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Preprint from the 1970

BUREAU OF MINES MINERALS YEARBOOK

The Mineral Industry of Montana



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UNITED STATES DEPARTMENT OF THE INTERIOR



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

BUREAU OF MINES • Elburt F. Osborn, Director

This publication is a chapter from the current Bureau of Mines Minerals Yearbook, comprising *Volume I, Metals, Minerals, and Fuels; Volume II, Area Reports: Domestic; Volume III, Area Reports: International*. Individual chapters from all volumes and the separate volumes of the Yearbook are sold by the Superintendent of Documents, Washington, D.C. 20402.

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The Mineral Industry of Montana

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

By J. M. West ¹

Montana mineral production in 1970 was valued at \$313 million, an increase of 11 percent compared with the 1969 value. The year 1970 was strike-free and the mineral industry produced at close to capacity levels. Copper production rose moderately in quantity and increased significantly in value compared with the previous year.

Because of a change in the Bureau's statistical procedures, output of base metals from The Anaconda Company's slag-fuming plant at East Helena are now excluded from primary metal production figures. Therefore, 1970 data for a few metals are

not directly comparable with those of earlier years.

Petroleum production continued to decline from a high reached in 1968, falling 14 percent in quantity compared with the 1969 output. The drop in value was less because of price increases. Output of natural gas increased 4 percent. Coal continued a sharp upturn in production with a threefold rise in quantity and a threefold rise in value.

¹ Physical scientist, Division of Nonferrous Metals.

Table 1.—Mineral production in Montana ¹

Mineral	1969		1970	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ² thousand short tons..	34	\$63	41	\$71
Coal (bituminous and lignite)..... do..	1,030	2,199	3,447	6,394
Copper (recoverable content of ores, etc.)..... short tons..	103,314	98,219	120,412	138,955
Gem stones.....	NA	109	NA	109
Gold (recoverable content of ores, etc.)..... troy ounces..	24,189	1,004	22,456	817
Iron ore (usable)..... thousand long tons, gross weight..	13	W	14	W
Lead (recoverable content of ores, etc.)..... short tons..	1,753	522	996	311
Lime..... thousand short tons..	255	2,737	208	W
Manganese ore and concentrate (35 percent or more Mn)..... short tons, gross weight..	755	26	512	W
Natural gas..... million cubic feet..	41,229	4,205	42,705	4,399
Petroleum (crude)..... thousand 42-gallon barrels..	43,954	118,359	37,879	105,403
Pumice..... thousand short tons..	134	102	-----	-----
Sand and gravel..... do..	16,595	14,383	19,275	20,249
Silver (recoverable content of ores, etc.)..... thousand troy ounces..	3,429	6,141	4,304	7,622
Stone..... thousand short tons..	7,667	10,579	³ 6,501	³ 6,896
Tungsten ore and concentrate..... short tons, 60-percent WO ₃ basis..	W	W	9	23
Zinc (recoverable content of ores, etc.)..... short tons..	6,143	1,794	1,457	446
Value of items that cannot be disclosed: Antimony (1970), cement, clays (bentonite), fluorspar, gypsum, natural gas liquids, peat, phosphate rock, stone (dimension), talc, vermiculite, and values indicated by symbol W.....	XX	22,189	XX	21,321
Total.....	XX	282,631	XX	313,016
Total 1967 constant dollars.....	XX	266,888	XX	^p 283,279

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

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

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

³ Excludes certain dimension stone; included with "Value of items that cannot be disclosed."

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

(Thousands)

County	1969	1970	Minerals produced in 1970 in order of value
Beaverhead.....	\$2,156	\$715	Stone, sand and gravel, talc, lead, silver, zinc, gold, copper.
Big Horn.....	1,072	1,702	Sand and gravel, stone, petroleum, lime, natural gas.
Blaine.....	498	349	Petroleum, natural gas, sand and gravel.
Broadwater.....	369	W	Iron ore, silver, zinc, lead, sand and gravel, stone, copper.
Carbon.....	7,437	7,366	Petroleum, stone, sand and gravel, natural gas, zinc, silver.
Carter.....	153	W	Clays, petroleum, sand and gravel.
Cascade.....	1,551	W	Sand and gravel, clays, stone.
Chouteau.....	56	W	Sand and gravel, stone.
Custer.....	156	935	Do.
Daniels.....	8	W	Sand and gravel, petroleum.
Dawson.....	2,680	W	Petroleum, sand and gravel, stone.
Deer Lodge.....	2,395	2,516	Lime, stone, sand and gravel, silver, copper, gold, lead, zinc.
Fallon.....	18,913	19,752	Petroleum, natural gas, sand and gravel, stone.
Fergus.....	W	W	Sand and gravel, gypsum, stone.
Flathead.....	727	W	Sand and gravel, silver, lead, copper, zinc.
Gallatin.....	W	W	Cement, stone, sand and gravel, clays.
Garfield.....	162	43	Sand and gravel.
Glacier.....	1,752	W	Petroleum, sand and gravel.
Golden Valley.....	15	W	Sand and gravel.
Granite.....	1,081	1,268	Silver, zinc, stone, copper, lead, sand and gravel, gold.
Hill.....	154	280	Sand and gravel, natural gas.
Jefferson.....	W	W	Cement, stone, silver, gold, lead, copper, sand and gravel, zinc.
Judith Basin.....	88	160	Sand and gravel, stone.
Lake.....	308	W	Sand and gravel, peat.
Lewis and Clark.....	2,114	W	Sand and gravel, lead, silver, zinc, stone, gold, copper.
Liberty.....	1,775	1,631	Petroleum, natural gas, sand and gravel.
Lincoln.....	6,561	12,691	Sand and gravel, vermiculite, stone, zinc, lead, silver.
McCone.....	1,593	1,203	Petroleum, sand and gravel.
Madison.....	W	W	Talc, silver, gold, sand and gravel, stone, copper, lead, zinc.
Meagher.....	36	W	Lead, silver, zinc, gold, copper.
Mineral.....	W	W	Sand and gravel, silver, stone, copper, lead, gold.
Missoula.....	3,278	536	Sand and gravel, stone, copper, gold, silver.
Musselshell.....	2,605	2,329	Petroleum, coal.
Park.....	191	261	Sand and gravel, stone.
Petroleum.....	23	6	Sand and gravel.
Phillips.....	103	W	Do.
Pondera.....	40	700	Sand and gravel, stone, petroleum.
Powder River.....	36,878	24,271	Petroleum, natural gas, sand and gravel, stone, coal.
Powell.....	W	W	Phosphate rock, sand and gravel, gold, silver, lead, zinc.
Prairie.....	820	1,186	Sand and gravel, stone.
Ravalli.....	W	W	Fluorspar, sand and gravel, silver, gold, lead, zinc, copper.
Richland.....	6,300	7,182	Petroleum, coal, lime, sand and gravel.
Roosevelt.....	5,784	W	Petroleum, sand and gravel.
Rosebud.....	5,174	7,425	Coal, petroleum, sand and gravel, clays, stone.
Sanders.....	252	W	Sand and gravel, stone, antimony.
Sheridan.....	6,393	W	Petroleum, sand and gravel.
Silver Bow.....	103,487	146,072	Copper, silver, gold, sand and gravel, manganese ore, clays.
Stillwater.....	1,721	1,355	Sand and gravel, stone, natural gas.
Sweet Grass.....	9	1,378	Sand and gravel, stone.
Teton.....	105	149	Sand and gravel, petroleum.
Toole.....	3,093	2,663	Petroleum, sand and gravel, natural gas.
Treasure.....	W	W	Clays.
Valley.....	287	W	Sand and gravel, clays.
Wheatland.....	136	9	Sand and gravel.
Wibaux.....	28	W	Petroleum, sand and gravel.
Yellowstone.....	1,940	2,168	Sand and gravel, talc, petroleum, stone, lime, clays.
Combined counties ¹	26,387	28,112	
Undistributed ²	23,787	36,604	
Total ³	282,631	313,016	

W Withheld to avoid disclosing individual company confidential data.

¹ Petroleum and natural gas production from fields underlying two or more counties.² Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.³ Data may not add to totals shown because of independent rounding.

Increases were realized in outputs of some construction materials; the most significant gains were in the value of sand and gravel (41 percent).

The Montana legislature actively discussed bills related to mineral exploration and mine reclamation, but no significant laws were passed during 1970. The Montana dredge law, passed in 1969, was ruled unconstitutional.

Important agreements were signed for large-scale development and exploitation of coal deposits in southeastern Montana. Posting of bonds for reclamation was included as a part of the agreements. New estimates for strippable subbituminous and

lignite coal resources in eastern Montana fields were prepared by the Montana Bureau of Mines and Geology and indicated the presence of approximately 22,000 million tons of such coal in about 50 different fields. The State's total reserves of all types of coal was estimated at 378,000 million tons, the greatest of any State. The State published a new report based on reconnaissance and drilling of coal beds in McCone County, where at least two large strippable lignite deposits were disclosed.²

² Matson, Robert E. Preliminary Report, Strippable Coal Resources, McCone County, Montana. Montana Bur. of Mines and Geol. Bull. 78, May 1970, 13 pp.

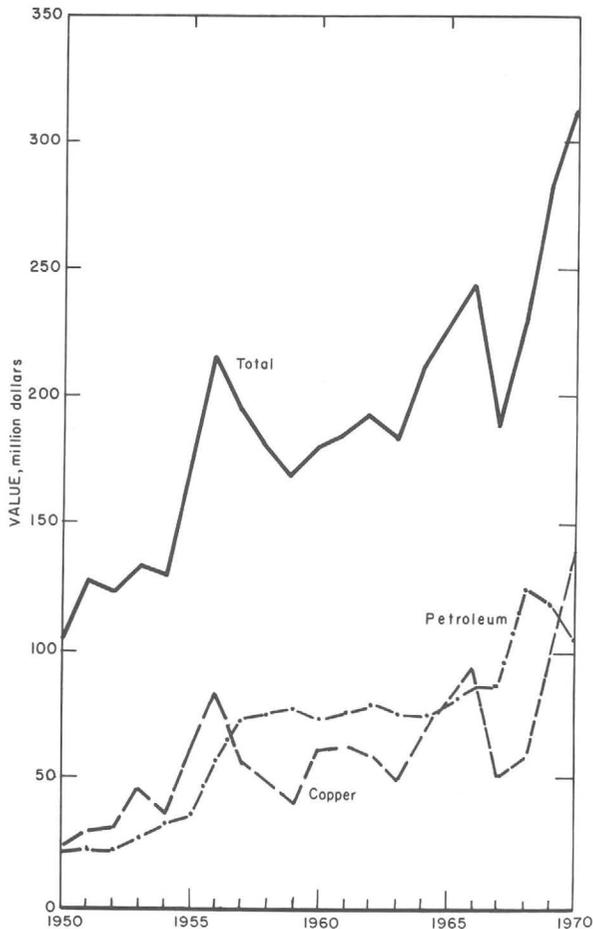


Figure 1.—Value of copper, petroleum, and total value of mineral production in Montana.

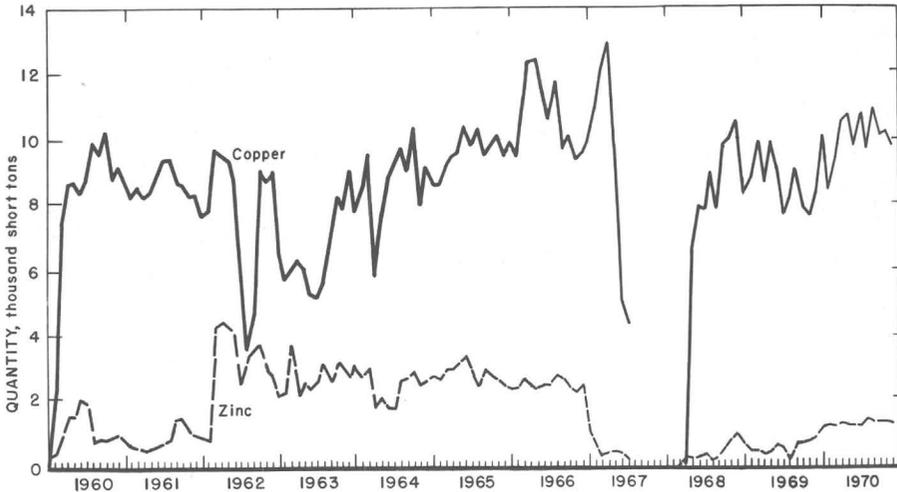


Figure 2.—Mine production of copper and zinc in Montana, by months, in terms of recoverable metals.

Elsewhere, a number of small coal mines in the Roundup area of Montana were closed, reportedly because of inability to meet requirements of the Federal Mine Health and Safety Act of 1969.³

Expansion and modernization programs were underway at The Anaconda Company's Butte and Anaconda operations, and plans were prepared or implemented for installation of various pollution abatement equipment and facilities at most of the firm's Montana operations. Recognition and response to environmental questions about existing and proposed new mineral production facilities was an increasing concern to all mining firms. The problem was heightened by enforcement of Federal Water Quality Control Standards and by expected new standards governing air pollution. Particularly threatened were smelt-

ing and other mineral operations at and near East Helena, Mont., where abatement was expected to be exceptionally costly. Other mineral-producing firms throughout the State prepared for greater expenditures to cover future pollution abatement and land reclamation costs.

Employment in most categories of mining was up for the year but in nonmetal mining employment was down. The average employment in mining was 5 percent higher than in 1969.

Vo-Tech, a vocational training school located in Butte, was selected for a federally supported program to train miners in various phases of underground work. First classes began in December 1970.

³ Ozman, Ray. Law "Killing" Small Coal Mines. Great Falls Tribune, July 11, 1971, p. 1.

Table 3.—Indicators of Montana business activity

	1969	1970	Change, percent
Annual average labor force and employment:			
Total labor force.....	276.9	282.1	+1.9
Unemployment.....	15.5	18.8	+21.3
Employment:			
Manufacturing.....	24.1	23.6	-2.1
Wholesale and retail trade.....	47.0	48.2	+2.6
Mining.....	6.4	6.7	+4.7
Construction.....	10.5	10.9	+3.8
Transportation and public utilities.....	17.6	17.2	-2.3
Finance, insurance, and real estate.....	7.9	8.1	+2.5
Services.....	32.1	33.5	+4.4
Government.....	52.1	52.3	+4
Personal income:			
Total.....	\$2,172	\$2,350	+8.2
Per capita.....	\$3,130	\$3,381	+8.0
Construction activity:			
Value of authorized nonresidential construction.....	\$20.2	\$19.8	-2.0
Highway construction contracts awarded.....	\$76.2	\$74.7	-2.0
Cement shipments to and within Montana thousand 376-pound barrels.....	2,077	1,699	-18.2
Farm marketing receipts.....	\$534.2	\$557.5	+4.4
Mineral production.....	\$282.6	\$313.0	+10.8

Sources: Area Trends in Employment and Unemployment; Employment and Earnings; Survey of Current Business; Construction Review; Streets and Roads; Farm Income Situation; and Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1969:								
Coal and peat..	81	160	13	101	-----	1	9.91	30
Metal.....	2,986	281	838	6,699	2	128	19.41	3,084
Nonmetal.....	562	248	139	1,126	1	23	21.32	5,793
Sand and gravel	831	155	129	1,124	-----	24	21.35	461
Stone.....	490	242	119	975	-----	12	12.31	481
Total ¹	4,950	250	1,237	10,025	3	188	19.05	2,810
1970: ^P								
Coal and peat..	90	162	15	113	-----	1	8.88	27
Metal.....	3,425	303	1,037	8,300	2	174	21.20	3,020
Nonmetal.....	420	245	102	828	-----	28	33.32	6,551
Sand and gravel	830	160	133	1,088	-----	20	18.38	663
Stone.....	470	251	118	962	-----	16	16.63	513
Total ¹	5,230	268	1,404	11,291	2	239	21.34	2,808

^P Preliminary.

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

REVIEW BY MINERAL COMMODITIES

METALS

Aluminum.—Production of aluminum at the Columbia Falls reduction plant of Anaconda Aluminum Co. slightly exceeded that of 1969. The plant utilized Jamaican alumina transported by rail from Everett, Wash., port facilities. A new \$1 million scrubber system was being installed to reduce average daily fluoride emissions of the plant to an expected 2,500 pounds or less. The fluorides have been a subject of complaints by environmental interests.

Antimony.—Only a small tonnage of antimony was produced during 1970. In the last several months of the year, concentrates totaling about 125 tons valued at \$200,000 were produced by U.S. Antimony Corp. from its property in the Prospect Creek area near Thompson Falls, Sanders County. A sink-float mill, reportedly capable of processing 1,800 tons of ore per day, was placed in operation. Reserves were estimated at 300,000 tons of ore occurring in at least two veins several inches to more than 10 feet in width.

Copper.—Mines of The Anaconda Company accounted for virtually all of the 120,412 tons of copper produced in the State. Major expansions were proposed or were in progress at the company's Butte properties. A new \$6 million crushing plant neared completion south of the Berkley pit. Scrap tin cans continued to be used in producing cement copper of about 80-percent purity at the firm's Butte cop-

per precipitation plant, where capacity was being expanded 60 percent. Plans were made to purchase a fleet of 150-ton trucks for use in the Berkley open pit mine, and two new 15-cubic-yard shovels were to be purchased to accompany seven 15-cubic-yard and seven 6-cubic-yard shovels already in service in the pit. Future trials were planned for several 200-ton trucks on order.

Table 5.—Montana: Mine production of gold, silver, copper, lead, and zinc in 1970, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode ore:							
Dry gold.....	2	40	4	19	1	-----	-----
Gold-silver.....	4	6,263	1,407	44,626	4	56	18
Dry silver.....	28	33,035	1,357	418,095	78	154	37
Total.....	34	39,338	2,768	462,740	83	210	55
Copper.....	3	18,720,390	19,438	3,583,016	102,732	-----	-----
Lead.....	12	11,506	157	98,196	7	636	39
Lead-zinc.....	2	26	10	215	-----	3	2
Zinc.....	6	4,994	43	151,587	28	147	1,361
Total.....	23	18,736,916	19,648	3,833,014	102,767	786	1,402
Other lode material:							
Gold-silver and silver tailings.....	4	3,893	26	8,572	6	-----	-----
Copper precipitates.....	1	21,516	-----	-----	17,556	-----	-----
Total.....	5	25,409	26	8,572	17,562	-----	-----
Total lode material.....	61	18,801,663	22,442	4,304,326	120,412	996	1,457
Placer.....	1	-----	14	-----	-----	-----	-----
Grand total.....	62	18,801,663	22,456	4,304,326	120,412	996	1,457

Table 6.—Montana: Gold production at placer mines

Year	Mechanical and hydraulic methods ¹			Small-scale hand methods			Total ²		
	Number of mines	Material treated (thousand cubic yards)	Gold (troy ounces)	Number of mines	Material treated (thousand cubic yards)	Gold (troy ounces)	Number of mines	Material treated (thousand cubic yards)	Gold (troy ounces)
1966.....	³ 4	36	422	1	(⁴)	1	5	36	423
1967.....	⁵ 3	15	141	-----	-----	-----	3	15	141
1968.....	⁶ 2	2	20	1	(⁴)	2	3	3	22
1969.....	⁷ 1	(⁴)	2	1	(⁴)	2	2	(⁴)	4
1970.....	⁷ 1	(⁴)	14	-----	-----	-----	1	(⁴)	14

¹ Combined to avoid disclosing individual confidential data.

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

³ Includes 3 dragline dredges and 1 power rocker.

⁴ Less than 1/2 unit.

⁵ Includes 1 nonfloat washing plant, 1 hydraulic, and 1 power rocker.

⁶ Includes 1 dragline dredge and 1 nonfloat washing plant.

⁷ Hydraulic.

Table 9.—Montana: Mine production of gold, silver, copper, lead, and zinc in Silver Bow County, in terms of recoverable metals

Year	Mines producing		Material sold or treated ¹ (thousand short tons)	Gold, lode and placer (troy ounces)	Silver, lode and placer (thousand troy ounces)
	Lode	Placer			
1966.....	5	-----	17,503	21,608	4,864
1967.....	5	-----	9,041	8,339	1,856
1968.....	6	-----	10,089	9,782	1,466
1969.....	5	-----	16,022	15,428	2,563
1970.....	4	-----	18,745	19,454	3,590
1882-1970.....	-----		² 392,583	2,476,830	652,655
	Copper (short tons)	Lead (short tons)	Zinc (short tons)	Total value (thousands)	
1966.....	127,885	2,411	22,284	\$106,749	
1967.....	65,448	64	816	53,450	
1968.....	69,362	-----	-----	61,580	
1969.....	103,179	-----	W	103,321	
1970.....	120,292	-----	-----	145,881	
1882-1970.....	8,523,253	415,425	2,406,818	4,335,890	

W Withheld to avoid disclosing individual company confidential data.

¹ Does not include gravel washed.

² Complete data not available: 1882-1904.

The Anaconda Company continued exploration for copper and molybdenum in the Continental area, near Butte, where it appeared there was good chance that a large low-grade ore body would be developed into a commercial mine; the company also drove several exploratory adits at its copper-nickel claims in the Stillwater District near Nye, Mont. Other companies reported active in the Stillwater District included Cyprus Mines Corp., Freeport Sulphur Corp., and Johns-Manville Corp. Deposits were reported to lie in a zone of metamorphic rocks extending between Mouat and Boulder Creek, a distance of about 30 miles. An area encompassing over 17,000 acres was reported under claim. Concern was expressed by conservationists and by company officials over maintenance of water quality in the drainage areas below the deposits where open pit mining was contemplated. Technical studies were scheduled to establish controls.

A proposed \$50 million open pit copper-molybdenum mine development by The Anaconda Company near Lincoln, in northwestern Montana, received a setback when the State Land Board withheld easements on school lands along Alice Creek where a tailings pond was planned for the proposed Heddleston mine and mill. The State offered the land subject to 11 protective provisions, which the company decided were too restrictive for a commercial operation. Consequently, Anaconda withdrew

its application. Further work on the property was curtailed and exploration drilling was terminated in December.

Bear Creek Mining Co., subsidiary of Kennecott Copper Corp., continued exploration work at its Spar Lake copper property, south of Troy, northwestern Montana, after reportedly establishing the existence of a sizable deposit minable by underground methods. Plans were announced to build a 20,000-ton-per-day mill and proceed with development. Production is scheduled to start in 1974. Phelps Dodge Corp. announced a lease agreement with Hillside Mines, Inc., and planned to explore a group of claims for copper near Trout Creek, Sanders County.

Gold.—Gold was produced principally as a byproduct of copper refining. During the year, gold output declined to 22,456 ounces valued at \$817,174. One placer mining operation in Meagher County reported a small recovery of gold. Two gold mines in Missoula and Ravalli Counties and four gold-silver mines in Deer Lodge, Jefferson, Lewis and Clark, and Madison Counties contributed to production.

Iron Ore.—Iron ore continued to come only from the Iron Cross open pit mine of R & S Iron Co. near Radersburg; all was used in cement manufacture.

Lead.—The American Smelting and Refining Co. (ASARCO) smelter, at East Helena, accounted for the State's production of refined lead. Mine production was

reported from 12 lead operations throughout the State and was less than in 1969. Shipments came mainly from the Flathead and West Flathead mines, Flathead County; from the Maulden mine, Beaverhead County; and from the True Fissure and Scratchal mines, Granite County. Lead was also recovered from old slag at East Helena as a result of zinc fuming plant operations by The Anaconda Company. Lead extracted during zinc reduction at Anaconda's Great Falls plant was returned to the ASARCO smelter for processing. Mine production statistics for 1970 excluded lead from the old slag, in contrast to earlier years when lead from this source was included.

Manganese.—No manganese production was reported in the State in 1970, but a small quantity of metallurgical-grade ore was shipped from stocks of The Anaconda Company at Butte.

Silver.—The principal source of silver was byproduct output from copper operations in the Butte area. Production rose 26 percent, reflecting expanded output of copper in 1970. Values for the year rose 24 percent; the average annual price for silver declined to \$1.77 per ounce. Production came from about 65 operations in 16 counties, including 28 mines that were principally silver producers. Silver Bow County produced 3,589,679 ounces, Granite County produced 326,961 ounces, and Mineral County had mine outputs exceeding 100,000 ounces. Outputs over 10,000 ounces were reported from mines in Deer Lodge, Flathead, Jefferson, and Madison Counties.

Interest in silver exploration remained high in mining districts throughout the State. Exploration was conducted at the Nancy Lee mine near Superior, Mineral County, and in late 1970 the mill operated at a rate of 150 tons of ore per day. Tierra Exploration, Inc., took over the Nancy Lee operations in April 1970. The Neihart district's Star silver-lead mine, reopened in 1969 by Northwest Mines Development Corp., was being explored, and the mill was rehabilitated. The New Departure mine, in the Bannock district, Beaverhead County, continued production under Spokane National Mines, Inc., and used newly acquired diesel-powered trackless underground mining equipment. Ores from this and other nearby mines were milled at Bannock where it was planned to expand milling capacity to 225 tons per day.

Silver-gold, and silver-lead mines were active also in the Argenta district, Beaverhead County. Midnight Mines, Inc., shipped ore reportedly averaging 19.5 ounces of silver per ton from the Polaris mine in Beaverhead County. Golden Eagle Mining Co. made its first ore shipment from the Hi Tariff mine in the Rimini district, west of Helena. Silver Champion Mines, Inc., used geochemical tests and trench sampling to disclose a series of gold-silver veins at its Silver Bell property near Clancy, south of Helena. Mine workings and surface plant were rehabilitated at the property.

Sierra Silver Mining Co. explored a vein on the Cadgie Taylor property near Philipsburg. Diamond drilling was planned at the property of Silver Lake Silver Mining Co. near Philipsburg where a rich vein about 1-foot wide was exposed by trenching. Hecla Mining Co. reassessed its plans to develop low-grade silver ores found at the Granite-Bimetallic mine at Philipsburg. Mountain Gold & Silver Inc. explored the Blue Bell and Jack Rabbit properties east of Melrose, Madison County, and Eddy Creek Silver Mining Co. core-drilled its property near Plains, north of Superior, Mont. Trojan Silver-Lead Mines, Inc., was completing construction of a 125-ton-per-day mill at the Snowstorm mine near Troy, Lincoln County, with plans to reactivate shaft and hoist facilities and drive a raise between the 1,200-foot level and 1,000-foot portal level. Rob Roy Mining Co. changed its name to Royal Silver Mining Co. and planned to develop its Chancellor group of silver-gold claims in the Warm Springs district of Fergus County.

Tungsten.—Only a few tons of tungsten concentrate was produced in 1970, and none came from Beaverhead County, the source of production in 1969. Montana dropped to fifth place among States producing tungsten. ASARCO completed exploration drilling for tungsten and molybdenum on claims near Goat Creek about 6 miles northeast of Thompson Falls in Sanders County.

Zinc.—Zinc was derived mainly from a number of small lead-zinc-silver operations in the western half of the State and in part as a byproduct of copper mining. Output was reported by 30 mines, including six mines classified as principally zinc producers and two mines classified as principally lead-zinc producers. The largest

zinc-mining operations in the State remained the Taylor-Knapp Unit Area in Granite County. Byproduct zinc was also recovered as zinc oxide at the slag fuming plant of The Anaconda Company at East Helena (this output was excluded from primary mine production data in 1970 in contrast with previous years). Cutbacks in zinc smelter production about mid-year resulted from accumulations of slab zinc inventories. Zinc ores were calcined at Anaconda's Great Falls plant, where the product was refined electrolytically to zinc metal.

NONMETALS

Cement.—Portland and masonry cement shipments declined 21 percent in quantity and 16 percent in value, chiefly because less cement was needed in construction at Libby Dam, which was nearing completion. The two firms that produced cement were Kaiser Cement & Gypsum Corp., at Montana City near Helena, and Ideal Basic Industries, Inc., with a plant at Trident near Three Forks, Mont. Because of consolidated reporting methods adopted in 1970, information on destination of cement shipments from Montana was no longer available. Of total finished portland cement shipped, about 48 percent went by rail and 52 percent by truck. The ratio of bulk to packaged cement was about 10 to 1. About 59 percent of the portland cement produced was distributed to building material dealers and companies making commercial concrete products, including ready-mix concrete. The balance went to highway contractors and Government agencies (34 percent), and to miscellaneous customers (7 percent).

Ideal Basic Industries, Inc. announced plans for a \$10 million modernization program at Trident to include replacement of four old kilns with a single kiln designed for 12 percent greater total capacity. Dust-control equipment was to be installed.

Clays.—Output of all types of clays and shale for use in building products, iron ore pelletizing, and in oil-well drilling muds (bentonite) rose 49 percent in quantity and 95 percent in value in 1970. More than three-fourths of all clays mined were bentonites. Lewistown Brick & Tile Co. near Lewistown, Fergus County, and Lovell Clay Products Co., near Billings, Yellowstone County, continued production of

heavy clay products from locally mined clays and shales.

Federal Ore & Mineral Corp. and Youghiogeny & Ohio Coal Co., both of Cleveland, Ohio, formed the Federal Bentonite Co. and purchased facilities of Ashland Oil, Inc., including a bentonite processing plant under construction near Glasgow and Ashland Oil's northeastern Montana bentonite reserves. The firm was expected to become one of the largest producers of western sodium-based swelling bentonite clays. The new Glasgow plant, expected to be a major supplier of clay binders for iron ore pelletizing, was to be completed in 1971 with a capacity of 300,000 tons per year of granular and pelletized clays.

National Lead Co. continued mining bentonite near Colony, Carter County, for use in drilling muds, and Hallett Minerals Co. mined bentonite near Vananda chiefly for use in pelletizing taconite iron concentrates in Minnesota.

Beds of bentonite within the Bearpaw Shale, exposed in the Ingomar-Vananda area of Treasure and Rosebud Counties were described.⁴

Kiln capacity was increased to 8 cubic yards of lightweight aggregates per hour at the Treasure State Industrial Products, Inc., shale expanding plant near Great Falls; simultaneously, fuel costs were reduced to about \$.70 per cubic yard of shale processed. Work continued on the replacement and expansion of crushing and screening facilities. Treasure State Industrial Products, Inc. operated one of the State's largest concrete block manufacturing plants at Great Falls, where much of the expanded clay product was used.

Fluorspar.—All production and shipments of fluorspar were from the Crystal Mountain mine of Roberts Mining Co. in Ravalli County. Crude fluorspar was upgraded to metallurgical grade at a heavy-media processing plant at Darby, Mont., and sold to steelmakers in the East and Midwest.

Gypsum.—The Shoemaker mine, Fergus County, of United States Gypsum Co., was the State's only producer of gypsum. Output of crude gypsum at the company's Heath plant declined 12 percent; ground

⁴ Berg, Richard B. Bentonite Deposits in the Ingomar-Vananda Area, Treasure and Rosebud Counties. Montana Bur. of Mines and Geol. Spec. Pub. 51, September 1970, 5 pp.

and calcined production remained about the same level compared with that of 1969.

Lime.—Lime production declined 18 percent and value decreased 8 percent in 1970. The Anaconda Company processed quicklime at its Limekiln plant, Deer Lodge County, for metallurgical use and for acid water treatment in tailings disposal. Sugar manufacturers calcined limestone for use in sugar refining in Big Horn, Yellowstone, and Richland Counties. Anaconda, using rock from its Brown's quarry, Deer Lodge County, began production of quicklime at Butte for neutralization of Silver Bow Creek waters.

Phosphate Rock.—Output of phosphate rock declined 51 percent in 1970 owing to a slack fertilizer market. Production, all from three mines in Powell County, went to consumers in the Rocky Mountain region and to Trail, British Columbia, for manufacture into phosphate fertilizers. The poor markets made it necessary for Cominco American, Inc., to phase out or curtail operations at the Anderson and Warm Springs sections of the Brock mine, near Garrison. Stauffer Chemical Co. continued to operate its elemental phosphorus plant at Silver Bow using rock from Soda Springs, Idaho. Litigation continued over questions of air pollution by Rocky Mountain Phosphates, Inc., from its phosphate-rock defluorination plant operations at Garrison, Mont. Phosphorus, the principal resource in Permian rocks of southwest Montana, and distribution of fluorine, uranium, oil shale, and several additional elements were subjects of a report.⁵

Sand and Gravel.—Sand and gravel output rose 16 percent, to 19.3 million tons valued at \$20.2 million, owing mainly to increased demand for highway construction. There was a total of 145 producing pits in 1970, compared with 165 in 1969.

Commercial firms operated 33 plants (22 stationary and 11 portable); total production was 2.2 million tons. Government-and-contractor production totaled 17.1 million tons from 26 plants (three stationary and 23 portable).

Sand and gravel was produced in 53 of the State's 56 counties. Production exceeded 1 million tons in Big Horn, Lincoln, Prairie, Stillwater, Sweet Grass, and Yellowstone Counties. The use distribution was as follows: Road material, 91 percent; building, 4 percent; and miscellaneous, including fill and railroad ballast, 5 percent.

Stone.—Output of stone declined in contrast with that of sand and gravel. Stone was produced in 29 counties, with output ranging from 0.5 to 0.75 million tons in Big Horn, Carbon, Custer, Jefferson, Stillwater, and Sweet Grass Counties.

Traprock, miscellaneous stone, granite, limestone, marble, sandstone, quartz, and quartzite were produced. The traprock and miscellaneous stone was used largely in road construction (4.0 million tons); some (855,000 tons) was also used for riprap, fill, and as railroad ballast.

Limestone output totaling 1.8 million tons came from seven quarries and was used for cement manufacture, lime, and metallurgical purposes. Some was also used as riprap in construction. Limestone was mined in Broadwater, Carbon, Chouteau, Deer Lodge, Gallatin, and Jefferson Counties.

Granite from one quarry in Gallatin County was used in embankments and jet-ties.

Marble was produced from three quarries in Madison and Park Counties and crushed and sized for use in roofing granules, for poultry grit, for manufacturing cement, and road construction.

Sandstone, quartz, and quartzite for use as a source of industrial silica came from six quarries in Broadwater, Dawson, Deer Lodge, Gallatin, Jefferson, and Lincoln Counties. Two quarries supplied sandstone for dimension stone. Crushed and sized silica products were used in cementmaking, ferrosilicon, and metallurgical processes.

Sulfur.—Output of high-purity elemental sulfur declined compared with the 1969 total. Sulfur was recovered by Montana Sulphur & Chemical Co. from byproduct hydrogen sulfide gas obtained from two oil refineries at Billings. Farmers Union Central Exchange operated a sulfur recovery system utilizing byproduct gases received from its oil refinery at Laurel. Sulfuric acid was produced from zinc smelter gases by The Anaconda Company.

Talc.—Four mines, all in Madison County, produced about 8 percent less talc than in 1969. The Smith-Dillon-Crown mine of Chas. Pfizer & Co., Inc. southeast of Dillon, in Beaverhead County reported no production in 1970. Talc was ground and sized by a firm at Barratts, Beaver-

⁵ Swanson, Roger W. Mineral Resources of Permian Rocks of Southwest Montana. U.S. Geol. Survey Prof. Paper 313-E, 1970, pp. 661-777.

Table 10.—Montana: Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1969		1970	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	249	\$463	272	\$440
Fill.....	3	3	5	6
Paving.....	79	149	77	122
Other uses ¹	36	47	14	32
Total ²	367	662	369	600
Gravel:				
Building.....	377	547	502	665
Fill.....	155	109	169	118
Paving.....	1,050	1,244	1,002	1,166
Railroad ballast.....	98	140	75	92
Other uses ³	94	152	72	120
Total.....	1,774	2,192	1,820	2,161
Government-and-contractor operations:				
Sand:				
Building.....	5	12	---	---
Fill.....	21	11	26	18
Paving.....	3,165	2,536	2,193	3,042
Other uses.....	243	121	---	---
Total ²	3,434	2,680	2,218	3,060
Gravel:				
Building.....	4	12	---	---
Fill.....	279	153	475	276
Paving.....	9,618	8,119	14,336	14,122
Other uses.....	1,119	560	57	31
Total ²	11,020	8,849	14,867	14,429
Total sand and gravel ²	16,595	14,383	19,275	20,249

¹ Includes railroad ballast (1969), blast, and other sands.

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

³ Includes miscellaneous gravel (1970), and other gravel.

head County. Output from the Madison County mines of United Sierra Division of Cyprus Mines Corp. was processed at the company grinding plant at Three Forks, and some was shipped out-of-State to grinding plants in Nebraska and California. During the year, the firm initiated a 50- to 100-ton-per-hour talc-washing and upgrading operation at Alder.

The use distribution of talc by industry was as follows, in percent: paper, 38; paint, 28; ceramics, 8; and exports and miscellaneous uses including insecticides, rice polishing, roofing, rubber, textile fillers, and toilet preparations, 26.

Vermiculite.—Montana continued to supply almost two-thirds of the U.S. market for vermiculite. The Zonolite Division, W. R. Grace & Co., operated its open pit vermiculite mine near Libby, Lincoln County, at slightly less than the rate of production in 1969. Most sized vermiculite was shipped out-of-State for exfoliating. Trans-

fer and storage facilities at the mine were changed to permit better use of the conveyor system. Research was directed toward recovery of an asbestos byproduct. Plans were considered for a new beneficiation plant to be built at Libby. The plant would increase output by one-third, to about 1,000 tons of vermiculite per day in 1973.

MINERAL FUELS

Coal.—Bituminous coal and lignite production from 12 active mines (seven underground and five strip in four counties) increased 235 percent above the 1969 level. The increase, as in 1969, was due mainly to further expansion of coal-mining facilities at Colstrip, Rosebud County, by Western Energy Co. and by Peabody Coal Co. It was predicted that Montana coal production would double in 1971 and probably reach 10 million tons per year by 1973.

Table 11.—Montana: Bituminous coal and lignite production, by type of mine and county

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

County	Number of mines			Production (thousand short tons)			Value (thousand dollars)
	Under-ground	Strip	Total	Under-ground	Strip	Total	
Bituminous coal:							
Musselshell.....	4		4	28		28	\$264
Rosebud.....		2	2		3,096	3,096	5,441
Lignite:							
Powder River.....		1	1		1	1	7
Richland.....		1	1		322	322	681
Total.....	4	4	8	28	3,419	3,447	1 6,394

¹ Data does not add to total shown because of independent rounding.

A 6-year contract for shipment to Minnesota of up to 500,000 tons of coal per year from Colstrip was signed in early 1970 between Montana Power Co. and Northern States Power Co., of Minneapolis, Minn. Western Energy Co., a subsidiary of Montana Power Co., by yearend 1970 produced coal from its Colstrip mine at a rate of about 4 million tons per year as a result of expansions. During the year, the firm's output amounted to 1,658,000 tons. The coal was sold mainly for electric power generation in the Chicago, Ill., Minneapolis, Minn., and Billings, Mont. areas. Peabody Coal Co. supplied coal from its Big Sky mine to the Minnesota Power & Light Co. steam-generating plant at Cohasset, Minn. The mine, 6 miles south of Colstrip and producing at 10,000 tons per week in early 1970, acquired a large new dragline for overburden stripping. Peabody considered construction of a rail line from Colstrip leading to extensive deposits of low-sulfur coal on the Cheyenne Reservation near Lame Deer and Ashland.

Richland County was the major source of lignite, mined by Knife River Coal Mining Co. for use at the Montana-Dakota Utilities Co.'s coal-fired steam-electric generating plant at Sidney. Pacific Power & Light Co., signed an agreement with Rosebud Coal Sales Co., subsidiary of Peter Kiewit & Sons, Inc., to mine and market 7 million tons of coal per year from southeastern Montana deposits near Decker, Big Horn County. The coal generally averaged about 9,700 Btu per pound with sulfur content of 1/2 to 1 percent and an ash content of 4 percent. An estimated 50 to 60 million tons was present in a 60-foot-thick seam. The cooperative Decker project was

established to supply coal for electric generating plants in the Midwest and Rocky Mountain States. A 60,000-ton shipment was sent to Illinois during the year for testing.

Consolidation Coal Co. conducted a core-drilling program over a wide area in the Bull Mountains of Musselshell and Yellowstone Counties without disclosing the results. The Powder River Co. drilled about 100 holes in the Moorhead coalfield during 1970. Coal mining leases were granted on 22,195 acres of State-owned lands in Rosebud, Big Horn, Powder River, and Musselshell Counties. Bids averaged \$7.20 per acre.

A proposal was made by a division of the Westmoreland Resources Group to build a \$200 to \$300 million coal-gasification plant that would utilize eastern Montana coal. Gulf Mineral Resources Co. of Denver, Colo., acquired coal exploration permits on 73,500 acres of the Crow Indian Reservation, Big Horn County, and planned a coal-based, synthetic-fuels complex capable of producing 100,000 barrels of crude oil per day. As a necessary part of the project, the firm requested the Bureau of Reclamation to set aside 50,000 acre-feet of water per year from the Yellowtail Unit of the Missouri River Basin Project for plant use. A legislative committee considered the feasibility and legality of a proposal to transport coal slurry by pipeline more than 700 miles from Colstrip to Midwest terminals.

In the Roundup area of Musselshell County, Square Deal Coal Co., Divide Mine, Nies Coal Co., P.M. Coal Co., Cow Creek Coal Co., Western Coal Co., and

Jonie's Mine closed their mines in the period between May 1 and June 7 because of inability to comply with provisions of the Federal Coal Mine Health and Safety Act of 1969. Owners contended that cost of full compliance would be prohibitive. Also closed during the year was the Milk River Coal Mine at Chinook, Mont., a long-time producer. About 10,000 consumers were estimated to have been affected by the closures.

Petroleum and Natural Gas.—Crude petroleum recovery declined 14 percent compared with the 1969 figure of 43.95 million barrels. Petroleum accounted for about 34 percent of the State mineral production value. About 63 percent of the crude oil produced came from the following six fields: the Bell Creek field (7.8 million barrels), in the Powder River Basin of southeastern Montana; the Cabin Creek (3.7 million barrels), Pine (3.3 million barrels), and Pennell fields (1.6 million barrels), in the Williston Basin; the Cut Bank field (5.4 million barrels), in northern Montana; and the Elk Basin field (2.1 million barrels), in south-central Montana.

The Bell Creek field, Powder River County, accounted for slightly over 20 percent of total production and operated at a significantly lower rate than in 1969. However, it remained the State's largest producing field. The Cut Bank field, Glacier and Toole Counties, which ranked second in 1970, remained the leading alltime producing field in Montana. Its cumulative output was 123.6 million barrels, about 17 percent of total cumulative State production of 721.84 million barrels.

During the year, the estimated recoverable reserves of petroleum declined 4.7 million barrels. Secondary recovery, mostly by waterflood, continued to contribute to Montana production, with good response reported at the Kevin Sunburst, Bell Creek, and Big Coulee fields. A total of 58 secondary recovery projects throughout the State provided an estimated 25 percent of overall production.

Marketed production of natural gas increased 4 percent to 42.7 billion cubic feet valued at \$4.4 million. The Bell Creek field was the largest source of natural gas, followed by the Cut Bank field. Although

an expected international pipeline outlet to Saskatchewan, Canada, failed to gain approval, development of important natural gas reserves in the Tiger Ridge field, north of the Bearpaw Mountains continued; the number of shut-in wells reached about 100 on a 640-acre grid spacing. Ten wells connected to a local pipeline produced slightly over 2 billion cubic feet of gas in 1970. Several large new lease blocks were assembled in Montana, principally for gas exploration. Montana-Dakota Utilities Co. announced plans for construction at Miles City, Custer County, of a 20-megawatt, natural gas-fired, steam-electric generating plant, to be operational about May 1972.

Montana Power Co., through its subsidiary, Canadian-Montana Pipe Line Co., entered into an agreement with Alberta & Southern Gas Co. Ltd. to purchase an additional 20 million cubic feet of Canadian natural gas per day, which was to start in November 1971. An application was filed with the National Energy Board of Canada for authority to export the gas from Canada, which would bring to 100 million cubic feet per day the volume imported into Montana from the Canadian firm.

Exploratory drilling declined both in footage and in the number of wells. The average depth of hole was slightly less in 1970, reflecting increased drilling for gas which tends to be at shallower depths. Percentage of successful oil and gas completions in 1970 was less than in 1969. Table 12 shows results by county, as reported by the American Petroleum Institute.

An estimated 42.33 million barrels of oil was refined in Montana at 10 oil refineries. The three largest refiners, which processed 87 percent of the total refined, were Humble Oil & Refining Co. (14.5 million barrels), Continental Oil Co. (13.8 million barrels), and Farmers Union Central Exchange, Inc. (8.7 million barrels). Montana wells supplied only part of the crude oil refined; other crude entered the State from Wyoming and Canada. During the year Canadian Hydrocarbons Ltd. of Calgary, Alberta, purchased the 4,100-barrel-per-day Union Oil Co. refinery at Cut Bank and planned to continue operation under the name of its U.S. affiliate, Wesco Inc.

Table 12.—Montana: Oil and gas well drilling completions in 1970, by counties

County	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Beaverhead.....						1	1	4,125
Big Horn.....						9	9	41,543
Blaine.....		14	13			44	71	203,755
Carbon.....			1			2	4	25,967
Carter.....	1					39	40	164,534
Chouteau.....					1	10	11	18,590
Custer.....						8	8	43,810
Daniels.....				1		8	9	53,552
Dawson.....	1					3	4	41,450
Fallon.....	3		1	2		5	11	79,841
Fergus.....						10	10	29,047
Garfield.....						4	4	24,126
Glacier.....	10	5	3			2	20	62,969
Golden Valley.....						1	1	1,700
Hill.....		27	22		9	53	111	203,212
Jefferson.....						1	1	1,005
Judith Basin.....						4	4	3,809
Liberty.....		3	3	1	2	20	29	81,555
McCone.....						4	4	23,479
Musselshell.....	2		6	5		10	23	100,824
Petroleum.....	1		1			3	5	6,296
Phillips.....					1	10	11	38,572
Pondera.....	11		5			5	21	65,370
Powder River.....	3		14			48	65	350,507
Prairie.....						4	4	22,545
Richland.....	3			5		7	15	178,495
Roosevelt.....				2		3	5	42,136
Rosebud.....			2			23	25	145,749
Sheridan.....	6		3	4		12	25	213,818
Stillwater.....						1	1	2,322
Sweet Grass.....						1	1	2,548
Teton.....						2	2	13,300
Toole.....	2	5	7	1	6	15	36	71,422
Treasure.....						1	1	7,177
Valley.....						4	4	19,113
Wibaux.....	1					2	3	30,895
Yellowstone.....						4	4	17,839
Total.....	43	54	82	21	20	383	603	2,447,497

Source: American Petroleum Institute.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Metals:			
Aluminum:			
Anaconda Aluminum Co.	Columbia Falls, Montana 59912.	Reduction plant.	Flathead.
	Great Falls, Montana 59401	Rolling mill.	Cascade.
Copper:			
The Anaconda Company ¹	Anaconda, Montana 59711	Smelter.	Deer Lodge.
	Butte, Montana 59701	Mine, concentrator, precipitating plant.	Silver Bow.
	Great Falls, Montana 59401	Refinery, rolling mill.	Cascade.
Iron ore:			
R & S Iron Co.	Radersburg, Montana 59641	do.	Broadwater.
Lead-zinc:			
American Smelting and Refining Co.	East Helena, Montana 59635	Smelter.	Lewis and Clark.
The Anaconda Company	do.	Slag fuming plant.	Do.
	Great Falls, Montana 59401	Zinc plant.	Cascade.
John Hand ²	Dillon, Montana 59725	Mine.	Beaverhead.
J. W. Keenan ²	Helena, Montana 59601	do.	Lewis and Clark.
William Schneider ²	Philipsburg, Montana 59858	do.	Granite.
Taylor-Knapp Co. ³	do.	Mine and mill.	Do.
Silver:			
Frank Antonioli ⁴	Butte, Montana 59701	Mine.	Granite, Silver Bow.
Delbert Bullock ⁴	Basin, Montana 59631	do.	Jefferson.
Flathead Mines, Inc. ⁵	Kalispell, Montana 59901	do.	Flathead.
Harold Giulio ⁴	Boulder, Montana 59632	do.	Jefferson.
Joe Metesh ⁶	Philipsburg, Montana 59858	do.	Granite.
Moulton Mines ⁷	Niehart, Montana 59465	do.	Broadwater.

See footnotes at end of table.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Metals—Continued			
Silver—Continued			
Pacific Mines, Inc. ⁴	Virginia City, Montana 59755	Mine	Madison.
Tierra Explorations, Inc. ⁴	2003 Wilco Bldg. Midland, Texas 79701	do	Mineral.
Dick Tunstall ⁶	Philipsburg, Montana 59858	do	Deer Lodge, Granite.
Albert Walkup ⁶	do	do	Granite.
James W. Young ⁶	do	do	Do.
Tungsten:			
Minerals Engineering Co....	Glen, Montana 59732	Mine and mill	Beaverhead.
Nonmetals:			
Cement:			
Ideal Cement Co.....	420 Ideal Cement Bldg. Denver, Colorado 80202	Plant	Gallatin.
Kaiser Cement & Gypsum Corp.	Permanente Road Permanente, California 95014	do	Jefferson.
Clays:			
Hallett Minerals Co.....	P.O. Box 491 Forsyth, Montana 59327	Pit	Rosebud, Treasure.
Ideal Cement Co.....	420 Ideal Cement Bldg. Denver, Colorado 80202	Pit and plant	Gallatin.
Kanta Products, Inc.....	P.O. Box 96 Three Forks, Montana 59752	do	Do.
Kaiser Cement & Gypsum Corp.	Permanente Road Permanente, California 95014	do	Jefferson.
Lewistown Brick & Tile Co...	P.O. Box 573 Lewistown, Montana 59457	do	Fergus.
Lovell Clay Products Co....	1312 Lockwood Road Billings, Montana 59101	do	Yellowstone.
Baroid Division (NL) Industries.	P.O. Box 1675 Houston, Texas 77001	Pit	Carter.
Stauffer Chemical Co.....	P.O. Box 3146 Butte, Montana 59701	Pit and plant	Silver Bow.
Treasurelite, Division of Treasure State Industrial Products, Inc.	P.O. Box 2750 Great Falls, Montana 59401	do	Cascade.
Fluorspar:			
Roberts Mining Co.....	P.O. Box 365 Darby, Montana 59829	Mine and plant	Ravalli.
Gypsum:			
United States Gypsum Co...	Lewistown, Montana 59457	Underground mine and calcining plant.	Fergus.
Lime:			
The Anaconda Company...	Butte, Montana 59701	Plant	Deer Lodge.
Phosphate rock:			
Cominco American, Inc....	Garrison, Montana 59731	Mine and plant	Powell.
A. G. Jackson.....	Elliston, Montana 59728	Mine	Do.
Stauffer Chemical Co.....	299 Park Ave. New York, New York 10017	Plant	Silver Bow.
Sand and gravel:			
Billings Sand & Gravel.....	215 N. 16th St. Billings, Montana 59101	Pit and plant	Yellowstone.
McElroy & Wilken, Inc....	Box 35 Kalispell, Montana 59901	do	Flathead.
Midland Materials Co.....	Box 2521 Billings, Montana 59103	do	Yellowstone.
Oscar J. Mortenson.....	Cascade, Montana 59421	do	Cascade.
Pioneer Ready Mix.....	Box 818 Bozeman, Montana 59715	do	Gallatin.
Richardson Constr. Co....	Box 449 Miles City, Montana 59801	do	Various.
Stone:			
The Anaconda Company...	Anaconda, Montana 59711	Quarry and plant	Deer Lodge.
Ideal Cement Co.....	420 Ideal Cement Bldg. Denver, Colorado 80202	do	Gallatin.
Kaiser Cement & Gypsum Corp.	Permanente Road Permanente, California 95014	do	Jefferson.
R. J. Studer & Sons.....	Billings, Montana 59101	do	Blaine, Toole, Yellowstone.
Washington Constr. Co....	500 Taylor Missoula, Montana 59801	do	Granite.
Sulfur:			
Farmer's Union Central Exchange, Inc.	P.O. Box 126 Laurel, Montana 59044	Plant	Yellowstone.
Montana Sulphur & Chemical Co.	P.O. Box 1084 Billings, Montana 59103	do	Do.
Sulfuric acid:			
The Anaconda Company...	Anaconda, Montana 59711	do	Deer Lodge.

See footnotes at end of table.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Nonmetals—Continued			
Talc and soapstone:			
Chas. Pfizer & Co., Inc.....	Dillon, Montana 59725.....	Plant.....	Beaverhead.
United Sierra Division of Cyprus Mines Corp.	Cameron, Montana 59720..... Three Forks, Montana 59752...	Mine..... do.....	Madison. Do.
Vermiculite:		Plant.....	Gallatin.
W. R. Grace & Co.....	62 Whittemore Ave. Cambridge, Massachusetts 01109	Pit and plant.....	Lincoln.
Exfoliated vermiculite:			
Robinson Insulation Co.....	12th St. N. & River Drive Great Falls, Montana 59401	Plant.....	Cascade.
Mineral fuels:			
Coal:			
Divide Coal Mining Co.....	P.O. Box 342 Roundup, Montana 59072	Mine.....	Musselshell.
Knife River Coal Mining Co.	Savage, Montana 59262.....	do.....	Richland.
Nies Coal Co.....	905 First St. W Roundup, Montana 59072	do.....	Musselshell.
Peabody Coal Co.....	Box 235 St. Louis, Missouri 63166	do.....	Rosebud.
P & M Coal Mine.....	Goulding Creek Route Roundup, Montana 59072	do.....	Musselshell.
John H. Schoonover.....	P.O. Box 94 Ashland, Montana 59008	do.....	Powder River.
Square Deal Coal Co.....	220 7th St. W Roundup, Montana 59072	do.....	Musselshell.
Western Energy Co.....	40 E. Broadway Butte, Montana 59701	do.....	Rosebud.
Natural gas processing:			
Union Texas Petroleum Division, Allied Chemical Corp.	P.O. Box 2120 Houston, Texas 77001	Plant.....	Fallon.
Westco Refining Co.....	Box 318 Cut Bank, Montana 59427	do.....	Glacier.
Peat:			
Martin's Peat & Potting Soils.	Swan Lake, Montana 59872....	Bog.....	Lake.
Petroleum Refining:			
Big West Oil Co. of Mon- tana.	Kevin, Montana 59454.....	Refinery.....	Toole.
Continental Oil Co.....	Billings, Montana 59101.....	do.....	Yellowstone.
Diamond Asphalt Co.....	Chinook, Montana 59523.....	do.....	Blaine.
Farmer's Union Central Ex- change, Inc.	Laurel, Montana 59044.....	do.....	Yellowstone.
Humble Oil & Refining Co..	Billings, Montana 59101.....	do.....	Do.
Jet Fuel Refinery.....	Mosby, Montana 59058.....	do.....	Garfield.
Phillips Petroleum Co.....	Great Falls, Montana 59401....	do.....	Cascade.
Spruce Oil Corp.....	Wolf Point, Montana 59201....	do.....	Roosevelt.
Westco Refining Co.....	Box 318 Cut Bank, Montana 59427	do.....	Glacier.

¹ Also gold and silver.² Also copper, gold, and silver.³ Also silver.⁴ Also copper, gold, lead, and zinc.⁵ Also copper, lead, and zinc.⁶ Also copper and gold.⁷ Also lead and zinc.

MONTANA PHOSPHATE PRODUCTS COMPANY

1124 Willow Creek Road
Prescott, Arizona
May 25, 1965

Mr. E. Grover Heinrichs
Heinrichs Geoexploration Co.
P.O. Box 5671
Tucson, Arizona



Dear Mr. Heinrichs:

I am enclosing herewith three copies of a proposed mining agreement and option on your claims at Poland Junction. Should this agreement be satisfactory, please sign before a notary and return to me.

If there are any questions, do not hesitate to call me at 445-4782.

Sincerely yours,

John S. Phillips

MINING AGREEMENT AND OPTION

THIS MINING AGREEMENT AND OPTION made and entered into this _____ day of May, 1965, by and between E. GROVER HEINRICHS, of Tucson, Arizona, first party, and MONTANA PHOSPHATE PRODUCTS COMPANY, a corporation, second party.

WITNESSETH:

First party does hereby lease unto second party with option to purchase under the terms and conditions hereinafter set forth, all those certain unpatented mining claims situate in the Big Bug Mining District, Yavapai County, Arizona, the location notices of which are recorded in the office of the County Recorder of Yavapai County, Arizona, as follows:

<u>Name</u>	<u>Book Official Records</u>	<u>Page</u>
Kathy No. 1	281	281
Kathy No. 2	281	282
Kathy No. 3	281	283
Kathy No. 4	281	284
Kathy No. 5	281	285
Kathy No. 6	281	286
Kathy No. 7	281	287
Kathy No. 8	281	288
Bug No. 33	282	596
Bug No. 34	282	597
Bug No. 35	282	598
Bug No. 36	282	599
Bug No. 37	282	600
Bug No. 38	283	1
Bug No. 65	283	27

I

Second party shall have exclusive possession of the above described property, subject to provisions of paragraph six (6) herein, for the purpose of conducting mining operations thereon, and second party is hereby granted an exploration period from June 1, 1965, to June 1, 1968, for the purpose of inspecting, sampling, drilling, assaying and performing other operations in conformity with good mining practice to determine ore content, value of minerals and feasibility of conducting mining operations on said property. Prior to September 1, 1965, and each assessment year thereafter so long as

this agreement shall remain effective, second party agrees to perform work on or for the benefit of said claims of a value of not less than \$1,500.00, said work to be of such character as to satisfy the annual labor requirements for the assessment year in which said work is performed.

II

At the end of such exploration period, unless this agreement is sooner terminated by second party, second party shall elect either to terminate this agreement and deliver possession of said mining claims to first party or purchase said mining claims for the sum of ^{750,000.00} \$250,000.00 payable by second party to first party at the VALLEY NATIONAL BANK OF ARIZONA, Prescott, Arizona, in installments as follows:

- \$5,000.00 on or before June 1, 1968; *JUNE 1 1966, or equivalent in work performed.*
- \$5,000.00 on or before June 1, 196⁷9; and
- ³ \$10,000.00 on or before the 1st day of June each year thereafter until the full amount of the purchase price of ~~\$250,000.00~~ ^{750,000.00} is paid.

In the event second party shall produce ores or concentrates from said property prior to full payment of the purchase price, first party shall receive a royalty of five per cent (5%) of the net value of such ores or concentrates produced from said mining claims. The net value shall be deemed to be the gross value after processing, where processing is necessary for commercial use, less the actual cost of transportation from the place of production to the place of processing, less costs of processing and taxes levied and paid upon the production thereof. In case of minerals not processed for commercial use, the net value shall be the gross proceeds, or gross value, at the place of sale or use, less the actual cost of transportation from the place of production to the place of sale or use, less taxes, if any, levied and paid upon the production thereof. Such royalties so paid by second party to first party shall apply and be credited to the minimum payments and the purchase price due

or to become due hereunder.

III

Upon the payment of the first installment on the purchase price on or before June 1, 1968, and upon demand by second party, first party agrees to enter into an escrow at the VALLEY NATIONAL BANK OF ARIZONA, Prescott, Arizona, and deposit therein a good and sufficient mining deed to second party conveying the mining property described herein. First party represents that he is the owner of the property described herein by right of location, subject only to the paramount title of the United States in unpatented mining claims. The escrow agent shall be instructed by the parties to deliver said deed to second party upon full payment of the purchase price, and the expenses of any title insurance and suit to quiet title required by second party shall be at the expense of second party.

IV

Second party shall have the right to use all water already developed, if any, on said mining claims for exploration and mining purposes and shall also have the right to develop additional water anywhere on the property described herein. First party shall have access to drill cores, assay reports, geophysical data, geochemical data and geographical maps during the progress of exploration work, and should second party elect not to purchase said property, all such factual technical data will be provided to first party within ninety (90) days after termination of this lease and option agreement.

V

Second party shall have the right to erect and operate a mill and other facilities on the premises described herein for the reduction of ores and shall have the right to construct and maintain all necessary facilities for the storage of tailings on the property described herein. Second party shall also have the

right to develop and use such water as may be necessary for mining operations on said property and , in this connection, it is understood that second party shall not allow any water used for mining operations which has been polluted with poisons or harmful substances to become exposed to livestock in the area or to escape and contaminate other sources of supply for domestic or stock waters.

VI

During the exploration period granted herein, first party shall have the right to enter upon said property for the purpose of inspection, surveying or taking samples therefrom in a manner so as not to interfere with the work of second party. Second party shall pay all taxes levied or assessed by reason of mining operations on the property described herein before the same shall become delinquent and shall be responsible for all debts and liabilities incurred in the performance of work on said property and shall keep posted notices of non-liability as provided by law, which notices shall be furnished by first party. Second party agrees that it will comply with all the rules and regulations of the Industrial Commission of Arizona pertaining to insurance of employees, and that all work performed on said property shall be in good miner-like fashion and in compliance with all state and federal rules and regulations pertaining to the mining industry.

VII

In addition to being responsible for annual labor on said mining claims for the assessment year 1964-1965, second party shall be responsible to first party for required annual labor on said claims while this lease and option is effective on September 1st of any year. Upon failure of second party to perform required annual labor or make required payments on the purchase price as provided herein or perform the covenants herein imposed on second party, this agreement may be

terminated by first party and possession of said property shall be redelivered by second party to first party. However, second party may terminate this agreement on June 1st of any year, providing all annual labor required or payments due for such current year are not delinquent. Notice of such termination shall be given by second party by mail addressed to his current address, not less than ten (10) days prior to the date of termination.

This agreement shall be assignable and its terms shall be binding upon the heirs, personal representatives, successors and assigns of the parties hereto.

IN WITNESS WHEREOF, the parties hereto have executed this agreement as of the day and year first above written.

E. Grover Heinrichs
First Party

MONTANA PHOSPHATE PRODUCTS COMPANY,
a corporation,

ATTEST:

By _____

Secretary

Second Party

STATE OF ARIZONA)
) SS.
COUNTY OF _____)

The foregoing instrument was acknowledged before me this _____ day of _____, 1965, by E. GROVER HEINRICHS, First Party.

Notary Public

My commission expires:

4/30/65

John Philipps Called;

RE: KATHY Claim Group

His lawyer wants to have an
end price set up.

I said I would discuss this
with Watt and let him know.

E.G.H

File Montana Phosphate

we call
him

Mont Thistle

John Phillips called re: Kathy agreement.

5/28/65

445 - 4782 office phone. (rings also at home)

Little tougher 2nd year. ok.

Work commitment, best.

Minimizing regret.

Count on our response by early next
week (ie) Draft today! ??

W.

either retype
or initial
changes &
additions

Montana Phosphate F

4/21/65

John Phillips called is in Tucson
wants to stop by late this P.M.

I said ok.

W.

Montana Phosphate
Sub. Consl.
Murray
4/22/65
Canada
(Venters
Ltd.)

John Phillips was in again.

1. Map I.P., Geochem
Drill logs, Claim maps, geol.
Core.

2. How geochem sampled. rock soils etc.

3. Chem assays on core or what kind of assays

4. Deeper I.P. data. check Rodgers

5. Map collation:

Mont Prospect

4/21/65

John Phillippe was in

Essentially state lease type

1500 assessment obligation 1964-1965 yr.

1500 " " 1965-1966 yr.

etc. term of agreement.

Lookup G.P. data and advise John re amt.
over & above that recorded.

State ownership title of record, (offered)
check on P.D. quit claim deed,

John will be in around 6 P.M. Thurs. 4/22/65