland County; and Carborundum Co. and Ervin Industries, Inc., both in Butler County. Silicon carbide, another manufactured abrasive, was produced by Satellite Alloy Corp., near Pittsburgh. The finished products were used as abrasives and in refractories.

Cadmium.—The primary producer of cadmium in 1980 was New Jersey Zinc Co. in Lehigh County. Cadmium, a byproduct of zinc smelting, was used for electroplating, plastic stabilizers, and pigments.

Ferroalloys.—In 1980, ferroalloys shipments in Pennsylvania totaled 6,823 tons valued at $92.6 million, reflecting a 21% decrease in quantity but a 24% increase in value, compared with those of 1979. Six ferroalloys plants were located in the State: AMAX Inc., Washington County; Molycorp, Inc., a subsidiary of Union Oil Co. of California, Washington County; Penn Rare Metals Div., a subsidiary of Cabot Corp., Bucks County; Pesses Co., Lawrence County; Reactive Metals & Alloys Corp., Lawrence County; and Reading Alloys, Inc., Berks County.

An expansion project began at Molycorp., Inc.'s, molysulfide roasting facilities in Washington, Pa., designed to add 20 million pounds of contained molybdenum annually to the plant's current 6-million-pound-per-year capacity. Molysulfide concentrates are to be shipped from the company's complex in New Mexico to the Washington plant for alloy processing. Completion is expected by December 1981.

Iron Oxide Pigments.—Pennsylvania led the Nation in value of finished iron oxide pigments, excluding regenerator oxides, in 1980. Shipments totaled 32,273 tons valued at over $26 million, reflecting a slight decrease in tonnage but a 9.1% increase in value, compared with those of 1979. Finished iron oxide pigments were shipped from eastern Pennsylvania; regenerator oxides, by one company in Allegheny County. Iron oxide pigments were used in paints, rubber products, plastics, concrete products, paper, magnetic ink, and fertilizers.

Iron and Steel.—In 1980, Pennsylvania ranked second nationally, behind Indiana, in pig iron shipments and value. Shipments amounted to over 15 million tons valued at nearly $3 billion, representing a decrease of 20% in quantity and 18% in value, compared with 1979 figures. Basic pig iron accounted for 93% of total production. Other types of pig iron produced were bessemer, malleable, and direct castings.

Numerous layoffs occurred in the steel industry in Pennsylvania during the first half of 1980. The cutbacks were attributed to depressed orders, slumping auto demand, and heavy imports of both steel and automobiles. United States Steel Corp., the Nation's largest steelmaker, had the largest number of employees laid off, mainly in Allegheny and Beaver Counties. This included the temporary shutdown of its Edgar Thomson Works in Braddock in early June, furloughing 2,000 people. Allegheny Ludlum Steel Corp. laid off 900 of 4,700 workers at three Pittsburgh area plants, and Jones & Laughlin Steel Corp. experienced reductions at its Pittsburgh and Aliquippa Works. The overall slump in the steel industry, however, began to turn about by fall, and United States Steel recalled 800 workers in September at its Edgar Thomson Works.

United States Steel reviewed plans to replace 11 open hearth furnaces at its Homestead plant with basic oxygen equipment or other advanced steelmaking technology. The company also began building a 1.3-million-ton-per-year continuous slab caster at Edgar Thomson Works.

Bethlehem Steel Corp. planned to build six new soaking pit furnaces at Bethlehem, costing $9 million; install a new electric furnace melt shop at Johnstown; and improve its rail-producing facilities at Steelton.

Sharon Steel Corp. began a $60 million expansion and modernization program at Farrell, Mercer County. The program in-

volves the installation of a fourth 150-ton basic oxygen furnace, enlargement of one of two 125-ton electric arc steelmaking furnaces, additional pollution controls at the melt shop, and six new soaking pits. Approximately 2,000 additional jobs are to be provided by 1983, when modernization is completed.

National Supply Co., a subsidiary of Armco, Inc., planned a $42 million plant expansion in Ambridge, Beaver County, to include installation of a stretch mill and supporting finishing facilities. Plant production of tubular goods is expected to increase by 25%.

Condec Corp., former owner of the Fort Pitt Steel Casting division in McKeesport, Allegheny County, sold the plant on May 1, 1980, to its employees. The foundry, which produced valve castings for the petrochemical industry, is now known as McKeesport Steel Castings Co.

Zinc.—Pennsylvania ranked fifth nationally in zinc production in 1980, producing 22,556 metric tons, or 7% of the national production total. Both quantity and value increased slightly over those of 1979. The unit price of zinc remained at 37 cents per pound. Lehigh County, in eastern Pennsylvania, was the only county in which zinc was produced.

In late 1980, St. Joe Minerals Corp. reopened its smelter in Monaca, Beaver County, as a result of a new zinc deposit discovered near Pierrepont, N.Y. The company plans to transport zinc concentrates from New York to the smelter for processing. Production at the Monaca plant is anticipated at about 50,000 tons of slab zinc and zinc oxide by 1981.

[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.
[2]Program assistant, Bureau of Mines, Pittsburgh, Pa.
[3]Penn Virginia Corp. Annual Report, 1980, p. 34.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Satellite Alloy Corp	Satellite Industrial Park Box 171 Springdale, PA 15144	Plant	Allegheny.
Cement:			
Coplay Cement Manufacturing Co.[1]	Nazareth, PA 18064	do	Lehigh and Northampton.
Crane Co	300 Park Ave. New York, NY 10022	do	Lawrence and York.
Keystone Portland Cement Co.[1]	Box 1785 Allentown, PA 18105	do	Northampton.
Louisville Cement Co	501 South 2d St. Louisville, KY 40202	do	Lawrence.
Penn-Dixie Industries, Inc.[1 2]	60 East 42d St. New York, NY 10017	do	Butler and Northampton.
Clays:			
Dresser Industries, Inc	Box 6504 Houston, TX 77005	Pit	Clearfield and Somerset.
Glen-Gery Corp	227 North 5th St. Reading, PA 19601	Pit	Adams, Berks, Northumberland, Union, York.
Hanley Co	28 Kennedy St. Bradford, PA 16701	Pit	Jefferson and McKean.
Resco Products, Inc	Box 108 Norristown, PA 19404	Pit	Clearfield and Huntingdon.
Graphite, synthetic:			
Airco Speer Carbon	800 Theresia St. St. Marys, PA 15857	Plant	Elk.
Charles Pfizer & Co., Inc	235 East 42d St. New York, NY 10017	do	Northampton.
Stackpole Carbon Co	St. Marys, PA 15857	do	Elk.
Gypsum, calcined:			
United States Gypsum Co.[3]	101 South Wacker Dr. Chicago, IL 60606	do	Philadelphia.
Iron oxide pigments:			
Prince Manufacturing Co	700 Lehigh St. Bowmanstown, PA 18030	do	Carbon.
Reichard-Coulston, Inc	15 East 26th St. New York, NY 10010	do	Northampton.
Lime:			
J. E. Baker Co.[1]	Box 1189 York, PA 17405	do	York.
Mercer Lime & Stone Co	1640 Oliver Bldg. Pittsburgh, PA 15222	do	Butler.

See footnotes at end of table.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Peat:			
Lake Benton Peat Moss	622 South Blakely St. Dunmore, PA 18510	Bog	Lackawanna.
Perlite, expanded:			
Armstrong Cork Co	Lancaster, PA 17603	Plant	Lancaster.
Pennsylvania Perlite Corp	Box 2002 Lehigh Valley, PA 18001	do	Lehigh and York.
Perlite Manufacturing Co	Box 478 Carnegie, PA 15106	do	Allegheny.
Sand and gravel:			
Davison Sand & Gravel Co	3d Ave. and 4th St. New Kensington, PA 15068	Dredge	Westmoreland.
Dravo Corp	One Oliver Plaza Pittsburgh, PA 15222	do	Beaver.
Erie Sand Steamship Co	Box 153 Erie, PA 16512	do	Erie.
Shippingport Sand & Gravel Co	1200 Stambaugh Bldg. Youngstown, OH 44503	Pit	Armstrong.
Warner Co.[1 4 5]	1721 Arch St. Philadelphia, PA 19103	Pit	Bucks.
Slag:			
Bethlehem Mines Corp.[1 4]	701 East 3d St. Bethlehem, PA 18016	Plant	Cambria.
Dunbar Slag Co	Box 666 Sharon, PA 16146	do	Mercer.
Standard Slag Co	1200 Stambaugh Bldg. Youngstown, OH 44503	do	Cambria.
Stone:			
G. & W. H. Corson, Inc.[4]	Plymouth Meeting, PA 19462	Quarry	Montgomery.
General Crushed Stone Co	712 Drake Bldg. Easton, PA 18042	do	Bucks, Chester, Delaware, Lancaster, Luzerne, Perry.
Glasgow Quarry, Inc	Box 248 Glenside, PA 19038	do	Montgomery.
Martin Marietta Corp	Box 30013 Raleigh, NC 27612	do	Centre, Chester, Fayette, Northampton.
New Enterprise Stone & Lime Co., Inc	New Enterprise, PA 16664	do	Bedford, Blair, Cumberland, Franklin, Huntingdon, Somerset.
Sulfur:			
Atlantic Richfield Co	3144 Passyunk Ave. Philadelphia, PA 19145	Plant	Philadelphia.
British Petroleum Corp., Ltd	Box 428 Marcus Hook, PA 19061	do	Delaware.
Gulf Oil Corp	Box 7408 Philadelphia, PA 19101	do	Philadelphia.
Tripoli:			
Keystone Filler & Manufacturing Co	Muncy, PA 17756	Pit	Lycoming.
Vermiculite, exfoliated:			
J. P. Austin Associates, Inc	300 Mt. Lebanon Blvd. Pittsburgh, PA 15234	Plant	Allegheny.
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	do	Lawrence.

[1]Also stone.
[2]Also clays.
[3]Also expanded perlite.
[4]Also lime.
[5]Also slag.

The Mineral Industry of Puerto Rico, the Virgin Islands, and Pacific Island Possessions

The Puerto Rico section of this chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Department of Natural Resources of the Commonwealth of Puerto Rico for collecting information on all nonfuel minerals.

By Doss H. White, Jr.,[1] and Robert J. Tuchman[2]

PUERTO RICO

Mineral production in Puerto Rico in 1980 was valued at $211.9 million. During the past 10 years, the island's mineral producers have added over $1.1 billion to Puerto Rico's economy and created thousands of jobs in the mineral and construction industries.

Table 1.—Nonfuel mineral production in Puerto Rico[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement, portland	thousand short tons	1,406	$70,197	1,482	$102,872
Clays	do.	260	556	291	677
Lime	do.	37	3,307	27	4,131
Salt	do.	27	639	--	--
Sand and gravel	do.	NA	NA	NA	NA
Stone:					
Crushed	do.	r14,040	r58,554	23,917	101,908
Dimension	do.	79	1,105	129	2,271
Total		XX	r [2]134,358	XX	[2]211,859

rRevised. NA Not available. 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 not available.

Table 2.—Value of nonfuel mineral production in Puerto Rico, by district

(Thousands)

District	1978	1979	Minerals produced in 1979 in order of value
Aguadilla	W	W	Stone.
Arecibo	W	W	Do.
Humacao	W	W	Do.
Mayaguez	$2,864	$4,180	Stone, salt.
Ponce	W	W	Cement, stone, lime, clays.
San Juan	W	W	Cement, stone, clays.
Undistributed[1]	130,057	130,178	
Total	[2] [3]132,922	[3]134,358	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes some stone that cannot be assigned to specific districts, and values indicated by symbol W.
[2]Data do not add to total shown because of independent rounding.
[3]Incomplete total excludes value of sand and gravel.

Trends and Developments.—Puerto Rican mineral production was used exclusively by the construction industry, and economic factors and social programs affecting construction had a direct bearing on the economic well-being of the mineral industry.

At the beginning of the past decade, value of the island's mineral production totaled $104 million. However, in 1972, strikes and production problems in the cement industry, coupled with a downturn in sand and gravel output, depressed mineral values below those reported for the previous year. During 1973 and 1974, the value of the island's mineral output demonstrated modest gains, but in 1975 the value of mineral production, mainly that of cement, dropped by over $10 million. This drop reflected the downturn in construction due to the general recession evident throughout most of the Northern Hemisphere. From 1976 to 1980, the value of Puerto Rican mineral production either remained static or increased slightly. However, value gains reported in 1979 and 1980 were mainly due to high inflation rates existing in Puerto Rico and the continental United States. Actual tonnages of minerals produced in 1979 and 1980 fell below 1978 levels.

Overall, the island's construction industry experienced a negative growth during 1980. Although construction activity increased during the first quarter because of a backlog of projects from 1979, the industry began to decline in the second quarter. By yearend, private construction, notably housing, was virtually at a standstill. In addition, construction materials suppliers expressed concern over President Reagan's plans to cut Federal spending, for the construction industry in Puerto Rico relies heavily on Government contracts.

During the fourth quarter, Puerto Rican mineral producers, along with other energy-intensive industries, felt the effects of a 25% increase in the cost of electricity. To combat the increase, industry officials began looking to other sources for power.

PPG Industries, Inc., agreed to sell its chlorine-caustic soda manufacturing complex at Guayanilla to a Taiwanese firm for approximately $3.5 million. The plant was scheduled to be disassembled and rebuilt either in Taiwan or the gulf coast area. The PPG facility had been shelved in November 1978 as a result of the bankruptcy of Commonwealth Oil Refining Co., Inc. (Corco). The bankruptcy had also forced the closing of a number of other plants in the Guayanilla area that relied on Corco-produced crude derivatives as basic feedstock.

The U.S. Economic Development Administration granted $45,000 for a master plan to upgrade the Port of Ponce, on the island's south-central coast. The improvements, which should see the port through the year 2000, include dredging to widen the port entrance.

Work continued on a secondary waste treatment plant in Barceloneta, scheduled to go into operation by mid-1982. The plant may not be ready, however, by the time a new Federal ban on ocean dumping goes into effect. The Puerto Rico Environmental Quality Board was attempting to obtain an exemption from the ban, which would affect the island's entire chemical industry. Otherwise, companies could be forced to ship their hazardous waste to the mainland,

entailing increased costs.

During 1980, the Puerto Rican Government and the Kennecott Copper Corp.-AMAX Inc. partnership continued to negotiate an agreement for developing the Utrado-Lares porphyry copper deposits in the west-central part of the island. The Commonwealth proposed eight basic, nonnegotiable conditions that the partnership must meet before the mining agreement can be finalized. Management officials of both companies indicated that the prerequisites can be met.

During fiscal year 1980, 16 foreign companies planned to establish facilities in Puerto Rico. For Spain in particular, the island proved to be an excellent overseas expansion market for manufacturing, for transportation is readily available and the same language is spoken. The Spanish firms were to manufacture, among other products, ceramics, fiberglass articles, and boiler equipment.

Legislation and Government Programs.—No significant legislation directly affecting mineral production on the island was enacted during the year. However, a decision by the U.S. Court of Appeals could have significant impact on segments of Puerto Rican metals and chemical processing and manufacturing industries. In a suit against the owners of an oil tanker that had polluted the Bahia Sucia mangrove swamp, the court ruled that the Commonwealth had the right to sue for damages to the island's natural resources. The captain of the tanker SS "Zoe Colocotroni" had released 1.5 million gallons of crude oil into the waters off Puerto Rico's southwestern coast in an attempt to free the vessel after grounding. Currently, a number of the island's manufacturing and processing industries dispose of toxic waste by offshore dumping.

During the year, the U.S. Geological Survey (USGS) continued investigations into the island's offshore sand resources. A reconnaissance cruise along the south coast was undertaken to study sand occurrences, and work was under way on a report documenting the findings from a seismic survey on the Cabo Rojo West deposit discovered off the island's southwest coast. The high-grade deposit contains 80 million cubic yards of sand in 30 to 40 feet of water.

The Geological Survey of Puerto Rico conducted a number of mineral-related projects. Among these was the completion of a report on beach sands suitable for construction purposes. In addition, the Commonwealth Survey signed an agreement with USGS to conduct islandwide stream sediment sampling for a 5-year geochemical program.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Cement continued to be the leading commodity in value. During the past decade, cement sales totaled over $500 million. The Puerto Rican Cement Co., Inc., at Ponce, and the San Juan Cement Co., Inc., at Dorado, comprised the island's cement industry.

In spite of the depressed construction industry, cement production increased 72,000 tons over that of 1979. Cement sales, buoyed by price increases ranging from 70 to 74 cents per 94-pound bag, increased $33 million over 1979 sales. The price increase, approved by the Puerto Rican Consumer Affairs Department (DACO), allowed the companies to recover increases in fuel and/or electric power. The DACO "pass-through" regulations also provided for a yearly revision of other manufacturing costs to allow the industry a 12% return, after taxes, on equity investments.

Clays.—The two cement companies produced clay for use in cement manufacturing. The clay pits are situated near the San Juan and Ponce plants. In 1980, production increased 31,000 tons over that of 1979.

Table 3.—Puerto Rico: Portland cement salient statistics

(Short tons)

	1979	1980
Number of active plants	2	2
Production	1,412,769	1,484,937
Shipments from mills:		
Quantity	1,406,214	1,482,162
Value	$70,197,172	$102,872,414
Stocks at mills, Dec. 31	37,212	39,987

Graphite.—Union Carbide Corp.'s Yabucoa facility produced synthetic graphite electrodes. Raw material, petroleum coke, was obtained from the company's Penuelas operation. The coke was ground, sized, heated, extruded, and reheated to 2,800° C to produce the synthetic material.

Lime.—Puerto Rican Cement Co., Inc., produced chemical-grade lime at the Ponce facility. Output, marketed primarily in Puerto Rico and the Virgin Islands, was

used in water purification, sugar refining, and S-type mason's lime.

Salt.—No salt production was reported during 1980; Mine Safety and Health Administration records indicated that the island's last evaporated salt producer ceased operations. The closure was attributed to economic conditions and heavy rains during 1979 that diluted the salt evaporation ponds.

Sand and Gravel.—One company, Owens Illinois, produced silica sand during 1980; production and value data were company confidential.

Stone.—Historically, stone has ranked second behind cement in terms of value. Over the past 10 years, the value of stone production totaled over $400 million, constituting approximately 40% of the value of the island's mineral output.

During 1980, Puerto Rican crushed stone operators quarried limestone, granite, marble, and traprock. Dimension stone output was restricted to limestone.

Limestone was mined and crushed in six of the island's seven districts. Production, totaling 21 million tons valued at slightly over $91 million, was reported from 128 quarries. Production in 1980 increased 9.4 million tons compared with that of the previous year. Aggregate for road construction, feed for cement manufacture, and aggregate for concrete products constituted the major end uses.

Granite was mined and crushed by one quarry in Humacao District and one in San Juan District. Output decreased approximately 60,000 tons below that of 1979. Sales of aggregate for concrete and road construction decreased markedly.

Marble was mined and crushed at two quarries in San Juan District and two in Ponce. Tonnage increased almost 100,000 tons above 1979 levels. Sales were mainly for bituminous aggregate, terrazzo, and poultry grit.

In 1980, a significant amount of the island's crushed stone production was used in projects funded by the U.S. Army Corps of Engineers. Four construction contracts on Ponce channel improvements required 33,000 cubic yards of riprap, 24,000 cubic yards of bedding stone, and 3,000 cubic yards of filter stone.[3]

Table 4.—Puerto Rico: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Poultry grit and mineral food	--	--	W	74
Concrete aggregate	1,229	3,739	1,621	5,908
Bituminous aggregate	444	1,729	660	2,868
Macadam aggregate	23	50	24	149
Dense-graded roadbase stone	211	650	311	919
Other construction aggregate and roadstone	r9,873	r47,339	18,619	84,724
Manufactured fine aggregate (stone sand)	W	66	178	709
Terrazzo and exposed aggregate	48	445	130	1,077
Other uses[2]	r2,214	r4,536	2,375	5,480
Total[3]	r14,040	r58,554	23,917	101,908

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1]Includes limestone, granite, marble, and traprock.

[2]Includes stone used for surface treatment aggregate, filter stone (1979), cement manufacture, lime manufacture (1979), asphalt filler (1979), and roofing granules (1979).

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

Traprock was produced from three quarries in San Juan District, two in Mayaguez District, and one in Arecibo District. Production totaled 21 million tons valued at $7 million. Output increased 400,000 tons over 1979 levels. Principal sales were for aggregate in road construction and concrete products manufacture.

Sulfur.—Elemental sulfur, a byproduct of oil refining desulfurization, was recovered by Corco and by Puerto Rico Sun Oil Co.

METALS

Puerto Rican metal producers enjoyed a better year than their counterparts in the construction minerals industry. Although shipments to the mainland declined by $4.2 million from $82.8 million in 1979, worldwide metal shipments increased approximately 10% to $145.5 million. Shipments included concrete reinforcing steel bars and various fabricated metal products.[4]

Shipments of recycled mercury from the

island's caustic soda production amounted to 6,839 flasks during the year.[5] Mercury was used in the mercury-cell process to produce caustic soda.

VIRGIN ISLANDS

The Virgin Islands, consisting of 3 large and 62 smaller islands, are located 34 miles east of Puerto Rico. The total land area of the island group is 133 square miles. The major islands are volcanic in origin and have a complex geologic history.

Trends and Developments.—Construction materials, predominately aggregates, are the only mineral commodities produced on the islands, and a healthy construction industry is of prime importance to the islands' stone producers. However, an address by the Governor at yearend created an atmosphere of concern for the mineral and construction industries. The Governor stated that no tax agreement would be negotiated that would involve any "future labor intensive expansion to be undertaken by heavy industry."[6] Effects of this announcement, which could seriously curtail new industry and construction, also threatened to reverse construction plans for a new catalytic cracking unit at the Amerada Hess refinery on St. Croix. A Hess spokesperson announced that plans for the construction of the new cracking unit will be shelved in January 1981 because of uncertainty surrounding the refinery's tax position.

The Virgin Islands' only other industrial company, Martin Marietta Aluminum Corp., continued its expansion plans for increasing alumina production from 550,000 to 700,000 tons per year. The company is interested in increasing output of the St. Croix alumina facility to 1.4 million tons; however, a partner is needed to share the cost of the $350 million expansion.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Cement was imported from Puerto Rico for industrial and residential construction.

Clays.—At yearend, Artistic Ceramics Corp., an Italian firm, was converting a vacant marina site into a factory and school on St. Croix's north shore at Salt River. The company plans to market a wide variety of ceramic and porcelain items and train local residents in all phases of the clay products manufacturing process. Clay is to be imported from Italy.

Stone.—Crushed basalt was the only mineral produced in the island group. Over the past decade, over 4 million tons of stone valued at over $20 million was produced.

Two companies, Devcon International Corp. and St. Croix Stone & Sand Corp., mined and crushed basalt from two quarries on St. Croix. Approximately 71% was used as concrete aggregate; 23%, for riprap and jetty application; and the remainder, for bituminous aggregate or crushed to sand size for fine aggregate applications.

Sulfur.—Elemental sulfur was recovered at the Hess Oil Virgin Islands Corp. refinery as a byproduct of crude oil desulfurization.

PACIFIC ISLAND POSSESSIONS

United States Pacific Island Possessions include American Samoa and the islands of Canton, Enderburg, Guam, Jarvis, Johnson, Midway, Palmyra, and Walker. American Samoa and Guam were the only possessions reporting mineral production in 1980. American Samoa, comprising seven islands, is situated approximately 2,200 miles southwest of Hawaii and 1,600 miles northeast of New Zealand. Guam, located at the southern end of the Mariana chain, is approximately 1,500 miles north of New Guinea and constitutes the largest island in the Mariana group.

Both American Samoa and Guam are underlain largely by volcanic rock, limestone, and coral; mineral production has been restricted to construction materials. During the year, the American Samoan Government operated one traprock quarry to produce material for use as concrete aggregate and in road construction.

On Guam, four producers—Hawaiian Rock Products Co., Perez Brothers, Inc., Pacific Rock Corp., and the public works department of the Guamanian Government—operated four limestone quarries to produce concrete and bitumi-

nous aggregate, roadbase material, filter, riprap, and jetty stone. Hawaiian Rock Products Co. and Perez Brothers, Inc., produced over 80% of the stone mined.

Table 5.—Nonfuel mineral production in the Pacific Island Possessions, 1980

Island and rock type	Quantity (short tons)	Value	Value per ton
American Samoa: Traprock	W	$167,240	$20.00
Guam: Limestone	528,672	2,162,957	4.09
Total	W	2,330,197	XX

W Withheld to avoid disclosing company proprietary data. XX Not applicable.

TRUST TERRITORY OF THE PACIFIC ISLANDS

Approximately 2,000 islands with a land area of about 1,335 square miles compose the Trust Territory, commonly termed Micronesia. In 1903, German engineers conducted the first systematic investigations of mineral occurrence on the islands. German firms produced a limited amount of phosphate until Japan occupied the territory during World War I; Japan was granted control of the territory after the war ended. Japanese geologists carried out an extensive exploration program throughout the island group, and Japanese mining companies were active on a number of the islands during the 1936-44 period.

The United States gained possession of the islands during the 1943-45 period, and in 1947, Micronesia was brought under U.S. stewardship by the United Nations. The stewardship is due to expire in 1981.

During the 1943-45 period, most of the mining operations on the islands were destroyed. However, following the cessation of hostilities in 1945, phosphate mining facilities on Angura in the Palau District were rebuilt and mining resumed. Mining by the Japanese under American direction terminated in 1955.

Although limited reserves of a number of mineral commodities remain, the only commodities produced in 1980 were sand and gravel and stone, which were used in construction. Mineral occurrence and past exports are summarized in table 6.

[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.
[2]Program assistant, Bureau of Mines, Pittsburgh, Pa.
[3]U.S. Army Corps of Engineers, Jacksonville, Fla.
[4]Am. Metal Market, Jan. 30, 1981, p. 5.
[5]Ryan, P. A. Mercury. Eng. and Min. J., March 1981, p. 122.
[6]Caribbean Business. Dec. 17, 1980, p. 54.

Table 6.—Mineral occurrence and past exports in the Pacific Trust Territories

Mineral	District					
	Marianas[1]	Marshall	Palau	Ponape	Truk	Yap
Nonmetallic:						
Asbestos						O
Clays	O		E	O		
Phosphate	E	E	E		O	E
Sand	O	O	O	O	O	O
Stone	O	O	O	O	O	O
Sulfur	E					
Metallic:						
Antimony			O			
Bauxite	O		E	O	O	O
Copper			O			E
Gold	O		O		O	O
Iron oxides	O					
Limonite	O		E	E	O	E
Manganese	E		E			O
Silver	O					
Zinc	O		O			

E Occurrence and exportation. O Occurrence only.
[1]Excludes Guam.

Source: Department of Resources and Development, Trust Territory of the Pacific Islands.

The Mineral Industry of Rhode Island

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Rhode Island Department of Environmental Management, for collecting information on all nonfuel minerals.

By L. J. Prosser, Jr.[1] and Robert J. Tuchman[2]

The value of nonfuel mineral production in Rhode Island in 1980 was $6.2 million, a decrease of $1.7 million from that of 1979. Commodities produced were sand and gravel and stone; minor quantities of gem stones were recovered by collectors. Sand and gravel mining accounted for over four-fifths of the value of mineral production in 1980. Nationally, the State ranked 49th in the value attributed to mineral extraction.

Trends and Developments.—Historically, sand and gravel has been Rhode Island's leading mineral commodity, in terms of both production and sales. Over the past decade, the value of the State's mineral output totaled about $60 million. During this period, mining of 27 million tons of sand and gravel accounted for nearly $47 million of the total. In 1980, residential and nonresidential construction activity (contract awards) dropped nearly 33%, compared with that of 1979.[3] The downturn in construction adversely affected sand and gravel production; output decreased 1 million tons and sales declined by $1.8 million, compared with those of the previous year.

Rhode Island's major shipping facility, the Port of Providence, is an important terminal for the movement of minerals and mineral-derived materials. During 1980, the port handled about 5.6 million tons, according to the Port Director's Office. Approximately two-thirds of the tonnage consisted of gasoline and fuels. Imported nonfuel mineral commodities included cement (179,000 tons), steel (102,000 tons), and iron ore (5,000 tons). Metal scrap was the leading export in 1980, with over 600,000 tons shipped mostly to the Far East.

Table 1.—Value of nonfuel mineral production in Rhode Island, by county[1]

(Thousands)

County	1979	1980	Minerals produced in 1980 in order of value
Kent	$1,819	$953	Sand and gravel.
Newport	W	W	Stone, sand and gravel.
Providence	W	W	Sand and gravel, stone.
Washington	W	W	Do.
Undistributed[2]	6,068	5,216	
Total[3]	7,886	6,170	

W Withheld to avoid disclosing company proprietary data; included in "Undistributed."
[1]Bristol County is not shown because no nonfuel mineral production was reported.
[2]Includes gem stones and values indicated by symbol W.
[3]Data may not add to totals shown because of independent rounding.

Table 2.—Indicators of Rhode Island business activity

	1979	1980[p]	Change, percent
Employment and labor force, annual average:			
Total civilian labor force ---- thousands	450.0	462.0	+2.7
Unemployment ---- do	30.0	33.0	+10.0
Employment (nonagricultural):			
Mining ---- do	(1)	(1)	--
Manufacturing ---- do	132.6	127.8	-3.6
Contract construction ---- do	13.9	12.7	-8.6
Transportation and public utilities ---- do	13.4	13.2	-1.5
Wholesale and retail trade ---- do	80.7	81.2	+.6
Finance, insurance, real estate ---- do	20.8	20.9	+.5
Services ---- do	[2]79.3	[2]82.8	+4.4
Government ---- do	59.3	59.9	+1.0
Total nonagricultural employment ---- do	400.0	398.5	-.4
Personal income:			
Total ---- millions	$7,900	$8,750	+10.8
Per capita	$8,500	$9,250	+8.8
Construction activity:			
Number of private and public residential units authorized	5,304	3,070	-42.1
Value of nonresidential construction ---- millions	$64.2	$63.4	-1.2
Value of State road contract awards ---- do	NA	$30.0	--
Shipments of portland and masonry cement to and within the State ---- thousand short tons	165	131	-20.6
Nonfuel mineral production value:			
Total crude mineral value ---- millions	$7.9	$6.2	-21.5
Value per capita, resident population	$8	$7	-12.5
Value per square mile	$6,496	$5,082	-21.8

[p]Preliminary. NA Not available.
[1]Included with "Services."
[2]Includes mining.

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

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Gem Stones.—In 1980, hobbyists and rockhounds recovered gem stones and mineral specimens in Rhode Island. Estimated value of the collected gem stones accounted for less than 1% of the State's value of mineral production.

Fourteen years ago, Rhode Island became the first New England State to officially recognize a State rock and mineral. The State rock, cumberlandite, which contains magnetite and ilmenite, was mined for iron in colonial times. The State mineral, bowenite, was marketed as jewelry in the 19th century as "Rhode Island Jade."

Sand and Gravel.—Output in 1980 dropped to 2.5 million tons, the lowest quantity produced since 1973. Although production was down because of a decline in construction activity, sand and gravel mining added about $5 million to the State's economy. As in 1979, about four-fifths of the value attributed to mineral output in Rhode Island came from sand and gravel.

Of the State's five counties, Providence County was the leading producer, followed by Washington, Kent, and Newport Counties. No production was reported from Bristol County.

During 1980, the State's sand and gravel industry was composed of 20 companies operating 22 pits. Fourteen of the operators produced less than 100,000 tons. All shipments were by truck.

Table 3.—Rhode Island: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	709	$1,620	$2.29	428	$986	$2.31
Plaster and gunite sands	25	100	4.00	W	W	W
Concrete products	W	W	W	W	W	W
Asphaltic concrete	619	1,702	2.75	357	1,286	3.61
Roadbase and coverings	606	1,135	1.87	572	1,080	1.89
Fill	1,180	1,338	1.13	963	1,133	1.18
Snow and ice control	W	W	W	W	W	W
Total or average	3,537	6,737	1.90	2,506	4,945	1.97

W Withheld to avoid disclosing company proprietary data; included in "Total."

Table 4.—Rhode Island: Construction sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	1,287	$2,232	$1.73	1,038	$2,123	$2.04
Gravel	2,250	4,505	2.00	1,468	2,822	1.92
Total or average	3,537	6,737	1.90	2,506	4,945	1.97

Stone.—Rhode Island's stone industry consisted of five companies operating five quarries. Compared with that of 1979, output dropped about 46,000 tons in 1980, but prices rose from $4.61 to $5.95 per unit. In the past 5 years, stone mining has added about $6.2 million to the State's value of production.

Limestone and granite were quarried and crushed in Providence County in the northern part of Rhode Island. Other producing counties were Newport (granite, graywacke) and Washington (granite).

M. A. Gammino Construction Co., the State's leading producer, marketed crushed granite for aggregate, riprap, and filter stone. The Conklin Limestone Co., Inc., operated the State's only limestone quarry. After washing and crushing, the limestone was used for landscaping applications and as a soil conditioner.

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[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

[2]Program assistant, Bureau of Mines, Pittsburgh, Pa.

[3]Rhode Island Economic Trends. R. I. Dept. of Econ. Development, February 1981.

Table 5.—Rhode Island: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Concrete aggregate	33	W	32	122
Bituminous aggregate	34	W	34	128
Filter stone	41	W	39	148
Riprap and jetty stone	14	47	W	W
Manufactured fine aggregate (stone sand)	24	W	24	85
Other uses[2]	104	1,101	73	725
Total[3]	249	1,148	203	1,208

W Withheld to avoid disclosing company proprietary data; included with "Other uses."
[1]Includes limestone, granite, and other stone.
[2]Includes stone used in agricultural limestone, other construction aggregate and roadstone, dense-graded roadbase stone (1979), flux stone, other fillers or extenders, and roofing granules.
[3]Data may not add to totals shown because of independent rounding.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Sand and gravel:			
A. Cardi Construction Co., Inc.	451 Arnold Rd. Coventry, RI 02816	Pit	Kent.
J. H. Lynch & Sons, Inc.	Box 325 Ashton, RI 02864	Pit	Providence.
Material Services, Inc	Greenville Rd. North Smithfield, RI 02895	Pit	Do.
V. J. Paolino Construction Co	Box 383 Slatersville, RI 02876	Pit	Do.
Rhode Island Sand & Gravel Co., Inc.	Kilvert St. Warwick, RI 02886	Pit	Kent.
River Sand & Gravel Co	Box 101 Pawtucket, RI 02861	Pit	Washington.
South County Sand & Gravel Co., Inc.	North Rd. Peace Dale, RI 02878	Pit	Do.
Tasca Sand & Gravel Co	Box 113, RFD 4 Esmond, RI 02917	Pit	Providence.
Stone:			
Granite and other stone:			
M. A. Gammino Construction Co.	875 Phenix Ave. Cranston, RI 02920	Quarry	Do.
G. J. T. Realty, Inc	Tiverton, RI 02878	do	Newport.
Peckham Bros. Co., Inc	Box 193 Newport, RI 02840	do	Do.
Limestone, crushed:			
The Conklin Limestone Co., Inc.	RFD 1 Lincoln, RI 02865	do	Providence.

The Mineral Industry of South Carolina

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of Interior, and the South Carolina Geological Survey, State Division of Research and Statistical Services, for collecting information on all nonfuel minerals.

By James R. Boyle[1] and Norman K. Olson[2]

The value of nonfuel mineral production in South Carolina was $194.8 million in 1980, a decrease of $6.8 million from that of 1979. Cement, stone, clays, and sand and gravel were the major contributors to total value.

South Carolina ranked second nationally in the production of kaolin and vermiculite, third in flake mica, sixth in ferroalloys and common clay, and eighth in fuller's earth.

Nationwide economic conditions adversely affected the State's minerals industry during the year. Industries supplying material for residential construction—such as clays, vermiculite, and sand—experienced a decrease in demand. Operations supplying kaolin to the paper, rubber, and steel industries also had reduced demand, although the export market remained firm. Cement facilities experienced fluctuating market conditions during the year, with production down.

Table 1.—Nonfuel mineral production in South Carolina[1]

Mineral		1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
Cement, portland	thousand short tons	1,831	$79,377	1,704	$74,539
Clays[2]	do.	2,272	24,492	2,211	25,169
Gem stones		NA	5	NA	5
Manganiferous ore	thousand short tons	26	W	20	W
Mica (scrap)	do.	rW	rW	W	W
Peat	do.	W	W	—	—
Sand and gravel	do.	8,321	26,665	5,556	22,855
Stone:					
Crushed	do.	16,589	48,352	16,107	49,207
Dimension	do.	9	482	12	703
Combined value of cement (masonry), clays (fuller's earth), vermiculite, and values indicated by symbol W		XX	r22,277	XX	22,301
Total		XX	r201,650	XX	194,779

rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

[2]Excludes fuller's earth; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in South Carolina, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Aiken	$17,100	$19,221	Clays, sand and gravel.
Anderson	W	W	Stone, sand and gravel.
Bamberg	115	W	Sand and gravel.
Berkeley	W	W	Stone.
Charleston	283	787	Sand and gravel.
Cherokee	4,185	3,090	Stone, clays, sand and gravel, manganiferous ore.
Chester	W	--	
Chesterfield	W	W	Sand and gravel, stone.
Clarendon	140	140	Sand and gravel.
Colleton	W	W	Sand and gravel, peat.
Dillon	W	W	Sand and gravel.
Dorchester	50,849	56,230	Cement, stone, clays, sand and gravel.
Edgefield	17	W	Clays.
Fairfield	W	W	Stone.
Florence	1,001	W	Sand and gravel.
Georgetown	W	W	Stone, sand and gravel.
Greenville	W	W	Do.
Greenwood	W	W	Stone, sand and gravel, clays.
Horry	W	W	Do.
Jasper	W	W	Sand and gravel.
Kershaw	W	W	Sand and gravel, clays, stone.
Lancaster	W	W	Clays, mica, sand and gravel.
Laurens	W	W	Vermiculite, stone.
Lexington	W	W	Sand and gravel, stone, clays.
Marion	W	W	Clays, sand and gravel.
Marlboro	W	W	Sand and gravel, clays.
Newberry	52	--	
Oconee	368	297	Stone.
Orangeburg	38,752	42,421	Cement, stone, clays, sand and gravel.
Pickens	W	W	Stone.
Richland	W	W	Stone, clays, sand and gravel.
Saluda	52	84	Clays.
Spartanburg	W	W	Stone, sand and gravel.
Sumter	2,820	W	Sand and gravel, clays.
Union	W	W	Sand and gravel.
York	W	W	Stone, clays.
Undistributed[2]	67,069	79,376	
Total[3]	182,801	201,650	

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

[1]The following counties are not listed because no nonfuel mineral production was reported: Abbeville, Allendale, Barnwell, Beaufort, Calhoun, Darlington, Hampton, Lee, McCormick, and Williamsburg.

[2]Includes gem stones and values indicated by symbol W.

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

Mineral commodities were produced in all but three counties in the State. Aiken County led in the number of operating mines with 34, followed by Cherokee with 25, and Lexington with 22.

The inflationary trend of the seventies is evident by comparison of 1980 mineral production with that of 1970. While tonnage of the individual commodities increased up to 60%, the total value of mineral production increased about 375% over that of 1970.

Trends and Developments.—Nassau Recycle Corp. opened a new $50 million plant south of Columbia to recycle materials for the Bell system. The primary raw material recycled is copper; but iron, steel, aluminum, lead, and precious metals such as gold, platinum, and silver are also recovered. The plant, which is expected to reach full capacity in 1981, will recover 250 million pounds of copper rod annually.

During 1980, mineral imports through the facilities of the South Carolina State Port Authority at Charleston were as follows: Colemanite (Turkey), charcoal (Ecuador), clinker (Spain), alumina (Australia), chromite (Japan), and lump iron ore (South America). Mineral exports were zircon (South America), kaolin (worldwide), feldspar (South America), and ferrochrome (Europe). Georgetown Steel Corp. received imports of 314,550 tons of bulk ore, up 122,831 tons from those of 1979.

American Selco Inc., a subsidiary of Selection Trust Ltd., London, England, established an office in Camden, S.C. The geological staff began an exploration program for gold and massive sulfide minerals in the northern part of the State.

Legislation and Government Programs.—The South Carolina Mining Council promulgated regulations providing for the administration of the South Carolina Mining Act. These regulations involve applications for mining permits, approval of applications for mining permits and reclamation plans, public announcements, inspection of mines, hearings, and minimum standards for properly completed reclamation. In addition, the regulations provide for

Table 3.—Indicators of South Carolina business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,306.0	1,306.0	--
Unemployment	do	65.0	90.0	+38.5
Employment (nonagricultural):				
Mining	do	1.9	1.9	--
Manufacturing	do	399.5	392.3	-1.8
Contract construction	do	73.1	73.0	-.1
Transportation and public utilities	do	53.0	53.5	+.9
Wholesale and retail trade	do	221.0	223.9	+1.3
Finance, insurance, real estate	do	46.3	47.5	+2.6
Services	do	152.4	158.0	+3.7
Government	do	228.8	237.3	+3.7
Total nonagricultural employment	do	1,176.0	1,187.4	+1.0
Personal income:				
Total	millions	$20,688	$23,082	+11.6
Per capita		$7,056	$7,519	+6.6
Construction activity:				
Number of private and public residential units authorized		26,819	21,153	-21.1
Value of nonresidential construction	millions	$274.6	$173.1	-37.0
Value of State road contract awards	do	$93.7	$34.5	-63.2
Shipments of portland and masonry cement to and within the State	thousand short tons	1,049	990	-5.6
Nonfuel mineral production value:				
Total crude mineral value	millions	$201.6	$194.8	-3.4
Value per capita, resident population		$69	62	-10.1
Value per square mile		$6,493	$6,272	-3.4

[p]Preliminary.

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

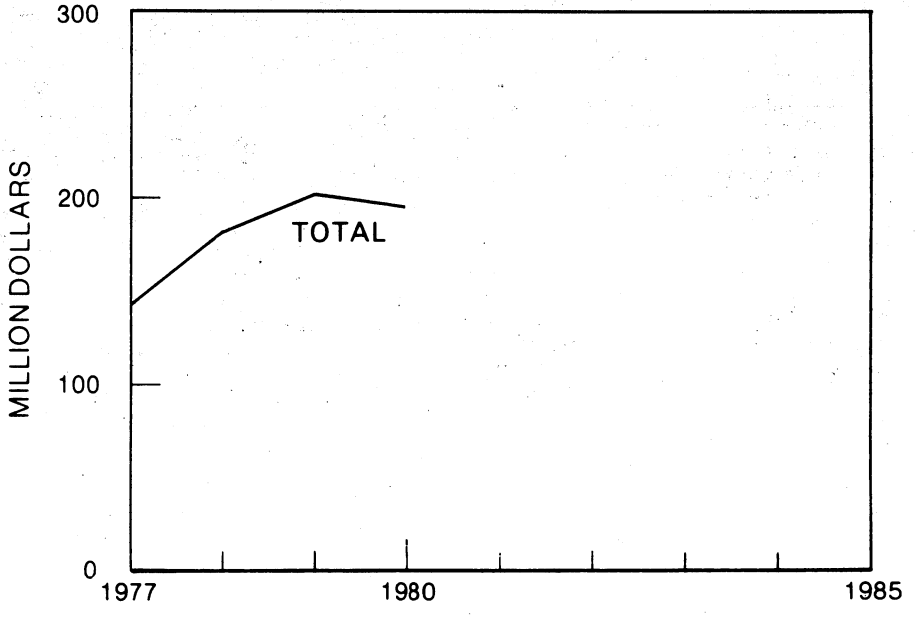

Figure 1.—Total value of nonfuel mineral production in South Carolina.

the repeal of previously promulgated Regulation 89-1 governing notice of intent to mine, and provide for the renumbering of the regulations. The newly promulgated regulations became effective July 18, 1980.

The Mining and Reclamation Division, South Carolina Land Resources Conservation Commission, reported that 20 new mining operations received permits to operate. Of the 20 operations, 1 was clay, 1 dimension granite, 1 limestone (coquina), 14 sand or sand and gravel, and 3 vermiculite.

During 1980, the South Carolina Geological Survey had 10 full-time and 14 part-time staff members. Activities of the survey were divided into two general areas; mineral industry assistance and field work. In the first area, information was provided to various companies and consulting firms; gold, metallic minerals, kaolin, and peat attracted the most interest. In the second area, 40 projects were underway; some of the more significant ones were (1) Geologic Map of South Carolina, (2) Mineral Resources and Mineral Industries Map of South Carolina, (3) South Carolina Peat Project, and (4) Abbeville County Geochemical Investigation. Projects completed during the year included an "Economic Sand Analysis of the Carolina Sandhills of Chesterfield County," and several geologic maps covering specific quadrangles or counties.

The University of South Carolina was awarded a $62,000, 2-year grant from the National Science Foundation to study ways of preventing the occurrence of environmentally harmful acid water from abandoned South Carolina gold mines. The prospect of reopening some of the State's gold mines, active in the 1800's, has grown. Geologists will study ways of dealing with the acid-laced waters.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Nonmetals accounted for the bulk of the value of South Carolina's total mineral production.

Cement.—Cement continued to rank first in value among South Carolina's mineral commodities. Production and value of both portland and masonry cement decreased. Portland cement was produced in southern South Carolina by Giant Portland and Masonry Cement Co. and Gifford-Hill & Co., Inc., in Dorchester County and by Santee Portland Cement Corp. in Orangeburg County. Giant and Santee also produced masonry cement.

Each company mined marl and miscellaneous clays as raw materials for cement manufacture. Other raw materials used were iron ore, fly ash, and gypsum. Most of the portland cement shipped was type I or type II. Principal uses were in ready-mix concrete, concrete products, highway construction, and building material.

During the year, Gifford-Hill & Co., Inc., at Harleyville, installed a heat exchanger on the clinker cooler and completed installation of computerized controls on the raw materials drying operation. The plant has a rated capacity of 564,000 tons per year, with marl reserves sufficient for 200 years. A D-10 bulldozer, the first of this size in operation in South Carolina, was purchased for ripping and bulldozing of the marl.

Clays.—Clay production included kaolin, common clay, and fuller's earth. In 1980, clays were mined by 23 companies at 46 pits in 16 counties. Leading producers were Gifford-Hill & Co., Inc., Richtex Corp., J. M. Huber Corp., Santee Portland Cement Corp., and Southern Brick Co.

South Carolina ranked second in the Nation in the production of kaolin, although output in 1980 decreased. Demand for kaolin was down primarily owing to reduction in the rubber and construction industries. Kaolin was produced in Aiken, Kershaw, Lexington, and Richland Counties by 9 firms operating 19 mines. Air-floated kaolin was used principally in rubber products, paints, high-quality paper, fertilizers, and pesticides. Water-washed kaolin produced at one plant near the North Edisto River was sold for paper filling and coating. Unprocessed kaolin was used in manufacturing refractories, in brick as a colorant, and in the manufacture of cement.

W. R. Grace & Co. purchased National Kaolin Products Co. of Aiken for $5.5 million. The Aiken facility will operate as part of the Davison Chemical Div. The clay was used as a filler and a coating for roofing granules and urea. However, Davison, a speciality chemical manufacturer, will use the clay in the production of catalysts used in petroleum refining. Reserves of kaolin at the mine were estimated at 6 million tons.

Table 4.—South Carolina: Kaolin sold or used by producers, by kind and use

(Short tons)

Kind and use	1979	1980
Airfloat:		
Adhesives	19,937	13,802
Animal feed and pet waste absorbent	2,595	1,444
Ceramics[1]	20,912	23,395
Fertilizers	16,564	20,383
Fiberglass	96,256	105,709
Paint	747	1,146
Paper coating and filling	4,519	4,292
Pesticides and related products	23,059	15,135
Plastics	9,310	11,499
Rubber	244,098	191,059
Other refractories[2]	8,514	7,213
Other uses[3]	4,233	7,268
Exports[4]	71,518	56,612
Total	522,262	458,957
Unprocessed: Face brick; firebrick, block, and shapes; miscellaneous	244,714	198,795
Grand total	766,976	657,752

[1]Includes floor and wall tile; glazes, glass, and enamels; pottery; roofing granules; and sanitary ware.
[2]Includes refractory mortar and cement, and refractory grogs and crudes.
[3]Includes common brick (1980), crockery and other earthenware, ink, roofing tile (1979), structural tile (1980), and miscellaneous.
[4]Includes ceramics, fertilizers (1979), paper filling, pesticides and related products (1980), plastics (1979), rubber, and miscellaneous.

Cyprus Industrial Minerals Co. and its parent, Cyprus Mines, were acquired by AMOCO, and became part of the AMOCO Minerals Group. Kaolin produced from their Aiken area mines will be used in various rubber and agricultural products.

South Carolina ranked sixth nationally in the production of common clay. Common clay was produced from 29 mines in 13 counties and was used almost entirely in the manufacture of brick. Although the number of operating mines dropped, production and value increased. Southern Brick Co. at Ninety Six, S.C., one of the largest brick producers in the State, converted its kiln to utilize sawdust as fuel and reduce energy costs.

Fuller's earth was produced by one operator in Sumter County and sold chiefly for use in various oil, grease, and pet products. Fuller's earth, a light-colored opaline claystone, upon calcining at high temperatures, has great absorptive capacities for oils, odor, and water.

Colemanite.—Industrial Minerals, Inc., York, S.C., processed colemanite (calcium borate) ore imported from Turkey at its York County plant. The ore was ground, dried, and shipped to PPG Industries, Inc., and to Owens-Corning Fiberglas Corp. for use in glass fiber manufacture.

Feldspar.—Spartan Minerals Corp., a division of Lithium Corp. of America, produced a feldspar-silica mixture from tailings shipped to Pacolet from Lithium Corp.'s spodumene operation in North Carolina. Demand was down, but Spartan plans to add another grinding circuit by early 1982. The mixture was sold for use in manufacturing glass containers, in ceramic whiteware, and as a latex filler. Mica was also recovered from the tailings for use in caulking. No feldspar was mined in South Carolina.

Mica (Sericite).—South Carolina ranked third in the Nation in the production of sericite. Output was from one mine in Lancaster County; production decreased substantially. Sericite was dry-milled to produce a micaceous product that was sold mainly for use as an inert filler in paint, expansion-joint cement, and in electronics. Spartan began grinding muscovite mica at its Pacolet plant using tailings from Lithium Corp. of America's spodumene operation in North Carolina.

Peat.—No production was reported in 1980, but American Peat and Organics Co. began operations late in the year at the site of the former U.S. Peat Corp. operation. Crude peat was mined from a bog near Green Pond in Colleton County, along the coast. At the company's processing plant, peat was mixed with special additives, bagged, and shipped for use in general soil improvements. The firm planned to market a line of organic products for use in the agricultural market.

Sand and Gravel.—In 1980, sand and gravel was mined by 37 companies at 53 pits in 21 counties. During the year, 14 new operations were permitted. Leading pro-

ducing counties were Lexington, with nine pits; Marlboro, with two pits; and Sumter, with two pits. Although none of the individual pits produced in excess of 500,000 tons, the top 15 companies, with 31 pits, produced 90% of the State's sand and gravel. Production of both construction and industrial sand and gravel decreased.

Sand and gravel was used mainly as aggregate in concrete and asphalt and as fill. Industrial sand from five pits was used primarily in glassmaking, sandblasting, foundry, and filtration applications. Most of the State's sand and gravel (81%) was shipped by truck. Pennsylvania Glass Sand Corp., Cayce, the largest silica flour producer in the Nation, planned a $1 million expansion to include concentrators and dryers to reclaim tailing ponds.

Stone.—The value of the State's stone production continued to rank second behind that of cement. Crushed stone production decreased slightly, while value increased. Production of dimension stone increased in tonnage and value.

Table 5.—South Carolina: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,119	$7,655	$2.45	2,151	$6,270	$2.92
Plaster and gunite sands	W	W	3.67	W	W	1.63
Concrete products	457	1,144	2.50	403	1,337	3.31
Asphaltic concrete	1,842	4,837	2.63	1,410	4,479	3.18
Roadbase and coverings	339	514	1.51	W	W	1.76
Fill	1,354	1,682	1.24	606	866	1.43
Snow and ice control	W	W	2.25	3	6	2.50
Railroad ballast	26	27	1.03	W	W	1.23
Other uses	118	136	1.15	W	W	1.69
Total or average	7,332	16,273	2.22	4,737	13,227	2.79

W Withheld to avoid disclosing company proprietary data; included in "Total."

Table 6.—South Carolina: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	5,535	$9,825	$1.78	3,460	$6,817	$1.97
Gravel	1,797	6,448	3.59	1,278	6,410	5.02
Total[1] or average	7,332	16,273	2.22	4,737	13,227	2.79
Industrial:						
Sand	W	W	10.59	819	9,628	11.76
Gravel	W	W	6.32	--	--	--
Total or average	989	10,392	10.51	819	9,628	11.76
Grand total or average	8,321	26,665	3.20	5,556	22,855	4.11

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

Table 7.—South Carolina: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	347	1,936	W	W
Concrete aggregate	2,547	8,255	3,045	9,521
Bituminous aggregate	1,804	5,563	1,860	6,298
Macadam aggregate	382	1,044	1,076	3,859
Dense-graded roadbase stone	2,753	8,081	1,984	5,556
Surface treatment aggregate	319	1,003	268	837
Other construction aggregate and roadstone	4,445	13,991	3,663	11,680
Riprap and jetty stone	179	612	171	639
Railroad ballast	479	1,483	572	1,872
Manufactured fine aggregate (stone sand)	633	2,007	726	1,818
Cement manufacture	2,667	4,300	2,308	4,564
Other uses[2]	35	75	434	2,562
Total[3]	16,589	48,352	16,107	49,207

W Withheld to avoid disclosing company proprietary data; included with "Other uses."
[1]Includes limestone, granite, and marl.
[2]Includes stone used in asphalt filler (1979), filter stone (1980), and sulfur dioxide.
[3]Data may not add to totals shown because of independent rounding.

Granite, limestone, and marl were mined and crushed for a variety of uses. Granite was also mined for use as dimension stone. In 1980, stone was produced by 16 companies from 34 quarries in 19 counties. Granite was produced by 11 companies from 25 quarries in 14 counties; limestone, by 5 companies from 6 quarries in 4 counties; and marl, by 3 companies from 3 quarries in 2 counties.

In 1980, 90% of the State's crushed stone tonnage was produced by the 7 largest producing companies from 21 quarries. Six quarries had production in excess of 1 million tons each during 1980. Crushed stone was shipped by truck (83%), railroad (6%), and by other means (11%). Leading producing counties were Richland, Berkeley, Pickens, Dorchester, and Lexington. The leading producers were Vulcan Materials Co., with five quarries; Martin Marietta Aggregates, with seven quarries; and the Lone Star Industries, Inc., with four quarries.

Dimension granite was produced by Granite Quarry Corp., a division of Matthews International Corp., and Comolli Granite Co. from four quarries in Kershaw County. Palmetto Quarries was also developing a dimension granite quarry in the county.

James River Limestone Co. planned to construct a $1 million agricultural lime plant in Georgetown County, adjacent to Martin Marietta's operation. The agricultural lime plant will use a high-calcium limestone, a byproduct of Martin Marietta's operation. The material will be mixed with dolomitic limestone, shipped from Virginia, in preparing a fertilizer product to be marketed regionally.

Vermiculite.—The Nation's crude vermiculite was produced in Montana, South Carolina, and Virginia. Production in the State remained at about the same level as 1979. South Carolina vermiculite ore was mined by W. R. Grace & Co., in Greenville County, and Patterson Vermiculite Co., in Laurens County. The group of deposits, usually a few feet thick and several hundred feet long, were open pit mined and beneficiated by a wet-concentrator process. The ore was exfoliated at two plants by W. R. Grace & Co. and at one plant by Patterson Vermiculite Co. W. R. Grace & Co. obtained permits for three new pits during the year; the Mason Donnan and Monroe Mines in Laurens County and the Simmons Mine in Spartanburg County.

Vermiculite, a group of hydrated micaceous materials, has the property of expanding 20 to 30 times its original volume when heated. Principal sales were for soil conditioning additives, for the manufacture of lightweight aggregates (concrete, plaster, and fireproofing), and in loose fill and block insulation.

METALS

No metal ores were mined in South Carolina in 1980 for the recovery of their metallic content. Ores formerly mined included gold, tin, lead, manganese, and copper. Exploration reportedly centered on gold and massive sulfides in the northern part of the

State. Although metals were not mined in South Carolina, production of aluminum, ferroalloys, iron, and steel from imported ores was significant in the State's economy in 1980. Ores were imported through the South Carolina State Port Authority's facilities at Charleston. The State ranked sixth nationally in shipments of ferroalloys.

Aluminum.—Alumax, Inc., began production of primary aluminum at mid-year at its $340 million primary reduction plant in Berkeley County. The plant has a rated capacity of about 180,000 tons per year. Alumina from Australia was imported through Charleston, and plans call for shipment of 30,000 to 40,000 tons per month. With the startup of Alumax's operation, South Carolina became the 17th state to produce primary aluminum.

Jim Walter Corp. started construction of an aluminum rolling mill in Mt. Holly. The $27 million mill, with a 25,000-ton-per-year capacity, will utilize primary aluminum ingot from Alumax's new plant.

Apex International Alloys, Inc., Mt. Holly, closed its secondary aluminum smelter reportedly because of environmental problems.

Ferroalloys.—Ferrochrome alloys were produced by Macalloy Corp., Charleston, using ores imported from the U.S.S.R., Turkey, the Republic of South Africa, India, Iran, Albania, and several other countries. Production and value decreased slightly.

Iron and Steel.—Steel was produced in Georgetown by the Georgetown Steel Corp., a subsidiary of Korf Industries of the Federal Republic of Germany. Georgetown Steel was one of the Nation's major producers of wire rod. Pelletized ore and natural lump ore averaging 68% iron were imported from South America, the Republic of South Africa, Sweden, and Australia. Sponge iron was produced from the ore by the MIDREX direct-reduction process by the company's companion firm, Georgetown Ferreduction. Georgetown Steel was one of two U.S. firms that were using this process, which allows a high-quality steel to be produced in electric arc furnaces without coke ovens or blast furnaces.

Georgetown Ferreduction, Georgetown, after the installation of a new heat recovery system designed by MIDREX, reached a new record low fuel consumption for direct reduction. The near 20% decrease in fuel consumption was expected to save the plant $3 million per year in operating costs. The new heat recovery system consists of a shell and tube heat exchanger with crosscounter flow. The new design preheats reformer feed gas to 540° C and combustion air to 675° C.

Andrews Wire, a division of Georgetown Steel Corp., planned to expand its wire drawing operations at Andrews to include a nail-producing plant. The new facility is scheduled to begin in mid-1981; it is expected to yield $10 million in net sales annually. Sixty-six percent of all nails in the United States are currently manufactured by foreign producers, primarily in the Republic of Korea, Japan, and Canada. The nails will be produced primarily for markets located in the Southeastern United States. Total annual output of 20,000 tons of nails is expected when the facility is operating at full production.

Manganiferous Ore.—Manganiferous schist was mined by three companies in Cherokee County; production decreased 25%, with value increasing substantially. The output was used by brick manufacturers in South Carolina and North Carolina for coloration.

Zircon.—Milled zircon (zirconium silicate) was produced by M & T Chemicals, Inc., in Georgetown County, using raw materials obtained from Florida and Australia. Zircon concentrates were processed by fine grinding and shipped for foundry, wall tile, whiteware, and general ceramic uses.

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[1]State mineral specialist, Bureau of Mines, Tuscaloosa, Ala.

[2]State geologist, South Carolina Geological Survey, Columbia, S.C.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum smelters:			
Alumax, Inc	Box 1000 Goose Creek, SC 29445	Plant	Berkeley.
Cement:			
Giant Portland and Masonry Cement Co.	Box 218 Harleyville, SC 29448	do	Dorchester.
Gifford-Hill & Co., Inc	Box 326 Harleyville, SC 29448	do	Do.
Santee Portland Cement Corp	Box 698 Holly Hill, SC 29059	do	Orangeburg.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Clays:			
Common clay and shale:			
Giant Portland and Masonry Cement Co.	Box 218 Harleyville, SC 29448	Mine	Dorchester.
Gifford-Hill & Co., Inc	Box 326 Harleyville, SC 29448	do	Do.
Palmetto Brick Co	Box 430 Cheraw, SC 29520	do	Marlboro.
Richtex Corp	Box 3307 Columbia, SC 29230	do	Kershaw, Richland, Sumter.
Santee Portland Cement Corp	Box 698 Holly Hill, SC 29059	do	Orangeburg.
Southern Brick Co	Box 208 Ninety Six, SC 29666	do	Greenwood, Newberry, Saluda.
Fuller's earth:			
Bennett Mineral Co	Box 158 Pinewood, SC 29372	Mine and plant	Sumter.
Kaolin, processed:			
Dixie Clay Co	Box B Bath, SC 29816	do	Aiken.
J. M. Huber Corp	Box 306 Langley, SC 29834	do	Do.
Palmetto Brick Co	Box 430 Cheraw, SC 29520	Mine	Kershaw.
Richtex Corp	Box 3307 Columbia, SC 29230	Mine and plant	Lexington and Richland.
Colemanite:			
Industrial Minerals, Inc	Box 459 York, SC 29745	Plant	York.
Feldspar, crude:			
Spartan Minerals Corp., a division of Lithium Corp. of America.	Box 520 Pacolet, SC 29372	do	Spartanburg.
Manganiferous ore:			
Ashe Brick Co	Van Wyck, SC 29744	Mine	Cherokee.
Broad River Brick Co., a division of Boren Clay Products.	Box 368 Pleasant Garden, NC 27313	do	Do.
Fletcher Brick Co., a division of Moland-Drysdale Corp.	Box 2150 Hendersonville, NC 28739	do	Do.
Mica (sericite):			
Mineral Mining Corp	Box 458 Kershaw, SC 29067	Mine and plant	Lancaster.
Peat:			
American Peat and Organics Co	Box 245 Green Pond, SC 29446	Bog and plant	Colleton.
Sand and gravel:			
Asphalt Products Corp	Route 2 Lancaster, SC 29720	Pit and plant	Chesterfield, Dillon, Florence, Horry, Sumter.
Becker Sand and Gravel Co., Inc	Box 848 Cheraw, SC 29520	Pits and plants	Chesterfield, Dorchester, Florence, Marlboro, Sumter.
Brewer Sand Co. Inc	Route 2 Lancaster, SC 29720	Pit and plant	Lancaster.
Foster-Dixiana Sand Co	Box 5447 Columbia, SC 29250	do	Lexington.
Pennsylvania Glass Sand Corp	Box 84 Cayce, SC 29033	do	Do.
Stone:			
Granite, crushed and broken:			
Lone Star Industries, Inc	Box 5185 Columbia, SC 29205	Quarry and plant	Fairfield, Greenwood, Laurens, Richland.
Martin Marietta Aggregates	Box 1758 Columbia, SC 29202	do	Fairfield, Lexington, Richland, York.
Vulcan Materials Co	Box 188 Blacksburg, SC 29702	do	Greenville, Laurens, Pickens, Spartanburg.
Granite, dimension:			
Comolli Granite Co	R.F.D. 2, Box 297 Kershaw, SC 29067	Quarry	Kershaw.
Granite Quarry Corp	Penn Circle East Pittsburgh, PA 15206	do	Do.
Limestone, crushed:			
Martin Marietta Aggregates	Box 1758 Columbia, SC 29202	Quarry and plant	Berkeley and Georgetown.
Vulcan Materials Co	Box 188 Blacksburg, SC 29702	do	Cherokee.
Ware Brothers Construction Co	Box 626 Moncks Corner, SC 29461	Quarry	Berkeley.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Marl, crushed:			
Giant Portland and Masonry Cement Co.	Box 218 Harleyville, SC 29448	Pit	Dorchester.
Gifford-Hill & Co., Inc	Box 326 Harleyville, SC 29448	Pit	Do.
Santee Portland Cement Co	Box 698 Holly Hill, SC 29059	Pit	Orangeburg.
Vermiculite, crude and exfoliated:			
W. R. Grace & Co	Route 1 Enoree, SC 29335	Mine and plant	Greenville and Laurens.
Patterson Vermiculite Co	____do	____do	Laurens.

The Mineral Industry of South Dakota

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the South Dakota Geological Survey for collecting information on all nonfuel minerals.

By James H. Aase[1]

The value of nonfuel minerals produced in South Dakota rose to a record high of $227.7 million in 1980, a 53% increase over that of the previous year, positioning the State 29th nationwide in value of output. The record high total value for the three metallic and nine nonmetallic minerals produced was attributed primarily to increases in their unit prices, partly supported by slight production increases for a few of the minerals.

The State was ranked second nationally in gold production, with the Homestake Mining Co. operation at Lead accounting for all the output.

Nonfuel mineral production, recorded by 123 firms and various Government agencies, came from 142 locations in 50 counties.

Gold, the principal commodity in the metallic sector, contributed approximately $7 out of every $10 of the State's nonfuel mineral value. Although the quantity of gold produced increased slightly over the 1979 level, the value of the 1980 production increased dramatically because of sharp advances in gold prices during the year,

Table 1.—Nonfuel mineral production in South Dakota[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry thousand short tons	7	$434	6	$377
Portland do	670	31,273	459	23,042
Clays do	205	292	[2]169	[2]283
Gem stones	NA	50	NA	50
Gold (recoverable content of ores, etc.) troy ounces	245,912	75,618	267,392	163,794
Mica, scrap thousand short tons	[3]	2	[3]	4
Sand and gravel do	6,001	10,119	4,209	8,243
Silver (recoverable content of ores, etc.) thousand troy ounces	58	643	51	1,058
Stone:				
Crushed thousand short tons	3,891	10,317	3,151	8,942
Dimension do	36	13,268	42	15,035
Combined value of clays (bentonite, 1980), feldspar, gypsum, iron ore, and lime	XX	6,670	XX	6,873
Total	XX	148,686	XX	227,701

NA Not available. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes bentonite; value included in "Combined value" figure.
[3]Less than 1/2 unit.

Table 2.—Value of nonfuel mineral production in South Dakota, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Beadle	$17	$43	Sand and gravel.
Brookings	946	718	Do.
Brown	508	461	Do.
Brule	--	W	Do.
Butte	W	W	Do.
Campbell	W	W	Do.
Charles Mix	224	216	Do.
Clark	99	W	Do.
Clay	21	44	Do.
Codington	W	498	Do.
Corson	W	11	Do.
Custer	W	W	Stone, feldspar, sand and gravel.
Davison	59	101	Sand and gravel.
Day	221	121	Do.
Deuel	119	W	Do.
Dewey	54	54	Do.
Douglas	W	W	Do.
Fall River	W	968	Sand and gravel, stone.
Faulk	76	75	Sand and gravel.
Grant	W	W	Stone, sand and gravel.
Gregory	65	51	Sand and gravel.
Haakon	18	18	Do.
Hamlin	W	W	Do.
Hand	W	W	Do.
Hanson	W	W	Stone, sand and gravel.
Harding	18	--	
Hughes	93	W	Sand and gravel.
Hutchinson	101	92	Do.
Hyde	113	150	Do.
Jerauld	74	54	Do.
Jones	50	35	Do.
Kingsbury	22	22	Do.
Lake	W	W	Do.
Lawrence	56,264	77,429	Gold, iron ore, silver, sand and gravel, stone.
Lincoln	32	--	
Lyman	78	44	Sand and gravel.
McCook	W	W	Do.
McPherson	W	W	Do.
Marshall	W	W	Do.
Meade	W	W	Sand and gravel, gypsum.
Miner	37	19	Sand and gravel.
Minnehaha	W	W	Stone, sand and gravel.
Moody	160	159	Sand and gravel.
Pennington	W	W	Cement, stone, lime, sand and gravel, clays, mica.
Perkins	462	230	Sand and gravel.
Potter	W	113	Do.
Roberts	W	W	Do.
Sanborn	W	W	Do.
Spink	217	133	Do.
Sully	68	34	Do.
Tripp	35	5	Stone.
Turner	W	W	Sand and gravel.
Union	112	156	Do.
Walworth	132	106	Do.
Washabaugh	164	(2)	
Yankton	W	429	Sand and gravel.
Ziebach	W	W	Do.
Undistributed[3]	54,107	66,103	
Total[4]	114,759	148,686	

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

[1]The following counties are not listed because no nonfuel mineral production was reported: Aurora, Bennett, Bon Homme, Buffalo, Edmunds, Jackson, Mellette, Shannon, Stanley, and Todd.

[2]Washabaugh County merged with Jackson County on Jan. 1, 1979, and will be known hereafter as Jackson County.

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

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

Table 3.—Indicators of South Dakota business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	337.0	337.0	--
Unemployment	do	12.0	16.0	+33.3
Employment (nonagricultural):				
Mining[1]	do	2.9	2.8	-3.4
Manufacturing	do	27.5	26.0	-5.4
Contract construction	do	12.9	10.7	-17.0
Transportation and public utilities	do	13.7	13.4	-2.2
Wholesale and retail trade	do	66.7	64.6	-3.2
Finance, insurance, real estate	do	10.9	11.1	+1.8
Services	do	48.5	50.2	+3.5
Government	do	58.3	58.3	--
Total nonagricultural employment[1]	do	241.4	237.1	-1.8
Personal income:				
Total	millions	$4,816	$5,130	+6.5
Per capita		$6,992	$7,452	+6.6
Construction activity:				
Number of private and public residential units authorized		3,916	3,284	-16.1
Value of nonresidential construction	millions	$99.7	$64.0	-35.8
Value of State road contract awards	do	$78.0	$57.5	-26.3
Shipments of portland and masonry cement to and within the State	thousand short tons	419	263	-37.2
Nonfuel mineral production value:				
Total crude mineral value	millions	$148.7	$227.7	+53.1
Value per capita, resident population		$216	$330	+52.8
Value per square mile		$1,930	$2,955	+53.1

[p]Preliminary.
[1]Includes oil and gas extraction.

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

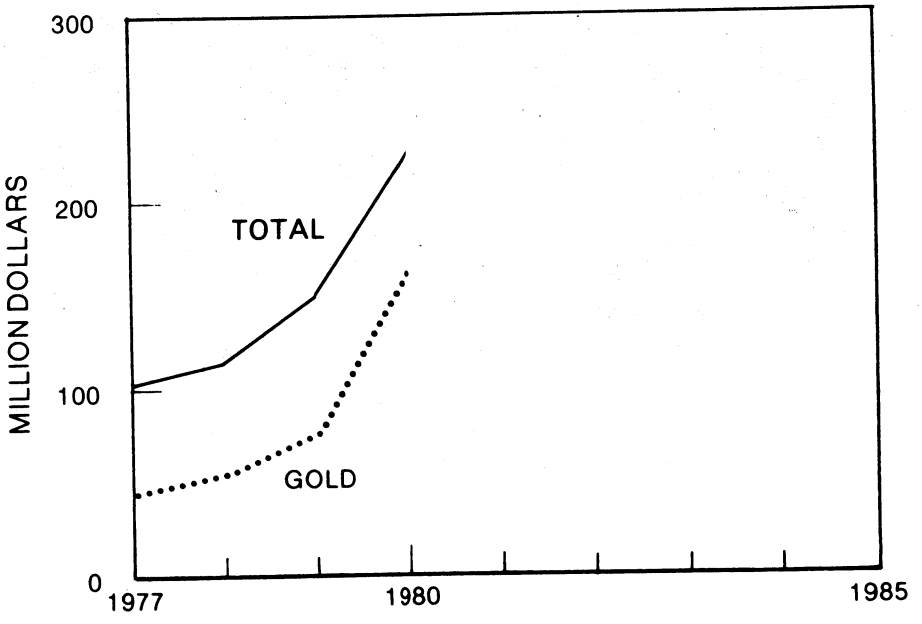

Figure 1.—Value of mine production of gold and total value of nonfuel mineral production in South Dakota.

averaging about $305 per troy ounce, and setting the average value of gold produced at $613 per troy ounce. Leading the nonmetallic commodities in value was stone, followed by cement and sand and gravel. All nonmetallic commodities except mica and dimension stone decreased in quantity produced, reflecting the construction industry's softening in demand for industrial minerals.

Employment.—Employment in the mining industry represented about 1.1% of the State's total private nonagricultural work force. According to statistics developed by the Business Research Bureau, School of Business, University of South Dakota, the mining sector work force averaged 2,800 persons during 1980, 3.4% less than the number employed during the previous year. Compared with 1979 figures, production workers in mining during the year received average hourly earnings of $9.12 and worked an average of 40 hours per week—a 16% increase in the hourly rate and an 18% decrease in the hourly workweek.

Trends and Developments.—The U.S. Supreme Court denied the State of South Dakota's request to hear arguments on the State's suit, *South Dakota v. Andrus*; litigation is based on the Department's requirement that an environmental impact statement (EIS) be prepared before a mineral patent is issued. In contention were patent applications of Pittsburgh Pacific Co. of Hibbing, Minn., to lands containing taconite in the Black Hills National Forest near the community of Nemo, which the State wanted preserved and withdrawn from possible future iron mining operations. The Supreme Court's refusal to hear the arguments affirmed the Eighth Circuit Court ruling that declared issuing a mineral patent is not a major Federal action "significantly affecting the quality of human environment" and, therefore, does not require an EIS. In addition, the court ruled that awarding patents is a nondiscretionary act where approval is automatic if specific criteria are met and may not be subject to EIS's.

Unique among the States, South Dakota owns and operates a cement plant. Ordinarily, the plant produces enough cement to supply both in-State and out-of-State customers. In 1978, because a cement shortage developed in South Dakota and in the surrounding region, State officials restricted sales to in-State customers. Out-of-State cement customers challenged this practice in court actions that carried to the U.S. Supreme Court. Siding with South Dakota, the Supreme Court in a 1980 decision ruled that a State has the freedom to run a business for the benefit of its residents only.

A marked change in economic conditions, however, greatly reduced the demand for cement during 1980; in late fall, slumping sales and unsold inventories, reportedly amounting to the equivalent of a half year's output, led the State Cement Commission to shut down three of its four kilns indefinitely. The three wet-process kilns taken out of operation accounted for about half of the plant's production capacity.

Voluntary revegetation of limestone quarry lands earned Pete Lien & Sons, Inc., Rapid City, the Citizens Participation Award from the U.S. Environmental Protection Agency (EPA). EPA recognized the company's initiative in revegetating its quarry lands northwest of Rapid City well before EPA required it to do so. Since the beginning of its reclamation program in 1961, the company has planted 2,450 trees and shrubs; seeded 135 acres; and spent more than $2 million on reclamation, dust control, and other environmental efforts.[2] The company's goal is to mine an acre one year and revegetate it the next in a continuous, step-by-step process.

At the Homestake gold mine at Lead, efforts to increase production and control rising costs received considerable attention. In response to higher gold prices, the company processed tailings and other waste rock that contained gold profitable for milling at current prices. Consequently, the total tonnage milled at the Lead operation was increased by 25% in 1980. To control rising costs, the company continued to replace the labor-intensive cut-and-fill method of mining with bulk mining systems, a method requiring extensive development work but offering economies of scale. Approximately 35% of the 1980 production was derived by bulk mining.[3] Other mine development activities carried on during the year included the following: Initiating studies for full production mining to the 8,000-foot level and development to the 10,000-foot level; continuing to assess the feasibility of sinking an additional new shaft on the property to expedite bringing the ore to the surface; and initiating work to deepen one of its two production shafts to extend mining depths.

Exploration conducted in the search for nonfuel minerals increased approximately threefold during 1980 over that of the previous year. Over half of the exploration permits the State issued indicated that pre-

cious metals were the commodities being sought.

The South Dakota Geological Survey continued its emphasis on basic data gathering and projects related to natural resource issues. Activities during the year included field and laboratory projects involving the following:

Basic Geology—(1) Geology of Aurora, Clark, Davison, Deuel, Hamlin, Hand, Hanson, Hughes, Hyde, Jerauld, Lake, Miner, Moody, Walworth, and Yankton Counties; (2) geology of the Upper Big Sioux; (3) geology of the Lower Big Sioux; (4) Cretaceous stratigraphy of South Dakota; and (5) subsurface geology of the Madison Limestone.

Economic Geology—(1) Clay and shale resources of South Dakota; (2) sand and gravel resources; (3) uranium evaluation; and (4) geothermal evaluation.

Water-Resources Projects—(1) Hydrologic studies of Aurora, Clark, Davison, Deuel, Hamlin, Hand, Hanson, Hughes, Hyde, Jerauld, Lake, Miner, Moody, Walworth, and Yankton Counties; (2) ground water study of three urban areas and two rural water districts; and (3) unit water studies of southern Spink and Beadle Counties and central Minnehaha and Brookings Counties.

Legislation and Government Programs.—The South Dakota Legislature enacted a number of bills into law during its 1980 session that affect the mining industry and mineral resource development activities in the State. Included among the measures were the following:

HB 1010—Solution Mining.—Prohibits solution mining without approval of the Conservation Commission and provides injunctive remedy.

HB 1011—Surface Effects of Underground Mining, and Surface Mining.—Provides for regulating the surface effects of underground mining and establishes additional standards for surface mining.

HB 1075—Preinspections for Exploration Permit Applications.—Specifies that the permit area may (instead of "shall") be inspected after the reclamation plan is submitted.

HB 1159—Minerals Belonging to the State.—Provides for prospecting and leasing of certain minerals belonging to the State.

HB 1245—Surface Mining and Mineral-Exploration Permits.—Revises procedures for application and approval for surface mining and mineral exploration permits.

HB 1290—Well Damage by Mineral Extraction or Development.—Protects domestic and municipal wells and natural springs from damages effected by withdrawal of water for mineral extraction or development.

HB 1363—Precious Metals Extraction Tax.—Excludes precious metals from the mineral extraction tax and sets up a new tax on them.

SB 117—Geothermal Resources on State Lands.—Adds geothermal resources to statute on sales, leases, and conveyances of lands belonging to the State and sets up royalty payments.

SB 119—Mining and Reclamation Plan and Consent of Surface Owners.—Requires certain criteria in a mining and reclamation plan and provides for the consent of surface owners to such plan.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Gold.—Gold prices soared to a record high in 1980, averaging $612.56 per troy ounce, a near doubling of the previous year's average price. Compared with the 1979 levels, South Dakota gold production rose 9% in quantity and 117% in value. The State ranked second nationally in gold output and accounted for 28% of the total U.S. production. Homestake Mining Co.'s operations at Lead accounted for the State's total 1980 gold output. Gold recovery from the nearly 1.8 million tons of ore treated averaged 0.15 troy ounce per ton.

During the year, one of the new mining techniques Homestake implemented at its underground mine was vertical-crater-retreat (VCR) stoping. Judged to be one of the safest underground mining methods known today, yet competitive with other forms of stoping in terms of cost and productivity, VCR consists of drilling 165-millimeter-diameter holes from the top sill of one level, down-dip to an undercut on the level below. The bottom of each hole is then loaded from above with an explosives charge. Horizontal slices up to 4.27 meters thick are blasted into an undercut. Broken ore is extracted from drawpoints on or below the undercut level.

Table 4.—South Dakota: Mine production of gold and silver in terms of recoverable metal

Year	Mines producing		Material sold or treated[1] (thousand metric tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Thousand troy ounces	Value (thousands)
1976	1	--	1,504	318,511	$39,916	58	$253
1977	1	1	1,432	r304,846	r45,212	69	317
1978	1	--	1,442	285,512	55,261	53	287
1979	1	--	1,297	245,912	73,618	38	642
1980	1	--	1,621	267,392	163,794	51	1,058
1876-1980	NA	NA	NA	37,530,321	1,549,104	13,449	14,014

rRevised. NA Not available.
[1]Excludes placer gravel.

Iron Ore.—A small amount of ore, mined and stockpiled in previous years, was shipped by Pete Lien & Sons, Inc., from a site near Nemo, Lawrence County, to the State-owned cement plant in Rapid City for use in cement manufacturing.

Silver.—Silver production, all obtained as a coproduct with gold produced at the Homestake Mine at Lead, was approximately 12% lower than that of the previous year. The value of the 1980 output, however, increased nearly 65% over that of 1979 because of record high silver prices, averaging $20.64 per troy ounce.

NONMETALS

Cement.—Nationwide, the State ranked 31st in portland and masonry cement production in 1980. All cement manufactured in South Dakota during the year came from the State-owned plant at Rapid City. Output from the plant amounted to approximately 39% of combined rated capacity of the facility's three wet- and one dry-process kilns.

Although the quantity of cement manufactured during the year was at its lowest level since the mid-seventies, the unit price of both portland and masonry cement reached highs of $50.16 per ton and $68.36 per ton, respectively.

During the year, slightly more than 1 million tons of nonfuel minerals—including limestone, shale, sand, iron ore, and gypsum—was consumed in manufacturing South Dakota's nearly one-half million tons of finished cement.

The largest end users of the portland cement were ready-mix companies, consuming slightly over two-thirds of the 1980 production. Other users, in descending order of amount consumed, were highway and other contractors, concrete product manufacturers, building material dealers, government agencies, and miscellaneous customers. Shipments of portland cement from the plant to end users were handled almost exclusively by truck. Approximately 95% of the shipments were in bulk form.

Clays.—Common clay and shale were produced from pits in Pennington County by the South Dakota Cement Commission for use in cement manufacturing, and by Dakota Block Co. for use in concrete blocks and structural concrete products. Although the quantity and value of the 1980 production dropped from that of the previous year, the unit value of the common clay and shale produced rose to a record high of $1.68 per ton.

Crude bentonite, from deposits within the State and Wyoming, was processed by American Colloid Co. at its plant near Belle Fourche in Butte County. The processed material was marketed for a wide variety of uses, including as an ingredient in oil and gas drilling muds, foundry sands, and waterproofing sealants. Bentonite mined in the State during 1980 accounted for the largest part of the total value of all clays produced during the year.

Feldspar.—Hand-cobbed feldspar was produced from several small operations in the pegmatite district of the southern Black Hills area of Custer County. The quantity and value of the 1980 output decreased 30% and 4%, respectively, from those of the previous year, whereas the unit price of the crude material rose by more than one-third. Most of the crude ore produced during the year was processed at a grinding plant Pacer Corp. operated in Custer.

Gem Stones.—Gem stone materials collected in the State during 1980 by rockhounds and other hobbyists were estimated to be valued at $50,000. The State does not have any commercial gem stone mining operations. Gem materials occur in a wide variety of geological environments in South Dakota. Pegmatite districts, principally in the southern Black Hills area, are favorite sites of mineral collectors seeking gem materials.

Gypsum.—The State's entire production of gypsum during the year came from a single open pit mine in Meade County, operated by the South Dakota Cement Commission. The output was consumed exclusively in cement manufacturing. Although output was down approximately 26% from that of 1979, value of the 1980 production increased slightly because of a 45% increase in the unit price.

Lime.—Pete Lien & Sons, Inc., was the sole producer of lime in the State during 1980. Production was from the company's plant in Rapid City, Pennington County. The high-quality lime rock used in manufacturing the lime was obtained from the company's quarry adjacent to its plant site. Compared with that of the previous year, output in 1980 decreased both in quantity and total value. The average unit price of the lime produced in 1980 increased to a new record high, approximately 12% above the 1979 level.

Approximately 49,000 tons of lime, obtained from all domestic sources, was consumed in South Dakota during 1980.

Mica.—A small amount of hand-cobbed mica was produced by Pendleton Mining Co. from a pegmatite deposit near Keystone, Pennington County. The average unit price of the material produced in 1980 was $80 per ton.

Concepts West, Inc., announced the purchase of a former mica property—the Crown Mine—near Custer and intended to start mining at the site in 1981.

Sand and Gravel.—The quantity of sand and gravel produced in South Dakota during the year was at its lowest level of the past three decades. Output decreased 30% in quantity and 19% in value compared with that of the previous year, whereas the average unit value of the 1980 sand and gravel production reached a high of $1.96 per ton.

As the most widespread mining activity in the State, sand and gravel operations were conducted at 109 pits by 97 firms and government agencies in 50 of the State's 66 counties. Operating from 14 locations, 10 companies and government agencies each produced in excess of 100,000 tons and collectively supplied more than 40% of the State's output. The four leading counties, in descending order of output value, were Minnehaha, Pennington, Yankton, and Brookings, cumulatively accounting for nearly one-third of the State total.

The quantity of material produced at the individual pit operations during the year varied, with 53 operations yielding less than 25,000 tons, 46 between 25,000 and 100,000 tons, 9 between 100,000 and 200,000 tons, and 1 in excess of 200,000 tons.

Nationwide, the State ranked 45th in quantity of sand and gravel produced during 1980.

Most of the sand and gravel produced in 1980 was used for road base and coverings, accounting for about one-half of the total. Other uses, in descending order of amount consumed, were for concrete aggregate, fill, asphaltic concrete, snow and ice control, concrete products, and other miscellaneous uses.

Table 5.—South Dakota: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,329	$3,305	$2.49	1,040	$3,449	$3.32
Plaster and gunite sands	W	W	3.24	5	22	4.06
Concrete products	W	W	2.01	18	40	2.22
Asphaltic concrete	605	934	1.55	439	755	1.72
Road base and coverings	3,110	4,660	1.50	2,115	3,167	1.50
Fill	853	1,030	1.21	514	652	1.27
Snow and ice control	42	55	1.29	63	132	2.09
Other	7	16	2.32	15	27	1.75
Total or average	6,001	10,119	1.69	4,209	[1]8,243	1.96

W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Data do not add to total shown because of independent rounding.

Table 6.—South Dakota: Construction sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	1,441	$2,750	$1.91	1,168	$2,941	$2.52
Gravel	4,560	7,369	1.62	3,041	5,302	1.74
Total or average	6,001	10,119	1.69	4,209	8,243	1.96

Table 7.—South Dakota: Construction sand and gravel sold or used by producers, by county

County	1979			1980		
	Number of mines	Quantity (thousand short tons)	Value (thousands)	Number of mines	Quantity (thousand short tons)	Value (thousands)
Beadle	1	32	$43	1	36	$54
Brookings	5	433	718	3	144	463
Brown	8	278	461	6	146	278
Charles Mix	4	146	216	3	130	227
Clark	1	W	W	1	W	76
Clay	1	35	44	1	32	48
Codington	3	201	498	2	W	W
Corson	1	7	11	1	6	10
Custer	1	17	17	1	14	16
Davison	4	88	101	5	134	246
Day	4	108	121	3	62	82
Deuel	2	W	W	3	84	95
Dewey	1	36	54	--	--	--
Fall River	3	200	527	2	76	285
Faulk	1	50	75	1	41	67
Gregory	3	32	51	5	128	218
Haakon	1	12	18	--	--	--
Hanson	1	W	W	1	22	29
Hughes	2	28	W	2	24	W
Hutchinson	5	86	92	2	W	W
Hyde	1	60	150	1	50	50
Jerauld	2	43	54	2	32	43
Jones	1	35	35	1	29	31
Kingsbury	4	17	22	1	W	W
Lake	2	W	W	2	W	222
Lyman	1	29	44	1	34	49
Miner	1	17	19	2	32	35
Minnehaha	11	993	1,399	8	595	864
Moody	3	123	159	2	W	W
Pennington	7	302	800	5	182	679
Perkins	3	79	230	2	W	W
Potter	1	70	113	1	67	67
Spink	2	W	133	2	W	W
Sully	1	32	34	2	84	347
Tripp	--	--	--	1	172	215
Turner	1	W	W	3	50	74
Union	4	112	156	3	70	79
Walworth	2	106	106	2	38	43
Yankton	5	246	429	4	275	675
Undistributed[1]	r28	1,948	3,194	21	1,421	2,579
Total[2]	132	6,001	10,119	109	4,209	8,243

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1]Includes Brule, Butte, Campbell, Douglas, Grant, Hamlin, Hand, Lawrence, McCook (1979), McPherson, Marshall, Meade, Roberts, Sanborn, and Ziebach (1979) Counties, sand and gravel that cannot be assigned to specific counties, and data indicated by symbol W.

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

Stone.—During 1980, stone production—granite, limestone, and sandstone—was obtained at 23 quarry sites, operated by 16 firms in 10 counties. Crushed stone output was at its lowest level since the midseventies; dimension stone production, however, rose to a record level for the same period. Combined output for all types of crushed and dimension stone decreased 19% in quantity and rose 2% in attendant value compared with that of the previous year.

The average unit value for the crushed stone produced in 1980 reached an alltime high of $2.84 per ton. Dimension stone average unit value was $355.31 per ton, slightly lower than in 1979. Leading in

crushed stone production was Pennington County. All dimension stone output, consisting of granite, was from Grant County.

Nationally, South Dakota ranked 38th in value among the 48 States reporting crushed stone production and 3d among the 38 States having dimension stone output in 1980.

Near Milbank, Grant County, dimension granite was quarried by six companies at eight sites. Output was used most extensively in making monuments. South Dakota continued its role as one of the leading granite-producing States in the Nation in value of sales. Cold Spring Granite Co.'s quarries and Dakota Granite Co.'s Mahogany Quarry were among the 10 leading operations in the Nation producing dimension stone of any type.

Limestone output, exceeding that of any other rock type quarried in the State, was obtained at 11 quarry sites in Custer, Fall River, Lawrence, Meade, Minnehaha, Pennington, and Yankton Counties. The product was used mainly in manufacturing cement, and secondly, as concrete aggregate.

Sandstone was quarried at four sites in Hanson, Minnehaha, and Tripp Counties. The crushed material was used principally as an aggregate for concrete, with lesser amounts marketed as bituminous aggregate, railroad ballast, riprap, surface treatment aggregates, and other unspecified uses.

The operations of two firms accounted for 53% of the State's total stone output in 1980. Individual quarry operations had a wide range of tonnage output in 1980. Twelve quarries produced less than 25,000 tons; 3 quarries, between 25,000 and 100,000 tons; 6 quarries, between 100,000 and 500,000 tons; and 2 quarries, between 500,000 and 1,000,000 tons.

Shipments of crushed stone were handled 69% by truck and most of the remainder, by rail.

[1]State mineral specialist, Bureau of Mines, Minneapolis, Minn.
[2]Pit & Quarry. EPA Honors South Dakota Producer. V. 72, No. 10, April 1980, pp. 54-56.
[3]Homestake Mining Co. Annual Report, 1980, p. 12.

Table 8.—South Dakota: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Concrete aggregate	1,576	5,612	1,222	4,437
Bituminous aggregate	251	658	275	801
Dense-graded roadbase stone	W	W	217	W
Surface treatment aggregate	80	169	42	108
Other construction aggregate and roadstone	131	160	W	46
Riprap and jetty stone	113	452	98	429
Railroad ballast	284	674	187	542
Lime manufacture	310	589	210	398
Other[2]	1,145	2,002	901	2,181
Total[3]	3,891	10,317	3,151	8,942

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes granite (1979), limestone, and sandstone.
[2]Includes stone used as agricultural limestone (1980), in cement manufacture, other miscellaneous uses, and data indicated by symbol W.
[3]Data may not add to totals shown because of independent rounding.

Table 9.—South Dakota: Stone sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Kind of stone	1979		1980	
	Quantity	Value	Quantity	Value
Dimension stone, total[1]	36	13,268	42	15,035
Crushed and broken:				
Granite	77	77	--	--
Limestone	2,789	6,640	2,237	5,428
Sandstone	1,025	3,600	914	3,515
Total[2]	3,926	23,585	3,193	23,977

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

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
South Dakota Cement Commission.	Box 360 Rapid City, SD 57709	Four rotary kilns	Pennington.
Clays:			
American Colloid Co	5100 Suffield Ct. Skokie, IL 60076	Open pit mine and plant	Butte.
Dakota Block Co	Box 2920 Rapid City, SD 57709	----do	Pennington.
South Dakota Cement Commission.	Box 360 Rapid City, SD 57709	Open pit mine	Do.
Feldspar:			
Pacer Corp	Box 311 Custer, SD 57730	Open pit mines and dry-grinding plant.	Custer.
Gold:			
Homestake Mining Co	Box 875 Lead, SD 57754	Underground mine, cyanidation mill, and refinery.	Lawrence.
Gypsum:			
South Dakota Cement Commission.	Box 360 Rapid City, SD 57709	Open pit mine	Meade.
Iron ore:			
Pete Lien & Sons, Inc	Box 440 Rapid City, SD 57709	----do	Lawrence.
Lime:			
Pete Lien & Sons, Inc	----do	1 rotary kiln, 1 vertical kiln, continuous-hydrator plant.	Pennington.
Mica:			
Pendleton Mining Co	Box 286 Keystone, SD 57751	Mine	Do.
Sand and gravel:			
Birdsall Sand & Gravel Co., Inc	Box 767 Rapid City, SD 57709	Pits and plants	Fall River, Pennington, Sully.
Concrete Materials, Inc	Summit, SD 57266	Pit and plant	Roberts.
L. G. Everist, Inc	302 Paulton Bldg. Sioux Falls, SD 57102	Pits and plants	Brookings, Pennington, Yankton.
Fodness Gravel	Route 5 Sioux Falls, SD 57101	Pit and plant	Minnehaha.
Luke Construction Co	Kimball, SD 57355	----do	Brule.
F. J. McLaughlin Co	Box 13 Watertown, SD 57201	----do	Codington.
N & M Construction, Inc	Box 337 Sturgis, SD 57785	----do	Meade.
Reynolds Construction Co	Box 689 Sioux Falls, SD 57101	----do	Minnehaha.
Silver:			
Homestake Mining Co	Box 875 Lead, SD 57754	*See* Gold	Lawrence.
Stone:			
Granite:			
Cold Spring Granite Co	Cold Spring, MN 56320	Quarries	Grant.
Dakota Granite Co	Box 1351 Milbank, SD 57252	----do	Do.
Delano Granite Works, Inc	Delano, MN 55328	Quarry	Do.
Robert Hunter Granite Co., Inc.	501 East Drake St. Milbank, SD 57252	----do	Do.
Steiner-Rausch Granite Co	Route 2, Box 36 Ortonville, MN 56278	----do	Do.
Limestone:			
Centennial Quarry Co	Box 311 Spearfish, SD 57783	Quarry and plant	Lawrence.
Pete Lien & Sons, Inc	Box 440 Rapid City, SD 57709	Quarries and plants	Custer and Pennington.
Northwestern Engineering Co. (Hills Materials Co.)	Box 1392 Rapid City, SD 57709	----do	Custer, Fall River, Meade, Pennington.
South Dakota Cement Commission.	Box 360 Rapid City, SD 57709	Quarry and plant	Pennington.
Sandstone:			
Concrete Materials Co	3000 West Madison St. Sioux Falls, SD 57102	----do	Minnehaha.
L. G. Everist, Inc	302 Paulton Bldg. Sioux Falls, SD 57102	----do	Do.
Spencer Quarries, Inc	Box 25 Spencer, SD 57374	----do	Hanson.

The Mineral Industry of Tennessee

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Tennessee Division of Geology for collecting information on all nonfuel minerals.

By Donald K. Harrison[1]

The value of Tennessee's nonfuel mineral production in 1980 was $407.8 million, up from $385.7 million in 1979. In terms of value, stone continued to be the leading commodity produced, accounting for almost one-third of the State's mineral value.

Tennessee ranked first nationally in the production of zinc, ball clay, and pyrite; second in synthetic graphite and ferroalloys; and fourth in phosphate rock and primary aluminum output. Other commodities produced included barite, bentonite, cement, common clay, copper, fuller's earth, lime, sand and gravel, and silver. Imported minerals processed or refined in the State included alumina, perlite, rare earths, titanium, and vermiculite.

Table 1.—Nonfuel mineral production in Tennessee[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Masonry	thousand short tons	170	$8,600	132	$7,241
Portland	do.	1,335	57,146	1,304	58,827
Clays	do.	1,561	26,071	1,188	22,844
Gem stones		NA	1	NA	1
Phosphate rock	thousand metric tons	1,873	14,770	1,582	12,765
Sand and gravel	thousand short tons	11,210	29,056	8,921	24,930
Stone:					
Crushed	do.	45,718	133,727	38,584	126,993
Dimension	do.	12	1,000	10	883
Zinc (recoverable content of ores, etc.)	metric tons	85,119	69,995	128,722	106,220
Combined value of barite, copper, lead (1979), lime, pyrites, and silver		XX	45,378	XX	47,133
Total		XX	385,744	XX	407,837

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 nonfuel mineral production in Tennessee, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Anderson	W	W	Stone, clays.
Bedford	W	W	Stone.
Benton	W	W	Sand and gravel, stone.
Bledsoe	--	$106	Stone.
Blount	$3,881	W	Sand and gravel, stone.
Bradley	W	W	Do.
Campbell	3,221	W	Stone, sand and gravel.
Cannon	W	W	Stone.
Carroll	1,497	W	Sand and gravel, clays.
Carter	W	W	Stone.
Claiborne	W	W	Do.
Clay	138	W	Do.
Cocke	149	192	Do.
Coffee	W	W	Stone, sand and gravel.
Cumberland	4,834	W	Do.
Davidson	W	W	Stone, cement, clays.
Decatur	W	W	Stone, sand and gravel.
DeKalb	W	W	Stone.
Dickson	W	W	Do.
Dyer	640	217	Sand and gravel.
Fayette	118	108	Do.
Fentress	W	W	Stone, sand and gravel.
Franklin	W	W	Cement, stone, sand and gravel, clays.
Gibson	428	W	Clays.
Giles	W	W	Phosphate rock, stone, sand and gravel.
Grainger	W	W	Zinc, stone.
Greene	W	W	Stone, sand and gravel.
Grundy	W	W	Stone.
Hamblen	W	W	Do.
Hamilton	26,661	29,824	Cement, stone, sand and gravel, clays.
Hardeman	W	1	Sand and gravel.
Hardin	W	W	Stone, sand and gravel.
Hawkins	W	W	Stone.
Henry	7,732	9,303	Clays, sand and gravel.
Hickman	W	W	Phosphate rock.
Humphreys	W	W	Stone, sand and gravel.
Jackson	W	W	Stone.
Jefferson	36,262	42,534	Zinc, stone, silver, copper, lead.
Johnson	W	W	Stone.
Knox	39,716	33,689	Cement, stone, zinc, lime, sand and gravel, clays.
Lauderdale	92	92	Sand and gravel.
Lawrence	804	1,000	Stone, sand and gravel.
Lincoln	W	W	Stone.
Loudon	W	W	Barite, stone.
McMinn	W	W	Lime, stone, sand and gravel.
McNairy	345	W	Sand and gravel.
Macon	W	W	Stone.
Madison	180	W	Sand and gravel.
Marion	W	W	Cement, stone, sand and gravel.
Marshall	W	W	Stone.
Maury	W	W	Phosphate rock, stone.
Meigs	W	W	Stone.
Monroe	W	W	Do.
Montgomery	W	W	Do.
Moore	W	W	Do.
Obion	779	817	Sand and gravel.
Overton	W	W	Stone.
Pickett	--	25	Do.
Polk	W	43,321	Copper, pyrites, zinc, silver.
Putnam	W	W	Stone, sand and gravel.
Rhea	W	W	Stone.
Roane	W	W	Stone, sand and gravel.
Robertson	W	W	Stone.
Rutherford	2,925	2,667	Do.
Sequatchie	W	W	Do.
Sevier	W	W	Stone, sand and gravel.
Shelby	7,763	9,785	Sand and gravel.
Smith	W	W	Zinc, stone.
Stewart	W	1,581	Sand and gravel, stone.
Sullivan	W	W	Cement, stone, clays.
Sumner	W	W	Stone.
Tipton	1,269	968	Sand and gravel.
Unicoi	W	W	Stone, sand and gravel.
Union	3,526	4,124	Do.
Warren	1,062	W	Do.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Tennessee, by county[1] —Continued

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Washington	W	$253	Clays, stone.
Wayne	W	W	Sand and gravel.
Weakley	W	W	Clays.
White	W	W	Stone.
Williamson	W	W	Phosphate rock, stone.
Wilson	W	W	Stone.
Undistributed[2]	$202,820	205,140	
Total	346,842	[3]385,744	

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

[1]The following counties are not listed because no nonfuel mineral production was reported: Cheatham, Chester, Crockett, Hancock, Haywood, Henderson, Houston, Lake, Lewis, Morgan, Perry, Scott, Trousdale, and Van Buren.

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

[3]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Tennessee business activity

	1979	1980[p]	Change, percent
Employment and labor force, annual average:			
Total civilian labor force, thousands	1,979.0	2,015.0	+1.8
Unemployment, do	115.0	145.0	+26.1
Employment (nonagricultural):			
Mining[1], do	10.5	NA	--
Manufacturing, do	524.7	NA	--
Contract construction, do	89.2	NA	--
Transportation and public utilities, do	87.3	NA	--
Wholesale and retail trade, do	388.7	NA	--
Finance, insurance, real estate, do	77.6	NA	--
Services, do	285.4	NA	--
Government, do	313.9	NA	--
Total nonagricultural employment[1], do	1,777.3	NA	--
Personal income:			
Total, millions	$32,046	$35,395	+10.4
Per capita	$7,316	$7,786	+6.4
Construction activity:			
Number of private and public residential units authorized	23,340	20,669	-11.4
Value of nonresidential construction, millions	$515.9	$551.5	+6.9
Value of State road contract awards, do	$310.0	$160.0	-48.4
Shipments of portland and masonry cement to and within the State, thousand short tons	1,687	1,503	-10.9
Nonfuel mineral production value:			
Total crude mineral value, millions	$385.7	$407.8	+5.7
Value per capita, resident population	$88	$89	+1.1
Value per square mile	$9,131	$9,654	+5.7

[p]Preliminary. NA Not available.

[1]Includes bituminous coal and oil and gas extraction.

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

Trends and Developments.—Historically, construction mineral commodities have accounted for the majority of the State's nonfuel mineral production. In 1980, total construction in Tennessee was down 43% from that of 1979. The value of all contracts for 1980 was $2.77 billion, down from $4.89 billion recorded in 1979. Contracts for nonresidential construction dropped 7% to $1.02 billion; those for residential, 13% to $1.19 billion; and those for nonbuilding—such as highways, bridges, and dams—77% to $565 million.[2] The construction decline would have been greater had not nonresidential building increased in December in Chattanooga, Knoxville, and Nashville; and residential construction improved in Chattanooga, Nashville, the Johnson City-Kingsport area, and Clarksville.[3]

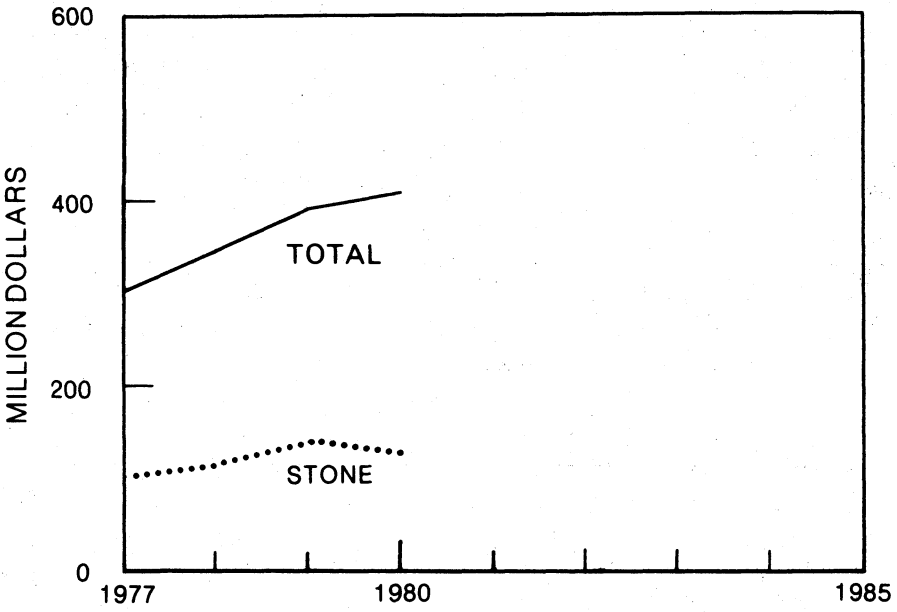

Figure 1.—Value of stone and total value of nonfuel mineral production in Tennessee.

The decrease in construction activity was mirrored in the State's construction mineral output in 1980. When compared with 1979 output, decreases were reported for cement (-5%), clays (-24%), sand and gravel (-20%), and stone (-16%). Although output of these commodities dropped, total State mineral value rose in 1980, reflecting higher unit prices for most commodities produced and a substantial increase in zinc production during the year. Output and value of zinc produced in 1980 were both up more than 50%.

In August, zinc mining began at New Jersey Zinc Co.'s Beaver Creek deposit in the Mascot-Jefferson City district. About the same time, development of Jersey Miniere Zinc Co.'s Gordonsville Mine was virtually completed and the mine was put on standby status. During the year, St. Joe Minerals Corp., in a joint venture with Freeport Minerals Co., shelved development of the Carthage zinc project near the city of Carthage in Smith County.

Legislation and Government Programs.—The Tennessee Department of Conservation's Division of Geology released a new aeromagnetic map, which should be useful to the mineral industry for exploration of various mineral resources. The map, on scale of 1:250,000, comprises four sheets representing the east-central, west, and west-central portions of Tennessee.

Also released was a series of nine geologic quadrangle maps and mineral resources summaries. The maps were prepared by the Division of Geology in cooperation with the Tennessee Valley Authority. Quadrangles released were Nashville, Fletcher Lake, Mount Airy, Scottsboro, Whitwell, Coble, Alto, Monteagle, and Morrison.

In the fall of 1980, when the State government decided to transfer the Division of Surface Mining of the Conservation Department from Nashville to Knoxville, 9 of the Division's 11 employees, including the Director, resigned. At yearend, office space was still being sought in Knoxville to house the newly transferred division.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Barite.—C. R. Wood Co., Inc., produced barite from its open pit mine and processed the ore at the company's plant in Loudon County near Sweetwater. The crushed and ground barite was shipped out-of-State for use primarily in the manufacture of paint and chemicals. Barite was also mined by A. J. Smith Co. at the Smith Mine in Loudon County; production at this mine began in 1979. Barite output and value increased 23% in 1980 compared with those of 1979.

Cement.—Four companies operating six plants produced both portland and masonry cement. All six plants produced portland cement; five of them also produced masonry cement. General Portland, Inc., operated at Chattanooga; Ideal Basic Industries, Inc., at Knoxville; Penn-Dixie Industries, Inc., at Richard City and Kingsport; and Gulf + Western Industries, Inc., at Nashville and Cowan.

Shipments of portland cement were down 2% in 1980, but value increased nearly 3% because of higher unit prices. Shipments of masonry cement were down 22%, and value decreased nearly 16%. Most of the cement was sold to ready-mix companies, followed by concrete product manufacturers, building material dealers, Government agencies, and highway contractors.

Table 4.—Tennessee: Portland cement salient statistics

(Short tons)

	1979	1980
Number of active plants	6	6
Production	1,394,276	1,328,170
Shipments from mills:		
Quantity	1,334,596	1,304,075
Value	$57,145,532	$58,827,066
Stocks at mills, Dec. 31	133,436	97,483

Table 5.—Tennessee: Masonry cement salient statistics

(Short tons)

	1979	1980
Number of active plants	5	5
Production	173,234	144,041
Shipments from mills:		
Quantity	169,835	132,407
Value	$8,600,241	7,241,345
Stocks at mills, Dec. 31	15,445	22,403

During the year, Penn-Dixie declared bankruptcy and filed a chapter 11 petition seeking court protection from creditors while it tried to devise a plan for repaying its debts. At yearend, the company awaited a Federal Bankruptcy Court decision on the sale of its two cement plants at Richard City and Kingsport to a subsidiary of Moore McCormack Resources, Inc., of Stamford, Conn.

Marquette Cement Co., a subsidiary of Gulf + Western Industries, Inc., closed two obsolete cement plants in Cowan and Nashville. Cement for the area served by these two plants is expected to be provided by a new cement plant being constructed by the company in Cape Girardeau, Mo. The new plant, with an annual capacity of 1 million tons, is scheduled to begin production in 1981.

Ideal Basic Industries, Inc., replaced four kilns at its Knoxville plant with a new type of preheater-precalciner kiln that will increase output from 470,000 to 580,000 tons per year. Also, the raw material system was converted from a wet to a dry process.

In early 1980, General Portland, Inc., purchased more than 3,000 acres along the Hiwassee River, northeast of Chattanooga, to insure future availability of raw materials for the manufacture of cement and construction aggregate. General Portland operates the Signal Mountain plant near Chattanooga.

The W. R. Bonsal Co., Lilesville, N.C., purchased a warehouse and buildings on a 5-acre tract of land in Franklin, near Nashville, and intends to invest more than $200,000 to convert the facilities into a plant for packaging dry cement mixes. The firm plans to produce the packaged cement mixes from the new plant by the spring of 1981.

Clays.—Tennessee's clay industry produced ball clay, fuller's earth, common clay, and a small amount of bentonite.

The State ranked first in the Nation in the production of ball clay, producing nearly 68% of the U.S. total. Production decreased nearly 21% in 1980 compared with that of 1979, dropping to near the 1977 level. Four companies in Carroll, Gibson, Henry, and Weakley Counties in the northwestern part of the State produced ball clay: Kentucky-Tennessee Clay Co. (nine operations); H. C. Spinks Clay Co., Inc., (eight

operations); Cyprus Industrial Minerals Co. (five operations); and Old Hickory Clay Co. (two operations). Principal uses were in the manufacture of pottery, floor and wall tile, sanitary ware, china dinnerware, oil refining catalysts, ceramics, and electrical porcelain.

The State ranked fifth in the production of fuller's earth (montmorillonite type). One company, Lowes, Inc., produced the State's entire output from one pit in Henry County. A small amount of bentonite was produced in Henry County by H. C. Spinks Clay Co., Inc., and was sold for use as drilling mud.

Table 6.—Tennessee: Ball clay sold or used by producers, by kind and use

(Short tons)

Use	1979			1980		
	Airfloat	Unprocessed	Total	Airfloat	Unprocessed	Total
Fine china and dinnerware	32,246	--	32,246	28,913	--	28,913
Electrical porcelain	W	W	32,179	21,405	--	21,405
Floor and wall tile, ceramic	W	W	99,410	W	W	62,064
Pottery	W	W	231,251	W	W	174,240
Sanitary ware	W	W	134,165	W	W	66,429
Other[1]	366,368	256,834	126,197	292,835	159,091	[2]149,193
Exports	68,690	37,999	106,689	56,459	46,881	103,340
Total	467,304	294,833	762,137	399,612	205,972	605,584

W Withheld to avoid disclosing company proprietary data; included in "Other."
[1]Includes common brick; catalysts (oil refining); china and dinnerware; crockery and other earthenware; fire brick, block, and shapes; floor and wall tile; fertilizers; fiberglass; high-alumina refractories; rubber; mortars and cement; adhesives (1980); pesticides and related products; kiln furniture; animal feed (1980); mineral wool and insulation (1980); chemical manufacturing (1980); textiles (1980); asphalt tile; waterproofing and sealing; and uses indicated by symbol W.
[2]Incomplete total; remainder included in individual totals.

Table 7.—Tennessee: Common clay sold or used by producers, by use

(Short tons)

Use	1979	1980
Brick	479,281	279,073
Portland cement	217,788	220,736
Total	697,069	499,809

Common clay and shale were produced by 8 companies at 13 pits in 9 counties. Production dropped nearly 28% in 1980 compared with 1979 levels, primarily because of the decline in construction activity in the State. Leading counties in order of descending output in 1980 were Hamilton, Knox, Davidson, and Sullivan. Principal producers were General Shale Products Corp., General Portland, Inc., and W. G. Bush & Co. Common clay was used principally in the production of face and common brick, portland cement, concrete block, and structural concrete.

Table 8.—Tennessee: Clays sold or used by producers

Year and type	Quantity (short tons)	Value	
		Total	Average per ton
1979:			
Ball clay	762,137	$19,663,038	$25.80
Common clay and shale	697,069	1,304,844	[1].87
Total	1,459,206	20,967,882	XX
1980:			
Ball clay	605,584	17,531,928	28.95
Common clay and shale	499,809	1,171,215	2.34
Total	1,105,393	18,703,143	XX

XX Not applicable.

Fluorspar.—United States Borax & Chemical Corp. discontinued development work on its fluorite-barite-zinc ore body near Sweetwater in eastern Tennessee. The company, which sank a 600-foot exploration shaft and development drifts, was reeval-

uating reserve data. If reevaluation is favorable, U.S. Borax plans to drive a decline from the bottom of this shaft into drilled reserves later in 1981.

Graphite.—Synthetic graphite was manufactured from petroleum coke by Union Carbide Corp. at its plant near Columbia in Maury County. Graphite electrodes and synthetic graphite powder used in steelmaking and as lubricants were produced at the plant.

Lime.—Quicklime and hydrated lime were produced at three plants in eastern Tennessee. Bowater Southern Paper Corp. operated a plant at Calhoun in McMinn County and Williams Lime Manufacturing Co. operated a plant in Knoxville, Knox County. In late 1979, Tenn-Luttrell Lime Co. began operating an 800-ton-per-day, coal-fired limekiln and ancillary facility at Luttrell, near Knoxville.

Total lime production in the State increased substantially in 1980 compared with that of 1979. This increase is attributed mostly to Tenn-Luttrell's operation attaining full production status. In 1980, the company reported a 15-fold increase in production compared with 1979 levels. Both quicklime and hydrated lime were produced. The lime was used principally for specialty chemical products.

Perlite.—Chemrock Corp., the only producer in the State, expanded perlite at its Nashville plant. The crude perlite was shipped from mines in Colorado and New Mexico. In 1980, output and value decreased 27% and 22%, respectively, compared with 1979 levels. This decrease can largely be attributed to the decrease in construction activity. Principal uses of the product were in concrete and plaster aggregate, as a filter aid, as insulation, and for horticultural purposes.

Phosphate Rock.—Among the seven States producing phosphate rock in 1980, Tennessee ranked fourth in tonnage and value of phosphate rock mined. Three companies operated surface mines in four counties (Hickman, Maury, Giles, and Williamson) in the Columbia-Mount Pleasant district of south-central Tennessee.

Hooker Chemicals & Plastics Corp., Monsanto Industrial Chemicals Co., and Stauffer Chemical Co. mined and beneficiated phosphate rock for reduction to elemental phosphorus in electric furnaces. The phosphorus was subsequently converted into a wide variety of industrial chemicals. Average grade of the mined ore was 20.2% P_2O_5.

Table 9.—Tennessee: Phosphate rock sold or used by producers

Year	Rock	P_2O_5 content	Value	
	(thousand metric tons)		Total (thousands)	Average per ton
1976	1,731	448	$15,326	$8.85
1977	1,723	436	14,064	8.16
1978	1,688	434	13,833	8.19
1979	2,140	545	17,008	7.95
1980	1,665	432	13,330	8.01

Table 10.—Tennessee: Production of phosphate rock

Year	Mine production (thousand metric tons)		Marketable production (thousand metric tons)		Value, marketable production	
	Rock	P_2O_5	Rock	P_2O_5	Total (thousands)	Average per ton
1976	3,023	618	1,633	421	$14,541	$8.90
1977	3,307	665	1,747	442	14,253	8.16
1978	3,052	646	1,709	442	14,047	8.22
1979	3,211	670	1,873	467	14,770	7.88
1980	2,981	602	1,582	410	12,765	8.07

Pyrite.—Tennessee led the Nation in output and value of pyrite, producing nearly 99% of the U.S. total. Colorado and Arizona were the only two other States reporting production. The only producer in the State was Cities Service Co. at Copperhill, Polk County, where pyrite was recovered by flotation from sulfide ore mined at the company's underground and surface operations. Concentrates from the plant yielded industrial chemicals, primarily sulfuric acid. Some of the acid was used at the plant to produce other chemicals, and the remainder was shipped to industry. During the year, the company dismantled its iron pellet facility at Copperhill, which closed in March 1979 because of its unprofitability.

Sand and Gravel.—Construction sand and gravel was produced by 59 companies in 32 counties. In 1980, output and value declined 20% and 10%, respectively, primarily because of the slowdown in the construction industry. Although construction sand and gravel is produced throughout the State, approximately 41% of the State's 8.7 million tons came from the Shelby-Memphis area in the western part of the State. Principal uses were for concrete and asphaltic aggregate, roadbase, and fill.

Industrial sand comprised less than 3% of the State's total sand and gravel production. Three companies with four mines in Benton, Campbell, and Carroll Counties produced the sand. Principal uses were for flatglass, foundry uses, and coal washing.

Table 11.—Tennessee: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,164	$8,803	$2.78	3,145	$9,370	$2.98
Plaster and gunite sands	191	664	3.48	133	765	5.74
Concrete products	265	825	3.11	287	941	3.28
Asphaltic concrete	2,062	5,180	2.51	1,503	3,879	2.58
Roadbase and coverings	3,644	7,356	2.02	2,195	4,389	2.00
Fill	1,286	1,839	1.43	734	1,055	1.44
Snow and ice control	W	W	3.05	10	37	3.65
Other	165	634	3.84	669	2,388	3.57
Total[1] or average	10,778	25,300	2.35	8,676	22,824	2.63

W Withheld to avoid disclosing company proprietary data; included in "Other."
[1]Data may not add to totals shown because of independent rounding.

Table 12.—Tennessee: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	4,422	$10,462	$2.37	4,668	$11,689	$2.50
Gravel	6,356	14,838	2.33	4,008	11,134	2.78
Total[1] or average	10,778	25,300	2.35	8,676	22,824	2.63
Industrial:						
Sand	402	3,578	8.91	244	2,106	8.61
Gravel	30	177	5.96	--	--	--
Total or average	r432	3,755	r8.69	244	2,106	8.61
Grand total[1] or average	11,210	29,056	2.59	8,921	24,930	2.79

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

Table 13.—Tennessee: Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1979			1980		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Benton	7	1,121	2,363	7	936	2,083
Coffee	2	W	W	1	120	432
Cumberland	1	150	263	1	W	W
Decatur	2	W	W	3	494	1,143
Dyer	3	135	217	3	193	364
Fayette	3	85	108	2	W	W
Fentress	1	57	85	1	45	78
Giles	1	250	250	1	20	20
Hardeman	1	1	1	2	W	W
Hardin	4	153	249	2	W	W
Henry	3	250	457	3	199	419
Humphreys	1	254	610	1	234	608
Knox	2	W	W	3	250	1,353
Lauderdale	4	56	92	1	W	W
Lawrence	1	12	18	1	9	16
McMinn	2	W	W	--	--	--
Madison	2	W	W	3	37	51
Marion	1	W	314	1	W	289
Obion	5	414	817	4	243	578
Overton	--	--	--	1	W	W
Shelby	16	4,406	9,785	12	3,535	8,113
Stewart	1	259	908	1	W	927
Tipton	5	388	968	4	417	1,318
Union	1	36	90	1	29	83
Undistributed[1]	14	3,182	11,462	12	2,158	7,056
Total[2]	r83	11,210	29,056	71	8,921	24,930

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1]Includes Campbell, Carroll, Franklin, Greene, Hamilton, McNairy, Putnam, Roane, Sevier, Unicoi, and Wayne Counties.

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

Silicon Carbide.—The Carborundum Co. plant in Jacksboro remained closed in 1980 after closing in late 1979 because of power cost increases by the Tennessee Valley Authority (TVA). The plant produced silicon carbide for abrasives, refractories, and metallurgical applications.

In late 1980, the company initiated a lawsuit against TVA requesting release from a minimum fee clause in its power contract. TVA was attempting to recover nearly $857,000 that it claimed the company owed it. At the same time, Carborundum faced a $10 million damage suit filed by the U. S. Environmental Protection Agency, which charged that the Jacksboro plant had continuously violated Federal air pollution laws, exceeding emissions on fly ash.

Stone.—Stone accounted for nearly one-third of the State's value of nonfuel mineral production. Crushed limestone accounted for 99.9% of the total stone production; dimension sandstone and marble for the remainder. Crushed stone was produced in 67 counties in central and eastern Tennessee by 80 companies operating 126 quarries. Three companies with 33 quarries produced nearly 50% of the State's total. Leading producers were Vulcan Materials Co., American Limestone Co., Ralph Rogers & Co., Inc., and Koppers Co. Principal uses were for roadbase, concrete, and bituminous aggregate and agricultural limestone.

Dimension sandstone and marble were produced at seven quarries for use as rubble, rough block, house stone veneer, cut stone, and other uses. Production decreased 14% in 1980 compared with the 1979 level. Leading producers were John J. Craig Co., Turner Stone Co., and Crab Orchard Stone Co., Inc.

Vulcan Materials Co.'s Riverside Drive plant in Knoxville was conferred an "Outstanding Achievement Award" by the National Crushed Stone Association. The award, presented under the Association's About Face Program, is given in recognition of exemplary programs for quarry beautification and reclamation planning in progress or near completion.

Vermiculite.—Construction Products Div. of W. R. Grace & Co. expanded crude vermiculite at its plant in Nashville. Output declined 15% in 1980 compared with 1979 production. Principal uses were for lightweight concrete aggregate, block insulation, horticulture, plaster aggregate, and loose fill.

Table 14.—Tennessee: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	2,068	5,767	1,864	5,973
Poultry grit and mineral food	444	2,030	448	2,271
Concrete aggregate	5,585	16,375	5,182	16,933
Bituminous aggregate	3,681	10,357	2,817	8,860
Macadam aggregate	2,071	5,698	2,034	6,320
Dense-graded roadbase stone	14,810	41,280	11,888	37,951
Surface treatment aggregate	1,402	3,984	1,492	4,773
Other construction aggregate and roadstone	10,062	29,092	7,477	23,142
Riprap and jetty stone	855	2,517	595	1,842
Railroad ballast	237	581	218	660
Filter stone	64	190	255	873
Manufactured fine aggregate (stone sand)	1,273	4,178	1,127	4,647
Cement manufacture	1,619	4,572	1,783	5,383
Lime manufacture	W	W	324	1,171
Glass manufacture	246	960	246	983
Other[2]	r1,301	r6,147	835	5,214
Total[3]	45,718	133,727	38,584	126,993

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Other."

[1]Includes limestone and marble.

[2]Includes stone used in mine dusting, asphalt filler, whiting or whiting substitute, other fillers or extenders, roofing granules (1980), terrazzo and exposed aggregate, refractory stone (1980), sulfur dioxide, waste material, and other uses.

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

Table 15.—Tennessee: Dimension stone[1] sold or used by producers, by use

Use	1979			1980		
	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)
Rough stone:						
Irregular-shaped stone	W	W	W	150	2	$5
Rubble	W	W	W	3,680	47	166
Flagging	W	W	W	652	8	29
Dressed stone:						
Cut stone	W	W	W	1,412	18	323
Sawed stone	W	W	W	739	8	159
House stone veneer	1,506	19	$56	W	W	W
Monumental	--	--	--	6	(2)	1
Flagging	46	1	11	73	1	18
Other[3]	10,436	124	932	3,606	41	184
Total[4]	11,988	144	1,000	10,318	125	883

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

[1]Includes marble and sandstone.

[2]Less than 1/2 unit.

[3]Includes stone used in rough blocks, and other uses (1980).

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

METALS

Aluminum.—Tennessee ranked fourth in the Nation in output of primary aluminum in 1980. Two companies, Aluminum Co. of America (Alcoa), Blount County, and Consolidated Aluminum Corp. (Conalco), Humphreys County, produced primary aluminum from imported alumina.

In November, Phelps Dodge Corp. sold a 40% equity interest in Consolidated Aluminum Corp. to Swiss Aluminum Ltd. (Alusuisse), owner of the remaining 60% of Conalco's equity. Alusuisse agreed to purchase Conalco's shares for $150 million in installments through 1985. The first installment, totaling $40 million, was paid at yearend.

In December, Alcoa opened a recycling plant in Memphis that will process nearly 6 million pounds of aluminum beverage cans during the first year of operation. The new $500,000 facility will serve as the central receiving point for used cans purchased from 24 recycling center operations in a surrounding seven-State area.

Copper.—Cities Services Co., the State's only copper producer, operated three underground mines (Boyd, Calloway, and Cherokee) and an open pit mine at Copperhill in Polk County. The Copperhill facilities also included a flotation plant and a metallurgical-chemical processing complex. Ore was separated into copper, pyrite, and zinc concentrates. Copper output and value decreased 13% and 4%, respectively, in 1980 compared with 1979 levels.

Table 16.—Tennessee: Mine production (recoverable) of gold, silver, copper, and zinc

		1978	1979	1980
Mines producing: Lode		9	r11	11
Material sold or treated:				
Ore:				
Copper-zinc	thousand metric tons	1,837	1,901	1,901
Zinc	do.	3,292	3,256	5,057
Total	do.	5,129	5,157	6,958
Production:				
Quantity:				
Gold	troy ounces	W	--	--
Silver	do.	W	W	W
Copper	metric tons	11,289	W	W
Zinc	do.	87,906	85,119	128,722
Value:				
Gold	thousands	W	--	--
Silver	do.	W	W	W
Copper	do.	$16,550	W	W
Zinc	do.	$60,078	$69,995	$106,220

rRevised. W Withheld to avoid disclosing company proprietary data.

Ferroalloys.—Tennessee ranked second in the Nation in output of ferroalloys in 1980. Six companies produced about 171,000 tons of ferrophosphorus, ferrosilicon, ferromanganese, and ferrochromium. Output in 1980 was down 25% because of lower demand by the steel industry. Principal sales were for additives and alloying elements in the manufacture of various steel products.

Chromasco Ltd., Toronto, Ontario, shut down its Woodstock ferrochromium operations in August because of flat demand for the alloy and a flood of imported South African product. At yearend, the company was uncertain when the plant would start up again.

Gold.—No gold production was reported in 1980. The last reported production was in 1978 when Cities Service produced a small amount at its Copperhill operations.

Iron and Steel.—Florida Steel Corp. was constructing a $55 million steel melting and rolling mill at Jackson. The new minimill will be Florida Steel's largest, with a capacity of 400,000 tons of billets and 350,000 tons of finished product. Expected date of operation is sometime in 1981.

Manganese.—Foote Mineral Co. continued to produce electrolytic manganese at its plant in New Johnsonville. Production remained curtailed because of worldwide oversupply of manganese metal.

Inco Electro Energy Corp. (formerly ESB, Inc.) produced electrolytic manganese dioxide at the Lavino plant in Covington. In 1980, the company contracted to receive all of the electrolytic manganese produced when a new 6,000-ton-per-year facility in Japan is completed in 1981.

Rare Earths and Thorium.—Davison Specialty Chemical Co., a subsidiary of W. R. Grace & Co., processed monazite and a minor amount of bastnasite concentrates at a plant in Chattanooga to produce rare-earth polishing compounds and catalyst materials. The company also extracted thorium from monazite during the year. About 4,200 tons of thorium was being stored at the plant site at yearend.

Silver.—Silver was recovered from concentrates produced during copper refining at Cities Service Co.'s Copperhill operations in Polk County.

Titanium.—E. I. du Pont de Nemours & Co., Inc., continued to produce titanium dioxide pigment at its New Johnsville plant from domestic and imported ilmenite concentrates. The plant produced a major portion of the firm's titanium dioxide. Pigments were used mainly in paints, varnishes, lacquers, paper, and plastics.

Zinc.—Tennessee ranked first in the Nation in output and value of zinc in 1980, producing 38% of the Nation's total. In 1980, there were 12 active mines operating in the eastern, central, and southeastern part of the State. Both output and value increased over 50% in 1980 compared with 1979 levels. This increase was largely the result of a worldwide shortage of zinc concentrates during 1980, which spurred Tennessee zinc producers to increase output.

In the Mascot-Jefferson City zinc district, in the eastern part of the State, ASARCO Incorporated operated four mines (Coy, Immel, New Market, and Young). In 1980, crude ore production was 66% greater than in 1979, and 50% greater than the average output for the 5-year period 1975-79. In December 1980, the company reported that its proven and probable ore in both its operating and nonoperating properties amounted to 8.3 million tons containing 3.52% zinc. The company continued diamond drilling at several zinc properties during the year.

New Jersey Zinc Co. (NJZ) operated the Jefferson City Mine in the Mascot-Jefferson

City district and the Idol Mine in the Copper Ridge district in Grainger County. In August, NJZ started mining the Beaver Creek deposit, which had been under development since December 1974.

Table 17.—Tennessee: Tenor of zinc ore milled and concentrates produced in 1980

Total material	metric tons	5,056,929
Metal content of ore:[1] Zinc	percent	2.47
Concentrates produced and average content:		
Zinc	metric tons	216,227
Recovery ratio	percent	4.28
Average zinc content	do	62.82

[1]Figure represents metal content of crude ore only as contained in the concentrate.

In the Middle Tennessee zinc district, Jersey Miniere Zinc Co. (JMZ) operated the Elmwood Mine in Smith County. Jersey Miniere is a joint venture of New Jersey Zinc Co. (60%), a wholly owned subsidiary of Gulf + Western Industries, and Union Miniere S.A. of Belgium (40%). Development of JMZ's Gordonsville Mine was virtually complete in July 1980. At yearend, the mine was put on standby basis because a sufficient supply of zinc concentrates was available for the company's Clarksville refinery from other sources at costs lower than those projected for concentrates from Gordonsville.

JMZ's Clarksville refinery, which was designed to produce 90,000 tons of slab zinc annually, commenced operations in November 1978. The refinery produced about 44,900 tons between August 1978 and July 1979, and about 81,200 tons between August 1979 and July 1980. During this latter period, approximately 56% of the refinery's requirements were provided from the company's mines. At yearend, the refinery was operating at approximately 95% capacity.

In the Ducktown district in southeastern Tennessee, Cities Service Co. continued recovering zinc sulfide from its mines in Polk County. The ore was processed at the nearby Copperhill plant.

St. Joe Minerals Corp. decided not to proceed with development of the Smith zinc property near Carthage. Since 1976, St. Joe and Freeport Zinc Co. have conducted a joint venture under which St. Joe acquired a 70% participating interest in exchange for a commitment to perform further evaluation work. A 1,150-foot exploration shaft was completed at the property in 1979.

[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.
[2]Knoxville News Sentinel, Feb. 7, 1981.
[3]Tennessee Journal, Feb. 16, 1981.

Table 18.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum smelters:			
Aluminum Co. of America	Box 158 Alcoa, TN 37701	Plant	Blount.
Consolidated Aluminum Corp	1102 Richmond St. Jackson, TN 38301	do	Humphreys.
Barite:			
A. J. Smith Co	Route 3 Sweetwater, TN 37874	Open pit mine	Loudon.
C. R. Wood Co., Inc	Box 284 Sweetwater, TN 37874	do	Do.
Cement:			
General Portland, Inc.[1 2]	1300 American National Bank Bldg. Chattanooga, TN 37402	Plant	Hamilton.
Gulf + Western Industries, Inc. (Marquette Cement Co.)[1 2]	First American Center Nashville, TN 37238	Plants	Davidson and Franklin.
Ideal Basic Industries, Inc.[1 2]	Box 6238 Knoxville, TN 37238	Plant	Knox.
Penn-Dixie Industries, Inc.[1 2]	60 East 42d St. New York, NY 10017	Plants	Marion and Sullivan.
Clays:			
W. G. Bush & Co	1136 2d Ave. North Nashville, TN 37208	Pits and plants	Davidson and Weakley.
Cyprus Industrial Minerals Co	Box 111 Gleason, TN 38229	do	Carroll and Weakley.
General Shale Products Corp	Box 3547 CRS Johnson City, TN 37601	do	Anderson, Hamilton, Knox, Sullivan, Washington.

See footnotes at end of table.

Table 18.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Clays —Continued			
Kentucky-Tennessee Clay Co	Box 449 Mayfield, KY 42066	Pits and plants	Carroll, Gibson, Henry, Weakley.
Lowe's, Inc	Box 819 Paris, TN 38242	do	Henry.
Old Hickory Clay Co	Box 188 Gleason, TN 38229	do	Henry and Weakley.
H. C. Spinks Clay Co., Inc	Box 820 Paris, TN 38242	do	Carroll, Henry, Weakley.
Copper:			
Cities Service Co.[3]	Copperhill, TN 37317	Underground mines, surface mine, and plant.	Polk.
Ferroalloys:			
Chromium Mining & Smelting Co.	Box 28538 Memphis, TN 38128	Plant	Shelby.
International Minerals & Chemical Corp.	818 First Tennessee Bank Bldg. Chattanooga, TN 37402	do	Marion.
Roane Electric Furnace Co	Box 298 Rockwood, TN 37854	do	Roane.
Graphite, artificial:			
Union Carbide Corp	Box 513 Columbia, TN 38401	do	Maury.
Lime:			
Bowater Southern Paper Corp	Calhoun, TN 37309	do	McMinn.
Tenn-Luttrell Lime Co	Box 69 Luttrell, TN 37779	do	Union.
Williams Lime Manufacturing Co	Box 2286 Knoxville, TN 37901	do	Knox.
Perlite, expanded:			
Chemrock Corp	Osage St. Nashville, TN 37208	do	Davidson.
Phosphate rock:			
Hooker Chemicals & Plastics Corp.	Box 591 Columbia, TN 38401	do	Do.
Monsanto Industrial Chemicals Co.[4]	Columbia, TN 38401	do	Do.
Stauffer Chemical Co.[4]	Box 472 Mt. Pleasant, TN 38474	do	Do.
Sand and gravel:			
Clyde Owen Sand & Gravel, Inc	10636 Shelton Rd. Collierville, TN 38017	Pits	Shelby.
Memphis Stone & Gravel Co	Box 38269 Germantown, TN 38138	do	Benton, Dyer, Shelby.
Ralph Rogers & Co., Inc	720 Argyle Ave. Nashville, TN 37203	do	Tipton.
Standard Construction Co., Inc	do	Pit	Shelby.
Stone:			
American Limestone Co	Box 2389 Knoxville, TN 37901	Quarries	Jefferson, Knox, Sullivan.
Koppers Co. (Stoneman, Inc.)	Box 2098 Chattanooga, TN 37409	do	Bedford, Hamilton, Rutherford, Warren.
Ralph Rogers & Co., Inc. (Mid-South Pavers, Inc.)	720 Argyle Ave. Nashville, TN 37203	do	Various.
Vulcan Materials Co	Box 7 Knoxville, TN 37901	do	Do.
Vermiculite, exfoliated:			
W. R. Grace & Co	4061 Powell Ave. Nashville, TN 37204	Plant	Davidson.
Zinc:			
ASARCO Incorporated[2]	Mascot, TN 37806	Underground mines and plant.	Jefferson and Knox.
Jersey Miniere Zinc Co	Elmwood, TN 38560	Underground mine	Smith.
New Jersey Zinc Co	Box 32 Jefferson City, TN 37760	Underground mines	Jefferson and Grainger.
United States Steel Corp	Jefferson City, TN 37760	Underground mine	Jefferson.

[1] Also clays.
[2] Also stone.
[3] Also silver, zinc, pyrites.
[4] Also ferroalloys.

The Mineral Industry of Texas

This chapter has been prepared under a Memorandum of Understanding 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 nonfuel minerals.

By Albert E. Ward[1]

Total value of nonfuel minerals increased 23.5% in 1980, compared with the 21.7% increase in 1979, and the 11.5% rise in 1978. (Based on the implicit price deflator for gross national product, the increases adjusted for inflation would be 13.3% in 1980, 12.2% in 1979, and 3.8% in 1978.) Texas was the Nation's leading producer of cement, gypsum, magnesium chloride, native asphalt, stone, sulfur, and talc, and number two in clay, salt, sand and gravel, and sodium sulfate.

Table 1.—Nonfuel mineral production in Texas[1]

Mineral	1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
Cement:				
Masonry thousand short tons	268	$15,593	241	$18,310
Portland do	9,353	475,836	9,517	535,690
Clays do	3,871	21,533	3,763	27,022
Gem stones	NA	170	NA	160
Gypsum thousand short tons	1,903	11,438	1,681	14,124
Helium (high-purity) million cubic feet	r38	r874	35	805
Lime thousand short tons	1,507	59,520	1,515	67,075
Salt do	11,283	67,602	9,978	93,414
Sand and gravel do	52,846	167,076	46,704	171,576
Stone:				
Crushed do	74,612	188,746	76,483	220,265
Dimension do	17	3,636	37	7,095
Sulfur (Frasch) thousand metric tons	4,649	W	4,810	W
Talc and soapstone thousand short tons	207	1,544	401	4,295
Combined value of asphalt (natural), fluorspar (1979), graphite (1979), helium (crude), iron ore, magnesium chloride, magnesium compounds, sodium sulfate, and values indicated by symbol W	XX	r391,071	XX	574,820
Total	XX	r1,404,639	XX	1,734,651

rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

Table 2.—Value of nonfuel mineral production in Texas, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Andrews	--	W	Stone.
Archer	$40	--	
Armstrong	W	W	Sand and gravel.
Atascosa	1,271	$1,460	Do.
Bailey	W	W	Stone.
Bastrop	536	599	Clays.
Bell	4,385	4,016	Stone, sand and gravel.
Bexar	W	W	Cement, stone, lime, sand and gravel, clays.
Borden	W	W	Sand and gravel.
Bosque	W	W	Lime, stone.
Bowie	643	495	Sand and gravel.
Brazoria	W	W	Magnesium chloride, salt, magnesium compounds, sand and gravel.
Brazos	W	W	Sand and gravel.
Brewster	W	W	Sand and gravel, fluorspar.
Brown	W	W	Stone, clays.
Burleson	W	W	Sand and gravel.
Burnet	W	W	Stone, graphite, sand and gravel.
Calhoun	W	W	Lime, stone.
Callahan	--	W	Stone.
Camp	W	W	Clays.
Carson	--	W	Stone.
Cass	W	W	Iron ore.
Chambers	W	W	Salt, sand and gravel, clays.
Cherokee	547	1,123	Clays.
Clay	4	--	
Coke	W	W	Sand and gravel.
Coleman	W	W	Clays.
Collin	W	W	Stone.
Colorado	31,471	32,049	Sand and gravel.
Comal	W	W	Stone, lime, sand and gravel.
Comanche	W	22	Stone.
Cooke	W	W	Sand and gravel, stone.
Coryell	W	W	Do.
Crockett	410	410	Stone.
Crosby	W	W	Sand and gravel.
Culberson	W	W	Sulfur, talc, stone.
Dallas	W	W	Cement, sand and gravel, stone, clays.
Deaf Smith	W	W	Lime.
Denton	1,594	W	Sand and gravel, clays.
Duval	W	W	Salt, sand and gravel.
Eastland	W	W	Clays, stone.
Ector	W	W	Cement, stone.
Ellis	W	W	Cement, stone, clays.
El Paso	W	W	Cement, stone, sand and gravel.
Falls	600	665	Stone.
Fannin	W	W	Sand and gravel.
Fayette	W	W	Clays, sand and gravel.
Fisher	W	W	Gypsum, clays.
Fort Bend	15,245	24,596	Sulfur, salt, clays.
Freestone	W	W	Stone, clays.
Gaines	W	W	Sodium sulfate, stone.
Galveston	W	W	Sand and gravel, clays.
Gillespie	W	W	Gypsum, sand and gravel, stone.
Gonzales	--	W	Clays.
Gray	W	--	
Grayson	W	1,086	Stone.
Gregg	364	364	Sand and gravel.
Grimes	--	W	Stone.
Guadalupe	W	W	Sand and gravel, clays.
Hall	263	263	Sand and gravel.
Hansford	W	W	Helium, stone.
Hardeman	W	W	Gypsum.
Hardin	W	W	Sand and gravel.
Harris	120,849	128,370	Cement, sand and gravel, salt, lime, clays.
Harrison	W	W	Clays, sand and gravel.
Hays	W	2,751	Sand and gravel.
Henderson	W	W	Sand and gravel, iron ore, clays.
Hidalgo	W	W	Sand and gravel, stone.
Hill	W	W	Lime, stone.
Hockley	352	352	Stone.
Hood	W	W	Do.
Hopkins	--	W	Clays.
Houston	W	W	Sand and gravel.
Howard	W	W	Sand and gravel, stone.
Hudspeth	W	W	Talc, stone, gypsum.
Hunt	--	48	Stone.
Hutchinson	W	W	Sand and gravel, salt.
Jack	W	1,348	Stone.
Jefferson	W	W	Sulfur, salt, sand and gravel.
Jim Wells	W	W	Stone.
Johnson	W	W	Lime, sand and gravel, stone.
Jones	W	W	Sand and gravel, stone.
Karnes	W	W	Stone.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Texas, by county[1] —Continued

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Kaufman	$1,310	$1,610	Stone.
Kent	4	4	Sand and gravel.
Kerr	W	W	Do.
Kimble	109	W	Sand and gravel, stone.
Kleberg	30	--	
Lamar	W	W	Sand and gravel.
Lamb	W	W	Stone.
Lampasas	143	143	Sand and gravel.
Liberty	W	W	Sulfur, sand and gravel.
Limestone	W	W	Stone, clays, sand and gravel.
Live Oak	W	W	Sand and gravel.
Llano	W	W	Stone.
Lubbock	219	362	Stone, sand and gravel.
Lynn	W	W	Stone.
McCulloch	W	W	Sand and gravel.
McLennan	W	W	Cement, sand and gravel, stone, clays.
McMullen	389	217	Stone.
Marion	W	W	Clays.
Mason	125	5	Stone.
Matagordo	W	W	Salt.
Maverick	W	W	Sand and gravel.
Medina	W	W	Stone, sand and gravel, clays.
Midland	826	W	Stone.
Mills	9	--	
Mitchell	--	W	Sand and gravel.
Montague	W	W	Stone.
Montgomery	61	W	Sand and gravel.
Moore	W	874	Helium.
Morris	W	W	Iron ore.
Motley	W	W	Sand and gravel.
Nacogdoches	W	W	Clays, stone.
Navarro	W	W	Do.
Newton	--	W	Sand and gravel.
Nolan	W	33,816	Cement, gypsum, stone, sand and gravel, clays.
Neuces	W	W	Cement, lime, sand and gravel.
Oldham	1,876	1,917	Sand and gravel.
Orange	W	W	Cement, sand and gravel, clays.
Palo Pinto	W	W	Sand and gravel, clays.
Parker	W	W	Stone, clays, sand and gravel.
Pecos	W	W	Sulfur, sand and gravel.
Polk	184	151	Sand and gravel.
Potter	13,792	17,824	Cement, sand and gravel, stone, clays.
Presidio	W	W	Sand and gravel.
Randall	W	W	Stone.
Reeves	W	W	Sand and gravel, stone.
Runnels	W	--	
Rusk	W	W	Clays.
San Patricio	W	W	Stone, clays.
San Saba	W	W	Stone.
Scurry	259	W	Magnesium chloride.
Smith	1,467	1,487	Sand and gravel, clays.
Somervell	W	W	Sand and gravel.
Starr	W	W	Do.
Stephens	W	--	
Stonewall	W	W	Gypsum.
Tarrant	W	W	Cement, sand and gravel, stone.
Taylor	W	W	Stone, sand and gravel, clays.
Terry	W	W	Sodium sulfate.
Tom Green	W	W	Stone.
Travis	W	W	Cement, lime, sand and gravel, stone.
Upshur	4	4	Sand and gravel.
Uvalde	W	W	Stone, asphalt, sand and gravel.
Val Verde	389	W	Sand and gravel, stone.
Van Zandt	W	W	Salt, clays.
Victoria	8,506	W	Sand and gravel.
Walker	W	W	Stone, clays, sand and gravel.
Waller	W	--	
Ward	1,166	W	Sand and gravel, stone.
Webb	W	W	Do.
Wharton	W	W	Sulfur.
Wheeler	--	W	Stone.
Wichita	W	6	Sand and gravel, stone.
Williamson	W	19,865	Stone.
Wilson	W	39	Clays.
Winkler	W	W	Salt.
Wise	W	W	Stone, sand and gravel, clays.
Wood	W	W	Sand and gravel, clays.
Yoakum	W	W	Salt.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Texas, by county[1] —Continued

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Young	W	W	Stone, sand and gravel.
Zavala	—	$40	Stone.
Undistributed[2]	$944,702	1,126,258	
Total[3]	1,154,160	1,404,639	

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

[1]The following counties are not listed because no nonfuel mineral production was reported: Anderson, Angelina, Aransas, Austin, Bandera, Baylor, Bee, Blanco, Briscoe, Brooks, Caldwell, Cameron, Castro, Childress, Cochran, Collingsworth, Cooch, Cottle, Crane, Dallam, Dawson, Delta, De Witt, Dickens, Dimmit, Donley, Edwards, Erath, Floyd, Foard, Franklin, Frie, Garza, Glasscock, Goliad, Hale, Hamilton, Hartley, Haskell, Hemphill, Irion, Jackson, Jasper, Jeff Davis, Jim Hogg, Kendall, Kenedy, King, Kinney, Knox, La Salle, Lavaca, Lee, Leon, Lipscomb, Loving, Madison, Martin, Menard, Milam, Ochiltree, Panola, Parmer, Rains, Reagan, Real, Red River, Refugio, Roberts, Robertson, Rockwall, Sabine, San Augustine, San Jacinto, Schleicher, Shackelford, Shelby, Sherman, Sterling, Sutton, Swisher, Terrell, Throckmorton, Titus, Trinity, Tyler, Upton, Washington, Wilbarger, Willacy, and Zapata.

[2]Includes gem stones and values indicated by symbol W.

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

Table 3.—Indicators of Texas business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	6,244.0	6,412.0	+2.7
Unemployment	do	263.0	337.0	+28.1
Employment (nonagricultural):				
Mining[1]	do	203.3	236.7	+16.4
Manufacturing	do	1,021.9	1,048.9	+2.6
Contract construction	do	416.2	428.6	+3.0
Transportation and public utilities	do	352.4	366.0	+3.9
Wholesale and retail trade	do	1,382.5	1,429.3	+3.4
Finance, insurance, real estate	do	314.9	336.6	+6.9
Services	do	957.4	1,017.6	+6.3
Government	do	953.2	998.1	+4.7
Total nonagricultural employment[1]	do	5,601.8	5,861.8	+4.6
Personal income:				
Total	millions	$117,454	$134,846	+14.8
Per capita		$8,778	$9,513	+8.4
Construction activity:				
Number of private and public residential units authorized		150,031	128,347	-14.4
Value of nonresidential construction	millions	$3,536.0	$4,334.4	+22.6
Value of State road contract awards	do	$765.0	$710.0	-7.2
Shipments of portland and masonry cement to and within the State	thousand short tons	8,996	9,063	+.7
Nonfuel mineral production value:				
Total crude mineral value	millions	[r]$1,404.6	$1,734.7	+23.5
Value per capita, resident population		$105	$122	+16.2
Value per square mile		$5,254	$6,489	+23.5

[p]Preliminary. [r]Revised.

[1]Includes oil and gas extraction.

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

The increasing diversity of the Texas economy insulates it from downturns in some cyclic industrial or supply-demand-sensitive agricultural categories; however, a robust mineral fuels sector was the major factor in the State's strong economic performance in 1980. Active exploration for and development of oil, gas, and lignite resources, in turn, created strong demand for a variety of construction minerals and products as well as for iron ore and finished steel supplies.

In 1980, nonfuel mineral production was recorded in 163 Texas counties. Essentially all of these nonfuel minerals are bulky, low-value commodities that favor expansion or development of in-State resources. Construction minerals and their manufactured products generally tend to satisfy local markets. Most construction activity is interest-sensitive, long-term highway projects and commercial buildings are exceptions; therefore, output of many construction minerals are adversely affected by high interest rates. During the year, most interest rates rose to record highs through April, declined to a trough in August, and resumed the climb to new record peaks at yearend. Owing to these volatile interest-rate gyrations, producers were confronted with production and inventory problems that undercut efficient operations. For example, Texas cement producers have been operating at near-capacity levels in recent years to satisfy strong regional demand; however, owing to the two interest-rate crests in 1980 and subsequent downturns in housing and other light construction activities, cement manufacturers were burdened by surging cement stocks in the spring and at yearend.

Economic indicators for Texas, as reported by the Texas Employment Commission, the U.S. Department of Commerce, and the U.S. Department of Labor, mostly were more favorable than nationwide figures. Employment in all major business sectors in Texas gained in 1980. Total employment in Texas was 6,412,000, an increase of 168,000 jobs or 2.7% over that of 1979, whereas U.S. total employment was up 325,000 or 0.3%. State unemployment was 5.0%, whereas the national figure was more than 7%. Personal income of $134.8 billion, or $9,513 per capita, increased 14.8% in the State compared with 11.1% for the country. Texas per capita income was slightly above the national figure and markedly higher than that of surrounding Southwestern States.

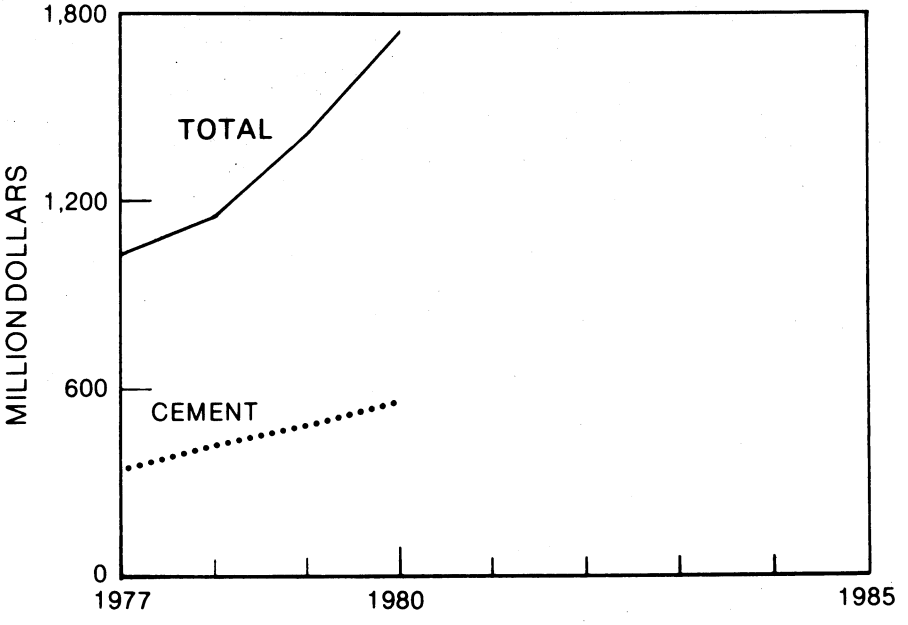

Figure 1.—Value of cement and total value of nonfuel mineral production in Texas.

Legislation.—The Texas Legislature, which meets biannually in odd-numbered years, was not in session in 1980, and no special session was called.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Asphalt (Native).—Naturally occurring asphaltic-impregnated limestone continued to be mined in Uvalde County and was used chiefly as a road-surfacing material. Texas again led the four States that recorded native asphalt output, producing more than 90% of the Nation's total in 1979 and 1980.

Cement.—Rising interest rates through much of 1980 capped activities in most sectors of the construction industry; this effect was mirrored in total cement production, up only 1.4% in 1980 compared with the 5.7% gain in 1979. Portland cement shipments edged up 1.7% in contrast to a 6.2% gain in 1979. Prices, however, held firm; average price was $56.29 per short ton, up 10.7% in contrast to the 1979 price of $50.87 that was up 11.7% from the previous year. Masonry cement shipments fell 9.9% in 1980, about in step with the 7.5% drop in 1979. Average price was $75.86 per short ton, up 30.3% and substantially above the $59.57 and $58.23 price plateau of 1978-79. Yearend total cement stocks increased 14.4% to a level approaching that of 1976, a year of economic recovery in which Texas cement plants operated at about 75% of capacity.

Several producers and ready-mix operators reported that a surge in cement stocks occurred at yearend as interest rates soared to new record highs. The first half of 1980 was marked by the January-July recession, when record interest rates were reached and cement shipments weakened. The subsequent V-shaped interest-rate trough in the third quarter—rates almost halved from April's high to the August low—stimulated midyear cement sales. However, by the fourth quarter, interest rates were climbing sharply again, setting records in December, and precipitating the yearend plunge in cement sales.

Thirteen companies operated 19 cement plants in 14 counties, with most plants in or close to the major metropolitan areas in Texas. Sales were about 99% gray portland cement; the remainder was white cement costing 2.4 times more than gray portland cement. Ready-mix companies took about 62% of the cement. Other markets were highway contractors 4%, other contractors 17%, concrete product manufacturers 8%, building material dealers 5%, miscellaneous customers 3%, and government agencies 1%. Trucking was the main mode for transporting finished portland cement; less than 3% moved by rail; and a negligible quantity was shipped by barge or other means. Natural gas remained the most important source of plant fuel and energy.

Production of portland cement was initiated at Texas Industries, Inc.'s new Hunter plant in Comal County, midway between San Antonio and Austin. The coal-fired preheater system, rated at 550,000 tons per year, was expected to achieve capacity output in early 1981. General Portland, Inc., in late 1980, began producing cement at its new $85 million preheater plant at Balcones. Annual capacity of the operation will be 925,000 tons. Alamo Cement Co., San Antonio (formerly San Antonio Portland Cement Co.), began constructing a $50 million plant on a 1,700-acre tract of land in northwest Bexar County, outside the San Antonio metropolitan area. Alamo's present plant in San Antonio will remain in operation at least through the construction of the new operation scheduled for completion in the fall of 1981. Gifford-Hill & Co., Inc., acquired Amcord, Inc., a cement-producing and metal-building systems company. The acquisition put Gifford-Hill in the top cement-producing position in the sunbelt market. Heidelberger Zement AG planned to acquire the cement assets of Universal Atlas Div., United States Steel Corp., that would include the facility at Waco. Kaiser Cement Corp. initiated a planned modernization of its facilities in San Antonio.

Table 4.—Texas: Portland cement salient statistics

(Short tons)

	1979	1980
Number of active plants	18	19
Production	9,069,950	9,151,423
Shipments from mills:		
Quantity	9,353,304	9,516,949
Value	$475,835,879	$535,690,104
Stocks at mills, Dec. 31	433,594	503,980

Table 5.—Texas: Masonry cement salient statistics

(Short tons)

	1979	1980
Number of active plants	11	13
Production	268,623	219,834
Shipments from mills:		
Quantity	267,765	241,364
Value	$15,593,175	$18,309,793
Stocks at mills, Dec. 31	27,173	23,105

Clays.—Continuing a moderate downtrend begun in 1979, clay production eased 2.8%. Common clay and shale, representing 92.3% of total output, was down 3.7%. Kaolin sharply declined in output; and fire clay was down slightly, both from modest production bases. The equally small-scale output of ball clay and fuller's earth was unchanged in 1980. Bentonite was up 65.2% in output in response to strong demand from energy-related drilling activities. Owing to firm prices for bentonite and common clay, average price for all clay rose 29.1% from $5.56 to $7.18. Unit price per ton for bentonite was $64.78, up an impressive 31.9% from $49.12 in 1979. Common clay, the statistical heavyweight, registered a 19.3% gain at $38.17, up from $31.99. Unit price for kaolin was up sharply, fire clay rose moderately, fuller's earth was essentially unchanged, and ball clay fell moderately.

Texas was ranked second nationally in total clay output, the same as in 1979; however, the total value of clay rose from eighth to fourth spot. The State's strong and broadening economy in the late 1970's is reflected in the plateau-like record of total clay production. Common clay and shale, the bulk of Texas' clay output, was used mostly in the cyclic construction industry; however, for most other clays, output was stable. Bentonite production surged from a small base in response to increasing demand from soaring drilling activity, mostly for mineral fuels.

Clay was produced by 44 companies at 94 mines in 43 counties. Fifty percent of the tonnage and 30% of the value was turned out by the top 5 operators; 13 produced 75% of the tonnage and 60% of the value, and 17 recovered 82% of the tonnage with 75% of the value. Eleven companies mined more than 100,000 tons each, 29 produced 10,000 or more tons, and four turned out less than 10,000 tons. Mines per company ranged up to 12.

Leading producers included Acme Brick Co.; Texas Industries, Inc.; Henderson Clay Products Co.; Featherlite Corp.; and Lone Star Industries, Inc.

Brazos Brick Co., a division of Michigan Brick, Inc., began manufacturing clay bricks at its new plant in Mineral Wells, Palo Pinto County. Annual plant capacity was 80 million bricks.

Table 6.—Texas: Clays sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Year	Ball clay		Bentonite		Fire clay		Common clay and shale		Total[1]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1976	16	109	39	850	54	259	3,597	7,627	3,786	13,695
1977	W	W	40	974	56	278	3,586	10,213	3,810	16,272
1978	W	W	56	1,101	50	273	3,955	13,500	4,189	19,818
1979	W	W	66	3,242	58	725	3,610	11,548	3,871	21,533
1980	W	W	109	7,061	57	743	3,475	13,265	3,763	27,022

W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Includes fuller's earth, kaolin, and data indicated by symbol W.

Fluorspar.—D & F Minerals Co., in 1980, slightly increased output of metallurgical-grade fluorspar from its La Paisano Mine in the Christmas Mountains in Brewster County. Most of the crude fluorspar was shipped to other dealers and producers; the remaining output was added to stocks. No finished fluorspar was produced in 1980.

Gem Stones.—Dealers and hobbyists collected rock and mineral specimens valued at an estimated $160,000 in 1980, down slightly from 1979, primarily because of

curtailed tourist and other travel in the 1980 recession year. Major rocks and minerals sought were agate, calcite, cinnabar, fluorite, fossiliferous limestone, jasper, opal, petrified wood, quartz, and topaz.

Graphite.—Southwestern Graphite Co. did not reopen its natural graphite mine near Burnet in Burnet County in 1980. The company, however, continued to operate nonmining facilities using imported graphite ore.

Gypsum.—In response to reduced demand in some construction markets, crude gypsum output eased 11.7% in 1980, thereby reversing the uptrend in production that began in 1976, a year of recovery from the November 1973-March 1975 recession. Calcined gypsum was down 11.6%. Average price per unit ton of crude gypsum soared 39.8%; average price of calcined gypsum slumped 32.1%. Although both crude and calcined gypsum output were down, 73.5% of the crude gypsum was calcined in both 1979 and 1980.

Texas led the Nation in crude gypsum mined and was second in calcined gypsum production. Texas gypsum output was 13.6% of the Nation's total, up from 13.0% in 1979. Seven companies mined gypsum in six Texas counties—Fisher, Gillespie, Hardeman, Hudspeth, Nolan, and Stonewall. Five companies calcined gypsum in Fisher, Hardeman, Harris, and Nolan Counties. The leading crude gypsum companies were United States Gypsum Co., Georgia Pacific Corp., and National Gypsum Co. These three companies led in calcined gypsum production also.

United States Gypsum Co. began expanding its gypsum mining and wallboard plant at Sweetwater in Nolan County. When this expansion is completed in 1981, full automation of one wallboard line is planned.

Helium.—Production of high-purity helium, valued at $23 per thousand cubic feet as in 1979, eased 7.9% in quantity in 1980. Recovery of crude helium, valued at $12 per thousand cubic feet, fell 34.2%. (National recovery of helium was down a sharp 44.3%, largely because of a steep decline in Kansas production.) All domestic helium is recovered from natural gas produced in Kansas, Oklahoma, and Texas, along with intermittent, low-volume helium recovery in New Mexico.

Lime.—Output of lime sold or used by producers in 1980 increased by a nominal 0.5% from that of 1979; however, average unit value increased from $39.50 to $44.27, a 12% increase. Strong demand for lime and accompanying firm prices were noted in most energy-related areas; weak demand and prices generally were confined to some construction-related sectors. Lime demand from the oil- and gas-drilling industry increased 26% and prices rose 35%. With lime demand essentially unchanged in the aluminum industry, price nevertheless, soared 45%. Demand and price levels were notably weak for masonry and other construction lime.

Chemical Lime, Inc., of Fort Worth began to double the capacity of its Clifton lime plant in Bosque County to 1,800 tons per day by installing a third coal-fired kiln and modernizing its original kiln that began operating in 1971. The $10 million expansion is to be completed in late 1981. Besides the major Texas markets, the pebble-lime product has been shipped to Arkansas, Louisiana, New Mexico, and Oklahoma.

United States Gypsum Co. is planning a major expansion of its lime plant at New Braunfels, Comal County. A new 600-ton-per-day rotary kiln will make the facility the largest lime producer in Texas. Construction is planned to begin in early 1981, with completion expected by mid-1982. The plant will be the only operation in Texas capable of both high calcium and dolomitic lime output. Dolomitic lime is used in the chemical, construction, glass, and steel industries. Currently, gulf coast industrial consumers of dolomitic lime receive most of their shipments from upper Midwest States and Nevada.

Table 7.—Texas: Lime sold or used by producers, by use

Use	1979		1980	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Road stabilization	NA	NA	427,139	$19,079
Soil stabilization	476,925	$18,832	W	W
Paper and pulp	153,736	6,070	174,292	7,936
Steel, open-hearth	W	W	143,070	5,743
Aluminum and bauxite	134,772	5,322	134,229	7,671
Water purification	231,074	9,124	124,116	5,548
Sewage treatment	34,101	1,346	107,203	3,964
Steel, electric	118,252	4,669	76,455	2,493
Oil well drilling	17,195	679	21,601	1,151
Mason's lime	15,418	609	13,218	578
Petroleum refining	5,983	236	W	W
Other uses[1]	319,942	12,633	293,956	12,912
Total[2]	1,507,400	59,520	1,515,279	67,075

NA Not available. W Withheld to avoid disclosing company proprietary data; included with "Other uses."
[1]Includes acid mine water; chrome; copper ore concentration (1979); food, animal and human; glass; magnesium; other chemical and industrial uses; other construction lime (1979); other metallurgy (1979); paint (1979); sugar refining (1980); tanning (1979); wire drawing (1979); and uses indicated by symbol W.
[2]Data may not add to totals shown because of independent rounding.

Perlite (Expanded).—Although Texas perlite mines have been inactive since 1972, seven companies operating plants in Bexar, Comal, Dallas, Harris, and Nolan Counties continued to process imported perlite. Texas, one of 33 States that turn out expanded perlite, produced 7.3% of the Nation's total, down from 7.9% in 1979. National output eased 1.1%. Average price per short ton unit was $160 in Texas in 1980, up 31% from the $122 average price in 1979. National figures were $129 in 1980, up 14% compared with 1979's $113.

Salt.—Seven companies continued to produce salt in brine from wells completed in salt deposits at nine plants, while two companies also produced rock salt from underground mines. Texas was ranked second in salt output, yielding 24.7% of the Nation's 40.4 million tons in 1980.

Production was off 11.6%; however, because of tight salt supplies, particularly early in 1980, prices were firm. Average price per short ton of total salt rose 56.3% from $5.99 in 1979 to $9.36. Prices at the various plants ranged from $2.47 per ton to $89.42 per ton, depending upon the type of salt produced.

Sand and Gravel.—High interest rates during 1980 triggered a downturn in the more interest-sensitive sectors of the construction industry, thereby precipitating a sharp decline in total construction activity that had prevailed at high levels since 1976. Total sand and gravel output was lower than that of any year since 1975, which saw the end of the prolonged November 1973-March 1975 recession. Total production continued to decline for the second year from the record 1978 output. Construction sand and gravel tonnage was down 12.3%; however, average price per ton increased 13.0%. Industrial sand output was up 5.2% while prices rose 15.3%. Total sand and gravel production slipped 11.6%. Sand and gravel for concrete products and fill increased significantly to fulfill needs of major long-term construction projects. Demand for plaster and gunite sands, used mostly in interest-sensitive family housing construction, was down sharply. Weakness in demand for plaster and gunite sands was mirrored in its average price per ton, down 11.1%. All other major uses of sand and gravel registered moderate to pronounced price increases. Uses in asphaltic concrete, roadbase, and road coverings, in contrast to their weak demand, recorded the largest price increases.

Texas was ranked second nationally in industrial and total sand and gravel production in 1980, the same as in 1979. In construction sand and gravel, Texas was ranked second in 1980, up from third place in 1979. Sand and gravel was produced by 142 companies from 183 operations and processed in 78 plants. Output was obtained from 77 counties. Colorado County retained its leading position in the State with 8.7 million tons of sand and gravel produced.

Other counties with 1 million tons or more of production in order of tonnage were Dallas, Victoria, Harris, McLennan, Travis, and Denton.

Gifford-Hill continued as the leading Texas producer of sand and gravel; other leading producers were The Fordyce Co., Lone Star Industries, and Thorstenberg Materials Corp.

Three companies produced 24% of Texas' sand and gravel that represented 28% of its value. Twelve companies were million-ton-plus producers; these operators accounted for 52% of the State's total tonnage and 57% of the value. The diversity of the industry is indicated by the 25% of State output recovered by 107 companies that each produced about one-third million tons or less.

At its Tin Top plant south of Weatherford in Parker County, Texas Industries, Inc., completed its 400-foot-long suspension conveyor system across the Brazos River. The system feeds sand and gravel from a 3,500-acre deposit in a horseshoe-like bend in the river to the processing plant on the east side of the Brazos, saving a 40-mile haul over county roads. Essentially, all of the product was marketed in Weatherford and in the nearby Fort Worth-Dallas metropolitan area.

Sodium Sulfate (Natural).—Ozark-Mahoning Co., a subsidiary of Pennwalt Corp., continued to extract sodium sulfate from shallow brine deposits at plants in Brownfield, Terry County and Seagraves, Gaines County. Combined annual capacity of the two facilities is about 150,000 short tons. Sodium sulfate was used in manufacturing detergents, glass, kraft paper, and other products.

Texas retained its number two position among States producing sodium sulfate. State output of sodium sulfate eased slightly, unit price per short ton slipped 12.2%, and stocks were reduced approximately 20%.

Table 8.—Texas: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	31,399	$97,655	$3.11	27,851	$98,040	$3.52
Plaster and gunite sands	386	1,466	3.80	135	456	3.38
Concrete products	1,424	4,546	3.19	1,753	5,588	3.19
Asphaltic concrete	5,293	12,433	2.35	2,381	7,628	3.20
Roadbase and coverings	6,012	13,875	2.31	5,668	16,295	2.88
Fill	5,860	9,057	1.55	6,451	10,296	1.60
Snow and ice control	W	W	5.39	3	5	1.99
Railroad ballast	74	183	2.49	W	W	2.92
Other uses	445	1,740	3.91	409	1,583	3.88
Total[1] or average	50,893	140,955	2.77	44,651	139,892	3.13

W Withheld to avoid disclosing company proprietary data; included in "Other uses."
[1]Data may not add to totals shown because of independent rounding.

Table 9.—Texas: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	28,757	$71,594	$2.49	25,680	$74,003	$2.88
Gravel	22,137	69,360	3.13	18,971	65,889	3.47
Total[1] or average	50,893	140,955	2.77	44,651	139,892	3.13
Industrial:						
Sand	1,953	26,121	13.38	2,054	31,684	15.43
Grand total or average	52,846	167,076	3.16	46,704	171,576	3.67

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

Stone.—Crushed and total stone production inched up 2.5% in 1980. Dimension stone, representing less than 0.05% of Texas' total stone output, more than doubled in 1980. Average price per short ton unit of crushed stone at $2.88 rose 13.8%. Average price for the dimension stone was $192 per ton. Stone produced for major construction projects held its share of the market, whereas some stone output channeled to interest-sensitive markets weakened in 1980. None of the major stone uses recorded a marked change in output or price.

Texas continued to be ranked 1st nationally in crushed and total stone output, and 11th in dimension stone. Stone was recovered from 178 sites (177 quarries and 1 shell operation) in 73 counties. Seven quarries cut dimension stone. Williamson County, with 11.7 million tons of stone output, was the pacesetter in 1980, closely followed by Bexar County at 11.5 million tons. Comal, Ellis, and Wise Counties each turned out more than 2 million tons, and nine other counties each had quarries that yielded more than 1 million tons. These 14 counties producing 1 million or more tons comprised 74% of Texas' stone output. Quarries with 100,000 to 1 million tons of output accounted for 25%; quarries yielding less than 100,000 tons made up the remanining 1%. Stone shipments were accomplished 77.5% by truck; 17.5% by rail; and 5.0% by waterway, other, or unspecified.

Texas Crushed Stone Co. was the State's leading producer. Other top producers were Gifford-Hill; McDonough Bros., Inc.; Parker Bros. & Co., Inc.; and Texas Industries, Inc. Of the 102 companies that reported stone output, 13 produced 1 million or more tons each, 60 turned out 100,000 to 1 million tons, and 29 quarried less than 100,000 tons. The top 13 companies produced 65.5% of the tonnage that captured 62.1% of total value; the 60 intermediate-sized companies showed 32.8% of tonnage and 33.3% of value; and the 29 smaller companies recorded 1.7% of tonnage and 4.6% of value (largely dimension stone).

Crushed stone tonnage included limestone 95.3%, sandstone 2.1%, shell 1.4%, marl 0.8%, marble 0.1%, traprock 0.06%, and granite 0.03%. Dimension stone tonnage comprised granite 58.3%, marble 22.9%, and limestone 18.8%. Average unit value per ton of crushed stone was granite $22.90, marble $18.94, shell $5.71, sandstone $4.61, traprock $4.25, limestone $2.78, and marl $1.83. Average unit value per ton of dimension stone was granite $297.35, marble $54.00, and limestone $34.65.

Dimension stone was quarried in five counties. Burnet and Gillespie Counties turned out granite, Jones and Williamson Counties yielded limestone, and Llano County provided marble and a small quantity of granite.

To increase production to 1,000 tons per hour on a near sustained basis, Trinity Metroplex Div. of General Portland, Inc., Dallas, introduced a 5 1/4-cubic-yard hydraulic shovel to its quarry near Chico. The shovel works a three-bench exposure in the limestone quarry. Speed, flexibility, and mobility of the hydraulic shovel compared with those of electric shovels in the quarry, increased output, largely eliminated use of a cleanup machine, aided spillage removal, and reduced truck-tire damage.

Sulfur.—Duval Corp. continued to recov-

er Frasch sulfur at its Culberson Mine; and, in late 1980, began Frasch sulfur output at its new Phillips Ranch operation, both mines in Culberson County. Frasch sulfur also was mined by Farmland Industries, Inc., in Pecos County; Jefferson Lake Sulfur Co. in Fort Bend County; and Texasgulf, Inc., in Liberty, Pecos, and Wharton Counties.

Recovered sulfur was extracted from natural gas and crude oil at 59 operations in 33 counties. Harris County yielded more than one-third of the recovered sulfur; Harris, Jefferson, and Van Zandt Counties contributed over one-half.

Demand for sulfur was firm in 1980. Frasch sulfur output in Texas was up 4.7%, recovered sulfur inched up 2.8%, and stocks of total sulfur were depleted by about 26%. Average price per unit metric ton was in a general uptrend, rising from about $90 in January to $114 at yearend.

Table 10.—Texas: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	310	620	299	639
Poultry grit and mineral food	154	971	153	1,299
Concrete aggregate	11,433	36,892	12,284	45,322
Bituminous aggregate	5,525	26,062	4,806	24,578
Macadam aggregate	218	619	W	W
Dense-graded roadbase stone	30,855	58,890	31,227	68,315
Surface treatment aggregate	3,190	10,791	3,325	13,064
Other construction aggregate and roadstone	4,949	11,689	6,219	16,122
Riprap and jetty stone	326	1,036	231	1,008
Railroad ballast	905	2,991	872	2,870
Filter stone	649	1,790	734	1,769
Manufactured fine aggregate (stone sand)	1,817	4,577	1,579	4,753
Terrazzo and exposed aggregate	97	1,224	210	3,359
Cement manufacture	9,984	16,609	10,334	19,678
Lime manufacture	2,101	4,814	2,446	7,792
Flux stone	987	2,080	364	1,039
Whiting or whiting substitute	W	W	62	W
Other fillers or extenders	358	4,699	356	5,174
Roofing granules	76	279	60	240
Sugar refining	24	71		
Waste material	19	23	W	W
Other uses[2]	636	2,021	923	3,244
Total[3]	74,612	188,746	76,483	220,265

W Withheld to avoid disclosing company proprietary data; included with "Other uses."
[1]Includes limestone, granite, marble, marl, sandstone, shell, and traprock.
[2]Includes stone used in chemical stone for alkali works, sulfur dioxide, asphalt filler, building products (1979), and other uses.
[3]Data may not add to totals shown because of independent rounding.

Table 11.—Texas: Sulfur produced and shipped from Frasch mines

(Thousand metric tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1976	3,838	3,470	W
1977	3,454	3,536	W
1978	3,720	3,752	W
1979	3,897	4,649	W
1980	4,081	4,810	W

W Withheld to avoid disclosing company proprietary data.

Talc and Soapstone.—Five companies mined talc from quarries in Culberson and Hudspeth Counties. Output almost doubled that of 1979; unit value per short ton increased 43.6%, from $7.46 to $10.71. Texas recorded 27.2% of national output, up from 14.2% in 1979. Uses of talc were primarily for manufacturing ceramics and paint, with lesser uses in cosmetics, insecticides, paper, plastics, roofing, and rubber.

Vermiculite (Exfoliated).—Texas' last producing vermiculite mine, in Llano County, was closed in 1979; however, two companies continued to operate three exfoliation plants in Bexar, Dallas, and Harris Counties using imported crude vermiculite. Exfoliated vermiculite uses included block and loose-fill insulation, concrete and plaster aggregate, fireproofing, and soil conditioner.

METALS

Aluminum.—Texas was ranked second nationally in primary aluminum production, recovered from alumina contained in bauxite. One of 17 States to produce primary aluminum, Texas had about 9.5% of total output, up from 8% in 1979. National production inched up about 2% as weak domestic demand, primarily in construction and transportation, was more than offset by strong exports. Prices increased from 66 cents per pound in January to 76 cents per pound at yearend. Average price was approximately 71.6 cents, up about 17% from 61.0 cents in 1979. Average annual price has been in an uninterrupted uptrend since 1973; the latest production uptrend began in 1975.

Imported bauxite was processed at alumina refineries of Reynolds Metals Co. near Corpus Christi and at the Aluminum Co. of America (Alcoa) operation near Point Comfort. Arkansas, and to a lesser extent, Alabama and Georgia turn out 10% to 12% of domestic bauxite requirements; however, most of the bauxite ores used in Texas originate in the Caribbean area.

Cometals, Inc., a subsidiary of Commercial Metals Co. of Dallas, signed a long-term agreement to buy a minimum of 150,000 tons of refractory-grade bauxite per year from mainland China for resale to North American consumers.

Alcoa was first in Texas to file its reapplication for surface mining authority since approval of the Texas Railroad Commission's "State Program" of regulation by the Federal Office of Surface Mining. Alcoa operates the Nation's largest aluminum smelter at Rockdale using essentially all of the electric output of the Industrial Generating Co. onsite powerplant, a subsidiary of Texas Utilities. Captive lignite coal is strip mined from the Sandow Mine at the plant site. Alcoa will increase lignite output from the current annual 2-million-ton level to about 5.5. million tons in 1985. The increased production will fuel a new 545,000-kilowatt plant to support enlarged aluminum smelter operations.

Alcoa's 175,000-ton-per-year Point Comfort aluminum smelter was shut down; two potlines were idled in July and the remaining two were idled in November. Point Comfort is the company's costliest smelter, principally because of high power costs. Inventories were piling up toward yearend in both the company and the industry, despite widespread cutbacks. Reynolds Metals Co. also curtailed output at its San Patricio plant near Corpus Christi.

Antimony.—PPG Industries began producing submicron-size, ultrapure antimony oxide for use in flame retardant plastics at its plant in La Porte, Harris County.

Copper.—Imported copper ores and concentrates continued to be smelted at the ASARCO Incorporated (Asarco) plant in El Paso. Copper was refined at Asarco's operation in Amarillo and by Phelps Dodge at its El Paso refinery.

Phelps Dodge Copper Products Co., a manufacturing division of Phelps Dodge Corp., announced plans to add a new $19.5 million continuous casting copper rod mill to its existing copper rod facilities in the El Paso plant. The rod mill is to be operational by late 1982.

Iron Ore.—Reflecting strong energy-related demand for steel products, iron ore output rose about 17% in 1980; unit value per long ton held to a 5% increase. Texas was ranked 8th in the roster of 12 iron ore producing States in 1980, the same position as in 1979 when 13 States turned out iron ore. Limonite and siderite ores recovered from open pit mines in Cass, Cherokee, Henderson, and Morris Counties were used mostly in producing pig iron, and in less volume, for cement manufacture and for miscellaneous products. Lone Star Steel Co. continued to be the State's largest of the four iron ore producers.

Texas used about 10.4 million tons of steel in 1980, more than 10% of the Nation's total consumption. The Houston area has become a thriving steel center, largely for distributing imported steel products through its port and other transportation facilities. However, United States Steel and Armco Steel Corp. have steelmaking operations in the area, and a number of small specialty plants have been established.

Lone Star Steel Co., a subsidiary of Northwest Industries, Inc., in midyear began formulating plans to revamp and expand company steelmaking. Primary objectives of the program will be to reduce energy

needs and enhance productivity. Lone Star, strong in output of oil industry tubular steel, initiated production of high-strength seamless drilling pipe in 1980; the new pipe was undergoing tests at an operational drilling rig in the latter part of the year.

Lead.—Asarco's modernization and environmental improvement of its large copper-lead-zinc plant, in El Paso completed in mid-1979, was formally dedicated in May. The metallurgical plant began operating in 1887. New units included twin facilities for indoor unloading of rail shipments to control dust; an enclosed 80,000-ton storage structure with dust-control equipment; a new sinter plant for roasting lead ores and concentrates; and an 800-ton-per-day sulfuric acid plant to recover sulfur dioxide from lead sintering and copper roasting.

The Bureau of Economic Geology at the University of Texas reported the discovery of Mississippi Valley-type lead-zinc mineralization in central and western Gillespie County. This discovery extends known lead-zinc mineralization 31 miles west of the Llano Uplift. The presence of lead and zinc along the southern and eastern flanks of the uplift has been known since 1886, and intermittent, small-scale mining was reported through 1931. The new lead-zinc mineralization occurs between depths of 500 and 2,800 feet in the Upper Cambrian Cap Mountain limestone member of the Riley Formation.

The Texas Air Control Board granted Asarco an extension to April 1, 1981, for establishing a permanent permissible ground-level concentration of sulfur dioxide at its El Paso copper-lead-zinc smelter.

Magnesium.—Magnesium again had the highest value of the metallic minerals produced in Texas. Magnesium chloride recovered from seawater in Brazoria County and from subsurface brine in Borden County was used to produce magnesium and magnesium compounds. Output of magnesium chloride for metal used by producers increased slightly in 1980, whereas magnesium compounds not used for metal production declined.

Rare-Earth Minerals.—Rhone-Poulenc, Inc., contracted to develop a rare earth separation and finishing plant in Freeport, Brazoria County. Scheduled to be completed in mid-1981, the plant will introduce updated techniques developed in France by Rhone-Poulenc to separate high-purity rare earths. This new addition will about double capacity of the established 2,000-ton-per-year plant.

Silver.—Gold Fields Mining Corp., an American subsidiary of the British firm, Consolidated Gold Fields, Ltd., obtained the necessary permits to open a silver mine near Shafter in Presidio County about 180 miles southeast of El Paso and 40 miles south of Marfa. Shaft sinking to about 1,000 feet was underway; initial ore production was targeted for early 1981. Planned production of up to 1,500 tons of ore per day is projected for mid-1982. The new mining venture will be adjacent to the old Presidio Silver Mine that was abandoned in 1942 after producing about 30 million ounces of silver during about 50 years of operation. Long-term plans call for constructing a small smelter with about a 170-ton-per-day capacity.

Tin.—At its Texas City smelter, Gulf Chemical & Metallurgical Co. continued to operate its $10 million, Kaldo-type furnace using a variety of tin-bearing materials. Reduced imports of tin concentrates forced the company to rely more upon recycled and stock materials for processing; slags and low-grade residues have been successfully used in the West German-designed furnace. Operational capacity of the furnace is expected to be 7,000 tons per year. Plant output is marketed in the United States.

Titanium.—D-H Titanium Co., a joint venture of Dow Chemical Co., and Howmet Turbine Components Corp., began operating its semiworks titanium plant in Freeport at yearend. The energy-efficient operation could be quickly expanded to a 5-million-pound-per-year plant; a decision to expand is expected in 1981. Because of increased domestic demand for titanium, D-H would become the fifth U.S. producer if commercialization plans materialize.

Zinc.—Asarco reduced zinc production at its refinery in Corpus Christi to 40% of rated capacity in late July because of strike-interrupted raw material shipments from its El Paso plant. Asarco's El Paso plant provides the refinery with crude zinc oxide recovered by the fuming of lead smelter slag. Operating through yearend at a reduced rate, the refinery produced about 160 tons per day of refined zinc from purchased ore concentrates. In late 1980, Asarco announced the initiating of a $42 million, 1-year, modernization program for its Corpus Christi refinery.

Proler International, the Nation's largest demolition and salvage company, completed demolition of Asarco's zinc plant in Amarillo. Opened in 1922, the zinc plant was periodically expanded and modernized, and finally closed on May 31, 1975.

[1]State mineral specialist, Bureau of Mines, Denver, Colo.

Table 12.—Texas: Primary smelters, refineries, and reduction plants

Product, company, and plant	Location (county)	Material treated
Aluminum:		
Aluminum Co. of America:		
Point Comfort (alumina)	Calhoun	Bauxite.
Point Comfort (reduction)	do	Alumina.
Rockdale (reduction)	Milam	Do.
Anderson County (reduction)	Anderson	Do.
Reynolds Metals Co.:		
San Patricio (reduction)	San Patricio	Do.
Sherwin plant (alumina)	do	Bauxite.
Antimony:		
ASARCO Incorporated:		
El Paso smelter	El Paso	Ore.
Anzon American, Inc.:		
Laredo smelter	Webb	Do.
Cadmium:		
ASARCO Incorporated:		
Electrolytic	Nueces	Do.
Copper:		
ASARCO Incorporated:		
Amarillo refinery	Potter	Blister and anode.
El Paso smelter	El Paso	Ore and concentrates.
Phelps Dodge Refining Corp.:		
Nichols refinery	do	Blister and anode.
Iron:		
Armco Steel Corp.:		
Houston plant	Harris	Ore and scrap.
Lone Star Steel Co.:		
Daingerfield plant	Morris	Do.
United States Steel Corp.:		
Baytown plant	Chambers	Do.
Lead:		
ASARCO Incorporated:		
El Paso smelter	El Paso	Ore and concentrates.
Magnesium:		
Dow Chemical U.S.A.:		
Freeport plants, electrolytic	Brazoria	Seawater.
American Magnesium Co.:		
Snyder plant, electrolytic	Scurry	Brine.
Manganese:		
Tenn-Tex Alloy Corp	Harris	Ore.
Sodium:		
Ethyl Corp	do	Salt.
Tin:		
Gulf Chemical & Metallurgical Corp.:		
Texas City smelter	Galveston	Ore, slag, residues.
Zinc:		
ASARCO Incorporated:		
Corpus Christi electrolytic	Nueces	Ore and concentrates.
El Paso fuming plant	El Paso	Dusts and residues.

Table 13.—Texas: Secondary metal recovery plants

County and company	Material	Product
Austin:		
Schindler Bros. Steel Co	Steel scrap	Reinforced steel bars.
Bexar:		
Newell Salvage Co. of San Antonio	Scrap metal	Smelter and refined scrap metals.
Brazoria:		
Texas Reduction Corp	Aluminum scrap	Alloyed aluminum ingot.
Collin:		
Electro Extraction, Inc	Aluminum and copper scrap	Aluminum ingots, copper bars.
Gould, Inc	Lead scrap	Battery lead oxide, pig lead.
Dallas:		
ABASCO, Inc	Aluminum scrap	Aluminum ingots, dioxidizing bars and shot.

Table 13.—Texas: Secondary metal recovery plants —Continued

County and company	Material	Product
Dallas —Continued		
American Smelting & Refining Works.	Lead and zinc scrap	Lead and zinc ingots, pigs, alloys.
Dixie Metals Co	Lead scrap	Lead pigs, alloys, chemicals.
Laclede Steel Corp	Steel scrap	Reinforcing steel.
Murdock Lead Co., a division of RSR Corp.	Lead scrap	Lead shot, solders, lead pipe.
NL Industries, Inc	Battery plates	Lead products.
Okon's Iron & Metal Co	Solder and lead scrap	Lead pigs and ingots.
El Paso:		
Border Steel Mills, Inc	Steel scrap	Reinforcing bars, bar shapes, steel grinding balls.
Proler International Corp	____do	Precipitation iron.
SEC Corp	Nickel-copper waste solution	Nickel.
Ellis:		
Chaparral Steel Co	Steel scrap	Steel reinforcing bars and shapes.
Industrial Metals Co	Scrap metal	Metal shapes and ingots.
Galveston:		
Gulf Chemical & Metallurgical Corp	Various metal scrap	Tin, tungsten, nickel.
Gregg:		
Marathon-LeTourneau Co	Steel scrap	Steel castings and shapes.
Southwest Steel Castings Co	____do	Steel castings.
Guadalupe:		
Structural Metals Inc	____do	Structural steel reinforcing bars.
Harris:		
A & B Metal Manufacturing Co., Inc	Scrap metal	Tungsten carbide.
Federated Metals Corp	Various metals	Lead ingot, solder, copper tubing, bearing metals, sheet lead, lead pipe.
Gulf Reduction Corp	Aluminum, zinc scrap	Aluminum, zinc ingots and alloys.
Houston Lead Co	Lead scrap	Lead pigs, ingots, alloys.
Lead Products Co., Inc	____do	Do.
Newell Metals, Inc	Zinc scrap	Zinc dust.
Proler International Corp	Various metals	Zinc slab, aluminum alloys, precipitation iron.
Redgate, Virgil, Co	____do	Recovery of gold, silver, platinum, rhodium, copper, nickel, cadmium, aluminum.
Jefferson:		
Georgetown Texas Steel Corp	Steel scrap	Steel rods and shapes.
Laclede Steel Corp	____do	Reinforcing steel.
Leon:		
Nucor Steel Co	____do	Steel rods and shapes.
Smith:		
Bloch Metals, Inc	Aluminum scrap	Aluminum ingots.
Tyler Pipe Industries, Inc	Steel scrap	Pipe and pipe fittings.
Tarrant:		
National Metal and 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 14.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt (native):			
Uvalde Rock Asphalt Co	Box 531 San Antonio, TX 78206	Quarry and plant	Uvalde.
White's Mines, Inc	Box 499 San Antonio, TX 78206	____do	Do.
Barite:			
Dresser Industries, Inc	Box 6504 Houston, TX 77002	Grinding plant	Cameron and Galveston.
Milwhite Co., Inc	Box 15038 Houston, TX 77020	____do	Cameron and Harris.
NL Industries, Inc	Box 1675 Houston, TX 77001	____do	Nueces.
Cement:			
Alamo Cement Co	Box 6925 San Antonio, TX 78209	Quarry and plant	Bexar.
Alpha Portland Cement Co	15 South 3d St. Easton, PA 18042	____do	Orange.

Table 14.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Cement —Continued			
Capitol Aggregates, Inc	Route 13, Box 412 San Antonio, TX 78209	Quarry and plant	Bexar.
Centex Cement Corp	4600 Republic Bank Tower Dallas, TX 75201	do	Hays and Nueces.
General Portland, Inc	2800 Republic Bank Tower Dallas, TX 75201	do	Dallas and Tarrant.
Gifford-Hill & Co., Inc	Box 520 Midlothian, TX 76055	do	Ellis.
Gulf Coast Portland Cement Co., a division of McDonough Co.	Box 262 Houston, TX 77001	do	Harris.
Ideal Cement Co., a division of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, CO 80202	do	Do.
Longhorn Cement Div., Kaiser Cement Corp.	Kaiser Center 300 Lakside Dr. Oakland, CA 94612	do	Bexar.
Lone Star Industries, Inc	Box 47327 Dallas, TX 75247	do	Harris and Nolan.
Southwestern Portland Cement Co.	Box 392 El Paso, TX 79943	do	Ector, El Paso, Potter.
Texas Industries, Inc	Box 146 Midlothian, TX 76065	do	Ellis.
Clay and shale:			
Acme Brick Co., a division of Justin Industries, Inc.	Box 425 Fort Worth, TX 76101	Pit and plant	Denton, Guadalupe, Nacogdoches, Parker, Van Zandt, Wise.
Balcones Minerals Corp	Box B Flatonia, TX 78941	do	Fayette.
Elgin-Butler Brick Co	Box 1947 Austin, TX 78767	do	Bastrop.
Featherlite Corp	Box 141 Ranger, TX 76470	do	Eastland.
General Portland, Inc	Box 2698 Dallas, TX 75201	do	Dallas and Limestone.
General Refractories Co	Box 546 Troup, TX 75789	do	Cherokee.
Gulf Coast Portland Cement Co., a division of McDonough Co.	Box 262 Houston, TX 77001	Pit	Chambers.
Henderson Clay Products Co	Box 1251 Henderson, TX 75652	Pit and plant	Rusk.
Lone Star Industries, Inc	Box 12449 Dallas, TX 75225	Pit	Fisher and Harris.
Milwhite Co., Inc	Box 15038 Houston, TX 77020	Pit and plant	Fayette and Walker.
Southern Clay Products, Inc	Box 44 Gonzales, TX 78629	do	Angelina, Cherokee, Gonzales.
Texas Clay Industries, Inc	Box T Malakoff, TX 75146	do	Henderson.
Texas Industries, Inc	8100 Carpenter Freeway Dallas, TX 75247	do	Comanche, Dallas, Ellis, Fort Bend, Henderson, Marion, Van Zandt.
Fluorspar:			
D & F Minerals Co	Box 75 Terlingua, TX 79852	Mine	Brewster.
Graphite:			
Southwestern Graphite Co	Burnet, TX 78611	Mill	Burnet.
Gypsum:			
Celotex Corp	1500 North Dale Mabry Tampa, FL 33607	Quarry and calcining plant.	Fisher.
The Flintkote Co	400 Westchester Ave. White Plains, NY 10604	do	Nolan.
Georgia Pacific Corp	900 SW. 5th Ave. Portland, OR 97204	do	Hardeman.
National Gypsum Co	2001 Rexford Rd. Charlotte, NC 20211	do	Fisher.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Nolan.
Do	do	Plant	Harris.
Iron ore:			
Lone Star Steel Co	Box 12226 Dallas, TX 75225	Mine	Cass and Morris.
Tex-Iron, Inc	Box 46 LaRue, TX 75770	do	Henderson.
Lime:			
Aluminum Co. of America	1501 Alcoa Bldg. Pittsburgh, PA 15219	Plant	Calhoun.
Armco Inc	Box 96120 Houston, TX 77015	do	Harris.

Table 14.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Lime —Continued			
Austin White Lime Co	Box 9556 Austin, TX 78766	Plant	Travis.
Champion International Corp	Box 872 Pasadena, TX 77501	do	Harris.
Chemical Lime Inc	P.M. Hwy. 2602 Clifton, TX 76634	do	Bosque.
Holly Sugar Corp	Drawer 1778 Hereford, TX 79045	do	Deaf Smith.
McDonough Bros., Inc	Route 2, Box 222 San Antonio, TX 78229	do	Bexar.
Round Rock Lime Co	Box 38 Blum, TX 76627	do	Hill.
Texas Lime Co	Box 851 Cleburne, TX 70631	do	Johnson.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Comal.
Salt:			
Dow Chemical Co	2020 Dow Center Midland, MI 48640	Brine	Brazoria.
Diamond Shamrock Corp	717 North Harwood Dallas, TX 75201	do	Chambers.
Morton Salt Co	110 North Wacker Dr. Chicago, IL 60606	Underground mine and brine.	Van Zandt.
Texas Brine Corp	2000 West Loop South Houston, TX 77027	Brine	Harris, Jefferson, Matagorda,
Sand and gravel:			
Capitol Aggregates, Inc	Route 13, Box 142 San Antonio, TX 78209	Stationary plant	Guadalupe and Travis.
Dresser Industries, Inc	Box 6504 Kosse, TX 76653	do	Limestone.
The Fordyce Co	Box 1981 San Antonio, TX 78206	do	Hidalgo and Victoria.
Fort Worth Sand & Gravel Co	Box 400 Arlington, TX 76010	do	Dallas, Denton, Tarrant.
Gifford-Hill & Co., Inc	Box 47127 Dallas, TX 75247	do	Brazos, Clay, Dallas, McLennan, Tarrant.
R. E. Janes Gravel Co	Box 2155 Austin, TX 78767	do	Borden, Crosby, Lubbock, Taylor.
Lone Star Industries, Inc	Box 47327 Dallas, TX 75247	do	Colorado and Denton.
Parker Bros. & Co., Inc	Box 107 Houston, TX 77001	Stationary plant and dredge.	Colorado, Harris, Victoria.
Thorstenberg Materials Corp	1435 Bank of the Southwest Houston, TX 77002	do	Do.
Shell:			
Parker Bros. & Co., Inc	5303 Navigation Bldg. Box 107 Houston, TX 77001	Dredge	Calhoun.
Sodium (metallic):			
Ethyl Corp	Box 472 Pasadena, TX 77502	Plant	Harris.
Sodium sulfate (natural):			
Ozark-Mahoning Co	1870 South Boulder Tulsa, OK 74119	do	Gaines and Terry.
Stone:			
General Portland, Inc	3333 Ft. Worth Ave. Dallas, TX 75211	Quarry	Dallas, Tarrant, Wise.
Gifford-Hill & Co., Inc	Box 47127 Dallas, TX 75247	do	Comal, Ellis, Wise.
Lone Star Industries, Inc	Box 86 Huston TX 77001	do	Burnet, Nolan, Wise.
McDonough Bros., Inc	Route 2, Box 222 San Antonio, TX 78228	do	Bexar.
Parker Bros. & Co., Inc	Box 107 Houston, TX 77001	do	Comal.
Texas Crushed Stone Co	Box 1000 Austin, TX 78717	do	Llano and Williamson.
Texas Industries, Inc	Box 515 Bridgeport, TX 76026	do	Ellis and Wise.
White's Mines, Inc	Box 421 San Antonio, TX 78206	do	Brown, Taylor, Uvalde.
Sulfur (byproduct):			
Amoco Production Co	Box 591 Tulsa, OK 74102	Secondary recovery	Andrews, Ector, Hockley, Van Zandt, Wood.
Cities Service Oil Co	Box 300 Tulsa, OK 74102	do	Cochran, Dawson, Gaines, Van Zandt.
Getty Oil Co	Box 8 Scroggins, TX 75480	do	Franklin and Freestone.
Gulf Oil Co	Box 701 Port Arthur, TX 77640	do	Jefferson.

Table 14.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sulfur (byproduct) —Continued			
Phillips Petroleum Co	Bartlesville, OK 74003	Secondary recovery	Brazoria, Crane, Ector, Hutchinson.
Shell Oil Co	Box 2099 Houston, TX 77001	do	Cass, Harris, Karnes.
Warren Petroleum Corp	Box 1589 Tulsa, OK 74101	do	Crane, Hopkins, Karnes.
Sulfur (native):			
Duval Corp	1906 First City National Bank Houston, TX 77002	Frasch mine	Culberson.
Farmland Industries, Inc	Box 850 Fort Stockton, TX 79735	do	Pecos.
Jefferson Lake Sulfur Co	Box 1185 Houston, TX 77001	do	Fort Bend.
Texasgulf, Inc	200 Park Ave. New York, NY 10017	do	Fort Bend, Jefferson, Liberty, Pecos, Wharton.
Talc:			
Amoco Minerals Co. (Cyprus)	7000 Yosemite St. Box 3299 Englewood, CO 80155	Mine and plant	Hudspeth.
Pioneer Talc Co., Inc	Chatsworth, GA 30705	do	Do.
Southern Clay Products, Inc	Box 44 Gonzales, TX 78629	Mine	Do.
Texas Talc Co	Box 866 Van Horn, TX 79855	do	Do.
Westex Talc Co	Box 15038 Houston, TX 77020	Mine and plant	Culberson and Hudspeth.
Vermiculite:			
W. R. Grace & Co	2601 Manila Rd. Dallas, TX 75200	Exfoliating plant	Bexar and Dallas.
Vermiculite Products, Inc	Box 7327 Houston, TX 77008	do	Harris.
Volite, Inc	Box 122 Llano, TX 78643	Mine and plant	Llano.

The Mineral Industry of Utah

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Utah Geological and Mineral Survey for collecting information on all nonfuel minerals.

By Lorraine B. Burgin[1]

The value of nonfuel mineral production in Utah reached a record $759 million during 1980. Leading commodities in value of output were copper, gold, molybdenum, silver, potash, and portland cement. Decreases, however, were noted in the amount of production of every commodity except native asphalt (gilsonite), clays, lime, magnesium compounds, pumice, and beryllium.

Nationally, in nonfuel minerals, Utah was ranked first in value of production of beryllium and gilsonite; second in copper, potash, and vanadium; third in gold and molybdenum; and fifth in silver.

Metals again contributed more than three-fourths of the value of nonfuel mineral production in the State, and, even with the impact of the copper strike, copper production was about half of that total value. Although copper production was down in value and amount, the increase in the price of gold and silver and consequent rise in value of production prevented a greater decline in value of metal production. The copper strike, which in Utah lasted from July 1 to September 8, was the principal cause of the decline in copper output and its major byproducts gold, silver, and molybdenum. The decrease in iron ore and vanadium production was attributed chiefly to depressed conditions in the steel industry, resulting from a slowdown in the automotive and construction industries. The continued drop in the consumption of lead as an additive in gasoline and in zinc used in the automotive and steel industries led to lower prices of those metals. In Utah, the effect of those declines has been the almost complete shutdown of mines that produce lead and zinc.

Most minerals and materials in the nonmetals group declined in the amount produced. Values increased, however, in potash, salt, gilsonite, lime, stone, phosphate, gypsum, clay, magnesium compounds, pumice, and masonry cement. Since output declined, the increase in value of production, in part, reflected the inflationary trend of the times. Leading nonmetal commodities ranked by value included potash, portland cement, salt, sand and gravel, gilsonite, lime, stone, and phosphate.

Table 1.—Nonfuel mineral production in Utah[1]

Mineral	1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
Clays thousand short tons	355	$1,246	365	$1,517
Copper (recoverable content of ores, etc.) metric tons	193,082	396,003	157,775	356,251
Gem stones	NA	75	NA	70
Gold (recoverable content of ores, etc.) troy ounces	260,916	80,232	179,538	109,978
Gypsum thousand short tons	r292	r2,450	287	2,612
Iron ore (usable) thousand long tons, gross weight	1,618	19,391	1,307	18,540
Lead (recoverable content of ores, etc.) metric tons	W	W	--	--
Lime thousand short tons	198	8,250	259	13,293
Perlite do.	W	W	(2)	2
Pumice do.	28	280	35	347
Salt do.	1,204	14,723	1,157	19,373
Sand and gravel[3] do.	10,363	18,621	8,906	17,234
Silver (recoverable content of ores, etc.) thousand troy ounces	2,454	27,216	2,087	43,083
Stone:				
Crushed thousand short tons	3,424	11,059	2,919	11,776
Dimension do.	5	216	3	272
Zinc (recoverable content of ores, etc.) metric tons	W	W	--	--
Combined value of asphalt, beryllium concentrate, carbon dioxide, cement, magnesium compounds, molybdenum, phosphate rock, potassium salts, sand and gravel (industrial), sodium sulfate, tungsten, vanadium, and values indicated by symbol W	XX	169,520	XX	164,570
Total	XX	r749,282	XX	758,918

rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. 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 industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Utah, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Beaver	$30	$92	Sand and gravel.
Box Elder	1,817	1,260	Stone, sand and gravel, salt, tungsten.
Cache	W	978	Sand and gravel, stone.
Carbon	W	W	Carbon dioxide, sand and gravel.
Daggett	--	20	Stone.
Davis	W	W	Sand and gravel, tungsten.
Duchesne	438	439	Sand and gravel, stone.
Emery	W	W	Sand and gravel, vanadium.
Garfield	W	W	Vanadium, stone, sand and gravel.
Grand	7,985	10,861	Potassium salts, salt, stone, vanadium.
Iron	W	W	Iron ore, sand and gravel.
Juab	W	W	Stone, silver, gypsum, gold, copper.
Kane	W	350	Sand and gravel.
Millard	W	W	Pumice, gypsum, sand and gravel, perlite, beryllium.
Morgan	W	W	Cement, stone, sand and gravel.
Salt Lake	403,007	589,016	Copper, gold, molybdenum, silver, cement, sand and gravel, salt, lime, stone, clays, lead, zinc.
San Juan	W	W	Vanadium.
Sanpete	2,339	1,466	Sand and gravel, gypsum, salt, clays.
Sevier	W	W	Gypsum, salt, clays, sand and gravel.
Summit	W	W	Clays, stone.
Tooele	17,972	18,187	Lime, salt, potassium salts, stone, sand and gravel, copper, gold, magnesium compounds, silver, tungsten, clays.
Uintah	W	W	Phosphate rock, asphalt, sand and gravel, stone.
Utah	17,095	12,140	Stone, gold, silver, sand and gravel, copper, clays.
Wasatch	W	1,301	Sand and gravel, stone.
Washington	W	W	Do.
Wayne	40	40	Sand and gravel.
Weber	22,513	34,787	Potassium salts, asphalt, salt, sodium sulfate, magnesium compounds, sand and gravel, clays.
Undistributed[2]	79,389	78,344	
Total	552,625	[3]749,282	

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

[1]Piute and Rich Counties are not listed because no nonfuel mineral production was reported.

[2]Includes sand and gravel and stone (1979) that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

[3]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Utah business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	584.0	607.0	+3.9
Unemployment	do	25.0	38.0	+52.0
Employment (nonagricultural):				
Mining[1]	do	17.7	18.3	+3.4
Manufacturing	do	86.8	88.6	+2.1
Contract construction	do	35.6	31.9	-10.4
Transportation and public utilities	do	33.6	34.7	+3.3
Wholesale and retail trade	do	129.3	129.0	-.2
Finance, insurance, real estate	do	25.8	25.9	+.4
Services	do	96.3	99.6	+3.4
Government	do	123.2	126.1	+2.4
Total nonagricultural employment[1]	do	[2]548.4	554.1	+1.0
Personal income:				
Total	millions	$9,819	$10,921	+11.2
Per capita		$7,182	$7,485	+4.2
Construction activity:				
Number of private and public residential units authorized		16,638	10,263	-38.3
Value of nonresidential construction	millions	$306.9	$279.0	-9.1
Value of State road contract awards	do	$77.0	$51.0	-33.8
Shipments of portland and masonry cement to and within the state	thousand short tons	923	801	-13.2
Nonfuel mineral production value:				
Total crude mineral value	millions	$749.3	$758.9	+1.3
Value per capita, resident population		$548	$519	-5.3
Value per square mile		$8,824	$8,937	+1.3

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.
[2]Data do not add to total shown because of independent rounding.

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

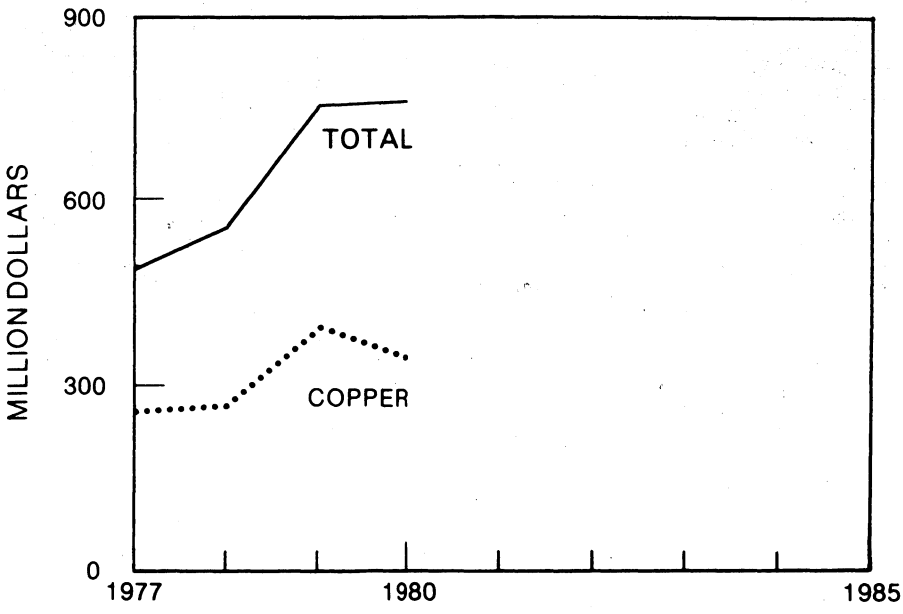

Figure 1.—Value of mine production of copper and total value of nonfuel mineral production in Utah.

Trends and Development.—The high prices of gold and silver in 1979 and early 1980 encouraged new exploration ventures, including the reopening of old mines. Noranda Mining Co. of Toronto continued rehabilitating the Ontario Mine. The company obtained a lease with the adjoining Park City Consolidated Mines Co. of Salt Lake City on the old Park City Consolidated properties that were operated from 1930 to 1942. Noranda also began negotiations to form a joint venture with New Park Resources, Inc. The agreement in principle provided for evaluating, and possible reopening of, the Mayflower Mine. From 1932 through 1972, the Mayflower Mine shipped precious and base metal ores, however, most of those mining operations are now under water.

In late February 1980, activities in the Tintic district were stepped up when Kennecott Minerals Co. announced a 3-year gold-silver exploration program in the East Tintic mining district. Underground exploration was to take place in the Trixie Fault, Eureka Standard Fault, Sioux Ajax Fault, and Homansville Fault areas. According to the Chief Consolidated Mining Co. 1980 annual report, exploration drilling from the 1,350-foot level in the northern area of Kennecott's Trixie Mine encountered a 120-foot length of significant mineralization with average assays per ton of 15.57 ounces of silver, 0.211 ounce of gold, 3.86% zinc, 2.28% lead, and 1.97% copper.

The Burgin Mine, leased and operated by Kennecott Copper Corp., was closed July 1978, and the property assigned out of Kennecott's East Tintic unit back to the owner, the Chief Consolidated Mining Co. Costly mining conditions such as heavy inflows of hot water, high rock temperatures, and poor ground led to Kennecott's decision to drop the property. On June 17, 1980, Sunshine Mining Co. of Dallas acquired an option to lease 1,387 acres of Chief Consolidated property, including the Burgin Mine. An exploration program was begun immediately. According to the Chief Consolidated 1980 10K annual report to the Securities and Exchange Commission, three drill holes encountered significant mineralization between 1,500 and 1,600 feet below the surface. Further exploration and evaluation of the new area were underway.

Sunshine Mining exercised its option to lease the Chief Consolidated properties, including the Burgin Mine, for 50 years and the right to renew the lease for an additional 25 years. Terms of the lease included an initial $100,000 annual royalty; after production begins, the royalty would be $150,000, or 7.5% of net smelter returns, whichever was greater.

Also, stimulated by the high prices of precious metals, other exploration activity was reported at the Yankee Gold and Silver, Inc., properties in American Fork mining district, Utah County; at the Stansbury Mining Co.'s Scranton property, western Tooele County; at the Toledo Mining Co. properties about 5 miles northwest of Milford, Beaver County; and at the property of Tintic Mineral Resources, Inc., and Horn Silver Mines, Inc., in the San Francisco mining district, Beaver County.

Controversy surrounded placing the Jordanelle Dam, a major arm of the Central Utah Project scheduled for construction in 1983, north of Heber, Wasatch County. The close proximity of the Park City mining district, faults in the area, and the possible flooding of mines in the vicinity were the immediate concern of the mining companies involved, and the center of a year-long debate. The U.S. Water, Power, and Resources Service (U.S. Bureau of Reclamation) continued geophysical and geological studies, including drilling of the proposed dam site.

The Park City mining district and the Cottonwood mining district, particularly, have become recreational areas as mining companies have sold surface rights to their properties. In October 1980, the Queen Esther Mining Co. (52% owned by the Park City Consolidated Mines Co.) sold outright 7 acres; the company also entered a developmental agreement to subdivide an additional 45 acres of Queen Esther property, subject to a joint venture agreement with Hanover Financial, Inc., of Salt Lake City.

Legislation and Government Programs.—The 1976 Federal Land Policy and Management Act required that the Bureau of Land Management (BLM) recommend to Congress public lands to be designated as wilderness areas. Between October 1978 and September 1979, the "initial inventory" of the proposed areas was accomplished, and certain areas were identified as nonwilderness. From September 1979 to November 1980, an "intensive inventory" of the remaining areas was conducted. In this phase, lands were examined for wilderness qualities. In the third phase, November 1980 to October 1991, lands established as Wilder-

ness Study Areas will be studied to determine the suitability for wilderness designation.

The U.S. Bureau of Mines and the U.S. Geological Survey were actively involved in assessing the mineral resources in the proposed areas.

Lands designated as primitive or natural areas before November 1975 were called instant study areas, and BLM made recommendations to the President as to their wilderness suitability by 1980. Instant-study areas in Utah were the Book-Cliffs, Link Flats, Devil's Garden, Joshua Tree, North Escalante Canyon, The Gulch, Phipps-Death Hollow, and Escalante Canyon natural areas, and the Dark Canyon, Grand Gulch, and Paria Canyon primitive areas. Accumulatively, these areas totaled approximately 170,605 acres in the State.

In 1980, the BLM Wilderness areas that the Bureau of Mines was investigating included Escalante Canyon (152,000 acres), Fiddler Butte (20,000 acres), and Phipps-Death Hollow (50,000 acres)—a total of 222,000 acres in Garfield County; and Dark Canyon (72,000 acres) and Grand Gulch (113,000 acres)—a total of 185,000 acres in San Juan County.

Concurrently, the U.S. Forest Service Second Roadless Area Review and Evaluation (RARE II) Further Planning Areas under study by the Bureau of Mines included Birdseye (13,220 acres) in Utah County, Box-Death Hollow (31,600 acres) in Garfield County, Stansbury (11,176 acres) in Tooele County, Nephi (23,980 acres) in Juab County, Santaquin (12,880 acres) in both Juab and Utah Counties, and Mount Naomi (77,830 acres, including 20,800 acres in Idaho) mostly in Cache County.

Also in 1980, the following publications were made available: Preliminary Report on Mineral Resource Potential of the Vermillion Cliffs, Paria Canyon Instant Study Area, Coconino County, Ariz., and Kane County, Utah, U.S. Geological Survey Open File Report 80-1056; and Bureau of Land Management, Intensive Wilderness Inventory, Final Decision on Wilderness Study Areas, Utah, November 1980, Utah State Office, Salt Lake City, Utah.

In 1980, Utah joined Arizona, Colorado, Idaho, Montana, Nevada, South Dakota, and Wyoming in the so-called "Sagebrush Rebellion." On February 14, 1980, Governor Scott Matheson signed into law the United States Land Reclamation Act which provided for State control over certain public lands. However, the bill gave the State Land Board no authority for action on the 22 million acres of public lands administered by the BLM until the matter is settled in the courts. Forest Service lands, national parks or monuments, or military and Indian reservations were not affected by the legislation. Concern over closing some public lands to mineral exploration was one impetus for the bill.

From January 1 to December 31, 1980, the Bureau of Mines awarded a number of research contracts and grants and modified existing contracts totaling $4,271,807 to 2 Utah universities, 12 private companies, and 3 Federal agencies in the State. The projects were on such subjects as methane control, mine machinery and equipment, radon emanation, recovering and recycling materials from automobile scrap, rock mechanics applied to mining, tailings stabilization, water supply and pollution problems, and zinc sulfide retorting without pollution.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Beryllium.—In 1980, production of beryllium concentrates increased over that of the previous year. The chief source for domestic ores containing beryllium was the Brush Wellman, Inc., property at Spor Mountain, Juab County. Bertrandite ore was mined by open pit and trucked to the company's processing plant near Delta, Millard County. In January 1980, Brush completed acquisition of The Anaconda Company claims and leases contiguous to its properties around Spor Mountain. During the year, Brush initiated a program to expand imports of beryl for treatment at its Delta plant. The mill was also equipped to handle custom ores. Bertrandite and imported beryl were processed to produce a beryllium hydroxide which was shipped to the company's refinery at Elmore, Ohio, where it was converted to beryllium alloys, beryllium oxide (beryllia), and metallic beryllium.

The $6.5 million expansion program, started in 1979 at the Delta mill and completed by yearend 1980, provided a 25% increase in processing capacity. In 1980, the Nuclear Regulatory Commission also granted Brush a source-material license to recover byproduct uranium from bertrandite

wastes.

Copper.—The world's largest open pit copper mine was operated by Utah Copper Div. of Kennecott Minerals Co., a subsidiary of Kennecott Corp. (in May 1980 Kennecott Copper Corp. changed its name to Kennecott Corp.). The mine is 25 miles southwest of Salt Lake City; ore is transported by rail 16 miles north to the Bonneville crushing plant, the Arthur and Magna mills, the smelter, and refinery. Waste dumps at the Bingham pit are leached and the solutions treated at the precipitation plant in lower Bingham Canyon.

According to the 1980 Kennecott annual report, total copper production from the Utah Copper Div. dropped from 205,931 net tons in 1979 to 200,053 net tons in 1980; ore mined, milled, and treated declined from 37,804,000 net tons in 1979 to 31,578,000 net tons in 1980. The average grade also dipped from 0.586% copper in 1979 to 0.575% copper in 1980. Principal byproducts recovered from the copper production included gold, molybdenum, silver, and sulfuric acid. Other byproducts recovered when economically feasible included bismuth, palladium, platinum, rhenium, selenium, and tellurium.

The decrease in copper production was attributed to the copper strike that lasted from June 30 to September 9, 1980, when employees began to return to work after the local union ratified the contract. Terms provided for an increase in wages of the average copper worker from $10.23 to $14.20 per hour by the end of the 3-year contract and included improved pensions and health benefits. Over 6,000 people were employed by the Utah Copper Div.

According to the 1980 Kennecott Corp. annual report, several programs were begun to improve productivity and to determine the modernization and development of the Utah Copper Div. operation into the next century. During the year, an engineering study was being conducted to determine the feasibility of changing the Bingham Canyon Mine from open pit to underground mining; a 4,200-foot shaft was being put down to develop a separate major deposit of high-grade copper, gold, and silver ore; and a study of the concentrators and related facilities for the Bingham Canyon complex was commenced. A rail modernization program was initiated with the purchase of larger, more powerful diesel-electric locomotives to replace the smaller locomotives powered by overhead electric cables. Eliminating towers for overhead electrification was expected to allow the use of larger power shovels.

In the fall of 1980, a $30 million, 6-year contract was awarded to an outside firm to begin development work on the North Ore Shoot Extension ore body, 1/2 mile north of the Bingham pit. Included in the project is a 20-foot-diameter shaft to be sunk 4,200 feet, excavation of eight intermediate stations for electrical and mechanical installations, a temporary and permanent pumping system, muck hoisting facilities, and approximately 3 miles of drift development. When full production is achieved, the mine could yield 12,000 tons per day.

The maintenance program at the Utah Copper Div.'s Bingham Canyon Mine involves a work force of 1,135, nearly half of the total mine employment. In addition to the service and repair of 900 equipment units in the pit, the department is responsible for 32 leach-water distribution pumps, 80 miles of pipeline, 160 miles of electrical transmission lines, and 95 miles of standard gage railroad.[2]

Kennecott reported its operations were complying with ambient air-quality standards and were implementing programs to meet waste water discharge regulations.

The Anaconda Company, a subsidiary of Atlantic Richfield Co., brought its Carr Fork underground copper operation onstream August 31, 1979, after 5 years of development. The mine is in the Bingham mining district, about 25 miles southwest of Salt Lake City. The production and service shafts, concentrator, and other surface facilities are in Pine Canyon on the west flank of the Oquirrh Range in Tooele County. At the east end of the property are the Carr Fork Mine ore bodies slightly west of the Bingham Canyon pit.

Under full production, Anaconda is scheduled to produce 55,000 short tons per year of copper; however, several operational difficulties prevented achieving that goal in 1980. While the mine was operated during the copper strike, concentrates had to be stockpiled and await settlement of the strike before shipment to the smelter. In addition, on May 9, 1980, an overloaded skip plummeted down the 3,600-foot production shaft and a second skip used as a counterweight flipped through the head frame. Fortunately, no personnel were injured, but damage to the shaft was extensive; restoration cost was almost $3 million and resulted in a production loss of about 10 million pounds of copper. Skip-hoisting operations were resumed July 25, 1980.

The company has reported reserves of 55 million metric tons of copper ore with an

average production grade of 1.85% copper. Byproducts include gold, silver, molybdenum, and magnetite.

Innovations in the operation include the use of the Vertical Crater Retreat mining method and a computer on the surface and underground terminals to monitor equipment maintenance and other mine activities.

Table 4.—Utah: Mine production (recoverable) of gold, silver, copper, lead, and zinc

Year	Lode mines producing	Material sold or treated (metric tons)	Gold		Silver	
			Troy ounces	Value	Troy ounces	Value
1978	8	32,792,033	235,929	$45,664,058	2,885,065	$15,579,351
1979	7	34,412,486	260,916	80,231,672	2,454,136	27,216,367
1980[1]	3	29,356,288	179,538	109,977,798	2,087,351	43,082,925

Year	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1978	186,330	$273,174,518	2,541	$1,887,852	3,509	$2,397,888	$338,703,667
1979	193,082	396,002,869	W	W	W	W	503,465,541
1980[1]	157,775	356,251,322	--	--	--	--	509,312,045

W Withheld to avoid disclosing company proprietary data.
[1]Includes Salt Lake, Tooele, and Utah Counties.

Table 5.—Utah: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1980, by class of ore or other source material

Source	Number of mines[1]	Material sold or treated (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:							
Gold-silver	1	77,062	W	W	[2]529	--	--
Copper	2	29,231,616	[3]179,538	[3]2,087,351	140,615	--	--
Total	3	29,308,678	[2]179,538	[2]2,087,351	[2]141,144	--	--
Other lode material:							
Copper precipitates	1	22,136	--	--	16,630	--	--
Copper tailings	--	25,474	W	W	W	--	--
Grand total	3	29,356,288	179,538	2,087,351	[4]157,775	--	--

W Withheld to avoid disclosing company proprietary data.
[1]Detail will not add to total because some mines produce more than one class of material.
[2]Includes recovery from copper tailings.
[3]Includes recovery from gold-silver ore and from copper tailings.
[4]Data do not add to total shown because of independent rounding.

Table 6.—Utah: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1980, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode:					
Smelting of concentrates	168,487	1,718,051	140,615	--	--
Direct smelting of:					
Ore and tailings[1]	11,051	369,300	529	--	--
Copper precipitates	--	--	16,630	--	--
Total	179,538	2,087,351	[2]157,775	--	

[1]Combined to avoid disclosing company proprietary data.
[2]Data do not add to total shown because of independent rounding.

Gold.—Utah dropped from first in domestic gold production in 1979 to third in 1980; the Utah Copper Div. of Kennecott was the principal producer. Other producers included the Kennecott Minerals' Trixie Mine, Anaconda's Carr Fork Mine, and the recycled tailings from Sharon Steel's UV Industries old operation at Midvale. Production decreased 31% because of the over 2-month copper strike; however, value increased 37% because of the rise in the average unit price of gold from $307.50 per ounce in 1979 to $612.56 in 1980. No production was recorded from the Mammoth Mine in 1980.

Getty Mineral Resources Co., a subsidiary of Getty Oil Co., continued exploration and evaluation of gold properties in Mercur Canyon, Tooele County. Located approximately 55 miles southwest of Salt Lake City in the Camp Floyd (Mercur) mining district, the project is a joint venture of Getty and Gold Standard, Inc., of Salt Lake City. The company reported that micron-sized gold is found in a zone of mineralization and could be mined by open pit methods. The district yielded over 1,115,000 ounces of gold and subordinate amounts of silver and mercury since its organization in 1870; however, it has been more or less dormant since the 1940's.

Iron Ore.—All iron ore mined in the State was obtained from open pit operations in the Iron Springs mining district 12 to 20 miles west of Cedar City in Iron County. Utah International, Inc., a subsidiary of General Electric Co., under contract to CF&I Steel Corp., direct-shipped magnetite from the Comstock Mine to the CF&I steel plant at Pueblo, Colo., until September 1980. United States Steel Corp. direct-shipped a hematite and magnetite ore from its Desert Mound Mine to its steel plant, the Geneva Works, near Orem, Utah County. Shipping from the Mountain Lion Mine of United States Steel was suspended in February 1980. Utah International also mined and concentrated a low-grade magnetite ore from the Thompson and Iron Springs Mines. Shipment was made to the Geneva Works. Utah's iron ore production decreased in amount and value during the year.

In June 1980, Utah International completed mining operations at the Iron Springs Mine; the mill shut down on July 25, and the final shipment of ore under the Iron Springs-United States Steel contract was made on August 28. The company had produced 22 million short tons of iron ore, and approximately 9.6 million tons was shipped to the Geneva Works during the last 22 years.

A pelletized iron ore derived from taconite was also shipped to the Geneva Works from United States Steel's Atlantic City Mine near Lander, Fremont County, Wyo.

United States Steel, Geneva Works, is the State's third largest employer, normally employing about 6,000 people. About 600 workers were laid off during the summer, and by early November, the plant was operating with 4,600 workers. Principal products include plates, hot-rolled sheets and coils, structural shapes, welded steel pipe, pig iron, metallurgical coke, blast furnace and open hearth slag products, and coal chemicals and nitrogen products for fertilizer and industrial use.

After negotiations lasting over 1 year, United States Steel and the U.S. Environmental Protection Agency agreed on air- and water-pollution controls. The final agreement, achieved on October 15, 1980, required United States Steel to install an air-pollution control system that would cost an estimated $78 million and water-pollution controls that would cost approximately $16.5 million. The company reported that operating the new facilities would cost an estimated $17 million annually. The Deseret News, November 4, 1980, reported the agreement could cut particulates (dust pollution) from 17,000 tons per year (1977 level) to 3,000 tons per year by December 31, 1982. With the best available technology, water-pollution controls would be in place by July 1984. Engineering on the control systems was designed during 1980, and construction was to begin by March 1981.

To control air emissions, a five-story, four-block-long enclosure was to be constructed over the coking side of the steel plant's four-oven coke batteries; a ninth electrostatic precipitator scrubber was to be added; emissions from the blast furnace operations would be directed to the new baghouse; and dust-control units were to be added throughout the plant. Waste water discharged into Utah Lake was to be purified and reduced; 90% of water used in the plant was already recycled.

In November 1980, United States Steel, Utah County and a bonding firm signed an agreement to issue $42 million in bonds to finance pollution-control equipment for the Geneva Works. Earlier in the year the county issued $27 million in bonds for the steel company.

During the year, civic groups rallied sup-

port for keeping the steel plant open; United States Steel had protested foreign steel imports and stated that compliance with strict pollution requirements might force closure of the Geneva Works.

In July 1980, Nucor Corp., a North Carolina corporation, began constructing a building to house a new steel products plant. Located in Box Elder County 1 mile northwest of Plymouth and 9 miles south of the Utah-Idaho state line, the new ministeel mill will use recycled steel, including automobile bodies. The $90 million plant was scheduled to produce 400,000 tons per year of steel products, including grinding balls, merchant bars, reinforcing bars, and structural steel. Although the products were priced higher per ton than those of the company's eastern mills, the differential in steel prices was expected to be made up in lower freight charges.

Lead.—On August 28, 1980, Noranda Mining Co. commenced shipping a lead-zinc-silver ore from the Ontario Mine in the Park City mining district, Summit County, to the smelter at Bunker Hill, Idaho. Ores had been stockpiled over the year. No other lead production in the State was reported. The low average unit of lead, $0.4246 per pound, was not conducive to recovering the metal. During the year, the price of lead reached a high of $0.5348 on January 4 and a low of $0.34 on July 4.

Magnesium.—NL Industries, Inc., Magnesium Div., recovered magnesium metal and byproduct chloride at its Rawley plant on the southwest shore of the Great Salt Lake, Tooele County. On November 1, 1980, the NL Magnesium Div. was sold to the Magnesium Div. of Amax Specialty Metals Corp., a subsidiary of AMAX Inc., for approximately $58 million. The plant was operated at the maximum production rate of 28,000 tons per year. An expansion program was underway to increase production capacity to 45,000 tons per year by 1983. About 750 workers are employed at the Rawley installation.

According to the AMAX 1980 annual report, the facility has one of the largest active solar pond systems in the world. Covering over 40,000 acres, energy collected by the system provides more than 95% of the energy used in magnesium recovery. The acquisition made AMAX the second largest magnesium producer in the United States; Dow Chemical Co., with an annual production capacity of 110,000 to 120,000 tons, is the first. NL Industries sold about 20,000 tons of chlorine per year and used 36,000 tons in its own process. The Rawley magnesium process, including solar evaporation, feed preparation, and production and handling of the metal, were described in a Utah Geological and Mineral Survey publication.[3]

Molybdenum.—Utah Copper Div. continued to ship molybdenum concentrates recovered as a byproduct of its copper production. As a result of the copper strike, output of molybdenum concentrate decreased nearly 21% in amount and about 33% in value. After Colorado and Arizona, Utah was ranked third in molybdenum production.

Pine Grove Associates, a joint venture of Getty Oil Co. and Phelps Dodge Corp., continued exploring in the Pine Grove mining district, southwest of Milford, Beaver County. Surface drilling in the porphyry-type molybdenum deposit was completed in 1980. Getty, operator of the project, was drilling pilot holes for two shafts that would permit underground work to further delineate the size of the mineralized body. By yearend, about $14.5 million had been expended on the property. During the year, engineering hydrologic studies, preliminary engineering investigations, and financial evaluations were being coordinated to determine the economic feasibility of the project. The companies control 36,500 acres in the vicinity of the deposit, and under the terms of the agreement, Getty was to spend $45 million (adjusted for inflation) on the project within 10 years ending in 1988. In 1977, drilling indicated molybdenum and tungsten mineralization between 4,000 and 6,000 feet deep. Getty has the right to acquire 52% interest on the property by spending $45 million on exploration and development work.

Selenium.—Utah Copper Div. continued producing selenium recovered as a byproduct from refining copper ores. Selenium production in 1980 was less than that of the previous year because of reduced throughput as a result of the copper strike.

Silver.—The principal producer of silver in the State continued to be the Bingham Canyon Mine of the Utah Copper Div. The metal is recovered as a byproduct during the electrolytic refining of smelter anode copper. According to Engineering Mining Journal, March 1981, the Bingham Canyon Mine was the third largest silver producer in 1979 and the fourth largest in 1980. Other producers of silver include Kennecott's Trixie Mine in Utah County, Sharon Steel's Midvale mill tailings in Salt Lake

County, and Anaconda's Carr Fork Mine in Tooele County. Silver-gold ore shipped from the Trixie Mine was mainly flux ore; however, some ore treated in the concentrator was also shipped. Compared with that of 1979, silver production decreased almost 15% in amount because of the copper strike; however, because of the increase in price, the value of production rose about 58%. The average daily price of silver increased from $11.09 per troy ounce in 1979 to $20.63 per troy ounce in 1980.

Noranda Mining Co., a subsidiary of Noranda Mines, Ltd., operated the Ontario Mine in the Park City mining district, Summit County. According to the Noranda 1980 annual report, the company continued to rehabilitate the old workings of the Ontario throughout the year; however, work was delayed by poor ground conditions, water problems, and lack of experienced miners. Nonetheless, beginning with a limited production of 230 tons per day in 1980, a total of 37,760 tons of ore averaging 3.19 ounces of silver, 3.88% lead, and 5.57% zinc was treated at the mill and the concentrates were shipped. Also, an additional 8,600 tons of purchased ores was milled on a trial basis.

Ranchers Exploration and Development Corp. continued developing its Escalante silver mine 8 miles north of Enterprise and 3 miles west of Beryl Junction, Iron County. According to the company annual report for the year ending June 30, 1980, construction of the underground mine commenced in September 1979, and about 3,000 feet of drift and decline had been completed by September 1980. During the year, Ranchers successfully tested the Vertical Crater Retreat mining method proposed for the operation. As mining proceeds below the water table, 25,000 to 40,000 gallons of water per minute may have to be pumped; initial production was to come from above the water table. A mine dewatering test was also conducted. Ores in the Escalante deposit are in a vein reportedly exposed for at least 3,000 feet. The near surface leached zone ranges in grade from 5 to 8 ounces of silver per ton. It appears the enriched zone lies mostly below the water table.

As of September 1980, approximately 20,000 tons of ore had been stockpiled on the surface and another 7,500 tons broken underground. At full production, the Escalante Mine was expected to produce 1.5 million ounces of silver per year for 10 to 12 years. Based on the present mine plan, Ranchers reported recoverable reserves were an estimated 1.64 million tons of ore containing over 10 ounces of silver per ton.

Construction of the 500-ton-per-day mill was begun in September 1980, and completion was scheduled for November 1981. The plant was designed to treat the crushed and ground ore by leaching with sodium cyanide to recover silver bullion or silver precipitate. Cost to bring the property into production was an estimated $25 million, including $13 million for the mill and other facilities.

Tungsten.—Tungsten production continued to decline in Utah. The sole producer, the Abracadabra Exploration Corp., mined scheelite and shipped tungsten concentrates from the Fracture Lode near Gold Hill in Tooele County. Other producers that were active in 1979 did only a small amount of exploration work or were idle during 1980.

Vanadium.—Vanadium was recovered from uranium-vanadium ores mined in Emery, Garfield, Grand, and San Juan Counties. Shipments from these areas were made to the Union Carbide Corp. mills at Rifle and Uravan, Colo.; Atlas Corp. near Moab, Grand County, Utah; or Energy Fuels Nuclear, Inc., at Blanding, San Juan County, Utah. Vanadium production declined during 1980 because of weakened demand resulting principally from lower activity in the steel industry.

Union Carbide cut back uranium and vanadium operations in southeastern Utah and southwestern Colorado late in the year and, in December, announced an approximate 6-month shutdown of the Uravan Mill.

Nonetheless, according to the Atlas Corp. 1980 annual report dated June 30, 1980, its Mineral Div. produced and sold 2,530,000 pounds of vanadium pentoxide during its 1980 fiscal year; a 9% gain over that of 1979. Most uranium-vanadium ores treated at the Atlas plant were mined at company properties in San Juan County, Utah, and in the Uravan Mineral Belt of Utah and Colorado. Additional ores from other uranium-vanadium producers were also treated. Energy Fuels Nuclear completed construction of its $30 million ore-buying station and 2,000-ton-per-day concentrator on White Mesa, 6 miles south of Blanding, San Juan County. Processing began in May 1980, with Energy Fuels properties supplying much of the ore. Custom ores, however, were also obtained from other mines on the Colorado Plateau.

The State continued with a program to clean up old uranium tailings. During the

year, a timetable was announced for removing tailings from the Vitro Chemical Co. uranium-vanadium plant in Salt Lake County. The facility was closed down July 7, 1965, because of the depressed vanadium market.

Zinc.—Low zinc prices resulted in little zinc production in the State. The Noranda Mining Co., the only producer, shipped a silver-lead-zinc ore from the Ontario Mine in the Park City mining district. Zinc prices in 1980 averaged $0.3743 per pound, with a high of $0.4114 per pound and a low of $0.355 per pound.

Zirconium.—Western Zirconium, Inc., a subsidiary of Westinghouse Electric Corp., produced its first zirconium ingots. The plant, however, was still in its qualifying stage because the product, which is used in the nuclear industry, was being tested for purity and uniformity. The zirconium was to be forged into plates and pipes and then shipped to fabricators to be processed into finished products for industrial use.

Located in the Southern Pacific Industrial Park, 12 miles south of Ogden, Weber County, the company obtained its raw material, zircon, from Australia where it is recovered from beach sands as a coproduct of ilmenite and rutile production.

At full capacity, the plant is expected to produce 3 to 4 million pounds of zirconium per year and to employ 430 people. In the first quarter of 1980, the company announced plans for a $3 to $5 million expansion of its $50 million plant to permit recovering hafnium as a byproduct of the zirconium process. Hafnium is also used in nuclear applications.

NONMETALS

Native Asphalt and Other Bitumens.—Utah was the only producer of gilsonite, an asphaltite or solidified hydrocarbon found only in Utah and Colo. One of the purest of the natural bitumens (99.9%), gilsonite was produced by the American Gilsonite Co. at Bonanza, Uintah County. Jointly owned by Barber Oil Corp. and Standard Oil of California, American Gilsonite operated the $5.3 million consolidated processing facility that was completed late in 1979. Four widely separated facilities in eastern Utah were consolidated with the construction of this plant, which has five concrete silos with a combined storage capacity of 6,800 tons of material to meet the demand when production is low. Production capacity is up to 154,000 tons per year of product.[4]

Gilsonite was used by the oil drilling, foundry, building board, and explosives industries; by the automotive, ink, paint, and varnish industries; and as a source of raw material in producing nuclear-grade graphite. Midas Gilsonite was organized in 1980 to mine a small gilsonite vein near Ouray, Uintah County.

Barite.—Although barite was not mined in Utah, the following companies, all in Salt Lake County, ground and crushed barite for drilling mud: All Minerals Corp.; Custom Milling and Supply Co.; Eisenmann Chemical Co., a subsidiary of Newpark Resources; Rocky Mountain Refractories, Unichem Minerals, a subsidiary of Uni Bar Corp.; and Westemco, Inc. During the year, All Minerals added a 60-inch roller mill to its Murray plant and Eisenmann Chemical Co. added two 51-inch mills to its Salt Lake City plant.

Cement.—Ideal Basic Industries, Inc., and Lone Star Industries, Inc., produced cement. Ideal Cement Co., a division of Ideal Basic Industries, Inc., quarried limestone and shipped finish portland and masonry cement from its Devil's Slide operation in Morgan County. The expansion and modernization project announced in 1979 for the Devil's Slide plant was still awaiting environmental and construction permits. Constructed in 1946, the present plant has a capacity of 360,000 tons per year. In 1979, the Portland Cement Co. of Utah was acquired by Lone Star Industries, Inc. During 1980, the company's newly added 11- by 300-foot wet kiln went onstream in Salt Lake County. An article describing the Portland Cement Co. operation appeared in the literature.[5]

In 1980, production of cement declined slightly in amount and value. Principal consumers of portland cement during the year included ready-mix companies, concrete product manufacturers, building material dealers, and highway contractors.

Martin Marietta Corp. commenced constructing an $85 million cement plant about 100 miles south of Salt Lake City near Leamington, Juab County. Groundbreaking of the new 650,000-ton-per-year plant was in June 1980. Located 5 miles east of Leamington and 23 miles west of Nephi, the facility was being built on a 350-acre site. The limestone quarry is on 150 acres. Other raw materials, shale and quartz, are also on the site, and the coal, gypsum, and iron ores required to produce cement are readily available in central Utah. The company expects the dry-process plant, featuring a

four-stage precalciner system, to use 45% less coal and electricity than wet-process plants. To be completed in late 1981, the plant will employ approximately 100 permanent full-time workers; the headquarters in the Salt Lake area will employ about 20 people. A planned distribution terminal will also be located in Salt Lake Valley.

Clay and Shale.—Clay and shale production increased in amount and value during the year. Common clay and shale were mined by Utelite Corp. in Summit County for use in concrete block and structural concrete; and by Interpace Corp. at its mines in Utah and Weber Counties for use in making face brick. Interstate Brick Corp., a division of Entrada Industries, a subsidiary of Mountain Fuel Supply Co., also mined clay and shale for common brick at its Cottonwood Mine in Salt Lake County, Henefer Mine in Summit County, Five Mile Mine in Tooele County, and Jim Gay Mine in Utah County.

Redmond Clay and Salt Co. mined bentonite in Sanpete County for use in animal feed and in waterproofing and sealing; Western Clay Co. produced bentonite at its Redmond Mine in Sevier County for use in fertilizers. Western Clay produced fuller's earth at its Aurora Mine in Sevier County for use in catalytic oil-refining, and in pesticides and related products. R. D. Wadley Clay Co. mined fire clay at the Wadley Mine in Utah County.

Gem Stones.—Mineral specimens and gem stone material were collected by amateurs and professionals at various deposits in the State. The Bureau of Mines estimated the value of production declined to $70,000 in 1980. Variscite nodules near Fairfield were described in the literature.[6] Red beryl from Delta, Utah, and petrified wood from Sundial Butte, Utah, were reportedly collected.

Graphite (Synthetic).—Production of synthetic graphite in Utah increased in amount and value in 1980; Hercules, Inc., was the only producer in the State. Expansion of its "Magnamite" graphite fiber-production facilities at Bacchus, Salt Lake County, was completed in March 1980. The company had two other projects in progress during 1980: A developmental plant at Clearfield, Davis County, to demonstrate to the automotive industry a high-speed filament-winding technique for manufacturing graphite-fiber reinforced tubing for drive shafts; and the construction of a $1.5 million plant for expanding pre-peg facilities. Pre-peg is a graphite fiber in tape form impregnated with epoxy or polyester resin. Also produced at the Bacchus facilities were impregnated unidirectional tapes, broadgoods, fabrics, and fibers sized with resins for the aerospace, industrial, and leisure markets.[7] The company employs over 2,600 people in Utah.

Gypsum.—At installations near Sigurd, Sevier County, Georgia-Pacific Corp. and United States Gypsum Corp. mined and calcined gypsum for use in manufacturing wallboard and plaster. Production of gypsum declined in amount in 1980 because of the depressed construction industry; however, value of gypsum increased. Other companies with gypsum operations in the State included Cox Enterprises, Inc., in Sanpete County; White Mountain Gypsum Co. in Millard County; and Thomas J. Peck & Sons, Inc., in Juab County.

Lime.—Utah Marblehead Lime Co., a division of General Dynamics; The Flintkote Co., a division of Genstar, Ltd., of Toronto; Utah Copper Div.; and Continental Lime Co., a subsidiary of Steel Bros., Ltd., of British Columbia, Canada, and Steel Bros., Ltd., of Sands Place, England, produced lime in Utah. Utah Marblehead and Flintkote have plants in Tooele County, Kennecott in Salt Lake County, and Continental Lime in Millard County.

During the year, Utah Marblehead Lime obtained dolomitic limestone from the Lakeside Mountains on the western shore of Great Salt Lake. The company expanded its plant at Marblehead, Utah (north of Delle), to 700 tons per day by adding a 10- by 300-foot kiln. The lime is used for refractory needs of steel mills in Utah, California, Washington, and British Columbia, Canada.[8]

Begun in June 1979, construction of the Continental Lime plant was completed by midyear. The plant is 6 miles from its Cricket Mountain limestone mine in Millard County. Mining companies use lime in uranium- and copper-processing plants; power companies use the product for antipollution scrubbers. The company employed about 25 workers at its Cricket Mountain operations.

Magnesium Compounds.—Production of magnesium compounds increased in amount and value during the year. Great Salt Lake Minerals & Chemicals Corp., a division of Gulf Resources & Chemical Corp., recovered byproduct magnesium chloride brine from its potash operations.

The plant is on the Bear River Bay on the east shore of Great Salt Lake west-northwest of Ogden, Weber County.[9] According to the company, the magnesium brine is used in processing sugar beets and as an antifreeze reagent. A road-dust suppression product is also manufactured from a magnesium chloride derivative.

Perlite.—Mountain Maid, Inc., continued to ship crude perlite from its mine near Fillmore in Millard County. Pax Co. processed expanded perlite at Salt Lake City, and Georgia-Pacific Corp. did so at Sigurd in Sevier County. Perlite shipments, however, declined in both amount and value in 1980. The principal uses for the expanded product were as a plaster aggregate in the construction industry, as a horticultural aggregate, and as an insulation material.

Phosphate.—Stauffer Chemical Co. continued as the only producer of phosphate in the State. Phosphate rock was mined and concentrated by flotation at the company operations, about 12 miles north of Vernal, Uintah County. These deposits, on the southern flank of the Uinta Mountains, occur in the Meade Peak Member of the Phosphoria Formation of Permian age. In 1966, reserves were reported to be about 700,000 million tons of rock, with an average grade of 21% P_2O_5.[10]

According to the Stauffer Chemical Co. 1980 annual report, at yearend Stauffer sold its phosphate holdings and fertilizer manufacturing operations to Chevron U.S.A. Inc., a subsidiary of Standard Oil Co. of California. The $130 million purchase included the phosphate reserves, the mine and mill near Vernal, and a fertilizer plant at Garfield, Salt Lake County; together with the phosphate-handling facility and rail terminal at Phoston, north of Heber, Wasatch County. Chevron Resources Co. was expected to operate the Vernal and Phoston installations, and Chevron Chemical Co. the Garfield plant. Both companies are divisions of Chevron U.S.A., Inc. According to the Standard Oil Co. of California's 1980 annual report, the large block of phosphate reserves may be developed in conjunction with byproduct sulfur from its southwest Wyoming natural gas production. Sulfuric acid had been purchased from Kennecott Corp. for use in the Garfield plant.

In 1980, the Vernal operations employed about 85 people, and the Garfield plant employed approximately 110.

Potash.—Three companies continued to produce potassium salts in the State: Texasgulf, Inc., Great Salt Lake Minerals and Chemicals Corp., and Kaiser Aluminum & Chemical Corp. Although production increased and the value rose substantially, sales dipped because of poor spring planting conditions and high interest rates.

Located at Cane Creek near Moab, Grand County, the Texasgulf, Inc., operation uses solution mining, solar evaporation, and flotation to recover the muriate of potash from brines. According to the Texasgulf 1980 annual report, reserves of K_2O are estimated at 15.5 million tons averaging 16% K_2O, of which 50% may be recoverable. Byproduct salt was shipped during the year.

Kaiser Aluminum & Chemical Corp. recovered muriate of potash from brines at its operation about 3 miles east of Wendover, Tooele County. The brines in the salt crust and underlying sediment of the Bonneville Salt Flats are collected in ditches, pumped through a series of solar evaporation ponds, and then processed through a froth flotation mill to separate the halite and sylvite (potash concentrate). Commercial products were standard and coarse muriate and manure salts (a muriate of potassium and sodium).[11]

Great Salt Lake Minerals & Chemicals Corp., a division of Gulf Resources & Chemical Corp., produced sulfate of potash and byproduct sodium sulfate, salt, and magnesium chloride from brines recovered from Great Salt Lake. Solar evaporation and selective crystallization are used to concentrate the brines over a nearly 27-square-mile pond complex west-northwest of Ogden, Weber County. Potassium sulfate production requires processing by flotation to separate out the salt.[12]

According to the Gulf Resources & Chemical Corp. 1980 annual report, the company is studying the feasibility of increasing the solar-pond complex from 17,000 acres to 34,000 acres; over 53 square miles. Cost of expanding the solar pond was estimated at $12 million. Addition of evaporation ponds would nearly double potash production and would reduce the company's dependence on the purchase of muriate of potash from other sources. Because the operations depend on solar evaporation, weather is a factor in the successful recovery of the product.

Pumice and Volcanic Cinder.—Fillmore Products, Inc., sold processed volcanic cinder from its Red Dome operation west of Fillmore in Millard County. Most of the volcanic cinder was used as landscaping

material; the remainder was used for concrete aggregate. Production increased in amount and value.

In March, Pozzolan Portland Cement Co., a subsidiary of Friar Oil Co., proposed a strip mining operation on a 400-acre site near South Jordan in Salt Lake County. The company planned constructing a mill to process the pumicite for pozzolan. Pozzolan is an additive used to replace a certain amount of portland cement in concrete aggregate.

Salt.—Producers of solar salt in 1980 included Morton Salt Co., a division of Morton-Norwich, Inc., in Salt Lake County; Great Salt Lake Minerals & Chemicals Corp., in Weber County; American Salt Co. and Lakepoint Salt Co. in Tooele County; Lake Crystal Salt Co. in Box Elder County; and Texasgulf, Inc., in Grand County. Redmond Clay & Salt Co. in Sevier County, and Albert Poulson Salt Co. in Sanpete County produced bulk rock salt. Moab Brine Co. in Grand County and Albert Poulson Salt also recovered a salt brine. Salt production decreased in amount and increased in value of output.

The history and technology of salt production from the Great Salt Lake were described.[13]

Salt domes and other formations in the State continue under investigation as possible sites for disposal of high-level radioactive waste.

Sand and Gravel.—Sand and gravel was mined by 56 producers from 67 sites in the State. Listed in order, the counties using the most sand and gravel were Salt Lake, Davis, Utah, Cache, and Wasatch. Major producers of construction sand were MONROC, Inc., Utah Sand and Gravel Div., with four deposits in Salt Lake County; Gibbons and Reed Co. with operations in Davis, Salt Lake, and Weber Counties; Concrete Products Co. with two operations in Salt Lake County; Savage Rock Products with operations in Davis and Box Elder Counties; and LeGrand Johnson Construction Co. with operations in Cache County. Thirteen county highway departments also mined construction sand in the State. Industrial sand was produced by the Salt Lake Valley Sand & Gravel Co. from a deposit in Utah County.

The 1980 production of sand and gravel decreased in amount and value from that of 1979.

Table 7.—Utah: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,362	$6,373	$1.90	3,578	$7,242	$2.02
Plaster and gunite sands	W	W	1.57	25	56	2.20
Concrete products	W	W	2.05	W	W	2.29
Asphaltic concrete	1,713	3,584	2.09	1,161	2,277	1.96
Road base and coverings	3,168	6,075	1.92	2,506	5,140	2.05
Fill	1,657	1,694	1.02	1,317	1,824	1.39
Snow and ice control	--	--	--	58	119	2.06
Other	179	339	1.90	W	W	2.14
Total[1] or average	10,363	18,621	1.80	8,906	17,234	1.94

W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Data may not add to totals shown because of independent rounding.

Table 8.—Utah: Construction[1] sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	2,643	$5,192	$1.96	3,203	$6,994	$2.18
Gravel	7,720	13,429	1.74	5,702	10,240	1.80
Total or average	10,363	18,621	1.80	[2]8,906	17,234	1.94

[1]A small amount of industrial sand was produced in 1979 and 1980.
[2]Data do not add to total shown because of independent rounding.

Sodium Sulfate.—Great Salt Lake Minerals & Chemicals Corp. recovered magnesium chloride, potash, salt, and sodium sulfate from the brines of the Great Salt Lake at its operations near Ogden. In 1980, output of the product declined in amount and value from that of 1979. Only California, Texas, and Utah produce natural sodium sulfate.

Stone.—The decline in the construction industry led to the decrease in the amount of crushed and dimension stone produced. Fourteen companies obtained stone at 41 quarries in 17 counties. Major producers included United States Steel Corp.; Ideal Basic Industries, Inc.; Lone Star Industries, Inc.; South Pacific Railroad Co.; Utah Marblehead Lime Co.; Legrand Johnson Construction Co.; Concrete Products Corp.; and the Flintkote Co. Crushed stone was used principally for cement manufacture, flux, riprap jetty, dead-burned dolomite, agricultural limestone, and lime manufacture. The U.S. Forest Service obtained crushed traprock, sandstone, limestone, and granite in 13 counties for use as an aggregate and for riprap. The leading counties producing crushed stone were Utah, Tooele, Morgan, Box Elder, and Salt Lake.

Dimension sandstone was quarried by Star Stone Co., Inc., by the Cleo and Raggie Teeter operation in Box Elder County; and by W. A. Hansen Stone Quarry, Inc., in Summit County. Utah Calcium Co., Inc., quarried dimension limestone in Tooele County.

Table 9.—Utah: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural Limestone	--	--	178	1,228
Concrete aggregate	2	7	--	--
Bituminous aggregate	44	110	--	--
Dense-graded road base stone	39	127	--	--
Surface treatment aggregate	188	655	W	W
Other construction aggregate and roadstone	W	W	50	156
Manufactured fine aggregate (stone sand)	--	--	(2)	4
Terrazzo and exposed aggregate	W	W	1	23
Cement manufacture	1,069	3,426	1,081	3,569
Dam construction	45	89	--	--
Other[3]	2,036	6,645	1,608	6,796
Total[4]	3,424	11,059	2,919	11,776

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes limestone, granite (1980), marble, sandstone, traprock (1980), and other stone (1979).
[2]Less than 1/2 unit.
[3]Includes stone used in poultry grit and mineral food, riprap and jetty stone, railroad ballast, lime manufacture, dead-burned dolomite (1980), flux stone, refractory stone, mine dusting, and unspecified uses.
[4]Data may not add to totals shown because of independent rounding.

Vermiculite.—No crude vermiculite was produced in 1980, however, Vermiculite Intermountain, Inc., produced exfoliated vermiculite from out-of-State sources. The construction and agriculture industries were the major users of exfoliated vermiculite. In construction, the exfoliated vermiculite was used for insulation, fireproofing, lightweight concrete aggregate, and concrete and plaster aggregate. In agriculture, exfoliated vermiculite was used for soil conditioning.

[1]State mineral specialist, Bureau of Mines, Denver, Colo.

[2]Jackson, D. (ed). Utah Copper, Keeping Equipment On Line and Available. How Strategic Upgrading of Equipment was Merged With a Comprehensive Mine Maintenance Program. Eng. Min. J., v. 181, No. 9, September 1980, pp. 70-75.

[3]Toomey, R. Production of Magnesium from the Great Salt Lake. Ch. in Great Salt Lake. (J. Wallace Gwynn-ed). Utah Geological and Mineral Survey Bull. 116, June 1980, pp. 218-222.

[4]Mining Engineering. American Gilsonite Completes New Processing Facility. V. 32, No. 2, February 1980, pp. 142-143.

[5]Pit and Quarry. More Cement for Growing Salt Lake Market Area. V. 73, No. 1, July 1980, pp. 98-102.

[6]Dunn, P. J. Carbonate-Fluorapatite From Near Fairfield, Utah. The Mineralogical Record, v. 11, No. 1, January-February 1980, pp. 33-34.

[7]Industrial Minerals. Hercules Expansion Plans. No. 157, April 1980, p. 15.

[8]Pit & Quarry. Marblehead Lime Expands Utah Plant. V. 73, No. 5, November 1980, pp. 61-62.

[9]Behrens, P. Industrial Processing of Great Salt Lake Brines by Great Salt Lake Minerals & Chemicals Corporation. Ch. in Great Salt Lake. Utah Geological & Mineral Survey Bull. 116, June 1980, pp. 223-228.

[10]Beall, J. W. and P. C. Merritt. Phosphate and Potash Minerals to Feed the World. Min. Eng., v. 18, No. 10, October 1966, pp. 94-95.

[11]Bingham, C. P. Solar Production of Potash From the Brines of the Bonneville Salt Flats in Great Salt Lake. Utah Geological and Mineral Survey Bull. 116, June 1980, pp. 228-242.

[12]Work cited in footnote 9.

[13]Clark, J. L. and N. Helgren. History and Technology of Salt Production From Great Salt Lake. Ch. in Great Salt Lake. Utah Geological and Mineral Survey Bull. 116, 1980, pp. 203-217.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt:			
American Gilsonite Co., a subsidiary of Standard Oil Co. of California.	Suite 1150, Kennecott Bldg. Salt Lake City, UT 84133	Underground mine and plant	Uintah.
Barite:			
All Minerals Corp	154 East Gordon Lane Box 7680 Murray, UT, 84107	Plant	Salt Lake.
Custom Milling & Supply	746 Everett Ave. Salt Lake City, UT 84116	do	Do.
Beryllium:			
Brush Wellman, Inc	67 West 2950 South Salt Lake City, UT 84115	Open pit mines and plant	Juab and Millard.
Cement:			
Ideal Cement Co., a division of Ideal Basic Industries, Inc.[1]	Star Route Morgan, UT 84050	Open pit mine and plant	Morgan.
Portland Cement Co. of Utah, a division of Lone Star Industries, Inc.[1]	615 West 800 South Box 1469 Salt Lake City UT 84110	Quarries and plant	Salt Lake and Tooele.
Clays:			
Interpace Corp., Harrisville Div.	736 West Harrisville Rd. Box 447 Ogden, UT 84012	Open pit mines and plant	Sevier, Utah, Weber.
Interstate Brick Co., a division of Entrada Industries, a subsidiary of Mountain Fuel Supply.	9200 South 5200 West Box 517 West Jordan, UT 84084	Open pit mines	Piute, Salt Lake, Toole, Utah.
Utelite Corp	Box 387 Coalville, UT 84017	Open pit mine and plant	Summit.
Copper:			
Kennecott Minerals Co., a subsidiary of Kennecott Corp., Utah Copper Div.[2]	Box 11299 Salt Lake City, UT 84147	Open pit mine, mills, smelter, refinery.	Salt Lake.
The Anaconda Company, a subsidiary of Atlantic Richfield Co., Carr Fork Operations.[3]	RFD 1, Box 79 Tooele, UT 84074	Underground mine and mill	Tooele.
Gypsum:			
Georgia Pacific Corp	Sigurd, UT 84657	Open pit mine and plant	Sevier.
United States Gypsum Co	Box 128 Sigurd, UT 84657	Quarry and plant	Do.
Iron ore:			
United States Steel Corp	Box 859 Cedar City, UT 84720	Open pit mines	Iron.
Utah International, Inc	Box 649 Cedar City, UT 84720	Open pit mines and plants	Do.
Lead:			
Noranda Mining Co., a division of Noranda Mines, Ltd., Ontario Project.[4]	Box 1450 Park City, UT 84060	Underground mine and mill	Summit.
Lime:			
The Flintkote Co., a division of Genstar Ltd.[1]	Box 357 Grantsville, UT 84029	Open pit mine and plant	Tooele.
Utah Marblehead Lime Co., a subsidiary of General Dynamics Corp.	Box 596 Tooele, UT 84074	do	Do.
Magnesium:			
AMAX Specialty Metals Corp. Magnesium Div., a division of AMAX Inc.	238 North 2200 West Salt Lake City, UT 84116	Plant	Do.
Phosphate rock:			
Stauffer Chemical Co., (As of 12/31/80—Chevron Resources Co., a division of Chevron U.S.A.)	Manila Star Route Vernal, UT 84078	Underground mine and plant	Wasatch, Salt Lake, Uintah.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Potassium salts:			
Great Salt Lake Minerals & Chemicals Corp., a division of Gulf Resources & Chemical Corp.[5]	765 North 10500 West Box 1190 Ogden, UT 84402	Plant	Box Elder.
Kaiser Aluminum & Chemical Corp., Bonneville, Ltd., Div.[6]	Box 580 Wendover, UT 84083	____do	Tooele.
Texasgulf, Inc	Box 1208 Moab, UT 84532	Underground mine and plant	Grand.
Salt:			
American Salt Co	Box 477 Grantsville, UT 84029	Solar evaporation and plant	Tooele.
Morton Salt Co., a division of Morton-Norwich, Inc.	A.M.F. Box 22054 Salt Lake City, UT 84122	____do	Salt Lake.
Sand and gravel:			
Concrete Rock Products Co., a division of Gibbons & Reed Co.	41 West Central Ave. Box 7356 Murray, UT 84107	Pits and plant	Davis and Salt Lake.
LeGrand Johnson Construction Co.	1000 South Main Box 248 Logan, UT 84321	____do	Cache and Rich.
Monroc Sand & Gravel	1730 Beck St. Box 537 Salt Lake City, UT 84110	____do	Salt Lake.
Stone:			
Southern Pacific Transportation Co.	One Market Plaza San Francisco, CA 94105	____do	Box Elder.
United States Steel Corp., Western Stone Operations.	Box 589 Cedar City, UT 84720	Quarry	Utah.
Uranium-vanadium:			
Atlas Minerals Div. of Atlas Corp.	Box 1207 Moab, UT 84532	Underground mines and plant	Emery, Grand, San Juan.
Energy Fuels Nuclear, Inc	Box 59 Blanding, UT 84511	Ore buying station and mill	San Juan.
Rio Algom Corp	Box 610 Moab, UT 84532	Underground mine and plant	Do.
Union Carbide Corp., Metals Div.	Box 1029 Grand Junction, CO 81501	Underground mines	Grand and San Juan.

[1]Also stone.
[2]Also gold, lime, molybdenum, rhenium, selenium, silver, and stone.
[3]Also gold and silver.
[4]Also copper, gold, silver, and zinc.
[5]Also magnesium compounds, salt, and sodium sulfate.
[6]Also magnesium compounds.

The Mineral Industry of Vermont

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Office of the State Geologist, Agency of Environmental Conservation, for collecting information on all nonfuel minerals.

By L. J. Prosser, Jr.[1], and Charles A. Ratté[2]

The value of nonfuel mineral production in Vermont was $42.6 million in 1980, a decrease of $11.5 million from that of 1979. The State's dimension stone industry accounted for about $24 million of the total. Nationally, Vermont ranked first in the value of dimension stone sales.

Asbestos, sand and gravel, stone (crushed), and talc were also mined. Although production of asbestos and talc declined for the year, Vermont remained the second leading U.S. producer of both mineral commodities.

Table 1.—Nonfuel mineral production in Vermont[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Sand and gravel	thousand short tons	3,660	$6,240	1,900	$4,171
Stone:					
Crushed	do.	2,077	13,927	1,320	4,787
Dimension	do.	180	23,006	169	23,649
Talc	do.	346	2,755	318	2,753
Combined value of other nonmetals		XX	8,208	XX	7,277
Total		XX	54,136	XX	42,637

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

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

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Addison	$3,956	W	Stone, sand and gravel.
Bennington	958	$1,453	Sand and gravel, stone.
Caledonia	W	1,094	Stone, sand and gravel.
Chittenden	W	W	Do.
Essex	W	W	Sand and gravel.
Franklin	W	W	Stone, sand and gravel.

See footnotes at end of table.

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

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Grand Isle	W	W	Stone.
Lamoille	W	W	Talc, sand and gravel, stone.
Orange	W	$1,093	Stone, sand and gravel.
Orleans	W	W	Asbestos, sand and gravel, stone.
Rutland	$11,755	W	Stone, sand and gravel.
Washington	W	W	Do.
Windham	162	W	Do.
Windsor	W	W	Talc, sand and gravel.
Undistributed[1]	31,003	50,494	
Total[2]	47,833	54,136	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes gem stones and values indicated by symbol W.
[2]Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Vermont business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	240.0	245.0	+2.1
Unemployment	do	12.0	16.0	+33.3
Employment (nonagricultural):				
Mining	do	.8	.7	-12.5
Manufacturing	do	50.8	50.6	-.4
Contract construction	do	10.3	10.0	-2.9
Transportation and public utilities	do	9.0	8.8	-2.2
Wholesale and retail trade	do	41.0	40.7	-.7
Finance, insurance, real estate	do	7.8	8.1	+3.8
Services	do	42.4	44.0	+3.8
Government	do	35.8	36.8	+2.8
Total nonagricultural employment	do	197.9	199.7	+.9
Personal income:				
Total	millions	$3,622	$4,010	+10.7
Per capita		$7,343	$7,839	+6.8
Construction activity:				
Number of private and public residential units authorized		3,170	2,918	-8.0
Value of nonresidential construction	millions	$14.7	$9.8	-33.3
Value of State road contract awards	do	$18.7	$62.4	+233.7
Shipments of portland and masonry cement to and within the State	thousand short tons	143	129	-9.8
Nonfuel mineral production value:				
Total crude mineral value	millions	$54.1	$42.6	-21.3
Value per capita, resident population		$110	$83	-24.6
Value per square mile		$5,634	$4,437	-21.2

[p]Preliminary.

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

Trends and Developments.—A general slowdown in residential building projects and reduced demand for construction-related commodities affected Vermont's mineral industry in 1980. Output of sand and gravel and crushed stone declined from that of the previous year. Sand and gravel tonnages dropped below the 2-million-ton level for the first time since 1964. Stone production fell approximately 750,000 tons compared with that of 1979, reflecting delays and cancellations of road construction and maintenance. Revenues for the State highway fund declined because of rising gasoline prices that resulted in energy conservation practices by motorists. In 1980, gas tax revenues dropped 11%.[3]

Other segments of Vermont's mineral industry weathered the economic sluggishness of 1980. Some dimension granite and marble producers benefited from increased sales because of an architectural trend toward stone for use in nonresidential construction. During the year, the State's manufacturing sector added 25 industries, including machine tools and electronic firms, providing potential employment for over 1,000 workers.

In other developments, Green Mountain Railroad— transporters of talc, cement, and other mining and manufacturing products—placed 100 new boxcars into service. The railway hoppers, with 100-ton capacities, were designed to facilitate handling bulk commodities. Toward yearend, marble mining interests and residents became involved in a controversy concerning the possible opening of new quarries in Middlebury in west-central Vermont. A decision by the town planning commission on amending local ordinances to remove quarrying as a conditional land use in agricultural and residential areas was expected in 1981.

Legislation and Government Programs.— A strict uranium mining control bill introduced in 1979 was passed into law in 1980. Mining and milling of uranium or other radioactive substances requires legislative approval. Under the new law, incorporated into the State's Land Use and Development Law (Act 250), exploration companies must also obtain a permit for subsurface investigations of radioactive materials. The Act 250 Environmental Board governing body continued work on rules concerning exploration for all minerals. One proposed rule change would require mining companies to apply for State approval before exploring for minerals on or in the vicinity of radioactive material deposits.

The Office of the State Geologist was the primary agency involved in mineral-related programs. During the year, long-range plans for completing topographic mapping of the State (7-1/2 minute, 1:25,000 scale) were established through a cooperative agreement with the U.S. Geological Survey.

A study of the slate mining industry of Vermont and New York, sponsored by the Federal Bureau of Mines, was published near yearend.[4] Current and future problems constraining growth in the region's slate industry were identified and analyzed. The Bureau also completed mapping and sampling work in the Bread Loaf (Addison and Washington Counties) and the Devils Den (Rutland and Windsor Counties) areas under the Roadless Area Review and Evaluation (Rare II) program. The Bureau's Tuscaloosa Research Center, in cooperation with the Federal Highway Administration, continued work on utilization of low-cost waste materials to produce synthetic aggregate. Of the raw materials included for testing were tailings from Vermont's asbestos and slate mines. A final report was scheduled for completion in 1981.

At yearend, the Barre Granite Association and the Central Vermont Planning Commission applied for a grant from the Environmental Protection Agency to investigate a granite sludge disposal problem. An estimated 20,000 tons of sludge is generated yearly from granite processing and fabricating.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Asbestos.—Shipments of asbestos by U.S. producers in 1980 totaled about 88,000 short tons with Vermont ranking second behind California; Arizona was the only other producing State.

The Vermont Asbestos Group, Inc. (VAG), Orleans County, mined chrysolite asbestos from open pit operations in the north-central part of the State. Output declined in 1980 because of a lack of orders from the automobile and building industries, and resulted in a 6-week shutdown around mid-year. Health concerns regarding asbestos exposure levels in the environment and workplace continued, but did not significantly affect production in 1980. On July 1, VAG announced a price increase ranging from 8% to 20% on all nine grades of asbestos produced.

Vermont Industrial Products, a subsidiary of VAG, continued to manufacture fire-resistant wallboard for use as a liner in bulkheads. The company, which had used asbestos tailings in the wallboard, now uses an inorganic resin system.

Sand and Gravel.—In the past decade, mining of 30.1 million tons of construction sand and gravel has added $44 million to the State's value of mineral production. In 1980, a decline in production was reported in 12 of the State's 13 counties, accounting for about a 1.8-million-ton drop in output compared with that of the previous year. Leading counties in tonnage were Bennington in the southwest and Addison in west-central Vermont. No industrial sand was mined in the State.

The Office of the State Geologist planned

to conduct an inventory of the State's sand and gravel reserves. The information will be used in land use planning and development projects.

Table 4.—Vermont: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,006	$2,108	$2.10	750	$1,812	$2.42
Plaster and gunite sands	W	W	3.15	9	26	3.00
Concrete products	8	21	2.67	93	155	1.67
Asphaltic concrete	610	1,321	2.17	202	518	2.57
Road base and coverings	1,136	1,614	1.42	314	663	2.11
Fill	563	674	1.20	236	452	1.92
Snow and ice control	140	221	1.57	83	134	1.61
Railroad ballast	W	W	2.80	W	W	2.84
Other	193	269	1.40	W	W	1.87
Total[1] or average	3,660	6,240	1.70	1,900	4,171	2.20

W Withheld to avoid disclosing company proprietary data; included in "Other" (1979) and "Total" (1980).
[1]Data may not add to totals shown because of independent rounding.

Table 5.—Vermont: Construction sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	1,715	$3,054	$1.78	842	$1,860	$2.21
Gravel	1,945	3,186	1.64	1,058	2,311	2.19
Total or average	3,660	6,240	1.70	1,900	4,171	2.20

Table 6.—Vermont: Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1979		1980	
	Quantity	Value	Quantity	Value
Addison	381	697	279	653
Bennington	588	1,205	302	737
Caledonia	W	W	W	W
Chittenden	W	W	W	W
Essex	W	W	W	W
Franklin	253	442	W	W
Lamoille	187	338	161	372
Orange	160	211	16	21
Orleans	W	W	209	432
Rutland	214	431	141	327
Washington	83	140	111	260
Windham	77	100	--	--
Windsor	314	466	132	213
Total	3,660	6,240	1,900	4,171

W Withheld to avoid disclosing company proprietary data; included in "Total."

Stone.—Vermont led the Nation in value of dimension stone sales and ranked second behind Georgia in the tonnage quarried. Vermont's contribution to the U.S. output has increased from 9% to 13% over the past 5 years. In 1980, two of the country's leading dimension stone quarrying operations, in value of sales, were in Vermont. Rock of Ages Corp.'s Wetmore and Morse Quarries in Washington County ranked third, and OMYA, Inc.'s Danby Imperial Quarry in Rutland County ranked ninth.

About four-fifths of the State's dimension stone was produced in adjacent Addison and Washington Counties in west-central Vermont. Other producing counties were Orange, Windsor, Bennington, and Orleans. Types and tonnages of dimension stone mined in 1980 were as follows: Granite, 94,565 tons (957,873 cubic feet); slate, 56,656 tons (623,216 cubic feet); marble, 18,055 tons (200,600 cubic feet).

In contrast to dimension stone in 1980, crushed stone sales were $9.1 million below the previous year's levels. A decline in highway construction, a major market for crushed stone, adversely affected production in 1980.

Table 7.—Vermont: Dimension stone[1] sold or used by producers, by use

Use	1979			1980		
	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)
Rough stone:						
Irregular shaped stone	W	W	W	3,704	41	$123
Monumental	107,546	1,094	$12,233	90,419	905	11,029
Flagging	W	W	W	82	1	4
Dressed stone:						
House stone veneer	1,452	16	317	1,411	16	346
Monumental	4,226	49	1,526	2,162	24	1,203
Flagging	22,574	248	796	24,752	272	995
Roofing slate (standard)	4,510	50	1,396	2,543	28	1,104
Roofing slate (architectural)	W	W	W	140	2	60
Flooring slate	21,646	238	3,787	27,027	297	5,063
Other[2]	18,278	203	2,950	17,036	195	3,721
Total[3]	180,232	1,898	23,006	169,276	1,782	23,649

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes granite, marble, and slate.
[2]Includes stone used in rough blocks, other rough (1979), sawed stone, structural and sanitary, other uses, and uses indicated by symbol W.
[3]Data may not add to totals shown because of independent rounding.

Table 8.—Vermont: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Concrete aggregate	93	304	85	332
Bituminous aggregate	430	1,215	219	712
Other construction aggregate and roadstone	559	1,676	265	839
Riprap and jetty stone	13	45	18	60
Other fillers or extenders	32	W	W	W
Other[2]	950	10,687	733	2,844
Total	2,077	13,927	1,320	4,787

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes limestone, granite, and other stone.
[2]Includes stone used in agricultural limestone, dense-graded roadbase stone, surface treatment aggregate, railroad ballast, filter stone, manufactured fine aggregate (stone sand), terrazzo and exposed aggregate, whiting or whiting substitute (1979), and uses indicated by symbol W.

Limestone (including marble) was the leading type of crushed stone produced. Nine operations in a five-county, north-south trending belt in western Vermont accounted for all the output. Crushed granite was produced by one company in Washington County in the north-central part of the State. Crushed stone was also produced in Lamoille and Orleans Counties in northern Vermont in conjunction with VAG's mining operations.

During the year, the State's dimension granite producers continued efforts to diversify fabrication capabilities to accommodate increasing demand for exterior building stone. Sales of granite for monument and memorial manufacture remained the major market of the State's industry in 1980.

Rock of Ages Corp. supplied a blue-gray granite for use in construction of a 75-story tower in Houston, Tex. When completed, the building will be the seventh tallest in the world.[5]

According to the Barre Granite Association, central Vermont's granite industry employed 2,000 workers in 40 companies and related businesses.

Toward yearend, marble quarrying in the town of Middlebury, Addison County, became an issue between residents and mining interests. Residents became concerned when Cyprus Mines Corp., a subsidiary of Standard Oil Co. (Indiana), began exploration work to determine the quantity and quality of marble on farmland the company had leased. According to present zoning ordinances, mining is a conditional land use in agricultural and residential areas. A petition was circulated requesting the town planning commission to ban new quarrying in any area zoned for farming and homes.

OMYA, Inc., a subsidiary of Pluess-Staufer, has operated a quarry in Middlebury for years. Both Cyprus and OMYA own an interest in the White Pigment Corp. marble processing plant in New Haven, Vt.; OMYA currently supplies White Pigment with marble. Demand for marble (calcium carbonate) has increased considerably in the last few years for use as a filler in various products including plastics, paper, and pharmaceutical items. A ban on marble quarrying would force Cyprus to cease exploration in the area. A change in zoning laws could also prevent OMYA from expanding operations in the future. A decision by the town's planning commission on revising the ordinance was expected in 1981.

Talc.—Vermont ranked second, behind Texas, in talc production. Mines and mills were operated by three companies: Eastern Magnesia Talc Co., Lamoille County; OMYA, Inc., Windham County; and Windsor Mine Mills, Inc., Windsor County. Talc was shipped by rail and truck to grinding facilities and then marketed in package or bulk quantities throughout the United States. Primary uses were as a filler-extender in cosmetics and plastics.

Vermont Soapstone Co. mined soapstone, a massive form of talc, in Windsor County. The soapstone was quarried at an open pit for about 6 weeks during the year and trucked to the company's fabricating facilities in Perkinsville. Products included linings for wood stoves, griddles, and bootdryers.

[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.
[2]State geologist, Montpelier, Vt.
[3]Vermont Business World. August 1980, p. 5.
[4]Watson, W. I., E. Ohlsson, C. E. Shorey, R. J. Miller, and A. J. Whittier. Study of the Slate Mining Industry of Vermont and New York. OFR 125-80, Oct. 15, 1980, 172 pp.
[5]White River Valley Herald. Mar. 12, 1981, p. 3.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos:			
Vermont Asbestos Group, Inc	Box 70 Hyde Park, VT 05655	Pit	Orleans.
Sand and gravel:			
Burgess Bros., Inc	Bennington, VT 05201	Pit	Bennington.
Calkins Sand & Gravel Co	Lyndonville, VT 05851	Pit	Orleans.
J. P. Carrara & Sons	Box 1043 Middlebury, VT 05753	Pit	Addison.
Lawrence Sand & Gravel Co., Inc	138 Portland St. St. Johnsbury, VT 05819	Pit	Essex.
Stone:			
Cooley Asphalt Paving Corp	Box 542 Barre, VT 05641	Quarry	Washington.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
OMYA, Inc	Proctor, VT 05765	Quarries	Addison, Rutland, Windsor.
Pike Industries, Inc	Route 3 Tilton, NH 03276	do	Addison.
Shelburne Limestone Corp	Bishop Rd. Shelburne, VT 05482	do	Chittenden and Franklin.
Frank W. Whitcomb Construction Corp	Box 429 Bellows Falls, VT 05101	Quarry	Chittenden.
Talc:			
Eastern Magnesia Talc Co	Menlo Park, NJ 00817	Underground mines.	Lamoille.
OMYA, Inc	Chester, VT 05143	do	Windham.
Windsor Minerals, Inc	Windsor, VT 05089	do	Windsor.

The Mineral Industry of Virginia

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Virginia Division of Mineral Resources for collecting information on all nonfuel minerals.

By Doss H. White, Jr.[1] and Palmer C. Sweet[2]

In 1980, Virginia's nonfuel mineral production was valued at $305.3 million, a decrease of $4.5 million from that reported in 1979. The nationwide recession, which began in the latter half of 1979, created depressed markets for many of the 14 mineral commodities mined in-State. Notable was the slump in sales of mineral construction materials that resulted from high interest rates, a scarcity of mortgage money, and a significant reduction in highway construction.

Despite the recessionary effects on the mineral industry, Virginia continued to rank among the top 20 States in industrial mineral output. The State led the Nation in the production of kyanite, was the only domestic aplite producer, and was one of three States mining vermiculite. A number of mineral commodities—iron oxides, lithium carbonate, magnetite, manganese, mica, perlite, and vanadium pentoxide—were imported into the State and processed.

Table 1.—Nonfuel mineral production in Virginia[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	1,059	$3,512	762	$3,172
Gem stones	NA	15	NA	15
Lead (recoverable content of ores, etc.) metric tons	1,596	1,852	1,563	1,463
Lime thousand short tons	872	34,935	824	33,872
Sand and gravel[2] do	11,803	32,268	8,264	29,508
Stone:				
Crushed do	51,080	165,223	44,615	167,839
Dimension do	9	2,042	27	2,287
Zinc (recoverable content of ores, etc.) metric tons	11,406	9,380	12,038	9,934
Combined value of aplite, cement, gypsum, iron oxide pigments (crude), kyanite, industrial sand, talc (soapstone), and vermiculite	XX	r60,562	XX	57,216
Total	XX	r309,789	XX	305,306

rRevised. NA Not available. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Virginia, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Accomack	$273	$299	Sand and gravel.
Albemarle	W	W	Stone, sand and gravel.
Alleghany	W	--	
Amherst	W	W	Stone.
Appomattox	W	W	Do.
Augusta	W	W	Stone, sand and gravel.
Bath	--	W	Stone.
Bedford	W	W	Do.
Bland	W	W	Do.
Botetourt	W	W	Cement, stone, clays.
Brunswick	W	W	Stone, clays.
Buckingham	W	W	Kyanite, stone.
Campbell	3,678	4,023	Stone, sand and gravel.
Caroline	953	1,336	Sand and gravel.
Charles City	W	W	Do.
Chesapeake (city)	W	811	Do.
Chesterfield	W	W	Sand and gravel, stone, clays.
Clarke	W	W	Stone.
Craig	175	175	Sand and gravel.
Culpeper	W	W	Stone.
Dinwiddie	W	W	Do.
Essex	--	W	Sand and gravel.
Fairfax	W	W	Stone, sand and gravel.
Fauquier	W	W	Stone.
Floyd	8	16	Do.
Franklin	W	W	Stone, soapstone.
Frederick	W	W	Stone, lime.
Giles	W	W	Lime, stone.
Gloucester	27	187	Sand and gravel.
Goochland	5,753	8,705	Stone.
Grayson	W	W	Stone, sand and gravel.
Greensville	W	W	Stone, clays.
Halifax	W	W	Stone, sand and gravel.
Hanover	W	W	Stone, aplite, sand and gravel.
Henrico	11,990	14,212	Sand and gravel, stone.
Henry	W	W	Stone, sand and gravel.
Highland	W	--	
Isle of Wight	67	W	Sand and gravel.
James City	W	W	Do.
King and Queen	--	W	Do.
King George	W	W	Do.
King William	33	30	Do.
Lancaster	44	W	Do.
Lee	W	1,973	Stone.
Loudoun	11,000	14,721	Do.
Louisa	--	W	Vermiculite.
Middlesex	W	8	Sand and gravel.
Montgomery	W	W	Stone, clays.
Nansemond	W	W	Sand and gravel.
Nelson	W	W	Aplite, stone.
New Kent	W	W	Sand and gravel.
Newport News (city)	W	W	Do.
Northampton	27	13	Do.
Northumberland	18	32	Do.
Nottoway	W	W	Stone.
Orange	W	W	Clays.
Page	W	W	Stone.
Patrick	--	W	Do.
Pittsylvania	W	W	Stone, sand and gravel.
Powhatan	W	--	
Prince Edward	W	--	
Prince George	W	1,886	Sand and gravel.
Prince William	W	W	Stone, clays.
Pulaski	W	W	Stone, crude iron oxide pigments.
Rappahannock	W	W	Do.
Richmond (city)	W	W	Stone, clays.
Roanoke	5,031	5,437	Do.
Rockbridge	W	W	Do.
Rockingham	W	W	Stone, sand and gravel.
Russell	6,937	7,068	Stone.
Scott	1,686	1,692	Do.
Shenandoah	W	W	Lime, stone.
Smyth	W	W	Stone, clays, lime, sand and gravel.
Southampton	175	175	Sand and gravel.
Spotsylvania	W	W	Stone, sand and gravel.
Stafford	W	W	Sand and gravel, stone.
Suffolk (city)	W	W	Sand and gravel.
Surry	W	W	Do.
Tazewell	W	W	Stone, clays.
Virginia Beach (city)	2,035	1,745	Sand and gravel.
Warren	W	W	Cement, lime, stone, sand and gravel.
Washington	W	W	Stone, gypsum.
Westmoreland	89	92	Sand and gravel.
Wise	1,566	1,557	Stone.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Virginia, by county[1] —Continued

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Wythe	$14,175	$16,864	Zinc, stone, lead.
York	91	W	Sand and gravel.
Undistributed[2]	r199,209	226,725	
Total[3]	265,039	309,789	

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1]The following counties are not listed because no nonfuel mineral production was reported: Alexandria (city), Amelia, Arlington, Bedford (city), Bristol (city), Buchanan, Buena Vista (city), Carroll, Charlotte, Clifton Forge (city), Colonial Heights (city), Covington (city), Cumberland, Danville (city), Dickenson, Emporia (city), Fairfax (city), Falls Church (city), Fluvanna, Franklin (city), Fredericksburg (city), Galax (city), Greene, Hampton (city), Harrisonburg (city), Hopewell (city), Lexington (city), Lunenburg, Lynchburg (city), Madison, Martinsville (city), Mathews, Mecklenburg, Norfolk (city), Norton (city), Petersburg (city), Portsmouth (city), Radford (city), Richmond, Roanoke (city), Salem (city), South Boston (city), Staunton (city), Sussex, Waynesboro (city), Williamsburg (city), and Winchester (city).

[2]Includes gem stones and values indicated by symbol W.

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

Table 3.—Indicators of Virginia business activity

	1979	1980p	Change, percent
Employment and labor force, annual average:			
Total civilian labor force, thousands	2,477.0	2,530.0	+2.1
Unemployment, do	117.0	129.0	+10.3
Employment (nonagricultural):			
Mining[1], do	24.2	23.9	-1.2
Manufacturing, do	413.1	410.5	-.6
Contract construction, do	135.4	124.3	-8.2
Transportation and public utilities, do	114.3	114.8	+.4
Wholesale and retail trade, do	439.9	447.3	+1.7
Finance, insurance, real estate, do	103.3	105.6	+2.2
Services, do	374.6	386.9	+3.3
Government, do	493.6	507.6	+2.8
Total nonagricultural employment[1], do	2,098.4	2,120.9	+1.1
Personal income:			
Total, millions	$44,631	$50,229	+12.5
Per capita	$8,588	$9,435	+9.9
Construction activity:			
Number of private and public residential units authorized	44,753	36,842	-17.7
Value of nonresidential construction, millions	$1,032.9	$934.1	-9.6
Value of State road contract awards, do	$243.0	$196.3	-19.2
Shipments of portland and masonry cement to and within the State, thousand short tons	2,164	1,935	-10.6
Nonfuel mineral production value:			
Total crude mineral value, millions	$309.8	$305.3	-1.4
Value per capita, resident population	$60	$57	-5.0
Value per square mile	$7,589	$7,480	-1.4

pPreliminary.

[1]Includes bituminous coal, oil, and gas extraction.

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

Trends and Developments.—During the past decade, nonfuel mineral production added over $2.1 billion to Virginia's economy and has directly and indirectly created jobs for thousands of the State's citizens. The economic slowdown that developed during late 1979 continued throughout 1980, creating a depressed market for many mineral commodities in the State. Hardest hit were those commodities used by the construction industry.

Both residential and nonresidential construction—an important market for clay products, cement, sand and gravel, and stone—decreased significantly. Residential building permits were down 6,000 from the 1979 level and 15,000 below that of 1978. Nonresidential construction was $153 million below that reported for 1979.[3]

Highway construction, one of the largest markets for cement and crushed stone, fell considerably below the 1979 level. The

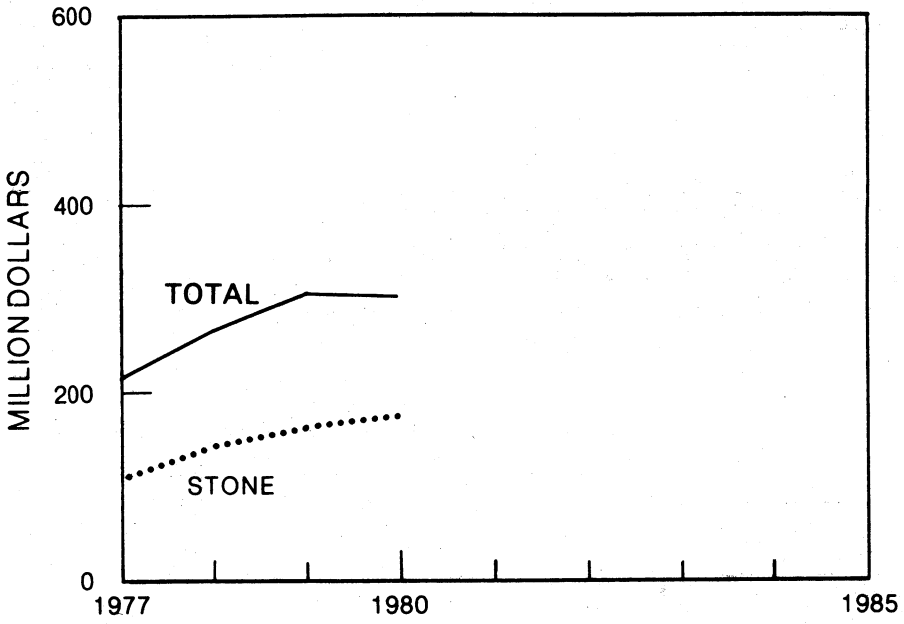

Figure 1.—Value of stone and total value of all nonfuel mineral production in Virginia.

State's 1980 highway construction and maintenance budget was $60 million less than 1979 funding.

Kyanite Mining Corp. terminated production at their Prince Edward County Mine and began site reclamation for grazing and timber use. The company continued to operate the Willis Mountain and East Ridge Mines in Buckingham County.

International Minerals and Chemical Corp., Inc., closed its "Virginia aplite" operation at Piney River in June because of a decline in aplite quality, which affected the material's use in glass manufacture.

A depressed zinc market and higher shipping costs forced New Jersey Zinc Co.'s mine at Austinville to reduce production by 27%.

Texasgulf Chemicals Co., Inc., purchased acreage in the Great Gossan lead district in Carroll County from Freeport Minerals, Inc. The property, part of a mineralized zone extending almost 17 miles through southwestern Virginia,[4] may provide pyrrhotite (an iron sulfide) for the sulfuric acid production required in the manufacture of fertilizer. Texasgulf operates a fertilizer manufacturing complex at Lee Creek, N.C.

At yearend, significant diatomaceous sediments were discovered in King and Queen County. The material has the potential for use as an industrial absorbent.

During late 1980, work began on burying ferrous sulfate "copperas" waste from 27 years of processing titanium ore at a site in Nelson County. The work was done under contract to the State Water Control Board. Runoff from the wastes has been responsible for three documented fish kills along the Piney River.

During the year, a number of companies were active in exploration throughout the State. Base-metal sulfide exploration continued along the Gold-Pyrite Belt in the central part of the State. Several major companies conducted geophysical and geochemical exploration programs in Goochland, Fluvanna, and Buckingham Counties. Marline Uranium Corp. conducted leasing and exploratory drilling in Pittsylvania County in southern Virginia, and at yearend the company had approximately 33,000 acres under lease.[5]

Legislation and Government Programs.—The 1980 General Assembly passed the Coastal Primary Sand Dune Protection Act, which would restrict mining of coastal dunes. This measure established a local dunes protection ordinance to be administered through local wetlands boards

in a manner similar to the current wetlands ordinances. The law will be effective in the counties of Accomack, Lancaster, Mathews, Northampton, and Northumberland, and the cities of Hampton, Norfolk, and Virginia Beach. It provides for oversight by the Marine Resources Commission.[6]

The Virginia Division of Mineral Resources continued geologic and mineral resource evaluation work during 1980. A Directory of the Mineral Industry was completed listing 267 mineral-producing companies and individuals, as of October 25, 1980, exclusive of coal mine operators.[7]

Other significant studies included geologic investigations of the Andersonville and Willis Mountain quadrangles.[8] Individual mineral commodities of economic significance—clay materials, gold, kyanite, lead, and zinc—were also discussed.

During 1980, a Minerals Other Than Coal Orphaned Land Advisory Committee was established by the Virginia Division of Mined Land Reclamation. The Committee, composed of representatives from industry, State, and Federal agencies, worked with the Division to set priorities for the reclamation of abandoned noncoal mining sites. Reclamation was conducted by private contractors. Under present law, mineral producers must post a performance bond with the Division to obtain a mining permit. The bond is releasable after a 5-year period if the operator has complied with regulations on mining and reclamation. The operator may then make payments into the Minerals Reclamation fund rather than post a performance bond. Payments are based on estimated acreage to be disturbed by mining. Money derived from the fund is placed in the State treasury and interest earned is applied by the Division of Mined Land Reclamation toward funding of reclamation efforts on nonfuel mineral orphaned lands.

Under an agreement between the U.S. Bureau of Mines and the Virginia Division of Mineral Resources, the Bureau's Tuscaloosa Research Center tested a number of material samples from Virginia to determine their raw and fired properties.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Aplite.—In 1980, Virginia was the only State with aplite production. The material, termed "Virginia aplite" because of a chemical composition variation from true aplite, is used in glassmaking to improve the workability of the molten material and to impart a chemical stability to the finished glassware.

At the beginning of 1980, two companies produced aplite for the glass industry. The Feldspar Corp. operated a mine and plant near Montpelier in Hanover County in east-central Virginia, and International Minerals & Chemicals Corp. (IMC), was in operation at Piney River in Nelson County in the west-central part of the State. In June, the latter operation closed because of a problem with deteriorating aplite grade.

The Feldspar Corp. mined aplite by open pit methods. Ore was trucked to the plant adjacent to the mine for crushing, grinding, classifying, and drying. Processed aplite was shipped by truck and rail to market, which includes the Southern States and New Jersey, Pennsylvania, Ohio, and Indiana.

Aplite in Amherst County was marketed as aggregate by the Dominion Stone Plant, Inc., and another operator produced aplite in Nelson County for aggregate sales. With the closing of the IMC operation, production fell below that of 1979.

Cement.—Virginia's cement industry, consisting of three companies, is located in Warren and Botetourt Counties and in the City of Chesapeake. The curtailment of Virginia Electric & Power Co.'s pumped storage project in Bath County and the slowdown in building and highway construction depressed the cement market in Virginia. Production decreased from that reported for 1979.

Riverton Corp. in Warren County produced masonry cement at their plant at Riverton. Crushed limestone was calcined, hydrated, and mixed with portland cement purchased from out-of-State sources. Major sales were to building supply dealers in Virginia and surrounding States.

Lone Star Cement, Inc., operated a plant west of Tinker Mountain in Botetourt County; the largest operation owned by Lone Star. This facility produces portland cement from locally mined limestone, shale, and sand. Iron ore for the cement manufacturing process was purchased from Roanoke Electric Steel Co. Clinker was manufactured in five coal-fired kilns and ground into cement. Over three-quarters was sold to ready-mix companies.

Lone Star La Farge, Inc., operated a cement manufacturing facility in the City of

Chesapeake. Clinker was imported and manufactured into three basic types of calcium aluminate cement. The company also imports calcium carbonate and alumina to produce clinker at the facility.

Clays.—The State's clay material industry was situated in three areas: Six counties in southwestern Virginia; five counties in eastern Virginia; and the city of Richmond. Clay, shale, phyllite, and schists and saprolite were used as raw material.

High interest rates and a shortage of mortgage money, which depressed residential and commercial building construction, adversely affected clay product sales. Production decreased almost 300,000 tons below the 1979 output; sales dropped more than $200,000.

In western Virginia, the clay material industry mined Paleozoic shales as a raw material. The primary end product was common and face brick. One company, Weblite Corp., Botetourt County, produced lightweight aggregate for use in concrete products, by sintering shale from the Rome Formation. One operation in Tazewell County extruded clay to produce clay dummies used by the coal industry to tamp shot holes.

Eastern Virginia clay producers mined a variety of materials for raw material to produce common and face brick.

Table 4.—Virginia: Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1976	862	1,210
1977	890	1,294
1978	1,043	3,266
1979	1,059	3,512
1980	762	3,172

During the year, a large occurrence of diatomaceous sediments was discovered in King and Queen County in the Walkerton area of eastern Virginia. Plans were announced to mine and process the clays to produce an industrial absorbent. Construction of a $2 million plant, which would employ 40 to 50 people initially, was scheduled to begin in 1981. The processing facility will use wood wastes, instead of oil, as a plant fuel.

Gypsum.—United States Gypsum Co. operated a mine and mill in the southwestern part of the State and a mill at Norfolk on the Atlantic coast. The mine, an underground operation at Locust Cove, is in Smyth County and the mill at Plasterco is in adjacent Washington County. The Norfolk facility is located within the metropolitan area.

The Locust Cove Mine is a slope entry, multilevel operation. Gypsum, occurring as isolated boulders in the Maccrady shale, was mined by a modified underhand stoping system. Crude gypsum, trucked to the plant at Plasterco, was made into wallboard. During the year, the company completed expansion of this plant.

The Norfolk operation received crude gypsum from Nova Scotia in company-owned ships, and the gypsum was ground and calcined to produce wallboard and other gyspum-based products. The facility received a few shipments of anhydrite from the Nova Scotia operations for sale to local cement manufacturers.

Kyanite.—The first recorded production of kyanite, worldwide, was in Prince Edward County in the 1920's. Currently, the State produces approximately 45% of the world's kyanite. Kyanite and calcined kyanite (mullite) are widely used in the refractories and ceramic industry.

Kyanite Mining Corp. operated two surface mines and processing plants at Willis Mountain and East Ridge in Buckingham County in central Virginia. After mining, the ore was crushed, ground, screened, classified, and washed. Flotation was used to separate pyrite and silica impurities; magnetic separators removed remaining iron contaminants. The Willis Mountain plant processed raw kyanite; kyanite from the Willis Mountain Mine used for mullite synthesis was trucked to the East Ridge facility for calcining.

About 40% of the output was shipped through the Port of Hampton Roads to worldwide customers. The company produces approximately 90,000 tons per year.[9] During 1980, the company closed its mine at Baker Mountain in Prince Edward County because of the transportation costs. The company also produced a byproduct sand from kyanite processing. Sales were for masonry, concrete, and other applications.

Lime.—In 1980, lime sales ranked second behind stone. Over the past 10 years, lime production has added over $200 million to the State's economy. During 1980, lime sales decreased almost 50,000 tons as a result of the slump in steel demand.

Virginia's lime industry is situated in Frederick, Giles, Shenandoah, Smyth, and Warren Counties. In northern Virginia, three companies quarried and calcined the high-calcium New Market Limestone, and

one company quarried the Athens Formation. Two companies in Giles County on the West Virginia border operated underground mines in the Five Oaks Limestone, and one company in Smyth County quarried the Effna Limestone for raw material in lime production. Principal sales were to the paper and steel industries. The paper industry used lime for regeneration of sodium hydroxide and the neutralization of sulfate water, a byproduct of paper manufacture. Lime was used by the steel industry to control slagging.

Mica.—Asheville Mica Co. and an affiliate, Mica Co. of Canada, Inc., processed mica at facilities in Newport News on the coast. Crude mica was purchased through New York brokerages, mainly from Brazil and India.

Table 5.—Virginia: Lime sold or used by producers, by use

Use	1979		1980	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Steel, basic oxygen furnace	273,635	$10,960	186,479	$7,745
Paper and pulp	207,135	8,297	129,831	5,354
Acid mine water	69,967	2,802	64,071	2,682
Water purification	94,107	3,769	60,559	2,663
Steel, open-hearth	51,084	2,046	48,178	1,988
Steel, electric	57,665	2,310	36,285	1,518
Sewage treatment	25,648	1,027	W	W
Agriculture	6,169	247	5,249	224
Other[1]	86,783	3,477	293,015	11,698
Total	872,193	34,935	823,667	33,872

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes construction lime, fertilizer (1979), mason's lime, other chemical and industrial uses, other construction uses, other metallurgical uses, petroleum refining (1979), road stabilization (1980), soil stabilization (1979), sugar refining (1979), tanning (1979), wire drawing (1980), and uses indicated by symbol W.

Perlite.—Johns-Manville Sales Corp. operated a plant at Woodstock in Shenandoah County to expand perlite shipped by rail from New Mexico. Expanded perlite was used in the manufacture of roof insulation board marketed throughout the Eastern United States. Although sales were off slightly, compared with the previous year, product demand for roofing insulation was strong.

Sand and Gravel.—During the past decade, sand and gravel sales totaled over $260 million. Historical cost data for sand and gravel in Virginia were compiled in a report by the Division of Mineral Resources.[10] The slump in construction during 1980 lessened demand for sand and gravel throughout the State. Producers of construction sand and gravel reported a 3.5-million-ton drop from the previous year's output.

In 1980, there were approximately 130 active operations; most of them in the eastern Coastal Plain province of the State. (Production and value data reflect 70 operations responding to the Bureau of Mines canvass.)

Table 6.—Virginia: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	4,738	$14,671	$3.10	3,811	$14,278	$3.75
Plaster and gunite sands	125	501	4.02	132	554	4.21
Concrete products	1,632	6,118	3.75	1,030	4,248	4.12
Asphaltic concrete	676	1,745	2.58	875	3,387	3.87
Roadbase and coverings	1,402	4,205	3.00	871	2,963	3.40
Fill	2,423	3,003	1.24	1,074	2,546	2.37
Snow and ice control	66	138	2.09	69	186	2.71
Other	741	1,886	2.54	401	1,345	3.35
Total[1] or average	11,803	32,268	2.73	8,264	29,508	3.57

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

Table 7.—Virginia: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	8,091	$18,638	$2.30	5,697	$17,745	$3.11
Gravel	3,712	13,629	3.67	2,567	11,763	4.58
Total or average	11,803	[1]32,268	2.73	8,264	29,508	3.57
Industrial sand	W	W	6.71	W	W	8.00
Grand total or average	W	W	2.75	W	W	3.58

W Withheld to avoid disclosing company proprietary data.
[1]Data do not add to total shown because of independent rounding.

Large tonnages of construction sand and gravel, produced east of Fredericksburg, were shipped by rail into the northern Virginia-Washington, D.C., market area. A portion of the production from the James River, below Richmond, was barged to the Norfolk area; rail and truck shipments were made to the western part of the State.[11]

Two companies reported industrial sand production. J. C. Jones Sand Co., Inc., mined industrial sand at Virginia Beach. Output was sold for use in casting applications and as a traction medium. Glass sand was produced by Unimin Corp. near Gore in Frederick County.

Stone.—In 1980, stone was Virginia's leading mineral commodity in output and sales, and the State ranked sixth nationally in crushed stone production. Over the past decade, Virginia stone operators have produced over 400 million tons valued at over $1 billion. During that period, stone output increased each year, excluding 1975 and 1980. During those 2 years, a slowdown in highway and building construction, the two major markets for stone, adversely affected sales.

In 1980, the State's stone operators mined and crushed limestone, dolomite, sandstone, quartzite, granite, gneiss, traprock (principally diabase, basalt, and amphibolite), slate, "Virginia aplite," marble, and marl. Crushed stone production decreased approximately 6.5 million tons over that reported by the industry in 1979.

Limestone, dolomite, and sandstone producers are located in the Valley and Ridge, and Plateau provinces in the western portion of the State. Crushed limestone and dolomite were produced at 65 quarries in 25 counties; output totaled approximately 18.5 million tons, a 4.2-million-ton decrease from that reported in 1979. Principal end uses were for road construction, concrete aggregate, and agricultural applications. Sandstone was mined and crushed at 10 operations in 8 counties. Production totaled 1.2 million tons, 300,000 tons less than the 1979 output. Principal sales were for road construction, manufactured fine aggregate, and ferrosilicon manufacture.

Granite and gneiss, traprock, slate, and marble were produced in the Piedmont-Blue Ridge provinces which includes much of the central portion of Virginia. Granite and gneiss output totaled 18.2 million tons, 600,000 tons less than the previous year's production; both types were produced at 29 quarries in a 16-county tier, extending from the North Carolina line to the Maryland border, in the Piedmont province. Crushed granite was also produced in four counties along the Virginia-North Carolina border. Major end uses were for road construction, concrete aggregate, and manufactured fine aggregate. Traprock totaling 5.9 million tons was mined and crushed at eight operations in four counties. Production was approximately 800,000 tons below the previous year's level. Principal end uses were the same as those for granite and gneiss.

Slate was mined and crushed by three companies in Buckingham County and one company in Amherst County. Two of the companies, Amlite Corp. and Solite Corp., expanded slate for lightweight aggregate production. Crushed slate sales increased as a result of local highway construction. Raw material was waste rock from past dimension slate quarrying. Sales of expanded slate decreased significantly over that experienced in 1979.

One company, Appomattox Lime Co., Inc., mined a Precambrian marble near Oakville in Appomattox County for agricultural lime. Sales, principally to the eastern coastal areas of Virginia and North Carolina, were severely curtailed because of drought conditions and the resulting peanut crop failure.

One company in Clarke County in northern Virginia mined and dried marl for agricultural applications. Production increased slightly over that reported during the previous year.

Table 8.—Virginia: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	1,710	8,361	1,678	9,421
Agricultural marl and other soil conditioners	W	10	5	10
Concrete aggregate	4,339	14,033	5,302	20,770
Bituminous aggregate	4,818	16,818	5,092	21,383
Macadam aggregate	438	1,309	532	1,933
Dense-graded roadbase stone	19,647	61,581	15,602	56,969
Surface treatment aggregate	3,417	11,968	1,494	5,652
Other construction aggregate and roadstone	9,078	27,219	7,995	26,377
Riprap and jetty stone	298	1,225	289	1,589
Railroad ballast	442	1,285	659	2,228
Filter stone	472	984	180	479
Manufactured fine aggregate (stone sand)	1,229	4,222	1,519	6,357
Cement manufacture	1,649	2,752	1,470	2,556
Lime manufacture	1,607	3,918	1,488	3,731
Flux stone	201	504	137	346
Mine dusting	331	2,079	335	1,674
Other fillers or extenders	139	963	186	1,302
Other[2]	1,265	5,993	652	5,064
Total[3]	51,080	165,223	44,615	167,839

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

[1]Includes limestone, granite, marl, sandstone, traprock, other stone, and slate.

[2]Includes stone used in poultry grit and mineral food, ferrosilicon, asphalt filler (1979), floor (slate) (1980), roofing granules, acid neutralization (1980), glass manufacture, lightweight aggregate, sulfur dioxide, and unspecified uses.

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

Table 9.—Virginia: Crushed stone statistics, 1980

Stone type	Number of quarries	Number of counties	Quantity (million short tons)	Quantity change, 1979-80
Limestone-dolomite	65	25	18.5	-4.2
Granite-gneiss	29	16	18.2	-.6
Sandstone	10	8	1.2	-.3
Traprock	8	4	5.9	-.8
Slate	3	2	W	W
Aplite	2	2	W	W
Marble	1	1	W	W
Marl	1	1	W	W

W Withheld to avoid disclosing company proprietary data.

Dimension slate, granite, sandstone, and quartzite production was reported from nine quarries in seven counties. Six of the operations were in the Valley and Ridge province, while three were located in the Piedmont province. Slate was the leading stone produced in terms of cubic feet and value. Two companies, Arvonia-Buckingham Slate Corp., Inc., and LeSueur-Richmond Slate Corp., quarried slate in the Arvonia area of Buckingham County. Arvonia slate production dates from the late 1700's when slate was quarried for roofing tile for the State Capitol in Richmond. Slate producers supply the building trade with a variety of products ranging from material for exterior applications such as roofing tile, deck, and flooring to interior uses such as hearths, window stools and sills, and stair treads.

Sulfur.—Elemental sulfur was recovered from hydrogen sulfide gas by the Claus process during crude oil refining by Amoco Oil Co. at a refinery in York County near Yorktown. Production was about equal to that reported during 1979.

Talc.—Blue Ridge Talc Co., Inc., in Franklin and Henry Counties in south-central Virginia, produced talc for foundry applications. Talc, mined by open pit methods, was trucked to the company's mill on the Franklin-Henry County border and ground for use as a releasing agent in mold coatings. Much of the ground talc was shipped to foundries in western Pennsylvania. Sales were down during 1980 because of the depressed state of the steel industry.

Vermiculite.—In 1980, Virginia was one of three States that mined vermiculite. Virginia Vermiculite, Ltd., operates an

open pit mine and processing facility near Boswells Tavern, in Louisa County, northwest of Richmond. Material, mined with a backhoe and front-end loader, was trucked to the adjacent plant where desliming, flotation, and drying and screening are used to produce four basic size products. Most of the crude vermiculite was shipped by rail to exfoliation plants in the Eastern States.

METALS

Ferrovanadium.—Engelhard Minerals & Chemicals Corp.'s subsidiary, Chemstone Corp., produced ferrovanadium at Strasburg in Shenandoah County in northern Virginia. Vanadium pentoxide, obtained from out-of-State, was used in ferroalloy production. Major sales were to the steel industry.

Iron Oxide Pigments.—Virginia was one of four States producing crude iron oxide pigments. Hoover Color Corp., in Pulaski County in the southwestern part of the State, produced ocher, umber, and sienna. The company was the only operation in the United States producing crude sienna. Raw pigments, mined by open pit methods and trucked to the company plant at Hiwassee, were pulverized, dried, ground, graded, blended, and packaged before shipping. The finished product, used as a coloring agent in a variety of products, was shipped throughout the United States and to Canada and Mexico.

Blue Ridge Talc Co., Inc., imports crude iron oxide pigments from a midwest supplier. The pigments were ground and calcined for use in paints, fertilizers, and cement and mortar coloring. Markets were domestic and foreign. Virginia Earth Pigments Co. produced a limited tonnage of iron oxide pigments from a former manganese mine in Wythe County.

Lead and Zinc.—New Jersey Zinc Co. operated an underground mine and mill at Austinville in southwestern Virginia. The mine, developed to the 1,100-foot level, extends for 2-1/2 miles along strike in the Shady Dolomite, the host rock for mineralization. Mining was by the open stope method; ore was crushed underground and hoisted to the surface in skips. Ore grade averages 0.5% lead and 3.0% zinc. The mill uses standard flotation technology. Zinc concentrate was shipped to Clarksville, Tenn., for smelting; lead concentrate was shipped overseas for processing. Lime, a byproduct of the concentrating process, was marketed in Virginia and North Carolina for agricultural applications. During the year, production was cut to 32,500 tons of ore per month, a 27% reduction; the work force was reduced by 71. This cutback resulted from the depressed state of the zinc market and high shipping costs.

Lithium.—Foote Mineral Co. processed lithium carbonate from North Carolina to produce lithium hydroxide at their Sunbright plant in Scott County in southwestern Virginia. Lithium carbonate was used in multipurpose grease applications.

Magnetite.—Two companies, Virginia Lime Co. and Reiss Viking Corp., in Giles and Tazewell Counties in southwestern Virginia processed out-of-State magnetite for use in coal preparation. The material was marketed in New York and Pennsylvania.

Manganese.—Union Carbide Corp. operated a manganese processing facility at Newport News on the Atlantic coast. Manganese ore, imported from Gabon, was dried, crushed, and ground, then shipped to other company facilities for use in the manufacture of batteries.

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[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

[2]Head geologist, Economic Geology Section, Virginia Division of Mineral Resources.

[3]U.S. Department of Commerce. Construction Review. January 1981.

[4]Kline, M. H., and T. J. Ballard. Investigation of the Great Gossan Lead, Carroll County, Va. BuMines RI 4532, September 1949, 39 pp.

[5]Star Tribune, Chatham, Va. Sept. 18, 1981.

[6]State of Virginia, Richmond. Impact Council on the Environment. V. 6, No. 1.

[7]Sweet, P. C. Directory of the Mineral Industry in Virginia—1980. Va. Div. of Min. Res., (Charlottesville, Va.), 1981, 57 pp.

[8]Marr, J. D. Va. Div. of Min. Res. Pub. 25 and 26.

[9]Dixon, G. B., Jr. Kyanite Mining in Virginia. Va. Min., v. 26, No. 1, February 1980.

[10]Sweet, P. C. Sand and Gravel Resources in Virginia. Contributions to Virginia Geology—III; Va. Div. of Min. Res. Pub. 7, 1978, pp. 67-74.

[11]Le Van, D. C. Production of Mineral Resources in Virginia. Contributions to Virginia Geology—III. Va. Dept. of Conservation and Econ. Development, Div. of Min. Res., Pub. 7, 1978, pp. 7-21.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Aplite (crude):			
The Feldspar Corp	Route 1, Box 23 Montpelier, VA 23192	Quarry and plant	Hanover.
Cement:			
Lone Star Cement, Inc.[1]	Box 27 Cloverdale, VA 24077	do	Botetourt.
Do	Box 5128 Chesapeake, VA 23320	Plant	Chesapeake (city).
Riverton Corp.[2]	Riverton, VA 22651	Quarry and plant	Warren.
Clay and shale:			
Brick and Tile Corp	Box 45 Lawrenceville, VA 23868	Pits and plant	Brunswick and Greensville.
General Shale Products Corp	Box 3547 Johnson City, TN 37601	do	Rockbridge, Smyth, Tazewell.
Webster Brick Co., Inc	do	do	Botetourt and Orange.
Ferroalloys:			
Chemstone Corp.[3]	Box 189 Strasburg, VA 22657	Plant	Shenandoah.
Gypsum:			
United States Gypsum Co	Box 4686 Norfolk, VA 23523	do	Norfolk (city).
Do	Route 1 Saltville, VA 24370	Mine and plant	Washington.
Iron oxide pigments (crude):			
Hoover Color Corp	Box 218 Hiwassee, VA 24347	do	Pulaski.
Kyanite:			
Kyanite Mining Corp	Dillwyn, VA 23936	do	Buckingham and Prince Edward.
Lime:			
Chemstone Corp.[4]	Box 71 Strasburg, VA 22657	Plant	Shenandoah.
National Gypsum Co	Star Route 635 Ripplemead, VA 24150	do	Giles.
Virginia Lime Co	Star Route Ripplemead, VA 24150	do	Do.
Perlite, expanded:			
Johns-Manville Sales Corp	Box 442 Woodstock, VA 22644	do	Shenandoah.
Sand and gravel:			
Lone Star Industries, Inc	Box 977 Norfolk Square Norfolk, VA 23501	Pits and plant	Charles City, Chesterfield, Henrico, Prince George.
Sadler Materials Corp	Box 5607 Virginia Beach, VA 23455	Pits	Henrico and Prince George.
West Sand and Gravel Co., Inc	Box 6008 Richmond, VA 23222	do	Henrico.
Stone:			
Lone Star Industries, Inc	Box 420 Norfolk, VA 23501	Quarries	Brunswick, Chesterfield, Dinwiddie.
Luck Quarrys, Inc	Box 4682 Richmond, VA 23229	do	Albemarle, Augusta, Fairfax, Goochland, Halifax, Mecklenburg, Pittsylvania, Prince William, Rockingham, Washington.
Vulcan Materials Co., Midsouth Div.	Box 7 Knoxville, TN 37901	do	Bristol.
Talc:			
Blue Ridge Talc Co., Inc.[5]	Box 39 Henry, VA 24102	Quarry and plant	Franklin.

[1]Also sand and gravel and stone.
[2]Masonry cement only; also produces limestone and lime.
[3]Also lime.
[4]Also ferroalloys.
[5]Also finished oxide pigments.

The Mineral Industry of Washington

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Washington Division of Geology and Earth Resources for collecting information on all nonfuel minerals.

By George T. Krempasky[1] and Bonnie Butler Bunning[2]

The value of nonfuel mineral production in Washington was $207 million in 1980. The nonmetals—cement, clays, gem stones, diatomite, gypsum, lime, olivine, peat, sand and gravel, and stone—accounted for 94% of the total output value. The metals—copper, gold, lead, silver, and tungsten—accounted for the remainder.

Exploration and development continued in the State to increase the resource and/or reserve base of known mineral commodities. Thirteen companies and/or individuals were exploring for copper and molybdenum, 6 for lead and zinc, 3 for molybdenum, 15 for silver and gold, and 1 individual for tungsten. In addition, companies and individuals continued their efforts in the evaluation of nonmetallics, primarily construction materials.

With its seven aluminum reduction plants, Washington was the leading State in primary aluminum production. Raw material used in the production of aluminum was imported, largely from Australia. Availability of interruptible energy during the year, supplied by Bonneville Power Administration (BPA), impacted the aluminum industry.

Trends and Developments.—ASARCO Incorporated, which operates a copper smelter in Tacoma, was granted a 1-year extension to complete an environmental impact statement on compliance with sulfur dioxide emission standards. The variance was granted by the Puget Sound Air Pollution Control Agency.

A labor-management dispute at Asarco's Tacoma operation closed the smelter July 1, 1980. The dispute was not settled until November 23, 1980.

A $17 million gypsum wallboard manufacturing facility is to be built by Domtar Gypsum America, Inc., on the Blair Waterway, Port of Tacoma.

Rockwell Hanford Co. is constructing a $20 million plant at Hanford to speed plutonium refining.

Officials of AMAX, Inc. projected a 43-year life for its proposed mine and mill complex near Keller, Wash., about 100 miles northwest of Spokane. The deposit, containing 900 million tons of 0.1% MoS_2 and 0.1% Cu, is to be mined at a rate of 60,000 tons per day. A total of 30 million pounds of copper and 20 million pounds of molybdenum will be produced each year. The cooperative venture, between the Colville Confederated Tribes and AMAX, must gain approval of the Tribal Council and the U.S. Secretary of the Interior.

The Mining and Mineral Resources and Research Institute at the University of Washington, Seattle, created under Title III of Public Law 95-87, received a research grant of $29,184 from the Office of Surface Mining, U.S. Department of the Interior.

Washington's Division of Geology and Earth Resources opened a new field office at Eastern Washington University in Cheney.

Table 1.—Nonfuel mineral production in Washington[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry thousand short tons	10	$741	W	W
Portland do	1,761	98,659	1,546	$89,208
Clays[2] do	339	1,549	301	1,571
Gem stones	NA	170	NA	150
Peat thousand short tons	11	148	W	W
Pumice do	r63	r202	23	W
Sand and gravel[3] do	24,258	59,382	19,019	46,731
Stone:				
Crushed do	15,192	35,783	11,062	29,024
Dimension do	4	268	6	248
Combined value of clays (fire clay), copper, diatomite, gold, gypsum, lead, lime, olivine, industrial sand, silver, tungsten (1979), and values indicated by symbol W	XX	28,248	XX	40,430
Total	XX	r225,150	XX	207,362

rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

[2]Excludes fire clay; value included in "Combined value" figure.

[3]Excludes industrial sand; value included in "Combined value" figure.

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

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Adams	W	W	Sand and gravel.
Asotin	$486	$288	Stone, sand and gravel.
Benton	W	W	Sand and gravel, stone.
Chelan	790	W	Do.
Clallam	W	W	Clays, sand and gravel, stone.
Clark	2,046	2,042	Sand and gravel, stone, clays.
Columbia	124	188	Stone.
Cowlitz	1,032	W	Stone, sand and gravel.
Douglas	W	W	Do.
Ferry	6,014	5,567	Gold, silver, stone, lead, copper.
Franklin	937	W	Stone, sand and gravel.
Garfield	337	293	Stone.
Grant	W	7,818	Diatomite, lime, sand and gravel, stone.
Grays Harbor	1,181	1,520	Sand and gravel, stone.
Island	374	329	Do.
Jefferson	W	W	Stone, sand and gravel.
King	W	W	Cement, sand and gravel, stone, clays, peat.
Kitsap	4,423	W	Sand and gravel, stone, peat.
Kittitas	W	W	Sand and gravel, stone, clays.
Klickitat	340	3,739	Sand and gravel, stone, pumice.
Lewis	W	W	Sand and gravel.
Lincoln	472	981	Stone, sand and gravel.
Mason	12	W	Stone.
Okanogan	W	W	Sand and gravel, stone, gypsum.
Pacific	786	717	Stone.
Pend Oreille	W	13,125	Cement, stone, sand and gravel.
Pierce	W	17,083	Sand and gravel, lime, stone, clays.
San Juan	W	W	Sand and gravel, stone.
Skagit	W	W	Olivine, sand and gravel, stone.
Skamania	373	613	Stone, sand and gravel.
Snohomish	W	W	Sand and gravel, stone, clays.
Spokane	W	W	Stone, sand and gravel, clays, peat.
Stevens	5,312	11,096	Lime, stone, sand and gravel, clays, tungsten.
Thurston	W	W	Sand and gravel, stone.

See footnotes at end of table.

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

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Wahkiakum	$7	$14	Stone.
Walla Walla	728	552	Sand and gravel, stone.
Whatcom	W	W	Cement, stone, sand and gravel.
Whitman	--	1,603	Stone.
Yakima	W	W	Stone, sand and gravel.
Undistributed[1]	154,659	157,579	
Total	180,433	[2]225,150	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes some gem stones, pumice (1979), sand and gravel, stone that cannot be assigned to specific counties, and values indicated by symbol W.
[2]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Washington business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,892.0	1,908.0	+0.8
Unemployment	do	128.0	143.0	+11.7
Employment (nonagricultural):				
Mining[1]	do	3.0	3.2	+6.7
Manufacturing	do	309.6	307.4	-.7
Contract construction	do	104.4	91.0	-12.8
Transportation and public utilities	do	89.4	91.2	+2.0
Wholesale and retail trade	do	379.1	383.6	+1.2
Finance, insurance, real estate	do	89.4	91.8	+2.7
Services	do	290.8	308.0	+5.9
Government	do	315.5	330.3	+4.7
Total nonagricultural employment[1]	do	1,581.2	1,606.5	+1.6
Personal income:				
Total	millions	$37,418	$42,641	+14.0
Per capita		$9,531	$10,363	+8.7
Construction activity:				
Number of private and public residential units authorized		51,950	32,822	-36.8
Value of nonresidential construction	millions	$1,141.4	$990.4	-13.2
Value of State road contract awards	do	$330.0	$248.0	-24.8
Shipments of portland and masonry cement to and within the State	thousand short tons	1,857	1,382	-25.6
Nonfuel mineral production value:				
Total crude mineral value	millions	$225.2	$207.4	-7.9
Value per capita, resident population		$57	$50	-12.3
Value per square mile		$3,302	$3,041	-7.9

[p]Preliminary.
[1]Includes bituminous coal extraction.

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

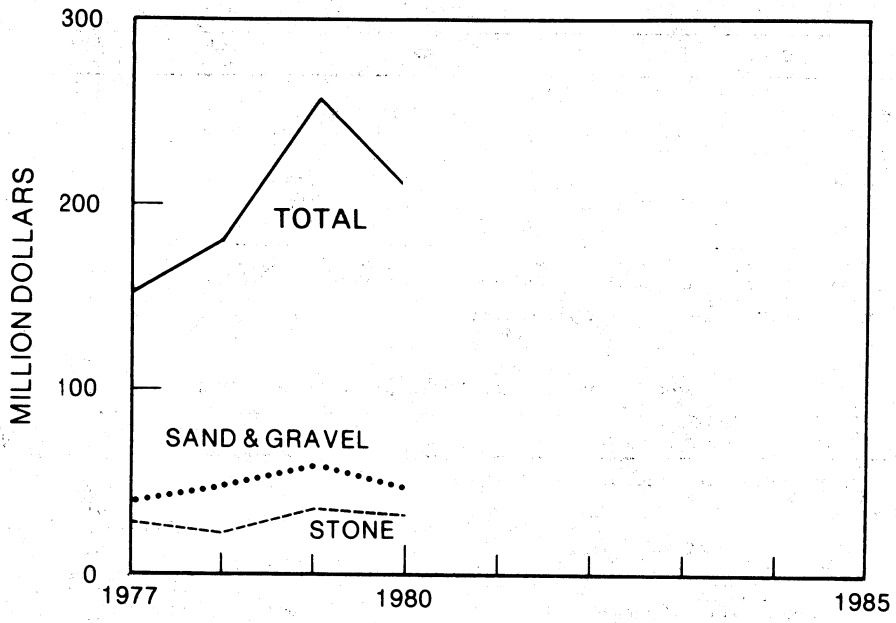

Figure 1.—Value of sand and gravel and stone, and total value of nonfuel mineral production in Washington.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Nonmetal mineral production in Washington during 1980 was 94% of the total value of nonfuel mineral production, compared with 98% in 1979. Cement, both masonry and portland, was the leading production value commodity. Other significant commodities in terms of value were sand and gravel, stone, lime, diatomite, olivine, and clays.

A gypsum wallboard manufacturing facility, expected to employ between 75 and 100 persons, was being constructed in the Tacoma area. Exploration and development activities for barite were underway in the O'Toole Mountain, Eagle Mountain, and Bruce Creek areas of Stevens County. Intermittent mining of jade, gypsum, feldspar, and talc continued in various counties.

Calcium Chloride.—Two companies in Pierce County produced synthetic calcium chloride in 1980: Hooker Chemical Corp. and Reichold Chemicals, Inc.

Cement.—Portland cement was produced by four companies: Columbia Cement Corp., a subsidiary of Filtrol Corp., Bellingham; Ideal Cement Co., Seattle; Lehigh Portland Cement Co., Metalline Falls; and Lone Star Industries, Inc., Seattle. The product was used mainly by ready-mix companies, concrete product manufacturers, building material dealers, highway contractors, and Government agencies. Production in 1980 was 12% less than in 1979; value of production was 10% less.

Clays.—Clays were produced in eight counties: Clallam, Clark, King, Kittitas, Pierce, Snohomish, Spokane, and Stevens. Production from Clallam, King, Pierce, and Spokane Counties was approximately 98% of the State total. Clays were used for a variety of end products, including portland cement, face brick, and flue lining. Clay suppliers tied closely to new construction markets were hard hit by a general building industry slowdown in 1980.

Diatomite.—Mine production of diatomite in 1980 was 10% greater than that of 1979, with value increasing 50%. The raw material was produced by Witco Chemical Corp. from a surface mine near George, in Grant County, and was processed at the company's plant near Quincy.

Lime.—Domtar Industries, Inc., produced lime in Pierce County, and Northwest Alloys, Inc., produced lime in Stevens County. Production remained constant; value increased about 15% compared with that of 1979.

Olivine.—Olivine was mined and processed in Skagit County. No change in production or value was noted in 1980 when compared with 1979 data.

Pumice and Volcanic Cinder.—Two operators recovered pumice and volcanic cinder from six pits for use as concrete aggregate, for landscaping, and for ballast and road construction. The U.S. Forest Service produced material from five pits in various counties, and Ed Layman produced from a pit in Klickitat County. In 1980, 9% of the total production was used as concrete aggregate, 40% for landscaping, and 51% for other uses.

Sand and Gravel.—Sand and gravel was produced by 120 companies from 138 pits in 31 of Washington's 39 counties. The 1980 production declined about 22% when compared with the 1979 level. A total of 131 pits, yielding less than 600,000 tons per pit, produced 61% of the total sand and gravel. Approximately 98% of the material was transported by truck.

Table 4.—Washington: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	8,505	$22,919	$2.69	7,084	$20,095	$2.84
Plaster and gunite sands	199	515	2.59	37	158	4.27
Concrete products	1,233	3,195	2.59	803	1,955	2.44
Asphaltic concrete	3,649	9,919	2.72	2,304	6,622	2.87
Road base and coverings	6,596	15,603	2.37	4,802	10,558	2.20
Fill	3,623	6,264	1.73	3,571	6,317	1.77
Snow and ice control	42	82	1.92	31	55	1.79
Railroad ballast	129	323	2.51	191	515	2.69
Other	283	561	1.99	195	458	2.34
Total[1] or average	24,258	59,382	2.45	19,019	46,731	2.46

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

Table 5.—Washington: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	8,061	$19,146	$2.38	6,732	$15,775	$2.34
Gravel	16,197	40,236	2.48	12,287	30,956	2.52
Total or average	24,258	59,382	2.45	19,019	46,731	2.46
Industrial sand	W	W	10.82	W	W	12.22
Grand total or average	W	W	2.52	W	W	2.56

W Withheld to avoid disclosing company proprietary data.

Stone.—Crushed and/or dimension stone was produced from 189 quarries in 36 of the State's counties. The U.S. Forest Service, which mined stone from 36 quarries in various counties, was the leading producer. Excluding Forest Service yield, Cowlitz, Grays Harbor, King, Pierce, Snohomish, Spokane, Stevens, and Whatcom Counties accounted for 52% of total State production. In 1980, crushed stone production was 27% less than in 1979; value decreased 19%. More than 40% of the quarries produced less than 25,000 tons each and accounted for about 6% of the total production. Quarries producing in excess of 100,000 tons each accounted for about 55% of total production.

Table 6.—Washington: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	8	107	24	307
Concrete aggregate	W	W	11	74
Bituminous aggregate	1,279	3,618	992	2,367
Macadam aggregate	181	384	29	98
Dense-graded roadbase stone	2,638	6,029	1,350	3,378
Surface treatment aggregate	3,938	7,394	1,051	2,861
Other construction aggregate and roadstone	3,420	8,454	4,298	11,531
Riprap and jetty stone	1,506	3,888	1,639	4,294
Railroad ballast	423	1,185	393	959
Manufactured fine aggregate (stone sand)	49	148	W	W
Terrazzo and exposed aggregate	32	134	21	113
Whiting or whiting substitute	(2)	2	--	--
Other fillers or extenders	(2)	2	--	--
Fill	15	19	--	--
Other[3]	1,700	4,419	1,254	3,042
Total	[4]15,192	35,783	11,062	29,024

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes limestone, granite, marble (1980), sandstone, traprock, and other stone.
[2]Less than 1/2 unit.
[3]Includes stone used in filler stone, cement manufacture, dead-burned dolomite (1980), ferrosilicon, chemical stone for alkali works, abrasives, poultry grit and mineral food (1979), roofing granules (1980), and magnesium metal (1979).
[4]Data do not add to total shown because of independent rounding.

Sulfur.—Four companies produced sulfur, sulfur dioxide (SO_2), or hydrogen sulfide (H_2S). Atlantic Richfield Co. and Mobil Oil Corp. produced sulfur in Whatcom County, Shell Oil Co. produced hydrogen sulfide in Skagit County, and Asarco produced liquid SO_2 in Pierce County.

METALS

The value of metals produced in Washington in 1980 was 5% of the total value of nonfuel mineral production, compared with 2% in 1979. However, exploration and development activities continued at a high rate to determine the resource and/or reserve base of metal commodities.

Search for precious metals was buoyed by relatively high prices for the commodities. Numerous individuals and companies were active: Bethex Corp. and Cyprus Exploration Corp. in Chelan County; Day Mines, Inc., Houston International Minerals, Matt Obersbee, and Ruby Mines, Inc., in Ferry County; Cominco American Inc. in King County; Cyprus Exploration Corp., JNT-GPM Enterprises, and Rocky Mines Co. in Okanogan County; AMOCO Minerals Co. in Pierce County; Arbor Resources Ltd., Charleston Resources, Joe McNamee, Spectre Engineering, and Lowell Warner in Stevens County; and U.S. Borax and Chemical Corp. and Lion Mines in Whatcom County.

Exploration for other metals was also accelerated. Copper was being sought in Okanogan, Pend Oreille, Pierce, Skamania, Snohomish, and Stevens Counties. Molybdenum exploration was active in Ferry, Okanogan, Pierce, Snohomish, and Stevens Counties. Lead and zinc prospects were being evaluated in Ferry, Okanogan, Pend Oreille, and Stevens Counties.

Aluminum.—Washington ranked first in the Nation in quantity and value of primary aluminum production, with approximately 23% of the national total. The seven aluminum reduction plants in the State obtained raw material feed from foreign sources, primarily Australia.

The aluminum industry, a major consumer of electricity in the State, operates its plants under interruptible supply contracts with BPA. Producers curtailed operations in January and March, increased production in June, curtailed production in October, and resumed operations in December as electric power was made available by BPA.

Table 7.—Washington: Primary aluminum plant production data

Year	Quantity (thousand short tons)	Percent of national total	Value (thousands)
1976	1,150	27	$1,021,662
1977	1,032	23	1,064,799
1978	1,203	25	1,301,367
1979	1,211	24	1,476,957
1980	1,171	23	1,678,645

Gold.—Washington ranked ninth in total gold production in the Nation. In 1980, gold production declined 3%, with the value of the product increasing 94% compared with statistics for 1979. Gold was recovered from the ores of two lode mines in Ferry and Pierce Counties. Exploration activities were increasing in Chelan, Ferry, Okanogan, Pierce, Stevens, and Whatcom Counties. Numerous placer operations extracted an undetermined quantity of gold from the Columbia and Similkameen Rivers, and from creeks in Kittitas, Chelan, and Whatcom Counties.

Silver.—In 1980, silver was recovered from the ores of two lode mines in Ferry and Pierce Counties. Washington ranked 11th in the Nation for total silver production. Silver production increased 54% in 1980, with the value of the product increasing 185% compared with 1979 statistics. Exploration activities, buoyed by the relatively high price of silver, were on the increase, especially in Chelan, Ferry, Okanogan, Pierce, Stevens, and Whatcom Counties.

[1]State mineral specialist, Bureau of Mines, Spokane, Wash.
[2]Geologist, field office supervisor, Washington Division of Geology and Earth Resources, Cheney, Wash.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum:			
Aluminum Company of America	Box 120 Vancouver, WA 98660	Plant	Clark.
Do	Box 221 Wenatchee, WA 98801	do	Chelan.
Intalco Aluminum Corp	Box 937 Ferndale, WA 98248	do	Whatcom.
Kaiser Aluminum & Chemical Corp.	Box 6217 Spokane, WA 99207	do	Spokane.
Do	3400 Taylor Way Tacoma, WA 98400	do	Pierce.
Cement:			
Filtrol Corp.[1]	Box 37, Marietta Rd. Bellingham, WA 98225	do	Whatcom.
Ideal Basic Industries Inc.[2]	420 Ideal Cement Bldg. Denver, CO 80202	do	King.
Lehigh Portland Cement Co.[1]	718 Hamilton St. Allentown, PA 18105	do	Pend Oreille.
Lone Star Industries, Inc.[3]	One Greenwich Plaza Greenwich, CT 06830	do	King.
Clays:			
Interpace Corp	3502 Breakwater Ct. Haywood, CA 94545	Pits and plant	King, Spokane, Stevens.
Mutual Materials Co	Box 2009 Bellevue, WA 98009	do	King and Pierce.
Copper:			
ASARCO Incorporated[4]	Box 1605 Tacoma, WA 98401	Plant	Pierce.
Diatomite:			
Witco Chemical Corp	277 Park Ave. New York, NY 10017	Mine and plant	Grant.
Gold:			
Day Mines, Inc.[5]	Box 1010 Wallace, ID 83873	Mine and mill	Ferry.
Lime:			
Domtar Inc., Lime Div	1220 Alexander Ave. Tacoma, WA 98421	Plant	Pierce.
Magnesium:			
Northwest Alloys, Inc.[1 6]	Box 115 Addy, WA 99101	Plant and mine	Stevens.
Olivine:			
Northwest International	329 Kincaid St. Mount Vernon, WA 98273	do	Skagit.
Peat:			
Maple Valley Humus	18805 SE. 170th St. Renton, WA 98055	Bog	King.
Pumice:			
D. M. Layman, Inc	Box 208 Goldendale, WA 98620	Pit	Klickitat.
U.S. Forest Service, Region 6[1]	319 SW. Pine St. Portland, OR 97208	Pits	Various.
Sand and gravel:			
Associated Sand & Gravel Co., Inc	Box 2037 Everett, WA 98203	Plant and pits	Grays Harbor and Snohomish.
Cadman Gravel Co	18816 NE. 80th Redmond, WA 98052	Plant and pit	King.

See footnotes at end of table.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel —Continued			
Central Pre-mix Concrete Co	805 North Division Spokane, WA 99220	Plants and pits	Various.
Fife Sand & Gravel Co	3120 Freeman Rd., East Puyallup, WA 98371	Plant and pit	Pierce.
Friday Harbor Sand & Gravel Co	Box 8 Bellingham, WA 98225	do	San Juan.
Glacier Sand & Gravel Co	5975 East Marginal Way, South Seattle, WA 98134	Plant and pits	King and Pierce.
Lakeside Gravel Co., Inc	Box 46 Issaquah, WA 98027	do	King.
Miles Sand & Gravel Co	Box 130 Auburn, WA 98002	do	King and Kitsap.
Woodworth & Co., Inc.[1]	1200 East D St. Tacoma, WA 98421	do	Pierce.
Stone:			
Black River Quarry, Inc	6808 South 140th St. Seattle, WA 98178	Quarry and plant	King.
Bohemia, Inc., Umpqua Div	Box 1031 Camas, WA 98601	do	Clark.
DeAtley Corp	Box 648 Lewiston, ID 83501	Quarries and plant	Various.
Industrial Rock Products, Inc	3707 California Bank Ctr. Seattle, WA 98164	Quarry and plant	Snohomish.
J. C. O'Connor Construction Co	110 West Pine Centralia, WA 98531	Quarries and plant	Lewis and Thurston.
Spokane County Road Dept	North 811 Jefferson Spokane, WA 99201	do	Spokane.

[1]Also stone.
[2]Also clays.
[3]Also sand and gravel.
[4]Also arsenic, gold, and silver.
[5]Also silver.
[6]Also lime.

The Mineral Industry of West Virginia

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the West Virginia Geological and Economic Survey for collecting information on all nonfuel minerals.

By Donald K. Harrison[1] and Dewey S. Kirstein[2]

The value of West Virginia's nonfuel mineral production in 1980 was $106.3 million. Crushed stone and construction sand and gravel accounted for nearly 45% of the State's nonfuel mineral value. Other commodities produced included salt, cement, clays, and lime. The State has an abundance of quality industrial sand resources and continued to be one of the Nation's leading manufacturers of glassware.

Trends and Developments.—Output of most nonfuel minerals and metals produced or processed declined during the year, primarily because of the general state of the economy, high interest rates, and a weakened demand for the materials. Hardest hit were commodities used by the construction industry and the steel and related industries. Total nonfuel mineral value also decreased, but at a lower percentage than the State's total output. This was largely the result of increased unit values for most commodities produced.

Table 1.—Nonfuel mineral production in West Virginia[1]

Mineral		1979		1980	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2]	thousand short tons	330	$592	291	$642
Salt	do	1,078	W	W	W
Sand and gravel[3]	do	4,138	18,501	2,728	11,454
Stone (crushed)	do	11,713	37,624	9,766	36,305
Combined value of cement, clays (fire), lime, sand and gravel (industrial), stone (dimension, 1979), and values indicated by symbol W		XX	61,878	XX	57,885
Total		XX	118,595	XX	106,286

W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

[2]Excludes fire clay; value included in "Combined value" figure.

[3]Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in West Virginia, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Berkeley	$29,841	$32,126	Cement, stone, lime, clays.
Boone	210	--	
Braxton	(2)	(2)	Stone.
Brooke	W	W	Sand and gravel.
Cabell	18	7	Clays.
Fayette	W	126	Stone.
Gilmer	W	W	Do.
Grant	266	302	Do.
Greenbrier	W	W	Do.
Hampshire	W	W	Do.
Hancock	W	W	Clays, sand and gravel.
Harrison	W	W	Stone.
Jefferson	W	W	Do.
Kanawha	W	223	Do.
Lincoln	W	W	Clays.
Logan	--	1,415	Stone.
Marion	21	--	
Marshall	W	W	Salt.
Mason	77	94	Sand and gravel.
Mercer	1,372	1,712	Stone.
Mineral	W	W	Do.
Monongalia	W	W	Do.
Morgan	W	W	Sand and gravel.
Pendleton	W	W	Stone, lime.
Pocahontas	663	680	Stone.
Preston	989	W	Do.
Raleigh	1,358	1,535	Do.
Randolph	3,897	5,645	Do.
Tucker	W	W	Do.
Tyler	W	W	Salt.
Wetzel	W	W	Sand and gravel.
Wirt	--	2	Stone.
Wood	W	W	Sand and gravel.
Wyoming	W	W	Stone, sand and gravel.
Undistributed	64,810	74,726	
Total[3]	103,518	118,595	

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

[1]Barbour, Calhoun, Clay, Doddridge, Hardy, Jackson, Lewis, McDowell, Mingo, Monroe, Nicholas, Ohio, Pleasants, Putnam, Ritchie, Roane, Summers, Taylor, Upshur, Wayne, and Webster Counties are not listed because no nonfuel mineral production was reported.

[2]Less than 1/2 unit.

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

Table 3.—Indicators of West Virginia business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	751.0	768.0	+2.3
Unemployment	do	51.0	72.0	+41.2
Employment (nonagricultural):				
Mining[1]	do	68.0	66.0	-2.9
Manufacturing	do	126.1	117.2	-7.1
Contract construction	do	39.0	36.3	-6.9
Transportation and public utilities	do	43.8	43.2	-1.4
Wholesale and retail trade	do	131.9	129.8	-1.6
Finance, insurance, real estate	do	21.7	22.0	+1.4
Services	do	97.8	97.9	+.1
Government	do	130.1	133.4	+2.5
Total nonagricultural employment[1 2]	do	658.6	645.9	-1.9
Personal income:				
Total	millions	$13,898	$15,127	+8.8
Per capita		$7,402	$7,831	+5.8
Construction activity:				
Number of private and public residential units authorized		3,839	2,927	-23.8
Value of nonresidential construction	millions	$69.6	$56.8	-18.4
Value of State road contract awards	do	$390.0	$330.0	-15.4
Shipments of portland and masonry cement to and within the State	thousand short tons	631	587	-7.0

See footnotes at end of table.

Table 3.—Indicators of West Virginia business activity —Continued

		1979	1980[p]	Change, percent
Nonfuel mineral production value:				
Total crude mineral value	millions	$118.6	$106.3	-10.4
Value per capita, resident population		$63	$55	-12.7
Value per square mile		$4,904	$4,395	-10.4

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.
[2]Data do not add to totals shown because of independent r ding.

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

Salt brines continued to be us by West Virginia's chemical industry o produce caustic soda, chlorine, and o er chemicals. The chemical industry em oys the greatest number of workers in ne State's manufacturing sector. Th Charleston area in the Kanawha Val y is among the largest chemical center a the world.

During the ear, Mobay Chemical Corp. completed e expansion program at its new syn etic iron oxide pigment plant in New M rtinsville, making the plant the larg single iron oxide facility in the U ted States in terms of producing capaci- y.

Legislation and Government Programs.—The West Virginia Geological and Economic Survey, in a cooperative effort with the U.S. Geological Survey (USGS), completed land use and land-cover maps for the State. Under this program, calculations of acreage and percentages of each land use category are being published for all 55 counties. Statistical data include total acreages for surface mines, quarries, and gravel pits.

The Economic Section of the West Virginia Survey continued to evaluate the State's limestone resources and to locate clays and shales suitable for the manufacture of brick. The Economic Section also began the final edit of the State Gazetteer. This directory, a compilation of 30,000 cultural and place names, includes all the proper names found on both old and recently published topographic and geologic maps, as well as the names found in other publications. All features with more than one common name, as well as specific information on localities, have been cross-referenced and computer-sorted. The Gazetteer should be especially useful in locating mineral occurrences that have been identified and located only by reference to a relatively unknown place name.

During 1980, the West Virginia Department of Natural Resources issued 16 surface mining permits for nonfuel minerals. Permits were issued for sand and gravel, limestone, sandstone, and clay and shale operations. The State now has 125 nonfuel mining permits issued covering surface, underground, and dredging operations.

A graduate-level mine safety program was offered at Marshall University in Huntington. Courses cover metal and nonmetal mining as well as coal, and focus on mine safety program analyses, legislation, hazard control, and philosophical concepts. The program, offered in cooperation with the National Mine Safety and Health Academy at Beckley and the U.S. Department of Labor, is one of only a few offered in the United States.

West Virginia University, under a 3-year contract with the U.S. Bureau of Mines, will develop and evaluate training materials to be used nationwide for developing mine safety teams. Proposed Federal regulations will require each mine operator to have two fully trained and equipped mine rescue teams by 1981.

In accordance with the provisions of the Wilderness Act (Public Law 88-577) and the Eastern Wilderness Act (Public Law 93-622), the U.S. Bureau of Mines and USGS continued to conduct mineral surveys of lands under consideration for wilderness designation. A report on the Dolly Sods Wilderness Area in Grant, Randolph, and Tucker Counties was published as USGS Bulletin 1483-A during the year. Another report, entitled "Mineral Resources of the Cranberry Wilderness Study Area, Pocahontas and Web-

ster Counties" and previously released as USGS Open File Report 78-142, was scheduled to be published as USGS Bulletin 1494 in the spring of 1981.

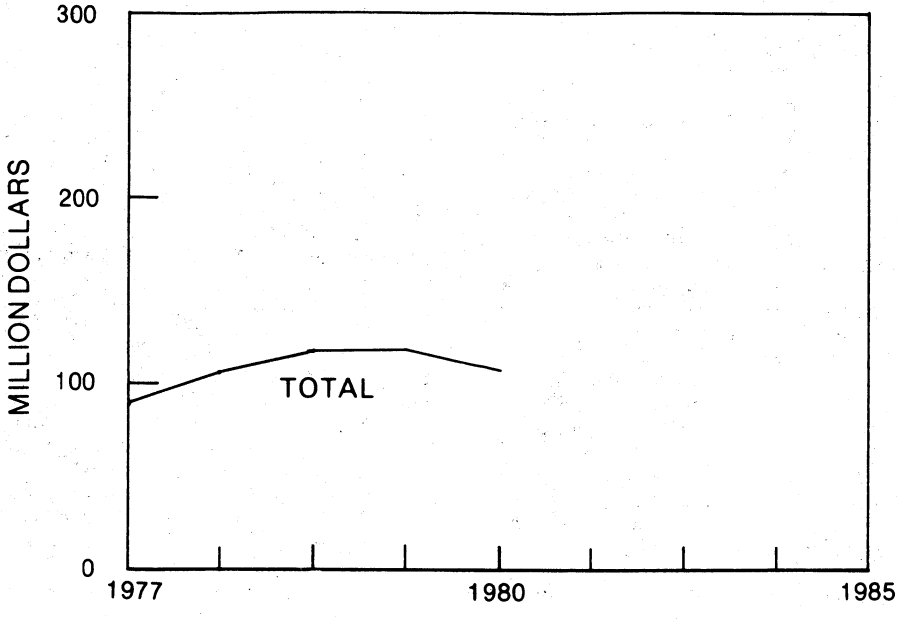

Figure 1.—Total value of nonfuel mineral production in West Virginia.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Martin Marietta Corp., the only cement producer in the State, produced both portland and masonry cement at its Martinsburg plant in Berkeley County. Most of the cement was used in ready-mix concrete and concrete products. Shipments of both portland and masonry cement declined in 1980 compared with 1979 levels because of recessionary factors that sharply reduced construction activity. In addition to in-State consumption, shipments were made to the District of Columbia, Maryland, North Carolina, Pennsylvania, and Virginia.

Clays.—Common and fire clays were produced by three companies in three counties—Berkeley, Hancock, and Lincoln. Berkeley County continued to be the leading producer of common clay, producing nearly 99% of the State's total output. Hancock County was the only producer of fire clay. Production of both clays was down during the year. Principal uses were in the manufacture of face brick, firebrick, and cement.

During the year, NL Industries, Inc., produced bentone, an organic derivative of hectorite clay, which is used as a gelling and pigment-suspending agent in paint, ink, plastics, and cosmetics. In early 1980, the firm began expanding its Charleston plant with the goal of doubling production by early 1981.

Graphite (Synthetic).—Union Carbide Corp. continued to produce synthetic graphite at its Clarksburg plant for graphite electrodes and the carbon specialties markets.

Iron Oxide Pigments (Synthetic).—West Virginia was one of the Nation's leading

producers of synthetic iron oxide pigments. Production and value increased 8% and 24%, respectively, over 1979 levels.

National Steel Corp. continued to produce regenerator iron oxide at its plant in Weirton. Chemetron Corp. sold its pigment division plant in Huntington to the West German BASF group of chemical companies in 1979. Iron oxides are no longer being produced at this plant.

Mobay Chemical Corp. completed the second phase of an expansion program at its New Martinsville iron oxide pigment plant, which raised plant capacity to 90 million pounds per year. The plant, which began production in 1978, is now the largest single iron oxide facility in the United States. The increase in production is expected to close a gap in U.S. iron oxide pigment demand, which has been largely met by imports.

Lime.—Lime was produced by two companies in 1980. Both quicklime and hydrated lime were produced in Pendleton County. Quicklime was also produced in Berkeley County. The lime was used principally in steelmaking, acid mine water neutralization, sewage treatment, and agriculture. Both quantity and value decreased because of a lower demand by the steel industry, which had its worst year since 1975.

Salt.—Three companies recovered salt from deep-well solution mining operations in Marshall and Tyler Counties. Production decreased in 1980. The salt was principally used by the producers for manufacturing chlorine, caustic soda, and other chemicals. LCP Chemicals-West Virginia, Inc., purchased Allied Chemical Corp.'s Moundsville brine operations in May and continued operating the brine wells and plant for the remainder of the year.

Sand and Gravel.—Output of construction sand and gravel declined substantially in 1980. All categories of contract construction—i.e., residential, nonresidential, highway, and other public works—were down during the year.

Six companies mined construction sand and gravel from seven operations. Leading counties, in order of output, were Wetzel, Brooke, and Hancock, accounting for more than 90% of the State's total output. Trucks transported the bulk of the aggregate; the remainder was shipped by rail or barge. Main uses for the material were for asphalt and concrete aggregate, roadbase, and concrete products.

Two companies produced industrial sand from three operations in two counties. Morgan County accounted for most of the State's total, and Brooke County produced the remainder. Production decreased nearly 10% in 1980 compared with 1979 output. The leading end uses were for containers, flat glass, and specialty glass.

Although West Virginia is one of the Nation's leading glassware manufacturers, both the sluggish national economy and the use of substitutes affected this industry. In 1950, 16,700 people were employed in the manufacture of glass products in the State. In 1980, fewer than 9,000 were employed. Although a good market still exists for specialty glass, container glass manufacturers have been hurt because beverage producers have rapidly converted from glass to plastic containers. Demand for flat glass, which reflects market trends in the automobile and housing industries, was also lower in 1980.

Table 4.—West Virginia: Construction sand and gravel sold or used, by major use category

Use	1979[r]			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	2,638	$11,822	$4.48	1,767	$7,726	$4.37
Plaster and gunite sands	W	W	4.85	W	W	5.81
Concrete products	190	917	4.84	W	W	5.79
Asphaltic concrete	825	3,522	4.27	W	W	3.50
Roadbase and coverings	290	1,298	4.48	161	564	3.50
Fill	35	160	4.59	W	W	5.64
Other uses	W	W	4.53	W	W	4.60
Total or average	4,138	18,501	4.47	2,728	11,454	4.20

[r] Revised. W Withheld to avoid disclosing company proprietary data; included in "Total."

Table 5.—West Virginia: Construction sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	2,405	$10,624	$4.42	1,618	$6,833	$4.22
Gravel	1,733	7,876	4.55	1,110	4,621	4.16
Total or average	4,138	[1]18,501	4.47	2,728	11,454	4.20

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

Stone.—Crushed stone was produced by 37 companies at 48 operations. Principal sales were for construction aggregate and roadbase. Leading counties, in order of output, were Greenbrier, Monongalia, Berkeley, and Randolph, each producing more than 1 million tons.

Crushed limestone was produced in 14 counties at 33 mines and quarries. Leading counties in production were Greenbrier, Monongalia, Berkeley, and Randolph. Major uses for crushed limestone were for construction aggregate, roadbase, concrete, riprap, agriculture, railroad ballast, abrasives, and mine dusting.

Crushed sandstone was produced in 10 counties at 15 quarries. Counties that led in output were Raleigh, Logan, Wyoming, and Boone. Major uses were for roadbase and construction aggregate.

Table 6.—West Virginia: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	83	348	60	368
Concrete aggregate	2,233	6,149	964	3,040
Bituminous aggregate	360	1,238	231	947
Macadam aggregate	W	W	235	1,017
Dense-graded roadbase stone	2,445	8,999	2,346	9,202
Surface treatment aggregate	526	1,728	434	1,591
Other construction aggregate and roadstone	2,728	9,342	2,881	11,247
Riprap and jetty stone	84	325	70	303
Railroad ballast	650	1,289	507	1,060
Manufactured fine aggregate (stone sand)	513	2,012	351	1,741
Abrasives	62	209	21	91
Mine dusting	139	1,216	148	1,365
Fill	W	W	25	77
Other uses[2]	1,891	4,770	1,493	4,255
Total[3]	11,713	37,624	9,766	36,305

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

[1]Includes limestone and sandstone.

[2]Includes stone used in agricultural marl and other soil conditioners, poultry grit and mineral food, filter stone, cement manufacture, lime manufacture, flux stone (1979), refractory stone, asphalt filler, sulfur dioxide, other uses, and uses indicated by symbol W.

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

METALS

Aluminum.—Kaiser Aluminum & Chemical Corp. continued to produce aluminum at its 163,000-ton-per-year primary aluminum smelter at Ravenswood, Jackson County. During the year, cost reduction projects were underway at the plant, including further progress on a program to automate the 72-inch cold-rolling mill. Kaiser also participated in natural gas exploration programs and joint ventures aimed at securing its own natural gas supply. At the Ravenswood plant, more than 25% of the carbon and fabricating operation's energy needs are met with company-owned natural gas.

In April, Kaiser announced a $15.2 million expansion of its Bedford, Ind., plant for an aluminum scrap reclamation project. The remelt facility will convert used bever-

age cans into an estimated 62 million pounds of recycled aluminum each year. The reconstituted metal will be shipped to the Ravenswood plant to produce can bodystock, replacing prime metal, which can be used elsewhere or sold as pure ingot.

Alcan Aluminum Corp. continued to modernize its facilities in Marion County. The plant fabricates aluminum fin stock for heat exchangers, blanks for cookware, lamp base stock, and transformer strip for the specialty aluminum sheet markets.

Ferroalloys.—Three companies produced 128,980 tons of ferroalloys during 1980, a 25% decrease compared with 1979 output. Union Carbide Corp. operated a plant near Alloy in Fayette County, where silicon metal, ferrosilicon, silicomanganese, and calcium alloys were produced. Ferroalloys were also produced by Foote Mineral Co. at its Graham plant in Mason County and by Chemetals Corp.'s subsidiary,SEDEMA S.A., a Belgian firm, at Kingwood in Preston County.

In June, Union Carbide announced it had signed an agreement in principle to sell its plant near Alloy to Elkem A/S, Shieldings Investment Ltd., and a group of Norwegian investors. The Alloy plant would be one of 10 plants owned by Union Carbide included in the transaction. Elkem, based in Oslo, Norway, is a major ferroalloys producer, with 30 plants around the world.

Iron and Steel.—Consumption of pig iron in 1980 decreased about 22% compared with 1979 levels.

National Steel Corp. agreed with the U.S. Environmental Protection Agency (EPA) to bring the company's Weirton Steel Division plant into compliance with all air and water pollution control requirements by the end of 1982. EPA's settlement with National Steel incorporates the company's plan for modernization and replacement of several basic steelmaking processes. Particulate emissions are expected to be significantly reduced at the plant.

In July, National Steel signed an agreement to lease a $35 million steam electric generating plant to be built by Foster-Wheeler Corp. at the Weirton plant. When completed in 1982, it will provide nearly 30% of Weirton's steam requirements, increase its energy self-sufficiency, and reduce energy costs by up to $20 million per year.

Two new coke batteries are proposed for the State to provide material for the steel industry. The largest, a $20 million, 225,000-ton-per-year coke plant in Prichard, would be a joint venture of National Steel Corp. and Elk River Resources, Inc. A portion of the plant's cost would be met by a $10 million industrial revenue bond sale. Construction is dependent on environmental clearances and the industrial bond sales. A second complex is under consideration at Fairmont. The facility would be built by Salem Corp. and the Pennsylvania Engineering Corp., both of Pittsburgh, at the old Sharon Steel Corp. coke plant site.

Nickel.—Huntington Alloys, Inc., Division of Inco Alloy Products Co., produced wrought and high-nickel alloys at its Huntington plant in Cabell County. These alloys are used by the chemical, energy, mineral exploration, aerospace, heat treating, pollution control, and marine industries.

Although deliveries declined in 1980, net returns were up 14% from those of 1979. This gain reflected significant price increases and a shift in product mix toward higher performance alloys. The sales gain was also aided by improved inventory turnover and production yields.

During 1980, Huntington Alloys felt the impact of the recession and laid off nearly 200 of its 3,200 employees. The company expected its business to improve in 1981 and has ordered a new vacuum arc remelting furnace, which should be on line in early 1982. Huntington alloys expects improved sales because of the increase in natural gas drilling and increased production of pollution control equipment.

Zinc.—The Meadowbrook Corp., a wholly owned subsidiary of T. L. Diamond & Co., Inc., operated a zinc plant at Spelter, Harrison County. Zinc drosses, ashes, and other residues were used to produce zinc dust, oxides, and other zinc products.

Zirconium.—Corhart Refractories Co. produced high-density zircon and chromic oxide refractory brick for the metallurgical industry at its Buckhannon plant in Upshur County.

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[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

[2]Economic geologist and Head, Economic Section, West Virginia Geological and Economic Survey, Morgantown, W. Va.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Martin Marietta Corp.[1]	Box 885 Martinsburg, WV 25401	Quarry and plant	Berkeley.
Clays:			
Continental Clay Products Co	Box 1111 Martinsburg, WV 25401	Pit	Do.
Globe Refractories, Inc	Box D Newell, WV 26050	Underground mine	Hancock.
Sanders Dummy Co	Box 146 Midkiff, WV 25504	Pit	Lincoln.
Iron oxide pigments:			
Mobay Chemical Corp	Penn Lincoln Parkway West Pittsburgh, PA 15205	Plant	Wetzel.
National Steel Corp., Weirton Steel Div.	Weirton, WV 26062	do	Hancock.
Lime:			
Greer Limestone Co	Greer Bldg. Morgantown, WV 26505	Quarry and plant	Pendleton.
Riverton Corp	Riverton, VA 22651	do	Berkeley.
Salt:			
FMC Corp	Box 8127 South Charleston, WV 25303	Brine wells	Tyler.
LCP Chemicals-West Virginia, Inc.	Drawer J Moundsville, WV 26041	Brine wells and plant	Marshall.
PPG Industries, Inc	1 Gateway Center Pittsburgh, PA 15222	do	Do.
Sand and gravel:			
Dravo Corp	1 Oliver Plaza Pittsburgh, PA 15222	Dredge	Hancock.
McDonough Co	Box 538 Parkersburg, WV 26100	do	Tyler and Wetzel.
Pennsylvania Glass Sand Corp	Berkeley Springs, WV 25411	Quarry and plant	Morgan.
Shippingport Sand and Gravel Co.	1200 Stambaugh Bldg. Youngstown, OH 44501	Plant	Hancock.
Smelters: Kaiser Aluminum & Chemical Corp.	Box 98 Ravenswood, WV 26164	do	Jackson.
Stone:			
Acme Limestone Co	Box 27 Fort Spring, WV 24936	Mine and quarry	Greenbrier.
Beckley Stone Co	Box 1284 Beckley, WV 25801	Quarry	Raleigh.
H. Frazier Co., Inc	Box 1877 Richmond, VA 23211	do	Greenbrier.
Greer Limestone Co., a division of Greer Steel Co.	Greer Bldg. Morgantown, WV 26505	Mine and quarries	Monongalia and Pendleton.
Marquette Co	Route 3, Box 489 Morgantown, WV 26505	Mine	Monongalia.
Shenandoah Quarry, Inc	Box C Millvale, WV 25432	Quarry	Jefferson.

[1]Also clays and stone.

The Mineral Industry of Wisconsin

This chapter has been prepared by the Bureau of Mines, U.S. Department of the Interior, and the Wisconsin Geological and Natural History Survey, under a Memorandum of Understanding for collecting information on all nonfuel minerals.

By James J. Hill[1] and Thomas J. Evans[2]

The value of Wisconsin's nonfuel mineral production in 1980 dropped to $152.3 million, the first decrease in 10 years and the lowest value since 1977. Nonmetallic mineral commodities used in construction contributed the greatest amount to the value of the State's mineral production. In decreasing order of value, these commodities were stone, sand and gravel, lime, cement, and clays. Also produced within the State were iron ore and peat. Sulfur was recovered as a refinery byproduct; perlite and vermiculite were imported into the State for processing.

Table 1.—Nonfuel mineral production in Wisconsin[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Iron ore (usable) thousand long tons, gross weight	736	W	679	W
Lime thousand short tons	429	$19,060	357	$17,287
Peat do.	11	720	11	535
Sand and gravel do.	32,046	58,576	22,014	47,565
Stone:				
Crushed do.	23,924	52,804	20,603	49,245
Dimension do.	54	4,204	45	4,501
Combined value of abrasive stone, cement, clays, lead (1979), zinc (1979), and values indicated by symbol W	XX	44,318	XX	33,151
Total	XX	179,682	XX	152,284

W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

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

Table 2.—Value of nonfuel mineral production in Wisconsin, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Adams	W	W	Sand and gravel.
Ashland	$65	$65	Do.
Barron	1,217	1,076	Do.
Bayfield	W	W	Do.
Brown	W	W	Lime, stone, sand and gravel.
Buffalo	260	574	Stone, sand and gravel.
Burnett	851	1,109	Sand and gravel.
Calumet	W	W	Stone, sand and gravel.
Chippewa	843	842	Sand and gravel.
Clark	374	664	Do.
Columbia	W	3,234	Sand and gravel, stone.
Crawford	W	W	Do.
Dane	W	W	Stone, sand and gravel.
Dodge	W	W	Stone, lime, sand and gravel.
Door	706	774	Sand and gravel, stone.
Douglas	W	W	Lime, cement, stone, sand and gravel.
Dunn	W	W	Stone, sand and gravel.
Eau Claire	495	495	Sand and gravel.
Florence	19	47	Do.
Fond du Lac	W	W	Stone, lime, sand and gravel, clays.
Forest	84	154	Sand and gravel.
Grant	W	1,680	Stone.
Green	W	W	Stone, sand and gravel.
Green Lake	3,949	W	Sand and gravel, stone.
Iowa	338	683	Stone.
Iron	W	W	Sand and gravel.
Jackson	W	W	Iron ore, sand and gravel.
Jefferson	515	637	Sand and gravel, stone.
Juneau	W	W	Stone.
Kenosha	3,875	3,706	Sand and gravel.
Kewaunee	1,044	774	Do.
La Crosse	W	W	Stone, sand and gravel.
Lafayette	W	W	Zinc, stone, lead.
Langlade	W	W	Sand and gravel.
Lincoln	339	365	Do.
Manitowoc	8,423	10,350	Cement, stone, lime, sand and gravel.
Marathon	8,341	6,868	Stone, sand and gravel.
Marinette	2,718	3,002	Do.
Marquette	W	W	Sand and gravel, stone.
Milwaukee	W	W	Cement, stone.
Monroe	916	1,305	Stone.
Oconto	822	978	Sand and gravel, stone.
Oneida	789	844	Sand and gravel.
Outagamie	W	W	Stone, sand and gravel.
Ozaukee	W	W	Sand and gravel, stone.
Pepin	W	197	Stone, sand and gravel.
Pierce	W	W	Sand and gravel, stone.
Polk	W	3,195	Stone, sand and gravel.
Portage	1,051	1,422	Sand and gravel.
Price	66	96	Do.
Racine	3,217	3,590	Stone, sand and gravel.
Richland	W	W	Do.
Rock	2,742	3,190	Sand and gravel, stone.
Rusk	773	702	Sand and gravel.
St. Croix	708	W	Stone, sand and gravel.
Sauk	W	W	Stone, sand and gravel, abrasive stone.
Sawyer	W	248	Sand and gravel.
Shawano	840	915	Sand and gravel, stone.
Sheboygan	1,333	1,188	Do.
Taylor	1,541	1,416	Sand and gravel.
Trempealeau	W	W	Stone.
Vernon	W	W	Do.
Vilas	728	728	Sand and gravel.
Walworth	891	1,839	Sand and gravel, stone.
Washburn	W	W	Sand and gravel.
Washington	W	W	Sand and gravel, stone.
Waukesha	13,943	15,849	Sand and gravel, stone, peat.
Waupaca	746	W	Sand and gravel, stone.
Waushara	W	W	Sand and gravel.
Winnebago	4,409	5,252	Stone, sand and gravel.
Wood	155	79	Stone.
Undistributed[2]	89,107	99,554	
Total[3]	159,228	179,682	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Menominee County is not listed because no nonfuel mineral production was reported.
[2]Includes some sand and gravel that cannot be assigned to specific counties and values indicated by symbol W.
[3]Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Wisconsin business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	2,381.0	2,401.0	+0.8
Unemployment	do	108.0	169.0	+56.5
Employment (nonagricultural):				
Mining	do	2.6	2.6	--
Manufacturing	do	591.3	560.2	-5.3
Contract construction	do	80.5	70.0	-13.0
Transportation and public utilities	do	92.2	92.0	-.2
Wholesale and retail trade	do	441.2	439.3	-.4
Finance, insurance, real estate	do	90.3	93.4	+3.4
Services	do	351.9	365.9	+4.0
Government	do	310.1	321.4	+3.6
Total nonagricultural employment	do	[1]1,960.2	1,944.8	-.8
Personal income:				
Total	millions	$39,976	$43,444	+8.7
Per capita		$8,470	$9,254	+9.3
Construction activity:				
Number of private and public residential units authorized		26,554	17,705	-33.3
Value of nonresidential construction	millions	$554.1	$552.7	-.2
Value of State road contract awards	do	$148.5	$142.0	-4.4
Shipments of portland and masonry cement to and within the State	thousand short tons	1,830	1,590	-13.1
Nonfuel mineral production value:				
Total crude mineral value	millions	$179.7	$152.3	-15.2
Value per capita, resident population		$38	$32	-15.8
Value per square mile		$3,200	$2,712	-15.2

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

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

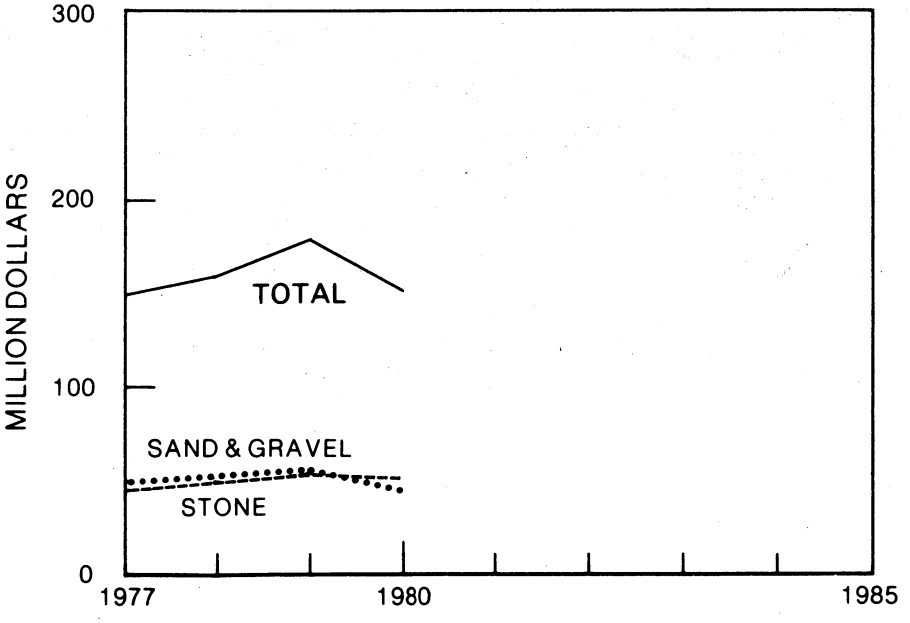

Figure 1.—Value of sand and gravel, and stone, and total value of nonfuel mineral production in Wisconsin.

Trends and Developments.—Several factors contributed to the decrease in value of Wisconsin's mineral production. High interest rates, a consequence of tight credit controls initiated to curb inflation, led to severe cutbacks in construction, which in turn reduced demand for nonmetallic mineral commodities.

According to the State's Department of Industry, Labor and Human Relations, the number of building plans examined for compliance with the State's commercial building code in areas outside of Milwaukee was down 18% from 1979 figures. The U.S. Department of Commerce reported a 33% drop in the number of units to which permits were issued for residential construction (public and private). Also, a 40% unemployment rate was reported for the road construction industry because of the economic recession and the lack of projects offered for bids by the State's Department of Transportation. Inflated fuel prices discouraged motorists, resulting in a decline in revenue from the motor fuel tax for the State's transportation fund. A strike by 7,300 construction trades workers also delayed building projects for up to 3 months.

Shipments of iron ore dropped during the year because of lack of demand for steel by the automobile industry and other durable goods manufacturers. The State's sole metallic mineral producer, Jackson County Iron Co., a subsidiary of Inland Steel Co., placed its iron mining and pelletizing operations on a 4-day-per-week work schedule in mid-June, and announced the possibility of a complete shutdown of the operation in November. However, improvements in steel orders during the last quarter allowed the firm to maintain production until yearend.

In September, officials of Exxon Minerals Co., U.S.A., announced a decision not to bulk sample the company's massive sulfide deposit south of Crandon, in Forest County. Originally, the firm had planned to sink a vertical shaft, estimated to cost $30 million, to obtain samples for milling and concentrating tests. Instead, a drilling program was initiated to obtain large-diameter cores for testing.

In October, Exxon filed a Preliminary Project Description with the Wisconsin Department of Natural Resources (DNR), which outlined plans for the Crandon deposit. This submittal initiated a formal environmental assessment of the project by DNR.

Exploration.—Although no new discoveries were announced, exploration continued at a rapid pace during 1980, with about 20,000 feet more of drilling reported than in the previous year. Mining firms concentrated on base metals and, to a lesser extent, uranium. Most of the exploration activity centered in north-central and northeastern Wisconsin, in Price, Forest, and Florence Counties.

Wisconsin statutes require companies engaged in exploration for metallic minerals to be licensed annually by DNR. These firms must notify DNR before commencing drilling operations and follow certain procedures when abandoning drill holes. Fifteen companies were licensed to explore during the year. Of these, nine drilled holes and two allowed their licenses to expire on July 1, the beginning of a new license year. Drilling activity during 1980 is summarized in table 4.

Table 4.—Wisconsin: Metallic mineral exploration, 1980

Licensed exploration companies	Number of drillholes	Total footage drilled	County
AMAX Exploration, Inc	3	1,239	Price and Taylor.
American Copper & Nickel Co., Inc	12	6,163	Langlade, Marathon, Taylor.
Central Wisconsin Joint Venture	--	--	
Duval Corp	--	--	
Eagle-Picher Industries, Inc.[1]	--	--	
Exxon Minerals Co., U.S.A.	12	11,062	Florence and Forest.
Inspiration Development Co	--	--	
Kerr-McGee Corp	7	2,724	Florence and Forest.
E. K. Lehmann & Associates of Wisconsin, Inc	19	12,072	Price and Rusk.
Minatome Corp	19	2,386	Florence.
Mineral Sciences Division, UOP, Inc	14	9,891	Forest and Marinette.
Noranda Exploration, Inc	3	1,803	Jackson and Oneida.
St. Joe American Corp	--	--	
United States Steel Corp.[1]	9	2,223	Portage and Waushara.
Western Nuclear, Inc	--	--	
Total	98	49,563	

[1]Metallic mineral exploration license lapsed July 1, 1980.

Source: Metallic Mineral Exploration Drillhole Abandonment Reports, Wisconsin Department of Natural Resources.

The U.S. Geological Survey (USGS) also conducted exploration drilling on Indian lands under an interagency agreement with the Bureau of Indian Affairs. Ten holes were drilled during 1979-80 on the Mole Lake Indian Reservation near Exxon's zinc-copper discovery at Crandon, and four holes were drilled on the Lac Du Flambeau Indian Reservation in 1980. Holes ranged from 600 to 700 feet in depth. Results of the drilling have not been released.

During the year, controversy developed over the potential hazards of uranium exploration, and several counties established moratoriums on drilling. As a result, a unique experiment was conducted by the Radiation Protection Division of the State's Department of Health and Social Services. For the first time in the Nation, holes were monitored for radon gas emissions during actual drilling operations. Background readings were taken at the drill site for 3 weeks before drilling commenced, during the drilling operations, and for 3 weeks after the hole reached total depth. Results of the project were inconclusive because uranium was not discovered, but the experiment developed monitoring techniques.

In early May, a paper presented in Eau Claire at the 26th Annual Institute on Lake Superior Geology and published in the Abstracts of Proceedings described a kimberlite deposit located in Iron County, Mich. The authors postulated that diamonds found in glacial deposits in central and southern Wisconsin at the turn of the century may have originated from this locality or from similar undiscovered deposits in northern Wisconsin and Michigan. Previously, the closest known occurrences of kimberlite were in Canada.

Shipping.—Domestic shipments of all commodities out of the Port of Duluth-Superior declined 15% in 1980. Shipments of iron ore and concentrates accounted for the greatest drop in tonnage. Burlington Northern, Inc.'s transshipment terminal on Allouez Bay in Superior handled nearly one-fourth of the port's domestic-bound iron ore and concentrates. Shipments were 10.1 million long tons in 1980, down from the 13.7 million long tons shipped in 1979. Domestic imports of limestone and limestone products at the port, used in part by Huron Cement Co.'s clinker grinding facility and CLM Corp.'s lime plant in Superior, dropped nearly 19%.

Softening the decline somewhat were slightly increased shipments of low-sulfur Montana fuels through the Superior Midwest Energy Terminal to electric-generating facilities in Michigan.

The Port of Milwaukee serves Wisconsin's densely populated southeastern region. Nonfuel mineral commodities imported in 1980, in descending order of tonnage, were cement, salt, sand, and clinker (table 5). All of these commodities came from domestic sources except salt, about half of which came from Canada. Cement was transferred to area distribution centers for ultimate use in construction. Salt was used mainly for snow and ice removal, and sand was used by the area's foundries. Clinker and gypsum were used at a local cement manufacturing facility. In 1980, combined imports of these commodities dropped 22% compared with 1979 levels. Clinker experienced the greatest percentage decline, followed by sand.

Bay Shipbuilding Corp., a subsidiary of Manitowoc Co., Inc., completed construction of the ore boat "MV Burns Harbor," which was christened at the Sturgeon Bay shipyard on May 24, 1980. This Great Lakes vessel is Bethlehem Steel Corp.'s third 1,000-foot-long ship. The new self-unloader has a capacity of 58,000 gross tons and can discharge cargo at 10,000 gross tons per hour. Taconite pellets from Bethlehem's plant in Minnesota are to be transported by the vessel to the firm's Burns Harbor and Lackawanna, N.Y., steel plants.

Table 5.—Port of Milwaukee: Nonmetallic mineral commodity imports

(Short tons)

Commodity	1979	1980
Cement	536,318	447,306
Salt[1]	315,228	254,725
Sand	98,270	65,965
Clinker	101,951	51,500
Gypsum	4,181	--
Total	1,055,948	819,496

[1]Includes Canadian imports.

Source: Port of Milwaukee, U.S.A.

During the year, Bay Shipbuilding also repaired Huron Cement Co.'s freighter "E. M. Ford," which sank at the Milwaukee City Dock during a severe winter storm. The vessel was towed to Sturgeon Bay for repairs and was returned to service in August.

Legislation and Government Programs.—In May, the Wisconsin State Legis-

lature passed a long-term liability bill for metallic mineral operations. Chapter 353, Laws of 1979, was signed by the Governor on May 21, 1980. This new statute (1) provides for application of "strict" liability to metallic mining or prospecting sites, (2) establishes a 3-year statute of limitations from the time the injured person or persons knew or could have known that the injury existed, and (3) creates a long-term liability fund to compensate individuals who successfully demonstrate to an administrative review board that an injury was sustained in connection with a prospecting site or a mining operation. Court action is not necessary.

The Wisconsin DNR approved for hearings four sets of administrative rules that directly or indirectly relate to metallic mining operations. Proposal NR 182 encompasses rules regulating metallic mine waste disposal, and revisions in NR 132 (Mining) and NR 131 (Prospecting) are proposed to bring these rules in line with NR 182 requirements. NR 105, a proposed ground water protection rule, was developed by DNR in concert with the construction of NR 182. Although applicable to activities other than metallic mineral development, this proposed rule would impose a maximum distance of 500 feet around a mine waste disposal facility beyond which no change in ground water quality would be permitted. Public hearings on the proposed rules are expected to be held in 1981.

A State law (Chapter 422) requiring mining firms to file results of exploration activities with the State geologist was declared unconstitutional by a county circuit court in late December. Noranda Exploration, Inc., filed the suit, stating that the disclosure provisions of section 107.15 of the Wisconsin statutes constituted a taking of property rights and impairment of contract. The State is expected to file an appeal to the decision.

Senate bill 604, providing for county authority to pass nonmetallic mining reclamation ordinances and to create mineral reservation districts through zoning, was introduced in the Senate in the spring, but no action was taken before the 1979-80 legislative session ended. The bill was expected to be reintroduced in the 1981 legislature.

Late in the year, the Wisconsin Association of Manufacturers released a draft bill expected to be introduced in the next legislative session that proposed a reduction in the State's mining tax on net proceeds and sought business deductions for such things as mine reclamation costs, interest on borrowed money, and income tax. The State's present tax reaches 18% when net proceeds are between $20 million and $30 million, and goes to 20% when net proceeds are above $30 million. The association proposal called for a 2% tax on net proceeds between $100,000 and $5 million, 4% on $5 million to $10 million, 6% on $10 million to $15 million, 8% on $15 million to $20 million, 10% on $20 million to $25 million, and 12% above $25 million. The bill was expected to be introduced in the 1981 legislative session.

In 1980, the U.S. District Court for the Eastern District of Wisconsin ruled that the Mine Safety and Health Administration has the power to conduct safety inspections of sand and gravel operations without a court-issued warrant. The Secretary of Labor instigated a suit so that Federal mine inspectors could gain access to a commercial sand and gravel mining operation. The company contended that sand and gravel operations were not covered by the Federal Mine Safety and Health Act and that warrantless inspections were unconstitutional.

On September 30, 1980, Wisconsin's Mining Investment and Local Impact Fund Board approved $237,686 in grants to local governments for use in dealing with the effects of metallic mineral development. The fund and the administrative board had been established by the State legislature to channel revenues generated by the net proceeds tax on metal mining to local governments. The Board draws on a $2 million general revenue fund loan to handle initial requests for assistance from communities until mining tax revenues accumulate in the State coffers.

The 1980 awards will be distributed in 1981 to 18 communities, 6 counties, and 4 Indian tribes. Uses of the funds include (1) support of local mining impact committees, (2) legal services, (3) planning assistance and planning studies, (4) environmental and technical studies, and (5) capital improvement projects. From September 1978 through January 1981, the board distributed or committed $995,026 to local governments in special allocations, loans, and grants.

The Wisconsin Geological and Natural History Survey continued programs in geology, mineral resources, water resources, soil, and climatology during the year. Along with several other publications, a new preliminary 1:250,000-scale reconnaissance

bedrock geology map of northeastern Wisconsin was completed. The map of this outcrop-sparse region of Precambrian strata was distributed for review in 1980. The map is the first of a series of map sheets to cover Wisconsin.

In June 1980, the Survey began publishing SUR/VIEW, a free newsletter that gives brief coverage of Survey activities and other items of interest pertaining to Wisconsin's earth resources and environment.

The Survey also completed a review of over 4,000 mineral deposits, prospects, and occurrences in northern Wisconsin under a contract with the Federal Bureau of Mines. The majority of deposits evaluated and located for inclusion in the Mineral Industry Location System (MILS) are for stone and sand and gravel. This computerized listing provides the most comprehensive data on aggregate resource locations available in Wisconsin.

The Upper Mississippi River Basin Commission distributed its Great I (Great River Environmental Action Team) report for public review during 1980. The study concerned a 240-mile stretch of the Upper Mississippi River from Minneapolis, Minn., to Guttenberg, Iowa. Several supplemental investigations examined possible uses of dredged material and legal and institutional marketing constraints. Results indicated that (1) dredge materials were suitable for asphalt, cement, roadsanding, and inland fill for the construction of roads and buildings, (2) demand exists for dredged material at several locations along the river, and (3) the Corps of Engineers has the authority to sell dredged material on a competitive bid basis.

The Upper Great Lakes Regional Commission funded two investigations in 1980 related to the mineral industry in Wisconsin. The first study conducted by the University of Wisconsin Survey Research Laboratory and the State Department of Administration surveyed residents' attitudes on mining in a 20-county area in the northern part of the State. Of the total respondents, 52% believed State and local governments should follow policies encouraging mining, but most were reluctant to trade off environmental quality for economic gains.

In the second study, researchers from Minnesota, Wisconsin, and Michigan were investigating the feasibility of direct reduction of iron ore in the region. Five sites are under consideration: The Mesabi Iron Range in Minnesota; two sites in the Duluth, Minn.-Superior, Wis., area; and the Marquette and Escanaba areas in Michigan.

The Lakes State Office of the Bureau of Land Management released six quadrangle maps in 1980 that cover northeastern Wisconsin and show the surface and mineral estate on land owned by the Federal Government. Maps released were Ashland, Iron Mountain, Merrill, Rhinelander, Wabeno, and Wakefield Quadrangles.

During the year, the U.S. Forest Service funded the Wisconsin Geological and Natural History Survey for a surficial mapping project on the Chequamegon National Forest. Results are to be used to outline sand and gravel resources for Forest Service use.

No action was taken in 1980 by the U.S. Congress on the seven areas previously nominated for wilderness designation in the Chequamegon and Nicolet National Forests during the Forest Service's Roadless Area Review and Evaluation (RARE II) program.

In fiscal year 1979, the Federal Government gave the State approximately $391,800 for its share from activities (timbering, minerals leasing, recreation, user fees, etc.) occurring in the two national forests. Approximately $469,600 was returned to the State in fiscal year 1980.

The Geologic Division of USGS conducted two investigations under a cooperative agreement with the Wisconsin Geological and Natural History Survey. In the northeastern part of the State, reconnaissance mapping continued on the Wisconsin portion of the Iron River 2 Degree Quadrangle. In the southwestern part of the State, work continued on geologic mapping and evaluation of the lead-zinc resources. Also, USGS conducted exploration drilling on two Indian reservations in the State.

The Federal Bureau of Mines had several active contracts and grants during the year with industrial firms, educational institutions, and consulting firms in Wisconsin. Research was conducted on various types of mining equipment and their application, mine safety, and mineral resources. Funding totaled approximately $700,000.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasive Materials.—Baraboo Quartzite Co., Inc., continued to mine quartzite for deburring and burnishing media from a deposit near Baraboo, Sauk County. The firm crushed, milled, and screened the material to produce about 15 different sizes of abrasives ranging from 3/16 by 1/8 inch to 1-3/4 by 1-1/4 inches. Most of the finished product was shipped in 100-pound bags to metal-stamping plants. For the past 5 years, production has remained fairly consistent, with value increasing about 26%.

Cement.—The State had three operating cement plants in 1980. Huron Cement Co. (National Gypsum Co.) operated grinding facilities in Superior; Medusa Cement Co., a subsidiary of Medusa Corp., did limited grinding at its facility in Manitowoc; and Universal Atlas Cement Div. of United States Steel Corp. ran a grinding facility in Milwaukee. Shipments of cement were down in 1980 owing to a decline in housing and highway construction.

Corporate decisions also affected the status of the three operating plants. On December 28, 1979, National Gypsum Co. announced its intent to dispose of its cement division, which includes the Huron Cement facility in Superior. Negotiations were held with General Dynamics Corp. over a possible purchase, but no agreements were reached by yearend.

Huron Cement completed an expansion program during 1978-79. In 1980, the firm installed an automatic loading facility that weighs cement while loading. Bulk cement was shipped by rail and 25-short-ton container trucks. Truckers hauled some cement to the Dakotas after delivering Dakota grain to local elevators.

Although Medusa Corp. announced the shutdown of its Manitowoc facility in 1979, limited grinding occurred at the facility in 1980. The firm planned to use part of the facility as a distribution terminal, supplied by the company's Charlevoix, Mich., operation. The firm also has a distribution terminal in Milwaukee.

In September 1980, United States Steel announced that a final agreement had been reached with Heidelberger Zement A.G., Heidelberg, Federal Republic of Germany, for the sale of United States Steel's Universal Atlas Cement Div. to Lehigh Portland Cement Co., a subsidiary of the German company. The sale included the grinding facility located in Milwaukee.

Dundee Cement Co. constructed a distribution terminal in Howard, Brown County, to serve the Green Bay area. Cement is to be transported to the terminal from the company's plant at Dundee, Mich.

Clays.—Oakfield Shale Brick & Tile Co. continued to be the State's only producer of common clay and shale from a deposit near Oakfield, Fond du Lac County. The product was used in the firm's nearby brick plant to manufacture common and face brick. Production of clay has remained about the same for the past 5 years. Demand for finished brick was down in 1980, owing to the decline in residential and commercial construction.

Lime.—Three companies operated six plants in Wisconsin, producing both quick and hydrated lime. The Western Lime & Cement Co. operated two plants at Green Bay, Brown County; one at Knowles, Dodge County; and one at Eden, Fond du Lac County. Rockwell Lime Co. operated a plant at Manitowoc, Manitowoc County, and CLM Corp. produced lime at its plant in Superior, Douglas County.

In 1980, production dropped nearly 17% and value dropped about 9%, reflecting the general state of the economy during the year. This was the first year since 1975 that output declined, and the first time in 10 years that value of production decreased.

Lime produced in the State was used in the manufacture of paper and pulp, steel, and leather; other applications included water and sewage treatment, food processing, and construction. The lime was distributed to customers in Illinois, Iowa, Michigan, Minnesota, North Dakota, South Dakota, Wisconsin, and Canada.

Peat.—Three companies located in Waukesha County, in southeastern Wisconsin, comprised the State's peat industry. Demilco, Inc., a division of Nitragin Sales Corp., produced and distributed packaged peat for use as seed inoculant. Certified Peat & Sod, Inc., distributed packaged and bulk peat for general soil improvement; Bogda's Top Soil & Excavation Co. distributed bulk peat for the same application. Both production and value of peat declined in 1980.

Perlite.—Two companies produced expanded perlite from crude ore shipped from Western States. W. R. Grace & Co. operated a plant at Milwaukee, and Midwest Perlite Co. operated another at Appleton, Outagamie County. Output and value dropped about 30% and 19%, respectively,

compared with 1979 figures. Most of the expanded perlite produced in Wisconsin was used in horticultural applications; lesser quantities were used for plaster aggregate and masonry and cavity fill insulation.

Sand and Gravel.—Although output was down for the year due to the decline in construction activity, sand and gravel was the second leading mineral commodity mined in Wisconsin in terms of value, dropping from first place in 1979. Production occurred in 57 of the State's 72 counties. Trucks moved 96% of the product to market.

Construction sand and gravel, which accounted for 96% of the State's production, was produced by 185 producers from 240 operations.

Industrial sand was produced in five counties by four companies. Major uses of the sand, in descending order of tonnage, were for molding and foundry applications, hydraulic fracturing, glass containers, sandblasting, and filtration. The products were shipped in both bulk and packaged form. Wisconsin's only active underground mine is operated by an industrial sand producer in a sandstone formation in Pierce County.

Production of sand for foundries dropped 18% compared with 1979 figures; unit value of the product increased almost 19%. The decline in production was related, in part, to the drop in orders from the automobile and heavy construction equipment industry.

Production of sand for oil well stimulation and fracturing increased dramatically, about 350%, from 1979 to 1980. Unit price increased about 25% to $22 per short ton.

Table 6.—Wisconsin: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	9,061	$17,365	$1.92	$6,520	$14,057	$2.16
Plaster and gunite sands	513	899	1.75	79	255	3.23
Concrete products	472	1,000	2.12	667	1,667	2.50
Asphaltic concrete	5,393	8,903	1.65	2,777	4,814	1.73
Road base and coverings	10,892	16,322	1.50	7,591	12,372	1.63
Fill	4,078	5,609	1.38	3,064	4,737	1.55
Snow and ice control	144	208	1.44	152	262	1.72
Railroad ballast	6	13	2.19	5	W	W
Other	320	505	1.58	287	514	1.79
Total[1] or average	30,879	50,824	1.65	21,143	38,678	1.83

W Withheld to avoid disclosing company proprietary data; included in "Other."
[1]Data may not add to totals shown because of independent rounding.

Table 7.—Wisconsin: Sand and gravel sold or used by producers, by use

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:						
Sand	9,650	$17,219	$1.78	7,016	$13,999	$2.00
Gravel	21,229	33,605	1.58	14,127	24,679	1.75
Total or average	30,879	50,824	1.65	21,143	38,678	1.83
Industrial sand	1,166	7,752	6.65	872	8,887	10.20
Grand total[1] or average	32,046	58,576	1.83	22,014	47,565	2.16

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

Table 8.—Wisconsin: Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1979		1980	
	Quantity	Value	Quantity	Value
Adams	W	W	--	--
Ashland	49	65	43	68
Barron	716	1,076	177	243
Brown	W	W	--	--
Buffalo	17	17	15	18
Burnett	723	1,109	446	753
Calumet	59	87	W	W
Chippewa	567	842	343	557
Clark	443	664	W	W
Columbia	577	2,758	389	2,949
Dane	1,612	3,009	1,124	2,525
Dodge	645	956	169	233
Door	301	583	166	432
Douglas	47	80	W	W
Eau Claire	298	495	W	W
Florence	26	47	10	18
Fond du Lac	398	502	302	435
Forest	67	154	61	229
Green Lake	966	4,694	805	4,323
Jefferson	203	332	137	252
Kenosha	1,517	3,706	742	1,737
Kewaunee	553	774	469	617
La Crosse	6	9	5	9
Lincoln	193	365	178	393
Manitowoc	1,223	1,800	1,182	1,774
Marathon	558	973	426	877
Marinette	130	181	W	W
Oconto	613	903	461	494
Oneida	428	844	184	493
Ozaukee	447	653	292	473
Pepin	40	59	9	10
Pierce	165	755	200	949
Polk	412	651	422	657
Portage	929	1,422	944	1,457
Price	48	96	43	101
Racine	225	348	W	W
Richland	64	98	12	23
Rock	1,385	2,081	869	1,814
Rusk	516	702	427	663
Sawyer	149	248	89	106
Shawano	322	774	254	606
Sheboygan	776	1,164	570	988
Taylor	978	1,416	896	1,369
Vilas	414	728	214	449
Walworth	1,290	1,718	1,259	1,862
Washington	1,556	1,853	609	898
Waukesha	5,754	9,789	3,623	6,759
Waupaca	577	793	513	767
Winnebago	453	1,007	W	W
Undistributed[1]	2,611	5,196	2,937	8,184
Total[2]	32,046	58,576	22,014	47,565

W Withheld to avoid disclosing individual company proprietary data; included in "Undistributed."

[1]Includes Bayfield (1979), Crawford, Dunn, Green, Iron (1979), Jackson, Langlade, Marquette, Outagamie (1979), St. Croix, Sauk, Washburn, and Waushara 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.

Stone.—Although production was down for the year, owing to the decline in construction activity, stone became the leading mineral commodity mined in Wisconsin, displacing sand and gravel in value. Production occurred in 48 of the State's 72 counties at 287 quarries. Several quarries extracted both dimension and crushed stone. Limestone was the major rock type mined, followed by sandstone, traprock, and granite. Most of the stone produced in the State was transported by truck to consumers.

Crushed stone, produced at 267 quarries, accounted for most of Wisconsin's stone production. Dane County led the State with 23 crushed stone quarries.

Dimension stone was produced in 5 counties at 26 quarries. Granite was the most valuable rock type mined, followed by limestone and sandstone. Marathon County led the State in value of dimension stone produced, and Waukesha County led the State with 12 quarries.

In 1980, Bryan Dresser Trap Rock, Inc., of

Dresser, Wis., was acquired by TCI, Inc., located in Benson, Minn. The company is a leading manufacturer of rough terrain, four-wheel-drive lift trucks, wheel loaders, and agricultural field equipment. The acquired firm's name was changed to TCI Trap Rock, Inc., a wholly owned subsidiary of TCI. The mining firm continued to produce crushed stone aggregate for railroad ballast, industrial flooring, highway and road surfacing, filtering material, insulation, cement, and other uses.

Table 9.—Wisconsin: Dimension stone[1] sold or used by producers, by use

Use	1979			1980		
	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)
Rough stone:						
Rough blocks	W	W	W	5,026	63	$61
Irregular-shaped stone	898	12	$21	4,127	52	199
Rubble	16,524	208	284	10,247	128	177
Monumental	2,288	15	350	1,840	15	453
Flagging	6,791	85	187	4,591	58	148
Dressed stone:						
Cut	2,585	32	282	2,897	36	219
Sawed	1,163	15	66	1,516	19	82
House stone veneer	15,162	190	739	10,890	136	563
Monumental	2,503	28	2,157	2,430	28	2,537
Curbing	W	W	W	41	1	1
Flagging	W	W	W	488	6	14
Other[2]	6,403	80	119	1,338	17	48
Total[3]	54,317	665	4,204	45,431	559	4,501

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes limestone, granite, and sandstone.
[2]Includes dressed construction and other uses.
[3]Data may not add to totals shown because of independent rounding.

Table 10.—Wisconsin: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979		1980	
	Quantity	Value	Quantity	Value
Agricultural limestone	929	2,870	837	2,848
Concrete aggregate	2,102	4,716	1,687	4,331
Bituminous aggregate	1,544	3,728	933	2,358
Macadam aggregate	W	W	399	849
Dense-graded roadbase stone	8,135	14,464	6,513	13,517
Surface treatment aggregate	1,760	3,814	2,230	5,055
Other construction aggregate and roadstone	5,912	11,544	4,934	10,316
Riprap and jetty stone	469	2,153	380	1,863
Railroad ballast	915	2,781	1,088	3,116
Filter stone	79	248	68	167
Manufactured fine aggregate (stone sand)	76	174	139	268
Lime manufacture	W	W	135	427
Flux stone	13	26	13	38
Fill	W	W	6	4
Roofing granules	1,435	4,966	1,228	4,065
Other[2]	556	1,320	14	23
Total[3]	23,924	52,804	20,603	49,245

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes limestone, granite, sandstone, and traprock.
[2]Includes stone used in other fillers or extenders (1979), and other uses.
[3]Data may not add to totals shown because of independent rounding.

Table 11.—Wisconsin: Crushed stone sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1979		1980	
	Quantity	Value	Quantity	Value
Brown	773	1,301	1,036	1,825
Buffalo	247	557	204	445
Calumet	386	586	139	296
Columbia	207	476	W	W
Crawford	208	272	116	169
Dane	1,410	3,083	795	2,025
Dodge	968	1,807	740	1,283
Door	106	191	130	256
Douglas	30	86	W	W
Dunn	81	270	40	190
Fond du Lac	635	1,438	467	1,127
Grant	791	1,680	690	1,643
Green	399	W	W	W
Green Lake	W	W	55	66
Iowa	406	683	529	1,010
Jefferson	158	305	159	314
Lafayette	525	848	501	876
Manitowoc	733	2,420	767	2,506
Marathon	1,626	3,290	1,468	2,887
Marinette	661	2,821	493	2,213
Marquette	W	W	22	55
Monroe	571	1,305	760	1,935
Oconto	51	75	81	164
Outagamie	1,310	2,380	989	2,023
Ozaukee	W	W	70	150
Pepin	65	138	13	46
Pierce	W	W	199	500
Polk	W	W	W	2,201
Racine	1,229	3,242	W	W
Richland	W	W	88	197
Rock	566	1,109	340	790
St. Croix	278	606	191	498
Sauk	683	1,365	715	1,609
Shawano	62	141	W	W
Sheboygan	4	24	W	W
Trempealeau	W	W	312	880
Walworth	W	121	W	147
Washington	W	W	47	95
Waukesha	2,561	4,610	2,140	4,312
Winnebago	1,625	4,245	1,662	4,377
Wood	35	79	104	188
Undistributed[1]	4,533	11,254	4,543	9,948
Total[2]	23,924	52,804	20,603	49,245

W Witheld to avoid disclosing individual company proprietary data; included in "Undistributed."
[1]Includes Ashland (1980), Bayfield (1980), Juneau, La Crosse, Milwaukee, Vernon, and Waupaca Counties.
[2]Data may not add to totals shown because of independent rounding.

Sulfur (Recovered Elemental).—Murphy Oil Corp. continued to produce sulfur as a byproduct at its refinery in Superior. Approximately 1,000 metric tons was produced in 1980.

Vermiculite.—Two firms exfoliated vermiculite from crude ore mined outside the State. Koos, Inc., operated a plant in Kenosha, and W. R. Grace & Co., Construction Products Div., operated a plant in Milwaukee. Product sales increased about 7%; value, about 12%. Exfoliated vermiculite was used mainly as a chemical fertilizer carrier and for loose fill insulation, block insulation, and horticultural aggregate. Minor uses included soil conditioning, concrete aggregate, packing insulation, and roofing and plaster aggregate.

METALS

Iron Ore.—The State's only metallic mineral producer, Jackson County Iron Co., a wholly owned subsidiary of Inland Steel Co., continued to produce iron ore from the Black River Falls Mine in west-central Wisconsin. Taconite pellets were shipped from the plant via the Chicago & Northwestern Railroad to Inland's Indiana Harbor Works' steel mill in East Chicago, Ind., a distance of 285 miles. Pellet shipments were down about 8% for the year owing to the lack of demand for steel, which mandated a reduced work schedule for the mine and pellet plant.

In December, DNR decided not to require an environmental impact statement for Jackson County Iron Co.'s mine permit

application. Filed as a requisite of the State's new mining laws, the application, including a mining and reclamation plan, had been submitted to DNR along with an application for a permit for a seepage collection pond to control and treat water discharged from the mine. A formal hearing on the mine permit application was scheduled for January 1981.

Zinc-Copper.—Although zinc and copper were not produced during the year, work continued at two of the three announced massive sulfide discoveries in the State.

Kennecott Minerals Co. continued environmental monitoring at Flambeau Mining Corp.'s deposit near Ladysmith, Rusk County. In September, the company announced its intent to reapply for a mining permit for the Flambeau deposit around January 1, 1982. Under an optimistic timetable, mine construction could start in early 1984. The company's schedule depends upon pending mining, reclamation, and environmental rules, local zoning requirements, mining tax laws, and tax incentives for marketing pyrite wastes.

Noranda Exploration, Inc., was essentially inactive at its Pelican deposit, discovered in 1974 in Oneida County. The firm did, however, drill three exploration holes during the year in Jackson and Oneida Counties.

Exxon Minerals Co., U.S.A., continued mine feasibility studies and environmental baseline programs at its Crandon discovery in Forest County. A large-diameter hole drilling program was initiated to obtain cores of ore and host rock material for mine engineering studies and for tests of milling and concentrating characteristics. Another study identified potential tailings pond sites. To provide information for an environmental impact report, work began on a socioeconomic study of the effects of the proposed mining operation.

Zinc-Lead.—A final chapter in Wisconsin mining history concluded in October when Eagle-Picher Industries, Inc., auctioned off its mine and mill equipment at Shullsburg and Linden in southwestern Wisconsin's zinc-lead district. The Shullsburg Mine in Lafayette County, the last operating underground metal mine in the State, had closed in October 1979.

A problem related to the mine's closure developed during the year. When pumping ended at the mine, the water table began to rise. Landowners stopped using their wells because of high concentrations of sulfates, and began hauling water. A State task force was formed to work on solutions to the problem. By yearend, an emergency grant application was filed by the Lafayette County Board of Supervisors with the Mining Investment and Local Impact Fund Board. The county applied for funds to investigate the extent and nature of the ground water impact in the Shullsburg area and to reimburse landowners for drilling new wells.

[1]State mineral specialist, Bureau of Mines, Pittsburgh, Pa.
[2]Assistant professor, Minerals Information, Wisconsin Geological and Natural History Survey, Madison, Wis.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasive stone:			
Baraboo Quartzite Co., Inc	Box 123 Baraboo, WI 53913	Quarry and plant	Sauk.
Cement:			
Lehigh Portland Cement Co	718 Hamilton Mall Allentown, PA 18105	Grinding plant only	Milwaukee.
Medusa Cement Co., a division of Medusa Corp.	Box 5668 Cleveland, OH 44101	do	Manitowoc.
National Gypsum Co., Huron Cement Div.	17515 West 9 Mile Rd. Southfield, MI 48075	do	Douglas.
Clay and shale:			
Oakfield Shale Brick & Tile Co	Box 337 Oakfield, WI 53065	Pit and plant	Fond du Lac.
Iron ore:			
Jackson County Iron Co., a subsidiary of Inland Steel Co.:			
Black River Falls	30 West Monroe St. Chicago, IL 60603	Mine, concentrator, agglomerator.	Jackson.
Lime:			
CLM Corp	12th Ave. West & Waterfront Duluth, MN 55802	Quicklime and hydrated lime.	Douglas.
Rockwell Lime Co	Route 2, Box 124 Manitowoc, WI 54220	do	Manitowoc.
Western Lime & Cement Co	141 North Main St., Box 57 West Bend, WI 53095-0057		

Table 12.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Lime —Continued			
Western Lime & Cement Co-Continued			
Green Bay plants (2)		Quicklime and hydrated lime.	Brown.
Knowles plant		do	Dodge.
Eden plant		do	Fond du Lac.
Peat:			
Bogda's Top Soil & Excavating Co	12600 West Cleveland Ave. New Berlin, WI 53151	Bog and processing plant.	Waukesha.
Certified Peat & Sod, Inc	19000 West Lincoln Ave. New Berlin, WI 53151	do	Do.
Demilco, Inc., a division of Nitragin Sales Corp.	3101 West Custer Ave. Milwaukee, WI 53209	do	Do.
Perlite, expanded:			
Construction Products Div., W. R. Grace Co.[1]	62 Whittemore Ave. Cambridge, MA 02140	Processing plant	Milwaukee.
Midwest Perlite Co	542 West Linberg Appleton, WI 54911	do	Outagamie.
Sand and gravel:			
Construction sand and gravel:			
American Materials Corp	1 American Ave., Box 338 Eau Claire, WI 54701	4 pits	Barron, Chippewa, Dunn, Eau Claire.
B. R. Amon & Sons	Route 3 Elkhorn, WI 53121	8 pits	Jefferson, Kenosha, Rock, Walworth.
Janesville Sand & Gravel Co	Box 427 Janesville, WI 53545	Pit and plant	Rock.
Johnson Sand & Gravel, Inc	22750 Bluemond Rd. Waukesha, WI 53186	do	Waukesha.
McHenry Sand & Gravel Co., Inc	Box 511 McHenry, IL 60050	2 pits and plant	Kenosha.
Mann Bros, Inc	Box 48 Elkhorn, WI 53121	9 pits	Walworth and Waukesha.
State Sand & Gravel Co	10833 West Watertown Plank Rd. Milwaukee, WI 53226	Pit and plant	Waukesha.
Industrial sand:			
Badger Mining Corp	Box 97 Fairwater, WI 53931	2 pits	Green Lake and Jackson.
Martin Marietta Corp., Industrial Sand Div.	110 East Main St. Rockton, IL 61072	Pit and plant	Columbia.
Stone:			
Granite:			
Anderson Bros. & Johnson Co	Box 26 Wausau, WI 54401	Quarries and plant	Marathon.
Ben Gottschalk, Inc	Route 1 Mosinee, WI 54455	do	Do.
Lake Wausau Granite Co	Box 397 Wausau, WI 54401	Quarry and plant	Do.
Limestone and dolomite:			
Courtney & Plummer, Inc	Box 767 Neenah, WI 54956	Quarries and plant	Calumet and Winnebago.
Halquist Stone Co., Inc	N52 W23564 Lisbon Rd. Sussex, WI 53089	do	Waukesha.
Arthur Overgaard Co	Box 87 Elroy, WI 53929	Quarries and plants	Buffalo, Juneau, La Crosse, Monroe.
Vulcan Materials Co., Midwest Div.	Box 6 Countryside, IL 60525	do	Milwaukee, Racine, Waukesha, Winnebago.
Sandstone and quartzite:			
Foley Bros., Inc	Rock Springs, WI 53961	Quarry and plant	Sauk.
Minnesota Mining & Manufacturing Co.	3M Center St. Paul, MN 55101	Quarries and plant	Marathon.
Traprock (basalt):			
GAF Corp	Box 630 Pembine, WI 54156	Quarry and plant	Marinette.
TCI Traprock, Inc	Box 176 Dresser, WI 54009	do	Polk.
Sulfur, recovered elemental:			
Murphy Oil Corp	Box 2066 Superior, WI 54880	Byproduct sulfur recovery plant.	Douglas.
Vermiculite, exfoliated:			
Koos, Inc	4500 13th Ct. Kenosha, WI 51340	Processing plant	Kenosha.

[1] Also exfoliated vermiculite.

The Mineral Industry of Wyoming

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Wyoming Geological Survey for collecting information on all nonfuel minerals.

By Karl E. Starch[1]

The value of nonfuel mineral production in Wyoming in 1980 was $761 million, an increase of 29% over the 1979 value. This large year-to-year growth resulted almost entirely from an increase in value of sodium carbonate produced. Wyoming ranked 10th among the States in value of nonfuel minerals produced in 1980 with 3% of the national total. Eight nonmetals and one metal were reported as produced in Wyoming in 1980. Of these, sodium carbonate, or natural soda ash, continued to be the most important nonfuel mineral produced in the State; bentonitic clay was second in value and iron ore third. The combined value of these three commodities was more than 90% of the State total.

Nationally, Wyoming ranked first in production of sodium carbonate and bentonite and fourth in iron ore.

Not only was Wyoming number one in sodium carbonate production in 1980, it was the source of most of this country's supply of that commodity. The trona district in southwestern Wyoming is the world's largest known deposit of this mineral resource. All of Wyoming's production came from four producers operating in the vicinity of Green River in Sweetwater County.

Wyoming's bentonite production was nearly two-thirds of the Nation's total. Output of the country's second-ranked bentonite producer, Montana, was less than one-third that of Wyoming. Wyoming ranked second only to Georgia in value of total clay output.

Although Wyoming was fourth among the 11 States that reported iron ore production in 1980, the actual amount was a small portion of the Nation's total. Wyoming's two iron mines were captives of steel-producing companies.

Only Niobrara and Hot Springs of Wyoming's 23 counties produced no nonfuel minerals in 1980. Sand and gravel or stone were produced in all of the 21 producing counties; clay came from 7 counties; iron ore was produced in Fremont and Platte Counties. Most of Wyoming's nonfuel mineral value was produced in Sweetwater County, the site of the trona mines.

Relatively important in the economy of Wyoming, nonfuel mineral production had a per capita value of $1,615, compared with approximately $109 nationally.

The Wyoming Employment Security Commission reported approximately 198,000 persons were employed in Wyoming in 1980. Of this number, approximately 3,800 were employed in trona mining, 1,200 in bentonite mining, 800 in mining iron ore, 800 in sand and gravel, and about 400 in other nonfuel mining operations. Nonfuel mineral mining thus directly employed about 3.5% of the total State work force in 1980. Trona mining employed about one-half of the nonfuel minerals work force; in Sweetwater County, trona mining directly provided more than one out of every five jobs.

Trona mining paid workers an average $513 weekly, iron ore mining $481, and

bentonite mining $348. The all-industry State average wage was $299 weekly. Average employment in the nonfuel mining industries increased about 5% between 1979 and 1980; the average weekly wage in those industries rose about 10%.

Nonfuel minerals production generated about $151 million, 3-1/3% of the State's total assessed valuation of $4.5 billion, and contributed about $7 million of the $138 million severance tax collected by the State. Trona—paying a severance tax of 5.5% and an average ad valorem tax of 7.1%—contributed about $6 million in severance taxes and $8 million in ad valorem taxes to State revenues.

Table 1.—Nonfuel mineral production in Wyoming[1]

Mineral	1979		1980	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	3,471	$75,096	3,081	$71,512
Gem stones	NA	200	NA	190
Gypsum thousand short tons	366	3,100	312	2,731
Sand and gravel[2] do	5,265	11,419	5,454	12,523
Stone do	5,013	15,634	4,374	14,835
Combined value of cement, feldspar (1979), iron ore, lime, phosphate rock (1979), sand and gravel (industrial), and sodium carbonate	XX	484,727	XX	658,755
Total	XX	590,176	XX	760,546

NA Not available. XX Not applicable.
[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2]Excludes industrial sand and gravel; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Wyoming, by county[1]

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Albany	W	W	Cement, stone, sand and gravel, clays, gypsum.
Big Horn	W	W	Clays, gypsum, sand and gravel, lime.
Campbell	W	W	Sand and gravel.
Carbon	$1,000	$1,000	Do.
Converse	252	281	Do.
Crook	W	30,336	Clays, stone.
Fremont	32,076	30,517	Iron ore, sand and gravel, feldspar.
Goshen	W	W	Lime, sand and gravel.
Johnson	W	W	Clays, sand and gravel.
Laramie	W	W	Stone, sand and gravel.
Lincoln	W	W	Phosphate rock, sand and gravel, stone.
Natrona	1,853	W	Sand and gravel, clays.
Park	2,202	1,931	Gypsum, sand and gravel.
Platte	W	W	Stone, iron ore, sand and gravel.
Sheridan	W	W	Sand and gravel.
Sublette	W	W	Stone, sand and gravel.
Sweetwater	W	W	Sodium carbonate, sand and gravel.
Teton	W	W	Sand and gravel, stone.
Uinta	W	W	Sand and gravel, clays.
Washakie	W	W	Lime, sand and gravel, stone.
Weston	W	W	Clays, sand and gravel.
Undistributed[2]	455,688	526,108	
Total[3]	493,069	590,176	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Hot Springs and Niobrara Counties are not listed because no nonfuel mineral production was reported.
[2]Includes gem stones and values indicated by symbol W.
[3]Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Wyoming business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	223.0	232.0	+4.0
Unemployment	do	6.0	9.0	+50.0
Employment (nonagricultural):				
Mining[1]	do	32.6	35.1	+7.7
Manufacturing	do	10.1	10.5	+4.0
Contract construction	do	20.8	20.1	-3.4
Transportation and public utilities	do	16.4	17.4	+6.1
Wholesale and retail trade	do	44.3	43.9	-.9
Finance, insurance, real estate	do	7.1	7.2	+1.4
Services	do	28.6	29.2	+2.1
Government	do	40.8	42.3	+3.7
Total nonagricultural employment[1]	do	200.7	[2]205.6	+2.4
Personal income:				
Total	millions	$4,332	$5,014	+15.7
Per capita		$9,630	$10,692	+11.0
Construction activity:				
Number of private and public residential units authorized		5,199	3,801	-26.9
Value of nonresidential construction	millions	$81.1	$69.9	-13.8
Value of State road contract awards	do	$41.7	$55.5	+33.1
Shipments of portland and masonry cement to and within the State	thousand short tons	466	481	+3.2
Nonfuel mineral production value:				
Total crude mineral value	millions	$590.2	$760.5	+28.8
Value per capita, resident population		$1,312	$1,615	+23.1
Value per square mile		$6,027	$7,767	+28.9

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.
[2]Data do not add to total shown because of independent rounding.

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

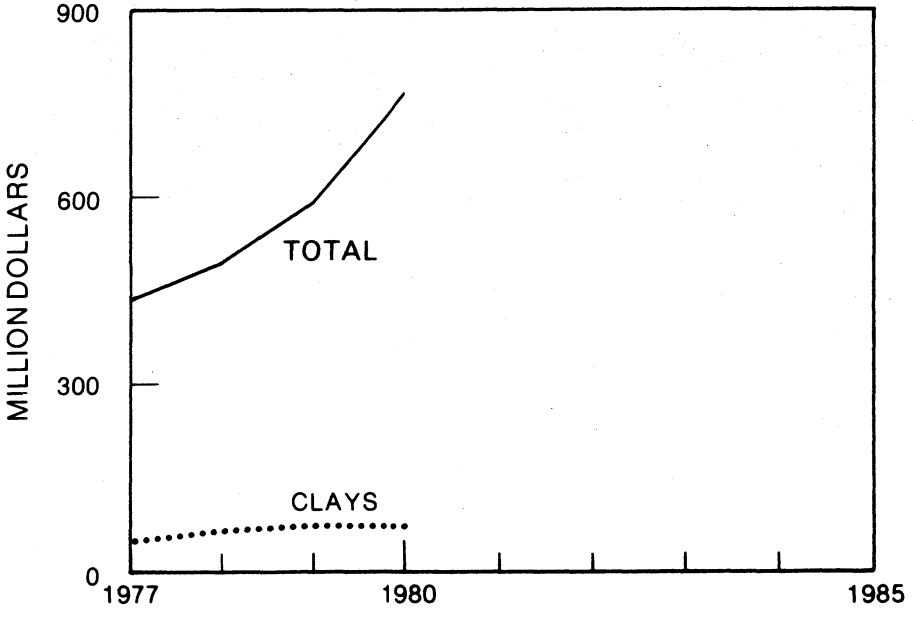

Figure 1.—Value of clays and total value of nonfuel mineral production in Wyoming.

Legislation and Government Programs.—Reconsidering the State severance tax on minerals was the major item of business of the 20-day budget session of the 45th Wyoming Legislature convened February 12, 1980. The Legislature refused to increase severance taxes, although presented with 10 different measures which proposed to increase the tax by 1.2% to 4%. Passage of an act to amend Wyoming Statute W.S. 9-7-1113, however, required severance taxes to be paid quarterly beginning January 1, 1981. Producers paying less than $2,000 in severance taxes annually were exempted from the quarterly payment requirement. The act also provides that severance taxes be based on current production rather than on the previous year's production. Legislation amending W.S. 35-11-103(e) required the Wyoming Department of Environmental Quality to act on mining permit applications within 60 days of submission rather than the previously allowed 90-day period. An act to amend W.S. 35-11-417(d) and 35-11-418 authorized self-bonding for all surface mining operations.

In an October 1980 decision, the U.S. District Court for the State of Wyoming ruled that public lands were to remain open to mineral exploration and development unless Congress closes them. In effect, the ruling asserts that the Secretaries of Interior and Agriculture lack the authority to withhold lands from mineral exploration and development during wilderness study (Mountain States Legal Foundation versus Secretaries of Interior and Agriculture).

The U.S. Bureau of Mines and U.S. Geological Survey continued their mineral land assessment of proposed wilderness areas. Areas studied and/or reported on in 1980 follow: U.S. Forest Service Wilderness areas—Bridger (392,000 acres), North Absaroka (351,000 acres), Savage Run (15,000 acres), and South Absaroka (484,000 acres); Forest Service Roadless Area Review and Evaluation (RARE II) Further Planning Areas—Cloud Peak contiguous area (36,000 acres), Huston Park (5,000 acres), and West Slope Tetons (10,000 acres)—Forest Service RARE II Wilderness Study Area—Gros Ventre (109,000 acres); and the Bureau of Land Management (BLM) Wilderness Projects—Scab Creek (9,000 acres) and Sublette Mountains (53,000 acres).

In one of the most important cases involving water rights in the State, the State Engineer was called upon to rule on the Pacific Power and Light Co. proposal to buy high-priority water rights from an agricultural use in southwestern Wyoming for use elsewhere in the State. Trona industry officials and some ranchers in western Wyoming with lower priority rights fear such authorization would cut them off from water in dry years. The State Engineer granted in part and denied in part Pacific Power and Light Co.'s request. The case, taken to the State Board of Control, will likely be appealed to the courts for final determination.

The Geological Survey of Wyoming expanded its assessment of diamond-bearing kimberlites into the Laramie Range of southeastern Wyoming. The State Survey collected stream sediment samples, conducted geophysical surveys, prepared geological maps, and built a diamond extraction laboratory to test for diamond occurrences in newly discovered kimberlites. Two previously unreported kimberlites were located during the summer of 1980. A project to examine the stratigraphy and potential resources of base, precious, and industrial metal occurrences in the State's ancient Archean greenstone was initiated; significant gold mineralization was reported during the first year of the project. New State Survey publications during the year included Report of Investigation (RI) 20, A Stratigraphic Evaluation of the Eocene Rocks in Southwestern Wyoming; RI 23, Gold Districts of Wyoming; and Public Information Circular 13, Rocky Mountain Foreland Basement Tectonics.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—The only producer of cement in Wyoming was the Monolith Portland Cement Co. located south of Laramie in Albany County. Annual output, as published in the State Mine Inspector's Report for 1980, was about 190,000 tons, little changed from that of 1979. Most of the output was type I and II general-moderate-heat portland cement; small amounts of high-sulfur-resistant, oil well portland cement and masonry cement also were produced. Most of the product was sold to ready-mix companies; smaller amounts went to concrete product manufacturers, other contractors, and building material dealers. The major portion was shipped to consumers in bulk

and by truck. The plant employed about 75 people.

A plant expansion program costing in excess of $20 million was completed in November; a finish mill and a second kiln, 12 by 13.6 by 50 feet, were added to the plant, which utilizes a wet process but is designed for possible later conversion to a dry process. New grinding facilities and high-speed rail-and truck-loading facilities are also part of the yet-to-be-completed expansion plan. When completed, the plant, originally built in 1928, will increase capacity from 200,000 to 500,000 tons per year. A vertically integrated operation, Monolith mines its own limestone and shale from locations east of the plant, its own sandstone, and its own gypsum; all these products are transported to the cement plant via a company railroad.

The company's service region is Wyoming, western Nebraska, and northern Colorado.

Clays.—Wyoming was one of the Nation's two largest sources of clay in 1980, second only to Georgia in total output. Most of the Wyoming clay, 99% by value, was bentonite; the State ranked first in the Nation with nearly 70% of total bentonite production. Twelve companies produced clay at 82 mine sites in 8 of Wyoming's 23 counties. Of these companies, eight produced bentonite and four produced common clay. Big Horn, Crook, and Weston Counties had the largest output with about 77% of the total. Johnson, Washakie, Albany, Uinta, and Natrona followed, in order of output.

Wyoming bentonite is the western or sodium type, unique because of its ability to retain a large volume of water and swell to 15 times its dry volume. Reputed to have 140 or more uses, Wyoming bentonite in 1980 was used mainly in drilling muds (51%), iron ore pelletizing (25%), foundry sands (16%), animal feeds (1.6%), and waterproofing seals (1.1%). A decline in steel production and an increase in oil and natural gas well drilling reversed the order of usage between drilling muds and iron ore pelletizing compared with that of 1979. The major use of Wyoming's relatively small amount of common clay and shale output was in cement manufacturing.

American Colloid Co., the State's (and the world's) largest sodium bentonite producer, operated five mines in Big Horn, Crook, and Weston Counties, and processing plants at Upton in Weston County and Lovell in Big Horn County. Dresser Minerals, a subsidiary of Dresser Industries, Inc., was second in output with a single mine and mill operation in Big Horn County. Following in order of output were Wyo-Ben, Inc., which reported 39 mine sites in Big Horn and Hot Springs Counties and processing facilities at Greybull, Lovell, and Thermopolis; Kaycee Bentonite Corp. with the Kaycee Mine in Johnson County, Ten Sleep Mines in Washakie County, and processing plants at Casper and Worland; NL Industries, Inc., Baroid Div., with 23 mining sites in Big Horn and Crook Counties and a mill at Colony in Crook County; Federal Bentonite, a division of Aurora Industries, Inc., with 2 mines in Weston and Crook Counties and mills at Colony and Upton; and International Minerals and Chemical Corp. with 3 mines and a mill in Crook County. The largest producer of common clay and shale was the Monolith Portland Cement Co. with its mine in Albany County.

In June 1980, NL Industries, Inc.,'s Baroid Div., began constructing its new 300,000-ton-per-year bentonite drying and grinding plant 8 miles east of Lovell. To be completed by mid-1981, the plant will occupy about 45 acres and employ about 85 people. Two 3,000-foot railroad siding tracks were installed, and the company projected that 80% of the plant output would be shipped by rail. A major supplier of oilfield services and equipment, NL Industries, Inc., anticipated the output of the Lovell plant would be used mainly as drilling mud and as a binder in foundry sands.

During the year, Wyo-Ben, Inc., brought into production a new bentonite grinding and drying plant at Thermopolis, utilizing 2 Raymond mills with 24-ton-per-hour capacity each, and employing about 15 people.

The Wyoming State Mine Inspector's Report for 1980 estimated employment in bentonite surface mines and milling plants in 1980 at about 1,200 people. The unit value of Wyoming bentonite ranged from about $11 to $38 per ton in 1980 depending on quality and use, with an average value of about $20; common clay was valued at about $3 to $7 per ton. Bentonite was marketed nationwide and to such diverse world markets as Australia for iron ore pelletizing and Somalia for irrigation well sealing. Economic conditions generally changed the marketing strategy of bentonite companies away from iron ore pelletizing and into oil-drilling muds.

Gem Stones.— Wyoming nephrite, commonly known as jade, was first discovered

in Wyoming in the mid-1930's and has been the official State stone since 1967. Jade fields are found in Carbon, Converse, Fremont, Natrona, and Sweetwater Counties but are most closely associated with an area of southern Fremont and southwest Natrona known as the Granite Mountains.

The first authenticated diamond discovery in Wyoming was in 1975 in the "state line" area south of Laramie. Since then, 12 out of more than 90 kimberlite pipes in the Colorado-Wyoming Front Range and Laramie Range have been demonstrated to contain microdiamonds. A placer diamond deposit was reported in the Medicine Bow Mountains west of Laramie. In 1980, the Geological Survey of Wyoming received a 1-year extension of a U.S. Department of the Interior, Office of Surface Mining grant to examine portions of the Laramie and Snowy Ranges for potential diamond deposits. Cominco American Inc., a subsidiary of Cominco, Ltd., continued investigating the economic feasibility of the diamond deposits on a 2,900-acre property south of Laramie. Construction of a diamond extracting test facility near Fort Collins, Colo., was begun during the latter part of the year. The facility will process kimberlite from Wyoming and elsewhere in the United States.

Gypsum.—Celotex Corp. in Park County, Georgia Pacific Corp. in Big Horn County, and Wyoming Construction Co. in Albany County reported production of crude gypsum. Celotex Corp. was the largest producer, followed by Georgia Pacific Corp. Both Celotex and Georgia Pacific also produced calcined gypsum. About 100 people were employed in gypsum production in Wyoming in 1980. The Celotex plant at Cody, which normally worked 3 shifts, 7 days per week, reported cutting back to 3, 4, or 5 days per week because of the housing industry slowdown. In addition to serving the local area, the plant shipped wallboard products to Alaska, Hawaii, Oregon, and Washington.

Lime.—Great Western Sugar Co. in Big Horn County and the Holly Sugar Corp. in Goshen and Washakie Counties produced lime for use in sugar refining. Sugar-beet processing plants served included a number in northeastern Colorado, as well as in Wyoming.

Phosphate Rock.—No phosphate rock was reported mined in Wyoming in 1980. Stauffer Chemical Co. continued to operate its Leefe, Wyo., phosphate rock-processing plant with ore from its Wooley Valley, Idaho, mine. The company's 1980 10K report, required annually by the Securities and Exchange Commission, stated its intention to continue operating this plant for a limited time only. The plant at Leefe is for sale. Operations will cease at the end of 1981.

Sand and Gravel.—Twenty of Wyoming's 23 counties produced sand and gravel; only Crook, Hot Springs, and Niobrara Counties did not report such production. Fremont was the largest producer, followed in order by Natrona, Carbon, Sweetwater, Laramie, and Johnson. The three leading counties produced nearly one-half of the State total. Construction sand and gravel was the major type produced with a relatively insignificant amount of industrial sand output.

The industry comprised 40 mining companies at 48 sites with 27 processing plants. Road base and covering was the major use of the sand and gravel produced, nearly one-half the total, followed in order by concrete aggregate, asphaltic concrete, and fill. Industrial sand was used for roofing granules. Four-fifths of total sand and gravel output was gravel. The average unit prices were $2.49 per ton for sand and $2.24 per ton for gravel. Unit prices varied according to use, ranging from $1.49 per ton for fill material to $4.33 per ton for plaster and gunite sands. Output, except for a small amount consumed on site, was transported by truck.

Fifteen of the State's 48 sand and gravel operations produced less than 25,000 tons during the year, 11 produced between 25,000 and 49,999 tons, and 8 produced 50,000 to 99,999 tons. Five operations producing over 300,000 tons accounted for 25% of total output. No operation produced more than 1 million tons. The largest sand and gravel producer in the State was Peter Kiewit and Sons Co., which operated one pit in each of Campbell, Carbon, Johnson, and Sweetwater Counties. Second in size of output was Gilpatrick Construction Co., Inc., with one operation in Fremont County. These two companies were followed in order of output by Rawlins Sand and Gravel Co., one pit in Carbon County; Casper Concrete Co., one pit in Natrona County; Teton Construction Co., one pit in Laramie County; and Boatright Smith, one pit in Natrona County. The top three companies produced about one-half the State's sand and gravel in 1980, and the top eight produced three-fourths of the total. About 800 people were employed in sand and gravel mining in the State in 1980.

The U.S. Government filed suit against a major Wyoming sand and gravel producer for mining gravel on the Wind River Reservation in Fremont County. The company owned surface rights to the land, whereas the Government held the mineral rights in trust for the Arapahoe and Shoshone Tribes. The suit implemented a U.S. District Court ruling in Cheyenne in August 1979 that gravel is a mineral reserved to the United States pursuant to patents issued under the Homestead Act of 1862.

Table 4.—Wyoming: Construction sand and gravel sold or used, by major use category

Use	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,207	$3,587	$2.97	1,289	$4,258	$3.30
Plaster and gunite sands	26	99	3.75	15	65	4.26
Concrete products	W	W	2.10	W	W	2.23
Asphaltic concrete	1,189	2,553	2.15	818	2,055	2.51
Road base and coverings	2,346	4,336	1.85	2,667	4,968	1.86
Fill	440	618	1.40	561	834	1.49
Other	57	227	3.98	103	342	3.32
Total[1] or average	5,265	11,419	2.17	5,454	12,523	2.30

W Withheld to avoid disclosing company proprietary data; included in "Other."
[1]Data may not add to totals shown because of independent rounding.

Table 5.—Wyoming: Construction[1] sand and gravel sold or used by producers

	1979			1980		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	1,106	$2,779	$2.51	1,164	$2,898	$2.49
Gravel	4,159	8,640	2.08	4,291	9,625	2.24
Total or average	5,265	11,419	2.17	[2]5,454	12,523	2.30

[1]A small amount of industrial sand was produced in 1979 and 1980.
[2]Data do not add to total shown because of independent rounding.

Sodium Carbonate.—In 1980, Wyoming was the Nation's major producer of sodium carbonate or soda ash, the State's most important nonfuel mineral in value produced. Annual reports of the companies involved in operating the four mines producing trona (the ore) and soda ash (the processed product) in southwestern Wyoming indicate a 1980 production of about 7 million tons of soda ash (nearly 13 million tons of trona ore), down slightly from the 1979 level of production. The decline was ascribed to reduced demand by glass manufacturers, who normally consume about 53% of the Nation's soda ash; demand for glass was off because of the decrease in new car sales and home construction. More than 80% of the U.S. soda ash in 1980 came from the Green River Basin in Sweetwater County, site of the largest known deposit in the world. The huge deposit, comprising 24 identified beds with combined reserves of about 67 billion tons of trona, is owned primarily by Rocky Mountain Energy Co., a subsidiary of Union Pacific Corp., and by the Federal Government; most mining of trona has occurred under long-term lease from these owners. The trona-soda ash industry is capital intensive and energy intensive; all four of the State's mines, located within a 25-mile radius of Green River, were expanding production facilities in 1980.

FMC Corp., the oldest and the largest producer of soda ash in the Green River area, beginning operations in 1952, produced about 2.5 million tons of soda ash in 1980, according to the company's 10K report. The FMC Westvaco Mine is the sixth largest underground mine in the United States. A 300,000-ton-per-year incremental expansion in capacity of the monohydrate soda ash

plant begun in 1979 was completed by the end of 1980, raising soda ash-processing capacity to about 2.5 million tons per year. A new men-and-materials access shaft, No. 8, was completed to a depth of about 1,700 feet. It replaced No. 3 shaft as the main access shaft, providing access closer to current working areas. Two other shafts, Nos. 5 and 7, also provide access to the underground workings. The new shaft is 22 feet in diameter and completely concrete lined.

Mining has been by conventional room-and-pillar methods with entries driven by continuous miners. In 1980, installation of longwall mining equipment began with an early 1981 startup planned. FMC expects rate of recovery to increase from less than 50% with room-and-pillar mining to more than 70% with longwall mining. Heavy-duty shearing machines capable of cutting trona, which is much harder than coal, were ordered from Scotland. Of the 1,400 people FMC employs in its trona mining and processing operation, 755 work in the mine.

In 1979, FMC announced a major technology breakthrough in in situ solution mining of trona. In 1980, permits were acquired to field-test FMC's process at a site about 15 miles south of its mine. The new process would simplify refining soda ash as well as mining trona. Twin 15-mile-long pipelines would carry the mining solution to the mining location and return the pregnant solution to the existing processing plant. The process was expected to reduce costs of producing soda ash by 20% to 25%. Development of a solution-mining process was not expected to affect other mining operations.

The State Land Board also approved a request from Vulcan Materials Co. of Birmingham, Ala., to conduct field tests on a solution-mining process it developed, independent of FMC, on three State leases it holds several miles from the FMC test site.

Second largest of Wyoming's trona mines, the Alchem Mine, operated by Allied Chemical Corp., produced about 2.2 million tons of soda ash in 1980, according to an article in the Riverton Ranger newspaper, June 18, 1981. To solve two problems that have kept it from operating at capacity—shortage of storage facilities and transportation facilities—Allied added to its rail hopper car inventory in 1979 and completed two 20,000-ton vertical-storage silos 100 feet in diameter by 100 feet high in 1980.

Allied mines with continuous miners by conventional room-and-pillar methods and also operates two longwall-mining machines. The Alchem was the first trona mine to use the longwall system. Also during 1980, new stores and administrative buildings were completed; and processing capacity was increased by matching crushing, calcining, and drying rates to the fixed capacity of the evaporators. Work continued on No. 5 ventilation shaft. Like other soda ash producers, Allied has partly converted its energy production to coal. Allied employs about 1,185 people, one-half in the mine and one-half in the refinery. Allied was also the only producer of synthetic soda ash in the United States, with a Solvay process plant, located at Syracuse, N.Y.

Stauffer Chemical Co. of Wyoming, jointly owned by Stauffer Chemical Co. and Rocky Mountain Energy Co., stated in its annual report that 1.6 million tons of soda ash was produced at its Big Island Mine in 1980. A 850,000-ton-per-year expansion in processing capacity was completed in 1980. In this second phase of an expansion program, Stauffer installed a mechanical vapor recompression (MVR) system, the first in the soda ash industry in Wyoming. MVR compresses steam, which increases the pressure in the five-story-tall evaporators and facilitates crystallization of soda ash at lower temperatures, thus conserving energy. Completion of a new No. 3 shaft, which duplicated the existing production shaft, doubled the ore-hoisting and ventilation capacity of the mine. No. 3 shaft—22 feet in diameter, finished-concrete lined, and 900-feet deep—transects both trona beds that Stauffer mines. At the foot of the shaft is an 800-ton-per-hour primary crusher; at the surface is a hoist house and screening plant. Stauffer had a payroll of about 670 with more than 200 working in the mine.

Texasgulf Chemicals Co., a division of Texasgulf, Inc., stated in its 1980 annual report that 877,000 tons of soda ash was produced at its Granger Mine in 1980. Mining method was room and pillar with use of a continuous miner. Engineering work and permit application to double capacity of the operation from 1 to 2 million tons per year proceeded throughout 1980. Impact of the proposed expansion on local environment, housing, schools, and community services was closely examined by the Wyoming Industrial Siting Council, the County Commission, and other local entities. Projected to cost about $63 million, the expansion would add 290 people to Texasgulf's payroll. Texasgulf employed about 550 people, 260 underground.

Tenneco Minerals Co., a subsidiary of Tenneco Oil Co., continued constructing its new 1-million-ton-per-year trona mine and soda ash processing plant about 16 miles west of Green River. Two shafts were sunk to trona ore bed 17, the same bed that FMC and Allied mine. The concrete-lined exhaust ventilation shaft is 18 feet in diameter; the production shaft, 26 feet in diameter, will have two hoisting systems for men and materials and will provide intake air to the mine. Commencement of mining was planned for early 1982.

A portion of Wyoming's soda ash production was processed into baking soda by Church and Dwight Co., Inc., at its Green River plant. Most of the State's output was exported to midwestern States and foreign markets; during the year, foreign markets were growing faster than domestic markets. Soda ash was priced at about $84 to $86 per ton f.o.b. plant.

Stone.—Twelve companies produced stone at 16 quarries in 9 counties. Forty percent of production occurred in Platte County; Laramie County was second in volume of production. Important amounts were also produced in Albany and Crook Counties; smaller amounts were quarried in Lincoln, Sublette, Sweetwater, Teton, and Weston Counties. The entire output was classified as crushed stone; no dimension stone production was reported.

Nearly 60% of the crushed rock produced was limestone; about 40% was granite. Marble, accounting for just one-third of 1% in output, generated 4% of total value because of a high $36.72 average unit value per ton.

The average unit value of crushed limestone was $3.60 per ton, with values ranging from $3.50 per ton for use as riprap to $7.47 per ton for use in sugar refining; crushed granite ranged in value from $2.75 to $3.05 per ton, averaging about $2.79 per ton.

Limestone was quarried at nine sites, granite at four, marble at one, and traprock at two. Two-thirds of the stone produced was from two quarries, each quarrying 1 million or more tons; one produced limestone, the other granite. The next largest quarry had an output of between 300,000 and 399,999 tons. Two quarries produced 200,000 to 299,999 tons; one produced 100,000 to 199,999 tons; two produced 75,000 to 99,999 tons; two produced 50,000 to 74,999 tons; one produced 25,000 to 49,000 tons; and five produced less than 25,000 tons during the year.

More than 50% of the stone produced during the year was used for railroad ballast. Other major uses were for fine aggregate, unspecified aggregate, dense-graded roadbase, concrete aggregate, cement manufacture, riprap, and sugar refining. Minor uses included agricultural limestone, terrazzo, roof aggregate and chips, and sulfur dioxide. About two-thirds of the crushed stone, mostly intended for use as railroad ballast, was moved to its point of use by railroad; the balance was shipped by truck.

Guernsey Stone Co. and Morrison-Knudsen Co. were the largest producers of stone. Intermediate-size producers were Union Pacific Railroad Co. (by contract with W. E. Wimmer Co.), Summit Materials Co., Monolith Portland Cement Co. (by contract with Wyoming Construction Co.), and the Great Western Sugar Co. The four leading companies produced more than 80% of the stone quarried.

A number of environmental controversies developed over proposed or existing quarrying operations. A proposal to reactivate a limestone quarry in Soldier Creek Canyon near Sheridan created controversy between the company and neighboring property owners, the County Commissioners, the County Planning Commission, and the Wyoming Department of Environmental Quality; concern centered around access right-of-way in which certification was both granted and withdrawn.

Although not included in reported production this year, the University of Wyoming stone quarry, 9 miles northeast of Laramie, has produced dimension stone intermittently. Since the building of Old Main in 1886, nearly every building on the University of Wyoming campus has been built of or trimmed with the native interbedded sandstone and limestone. Quarried by the university's own crew and equipment, the stone is transported 400 miles to the nearest stone cutter in Salt Lake City and back to the university. Rising costs have limited use of the native stone in more recent university buildings.

Sulfur.—Sulfur, as a byproduct of natural gas processing, was produced in Carbon, Fremont, Laramie, Park, and Sweetwater Counties. Park County, first among the five counties in production, and Sweetwater County accounted for 90% of the total. Chevron, USA, Inc., and Amoco Production Co. began constructing gas-processing plants in the Whitney Canyon-Carter Creek area of southwestern Wyoming, which would produce sulfur as a byproduct of

processing natural gas from wells on the Overthrust Belt. Gas from these wells is heavily laden with hydrogen sulfide, which must be removed before the gas can be transported in pipelines to users. The Amoco facility, about 20 miles north of Evanston, was designed to process 250 million cubic feet of sour gas per day. It was projected that the plant would yield 1,200 tons of byproduct sulfur daily, making it one of the largest sulfur-producing plants in the United States. Expected to cost about $200 million, the plant was to begin production in the first quarter of 1982. The company plans to build a 30-mile roadway to truck the sulfur to a railroad terminal south of Kemmerer. Cost of the Chevron facility, located 8 miles away, was estimated at $300 million. Plant intake was set at 140 million cubic feet of gas per day, from which 1,000 tons of sulfur would be extracted. Water for the plant's operation would come from the Woodruff Narrows reservoir. Scheduled for completion in mid-1982, the plant would employ about 120 people. A pipeline was proposed to move the sulfur in molten form from the plant to terminal facilities the company planned to share with Amoco south of Kemmerer.

METALS

Gold.—Although no gold was reported produced in Wyoming in 1980, interest in exploring for the metal increased. Mallon Oil Co. of Denver received permission to drill 40 to 60 holes on 920 acres of national forest land in the Pacific Creek area northeast of Moran to determine whether there was enough gold to warrant commercial mining. Crosby Exploration Co. drilled about 200 holes on its claims in the Cookstove Basin in the Big Horn Mountains but did not report findings. Homestake Mining Co., headquartered in San Francisco, Calif., continued its exploration activity in the Atlantic City area. Timberline Minerals of Dubois reportedly expressed interest in building a small mill in the Atlantic City area. The Nedlog Technology Group, based in Arvada, Colo., bought an old Federal Government facility on 32 acres near Laramie; the company intends to conduct a commercial test in a 10-ton-per-day pilot plant of its hydrometallurgical process to remove gold, silver, and other metals from smelter flue dust accumulated from around the country. In a gold-fever sidelight, five Californians were indicted by a Federal grand jury for conspiracy to defraud investors by promoting a secret process to extract gold and platinum from ore mined in the South French Creek area on the west slope of the Medicine Bow Range; ore was shipped from Wyoming to California for processing, but no gold was produced.

Iron Ore.—Iron ore was produced at two mines, the Atlantic City Mine near Lander in Fremont County and the Sunrise Mine near Guernsey, Platte County. Output increased slightly over that of 1979, whereas value of output decreased slightly. Wyoming was fourth in the Nation in iron ore output; production, however, was a small percentage of the national total.

Operations at Sunrise Mine, one of the Nation's few remaining underground iron ore mines, were shut down July 13 because of adverse economic conditions affecting its parent company, CF&I Steel Corp. In production since 1900, Sunrise was Wyoming's oldest continuously operating mine. Its entire output was shipped to the CF&I plant at Pueblo, Colo., and constituted about one-third of the iron ore requirements of that plant. Although the mine was closed shortly after midyear, its shipments for the year were only moderately less than in 1979; Skillings Mining Review, March 28, 1981, reported 245,536 tons of beneficiated ore shipped. The shutdown involved loss of work for about 270 employees, one-half of whom had worked underground and the remainder either in the pit or beneficiating plant. No plans for reopening had been made public at yearend.

As the principal supplier of pelletized iron ore to the Geneva Steel Works at Provo, Utah, the future of United States Steel Corp.'s Atlantic City Mine has been tied to that of the Geneva plant. Over the past 2 years, questions about the profitability and possible closing of the Geneva plant, particularly as to its ability to meet air pollution standards, have clouded the future of the Atlantic City Mine. In October 1980, United States Steel and the Environmental Protection Agency reached agreement over pollution-control measures that would bring Geneva into compliance with local and Federal air-and water-pollution control standards. Cost to United States Steel was estimated at $94 million.

The Atlantic City Mine produced about 1.7 million tons of agglomerates (as reported in Skillings' Mining Review, March 14, 1981) from 5 million tons of crude ore. Taconite ore containing less than 30% iron

was concentrated to more than 60% iron, pelletized, and then shipped 355 miles to Geneva via the company's 78-mile industrial railroad spur and the Union Pacific Railroad. The mine operation employed about 550 people.

[1]State mineral specialist, Bureau of Mines, Denver, Colo.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Monolith Portland Cement Co.[1]	Box 40 Laramie, WY 82070	Plant	Albany.
Clays:			
American Colloid Co	Box 818 Belle Fourche, SD 57717	Pits and plants	Big Horn, Crook, Weston.
Dresser Minerals, a division of Dresser Industries, Inc.	Box 832 Greybull, WY 82426	do	Big Horn.
Federal Bentonite, a division of Aurora Industries, Inc.	1002 Greenfield Rd. Montgomery, IL 60538	do	Crook and Weston.
International Minerals & Chemical Corp.	5401 Old Orchard Rd. Skokie, IL 60076	do	Crook.
Kaycee Bentonite Corp	Box 9 Mills, WY 82644	do	Johnson, Natrona, Washakie.
NL Industries, Inc., Baroid Div	Box 1675 Houston, TX 77001	do	Big Horn and Crook.
Wyo-Ben, Inc	Box 1979 Billings, MT 59103	do	Big Horn and Hot Springs.
Gypsum:			
Celotex Div., Jim Walter Corp	1500 North Dale Mabry Tampa, FL 33607	Surface mine and plant.	Park.
Georgia Pacific Corp	900 SW. 5th Ave. Portland, OR 97204	do	Big Horn.
Wyoming Construction Co.[2]	Box 907 Laramie, WY 82070	Surface mine	Albany.
Iron ore:			
CF&I Steel Corp	Box 316 Pueblo, CO 81002	Underground mine and plant.	Platte.
United States Steel Corp	Lander, WY 82520	Open pit mine and plant.	Fremont.
Lime:			
The Great Western Sugar Co.[2]	Box 5308 Denver, CO 80217	Plant	Big Horn.
Holly Sugar Corp	Holly Sugar Bldg. Colorado Springs, CO 80902	do	Goshen and Washakie.
Sand and gravel:			
Boatright Smith	Box 1129 Casper, WY 82602	Pit and plant	Natrona.
Casper Concrete Co	Box 561 Casper, WY 82601	do	Do.
Gilpatrick Construction Co., Inc	Box 973 Riverton, WY 82501	do	Sublette.
Peter Kiewit & Sons Co	Box 1009 Sheridan, WY 82801	Pits and plants	Campbell, Carbon, Johnson, Sweetwater.
Rawlins Sand & Gravel Co	1523 Daley St., Box 1360 Rawlins, WY 82301	Pit and plant	Carbon.
Teton Construction Co	Box 3243 Cheyenne, WY 82001	Pit	Laramie.
Sodium carbonate:			
Allied Chemical Corp	Box 551 Green River, WY 82935	Underground mine and plant.	Sweetwater.
FMC Corp	Box 872 Green River, WY 82935	do	Do.
Stauffer Chemial Co. of Wyoming	Box 513 Green River, WY 82935	do	Do.
Texasgulf Chemical Co	Box 100 Granger, WY 82934	do	Do.
Stone:			
Guernsey Stone Co	Box 337 Guernsey, WY 82214	Quarry	Platte.
Morrison-Knudsen Co., Inc	Box 7808 Boise, ID 83729	do	Laramie.
Summit Materials Co	Box 1716 Rapid City, SD 57709	do	Crook.
Union Pacific Railroad Co., W. E. Wimmer.	115 West 15th St. Cheyenne, WY 82001	do	Albany.

[1]Also clays.
[2]Also stone.

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