

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.

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MINERAL production value in Montana in 1962 was the third highest on record. The \$190.7 million produced from mines, pits, quarries, and wells in the State was exceeded only in 1956 (\$213.8 million) and 1957 (\$191.7 million). The advance of \$6.4 million over that of 1961 was the result of greater production of crude petroleum, sand and gravel, zinc, and silver. These gains more than offset the lower output of copper caused by a strike at Butte and the loss resulting from the termination of chromite mining at the Mouat mine in Stillwater County.

Output of crude petroleum continued to increase. Petroleum was the leading mineral product in Montana in terms of value. The rise in sand and gravel production was attributed to increased highway construction. Greater zinc and silver production resulted from the start of production from the Elm Orlu-Black rock block caving project at Butte; no zinc ore had been mined at Butte in 1961. The increased price of silver was a factor in the higher annual value of that commodity.

Crude petroleum, copper, and sand and gravel supplied 80 percent of the annual value of mineral production in Montana in 1962. Silver Bow County (mainly copper, zinc, and silver) and Fallon County (petroleum and natural gas) furnished 47 percent of the State total. The production-quantity index increased 1 point, from 123 to 124 (1959=100).

The Anaconda Company began building a 42,000-ton-per-day copper-ore concentrator next to the Berkeley pit at Butte. The new plant, part of which was scheduled to begin operating late in 1963, would eliminate rail transportation of crude ore from Butte to the concentrator at Anaconda, Deer Lodge County.

Work began on the Permanente Cement Co. plant near Helena. Completion of the \$9.6 million facility was expected early in 1963, and thereafter shipments of cement were to begin for constructing the Yellowtail Dam on the Big Horn River.

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TABLE 1.—Mineral production in Montana¹

Mineral	1961		1962	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Chromium ore and concentrate ²short tons, gross weight..	82,258	\$2,939		
Clays ³thousand short tons..	55	76	56	\$77
Coal (bituminous and lignite).....do.....	371	1,207	382	1,140
Copper (recoverable content of ores, etc.).....short tons..	104,000	62,400	94,021	57,917
Fluorspar.....do.....	14,905	(⁴)	(⁴)	(⁴)
Gold (recoverable content of ores, etc.).....troy ounces..	35,377	1,238	24,387	854
Iron ore (usable).....thousand long tons, gross weight..	34	209	9	62
Lead (recoverable content of ores, etc.).....short tons..	2,643	544	6,121	1,126
Lime.....thousand short tons..	118	986	104	1,049
Manganese ore and concentrate (35 percent or more Mn) short tons, gross weight..	17,515	⁵ 1,372	24,758	(⁴)
Manganiferous ore and concentrate (5 to 35 percent Mn).....do.....	2,236	33	2,264	29
Natural gas.....million cubic feet..	33,901*	2,509	29,955	2,217
Peat.....short tons..	7,385	112	(⁴)	(⁴)
Petroleum (crude).....thousand 42-gallon barrels..	30,906	74,793	⁵ 31,648	⁵ 76,690
Sand and gravel.....thousand short tons..	14,702	13,506	18,473	17,642
Silver (recoverable content of ores, etc.).....thousand troy ounces..	3,490	3,227	4,561	4,948
Stone.....thousand short tons..	1,512	1,849	996	1,708
Uranium ore.....short tons..	729	10	(⁴)	(⁴)
Zinc (recoverable content of ores, etc.).....do.....	10,262	2,360	37,678	8,666
Value of items that cannot be disclosed: Barite, cement, gem stones, gypsum, mica, natural gas liquids, phosphate rock, talc, thorite concentrate (1962), tungsten, vermiculite and values indicated by footnote 4.....		⁵ 14,863		16,531
Total.....		⁵ 184,233		190,656

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

² Excludes tonnage used for ferrochromium production; included with "Value of items that cannot be disclosed."

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

⁴ Figure withheld to avoid disclosing individual company confidential data.

⁵ Revised figure.

⁶ Preliminary figure.

Consumption, Trade, and Markets.—Demand for construction materials, such as sand and gravel and cement, increased owing to the impact of several large projects, including record highway construction, dams near Hardin and Dillon, and missile base construction. The \$45 million total of contracts awarded by the Montana Highway Commission in 1962 included \$23.7 for interstate highways, \$9.8 for primary highways, and \$7.9 million for secondary roads.

Personal income in Montana increased 17 percent as the result of higher farm income following a 1961 decrease in farm marketings, the result of a drought.

Employment.—In nonagricultural industries, average employment rose 2 percent. Average monthly employment in metal mining and primary metals processing decreased owing to a strike in the Montana copper-mining industry. Small gains in employment were recorded in the production and refining of petroleum. Average employment in the construction industry advanced 6 percent.

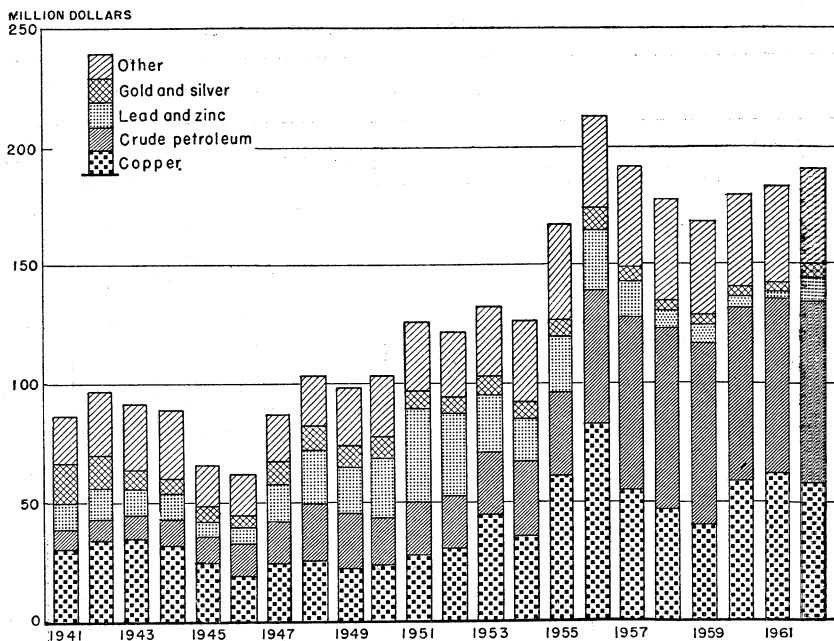


FIGURE 1.—Value of copper, crude petroleum, lead and zinc, gold and silver, and total value of mineral production in Montana, 1941-62.

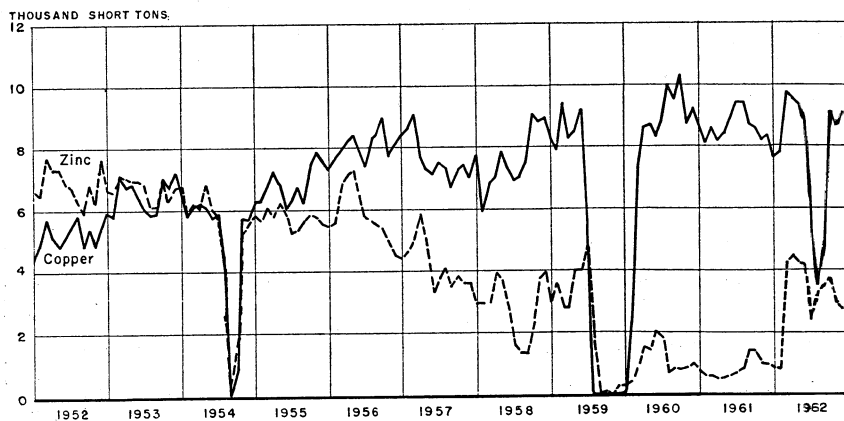


FIGURE 2.—Mine production of copper and zinc in Montana, 1952-62, by months, in terms of recoverable metals.

TABLE 2.—Indicators of Montana business activity

	1961	1962 ¹	Change, percent
Personal income:			
Total.....million dollars..	1,339.0	1,572.0	+17.4
Per capita.....dollars..	1,963.0	2,217.0	+12.9
Construction activity:			
Building permits.....million dollars..	33.9	29.9	-11.8
Heavy engineering awards.....do...	178.5	71.0	-60.2
Highway construction contracts awarded.....do...	42.6	45.0	+5.6
Cement shipments to and within Montana.....thousand 376-pound barrels..	1,085.3	1,291.5	+19.0
Cash receipts from farm marketings.....million dollars..	365.3	428.2	+17.2
Mineral production.....do...	184.3	190.7	+3.5
Annual average employment:			
Total nonagricultural industries.....thousands..	166.2	170.0	+2.3
Total manufacturing.....do...	20.2	22.0	+8.9
Lumber and timber industries.....do...	7.3	8.0	+10.0
Metal-mining and primary-metal industries.....do...	7.8	7.4	-5.1
Contract construction.....do...	11.6	12.3	+6.0
Transportation and utilities.....do...	18.3	18.0	-1.6

¹ Preliminary figures.

Source: Survey of Current Business, Construction Review, Pacific Builder & Engineer, Montana Highway Commission, The Farm Income Situation, Montana Labor Market, and Bureau of Mines.

TABLE 3.—Employment for selected mineral industries

Year	Total mining	Metal mining	Nonmetals, including coal	Petroleum and natural gas	Processing	
					Primary metals	Petroleum refining
1953-57 (average).....	11,600	8,000	1,000	2,600	4,140	1,200
1958.....	8,700	5,300	700	2,700	4,200	1,000
1959.....	7,800	4,600	700	2,500	3,100	900
1960.....	7,400	4,500	700	2,200	3,800	900
1961.....	7,100	4,200	700	2,200	3,600	1,000
1962.....	6,900	3,900	700	2,300	3,500	1,100

Source: Montana State Employment Service, Montana Labor Market. Excludes proprietors and self-employed. Industry groups may vary from those in the Bureau of Mines canvass.

TABLE 4.—Hours and earnings data in mining and related industries

Industry	1958	1959	1960	1961	1962
Mining:					
Average weekly earnings.....	\$97.42	\$101.91	\$103.74	\$108.14	\$111.24
Average weekly hours.....	39.6	40.6	39.9	40.2	41.2
Average hourly earnings.....	\$2.46	\$2.51	\$2.60	\$2.69	\$2.70
Metal mining:					
Average weekly earnings.....	\$93.56	(1)	\$101.79	\$106.52	\$107.25
Average weekly hours.....	38.5	(1)	39.0	39.6	39.0
Average hourly earnings.....	\$2.43	(1)	\$2.61	\$2.69	\$2.75
Primary-metals processing:					
Average weekly earnings.....	\$91.57	(1)	\$96.53	\$102.40	\$102.82
Average weekly hours.....	39.3	(1)	39.4	40.0	39.7
Average hourly earnings.....	\$2.33	(1)	\$2.45	\$2.56	\$2.59

¹ Strike in metal-mining industry beginning Aug. 19, 1959, unsettled at yearend.

Source: Montana State Employment Service, Montana Labor Market. Hours and earnings data exclude administrative and salaried personnel. Average weekly and hourly earnings include overtime and other premium pay.

Government Programs.—Two new contracts were active under the program of the Office of Minerals Exploration (OME), U.S. Department of the Interior. These involved work at gold-silver claims in Phillips County by Northern Continental, Inc., and at silver-lead-

zinc properties in Granite County by Trout Mining Co. The costs were \$76,100 and \$77,610, respectively, with Government participation of 50 percent. Also active was a contract approved in 1960 for lead-zinc exploration in Broadwater County by Northern Milling Co., Inc.

TABLE 5.—Employers, wage earners, and wages in mining

Fiscal year	Average number of employers	Average number of wage earners	Wages (thousands)	Average annual wage
1953-57 (average).....	525	11,593	\$57,324	\$4,945
1958.....	448	9,019	48,503	5,378
1959.....	416	8,722	46,017	5,276
1960.....	492	6,641	36,031	5,426
1961.....	480	7,453	44,092	5,916
1962.....	464	6,882	41,800	6,075

Source: Unemployment Compensation Commission of Montana, Montana Labor Market. Industries and employment covered under unemployment insurance laws of Montana.

TABLE 6.—Employment and injuries in the mineral industries

Year and industry	Men working daily	Average active days	Man-hours worked	Fatal injuries	Nonfatal injuries	Injuries per million man-hours
1961:						
Quarries and mills ^{1,2}	221	257	455,127	-----	5	11
Nonmetal mines and mills.....	713	210	1,198,661	-----	33	28
Sand and gravel operations ²	276	164	361,077	-----	14	39
Metal mines and mills.....	3,470	279	7,753,392	3	187	25
Coal mines.....	159	145	179,560	1	12	72
Total.....	4,839	257	9,947,817	4	251	26
1962: ³						
Quarries and mills ^{1,2}	221	214	378,921	-----	5	13
Nonmetals mines and mills.....	627	234	1,175,849	-----	33	28
Sand and gravel operations ²	256	135	276,729	1	6	25
Metal mines and mills.....	3,805	250	7,616,509	5	176	24
Coal mines.....	130	130	135,465	-----	4	30
Total.....	5,039	238	9,583,473	6	224	24

¹ Includes cement- and lime-processing plants.

² Includes only commercial operations.

³ Preliminary figures.

REVIEW BY MINERAL COMMODITIES

METALS

Aluminum.—The Anaconda Aluminum Co. operated its Columbia Falls primary aluminum plant at capacity (approximately 65,000 tons annually) throughout the year. This was the first full year of capacity production since operations began in 1955. Wire and sheet ingots for fabrication and casting ingots for use by foundries were the major products. Wire ingots were shipped to the Anaconda Wire & Cable Co. plant at Great Falls, and sheet ingots were sent to a company sheet-rolling plant at Terre Haute, Ind.

The Anaconda Company reactivated an experimental metallurgical pilot plant at Anaconda, Deer Lodge County, to extract alumina from clay mined from deposits near Moscow, Idaho. Approximately 5 tons of alumina per day was produced at the plant.

A study of the Pacific Northwest aluminum industry was published by the Bureau of Mines.⁴

Chromite.—No chromite was produced. American Chrome Co. stopped production in 1961 following the completion of a Federal stockpiling contract. The company had planned to build a \$7 million, 100-ton-per-day, ferrochromium smelter on optioned property near Butte, provided a proposed barter program would be acceptable to the Government. The barter proposal, under which American Chrome would smelt 900,000 tons of stockpiled chromite concentrate for the Government and receive payment in surplus agricultural commodities for disposal overseas, was not accepted by the Government. At midyear, the property option was dropped.

Ferrochromium produced in the company pilot smelter before it shut down in 1961 was shipped to eastern steel plants until stocks were exhausted.

Pyrometallurgical beneficiation of chromite from the Mouat mine of American Chrome Co. and production of ferrochromium were described.⁵

A study of the Pacific Northwest ferroalloy industry was completed by the Bureau of Mines.⁶

Copper.—Output of copper was 10 percent below the 1961 total. As in previous years, more than 99 percent of the output was from The Anaconda Company mines in the Summit Valley (Butte) district, Silver Bow County. The production drop was the result of a strike by Teamsters Union Local No. 2 which idled the Berkeley pit operation from July 16 until September 21. All company mining operations in the Butte area were halted from July 24 to August 2, and from September 17 to 21.

The Berkeley pit yielded 46,686 tons of copper, a 7-percent decline from its 1961 output. Production of ore from the Berkeley pit averaged 35,128 tons per operating day, compared with 31,310 tons in 1961. The stripping ratio was 2.91 tons of waste for each ton of ore mined. Output from the Kelley mine dropped 40 percent to 9,808 tons because of a decision to terminate block caving as soon as all existing production blocks were mined to completion. Most of the Kelley ore in the upper levels was to be mined by open-pit methods. Production from the Butte Hill mines (Mountain Con, Steward, and Leonard) increased slightly over the 1961 output. Nearly 2,407 tons of copper was recovered from water pumped from Butte mines through the High Ore shaft to the precipitation plant.

Construction of a 42,000-ton-per-day concentrator adjacent to the Berkeley pit was started. The new plant was to eliminate the haulage of copper ore from Butte to the concentrator at Anaconda, Deer Lodge County. Part of the concentrator was scheduled to begin operating in the third quarter of 1963, and completion of the entire plant was planned for early in 1964. Water for the operation was to be obtained through a 34-inch pipeline being constructed from the

⁴ Fulkerson, Frank B. Trends and Outlook in the Pacific Northwest Aluminum Industry. BuMines Inf. Circ. 8046, 1962, 42 pp.

⁵ Hunter, Willard L., and Lloyd H. Banning. Pyrometallurgical Beneficiation of Off-grade Chromite and Production of Ferrochromium. BuMines Rept. of Inv. 6010, 1962, 16 pp.

⁶ Kingston, Gary A. The Pacific Northwest Ferroalloy Industry. BuMines Inf., Circ. 8050, 1962, 26 pp.

Anaconda Reduction Works at Anaconda to the plant site. The pipe was to be capable of transporting 18 million gallons of water daily. Another 24 million gallons per day was to be recovered from thickeners and from the tailings pond.

Gold.—Production of gold declined 31 percent (10,990 ounces) from the 1961 total. Five placer mines were operated, compared with 17 in 1961, and placer output was 110 ounces—22 ounces less than in 1961. The Anaconda Company mines in the Summit Valley district accounted for 73 percent of the total. The largest gold-producing mine was the Berkeley pit (9,933 ounces); followed by the Kelley (3,447 ounces), Badger State (2,616 ounces), and the Butte Hill mines (1,641 ounces). The strike at operations of The Anaconda Company was an important factor in the decline, because much of the State output was a byproduct of copper production.

The Mayflower and West Mayflower property, Madison County, one of the top 25 domestic gold-producing mines from 1959 to 1961, was idle. The property had been leased previously from The Anaconda Company by the Peter Antonioli estate, but the lease was dropped late in 1961.

Iron Ore.—Compared with that of 1961, production dropped by 25,067 long tons to the lowest output since 1955. The entire State output was shipped by Ralls & Harris Bros. from the Iron Cross (2,930 tons) and Iron Magnet (6,271 tons) open-pit mines near Radersburg, Broadwater County, for use by the cement industry.

TABLE 7.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals¹

Year	Mines producing		Material sold or treated ² (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1953-57 (average)	126	10	7,758	29,488	\$1,032	6,178	\$5,592
1958	125	11	10,861	26,003	910	3,631	3,286
1959	96	14	8,779	28,551	999	3,420	3,096
1960	129	13	12,317	45,922	1,607	3,607	3,265
1961	135	17	12,792	35,377	1,238	3,490	3,227
1962	107	5	11,835	24,387	854	4,561	4,948
1862-1962			(3)	17,682,000	403,329	837,457	627,887
	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1953-57 (average)	81,289	\$55,490	16,748	\$4,804	66,170	\$15,909	\$82,827
1958	90,683	42,699	8,434	1,974	33,238	6,781	60,649
1959	65,911	49,469	7,672	1,765	27,848	6,405	52,734
1960	91,972	59,046	4,879	1,142	12,551	3,238	68,298
1961	104,000	62,400	2,643	544	10,262	2,360	69,770
1962	94,021	57,917	6,121	1,126	37,678	8,666	73,511
1862-1962	7,778,000	2,599,117	923,000	144,270	2,709,000	514,277	4,288,880

¹ Includes recoverable metal content of gravel washed (placer mines), ore milled, old tailings retreated, and ore, old slag, and copper precipitates shipped to smelters during the calendar year indicated. Owing to rounding, individual items may not add to totals shown.

² Does not include gravel washed.

³ Data not available.

TABLE 8.—Gold production at placer mines

Year	Mechanical and hydraulic methods ¹			Small-scale hand methods			Total		
	Number of operations	Material treated (thousand cubic yards)	Gold (troy ounces)	Number of operations	Material treated (thousand cubic yards)	Gold (troy ounces)	Number of operations	Material treated (thousand cubic yards)	Gold (troy ounces)
1953-57 (average).....	6	229	1,638	* 4	1	42	10	230	1,680
1958.....	7	209	1,069	4	1	19	11	210	1,088
1959.....	9	157	973	5	4	29	14	161	1,002
1960.....	2	2	41	11	8	94	13	10	135
1961.....	5	30	82	12	4	50	17	34	132
1962.....	* 3	7	64	2	4	46	5	11	110

¹ Combined to avoid disclosing individual company confidential data.

² Includes surface and underground (drift) placers.

³ Includes 1 dragline dredge, 1 nonfloating washing plant, and 1 electric shovel.

Beneficiation and smelting of ore from the Carter Creek deposit in Beaverhead and Madison Counties were described.⁷

Lead.—Output of lead was 3,478 tons above the 2,643 tons produced in 1961. Approximately 70 percent was produced by The Anaconda Company from the Badger State mine and shipments were from the purchased Government low-grade manganese stockpile and the Emma mine stockpile. Production from the Badger State was the first lead-bearing ore mined by the company since 1960. Other major production came from the Anaconda slag-fuming operation at East Helena, Lewis and Clark County; the Trout Mining Co. Algonquin mine, Granite County; and the Maulden mine of Ida B. Hand, Beaverhead County.

Two operators of lead-zinc mines received subsidy payments totaling \$43,097 for the production of 277 tons of lead (\$20,410) and 750 tons of zinc (\$22,687) under the Government program to stabilize the mining of lead and zinc by small producers. Six operators were certified as eligible to receive payments on 1,528 tons of lead and 2,128 tons of zinc, but production by these operators was far below the eligible amounts.

A comprehensive study of lead-zinc marketing by small producers was published.⁸

Manganese.—Shipments of manganese ore and concentrate (35 percent or more manganese) totaled 24,758 short tons—a 41-percent increase over that of 1961. Manganiferous ore and concentrate (5 to 35 percent manganese) shipments increased 1 percent to 2,264 short tons.

The Anaconda Company did not mine manganese ore during 1962 but shipped metallurgical-grade nodules from stocks, mostly for use at the company ferromanganese plant at Anaconda. Nodules were produced at the sintering plant at Anaconda in October and November from manganese raw material obtained from the Emma mine stockpile at Butte and from low-grade manganese ore from a Government

⁷ Holmes, Wesley T., II, W. Floyd Holbrook, and Lloyd H. Banning. Beneficiating and Smelting Carter Creek, Mont., Iron Ore. BuMiner Rept. of Inv. 5922, 1962, 21 pp.

⁸ Young, Francis M., Frank A. Crowley, and Uuno M. Sahinen. Marketing Problems of Small Business Enterprises Engaged in Lead and Zinc Mining. Montana Bureau of Mines and Geol. Bull. 30, 1962, 58 pp.

stockpile. Anaconda purchased the Government stockpile in August for \$8 per ton. It contained 136,143 long dry tons of low-grade manganese carbonate ore (rhodochrosite) averaging approximately 19 percent manganese. The ore, stockpiled at Butte (123,345 tons) and Philipsburg (12,798 tons), was purchased by the Government from 1951 to 1958. In addition to manganese, values of gold, silver, lead, and zinc recovered from the ore were included in the State totals.

Taylor-Knapp Co. mined 11,054 long tons of ore from the Moorlight group near Philipsburg, Granite County. Twenty tons of chemical-grade concentrate was sold, and battery-grade material was shipped to battery manufacturers. Shipments averaged 40.1 percent manganese. Taylor-Knapp also shipped 2,021 long tons of manganif-

TABLE 9.—Mine production of gold, silver, copper, lead, and zinc in 1962, by counties, in terms of recoverable metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)		
	Lode	Placer	Troy ounces	Value (thousands)	Troy ounces	Value (thousands)	
Beaverhead.....	13		1,826	\$64	40,832		\$14
Broadwater.....	7		82	3	1,515		2
Fergus.....	2		8	(1)	106	(1)	
Flathead.....	3		10	(1)	6,728		7
Granite.....	15		1,847	65	357,753		388
Jefferson.....	16		962	34	54,046		59
Judith Basin.....	2		1	(1)	709		1
Lewis and Clark.....	8	1	183	6	12,661		14
Madison.....	11	1	1,503	53	41,223		45
Meagher.....	2		5	(1)	4,203		5
Mineral.....	1				10	(1)	
Missoula.....	3		29	1	22	(1)	
Powell.....	3	1	149	5	234	(1)	
Sanders.....	4		20	1	940		1
Silver Bow.....	9	1	17,657	618	4,026,697		4,369
Unassigned.....	3		6	(1)	256	(1)	
Undistributed 4.....	5	1	99	3	12,779		14
Total 5.....	107	5	24,387	854	4,560,714		4,943
	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
Beaverhead.....	10	\$6	155	\$28	23	\$5	\$143
Broadwater.....	16	10	5	1	3	1	15
Fergus.....			(2)	(1)	(2)	(1)	(1)
Flathead.....	2	1					9
Granite.....	97	59	292	54	1,855	427	998
Jefferson.....	33	20	109	20	92	21	154
Judith Basin.....	(2)	(1)	13	2	2	1	4
Lewis and Clark.....	(3)	(3)	(3)	(3)	7,052	1,622	1,537
Madison.....	4	3	1	(1)	1	(1)	101
Meagher.....	1	(1)	133	25	8	2	32
Mineral.....	1	(1)					(1)
Missoula.....							1
Powell.....	(2)	(1)	3	1	(2)	(1)	6
Sanders.....	8	5	40	7	6	1	15
Silver Bow.....	93,845	57,808	4,319	795	28,636	6,586	70,175
Unassigned.....	(2)	(1)	(2)	(1)	(2)	(1)	1
Undistributed 4.....	4	3	1,051	193	(2)	(1)	19
Total 5.....	94,021	57,917	6,121	1,126	37,678	8,666	73,511

1 Less than \$500.

2 Less than 0.5 ton.

3 Included with "Undistributed" to avoid disclosing individual company confidential data.

4 Includes values and quantities that cannot be shown separately for Deer Lodge, Lincoln, and Ravalli Counties.

5 Data may not add to totals shown because of rounding.

TABLE 10.—Mine production of gold, silver, copper, lead, and zinc in 1962, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines ¹	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Dry gold.....	30	3,051	2,896	2,786	7,500	4,200	7,000
Dry gold-silver.....	18	7,784	1,752	62,855	71,100	7,300	52,300
Dry silver.....	27	23,800	430	127,908	88,100	205,000	132,500
Total.....	75	34,605	5,078	193,549	166,700	216,500	191,800
Copper.....							
Lead.....	9	10,742,516	15,034	2,506,824	181,139,400	600	100
Lead-zinc.....	11	2,233	236	14,442	4,700	710,600	65,400
Zinc.....	5	147	3	1,204	500	104,800	17,600
Total.....	3	940,000	2,956	1,797,431	1,859,900	9,215,600	60,973,700
Total.....	28	11,684,896	18,229	4,319,901	183,004,500	10,031,100	61,056,800
Other lode material:							
Dry gold-silver old tailings, gold-silver assay rejects and gold-silver mill cleanings ²	5	23,629	724	19,226	29,800	1,700	300
Dry silver old tailings.....	5	5,112	244	27,399	27,300	49,500	83,700
Copper precipitates.....					4,813,600		
Lead-zinc assay rejects.....	1	40	2	628	100	5,000	8,200
Zinc slag.....	1	86,584				1,938,200	14,015,200
Total lode material.....	107	11,834,866	24,277	4,560,703	188,042,000	12,242,000	75,356,000
Gravel (placer operations).....	5	(³)	110	11			
Total.....	112	11,834,866	24,387	4,560,714	188,042,000	12,242,000	75,356,000

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

² Includes 177,666 tons of manganese ore containing gold, silver, copper, lead, and zinc.

³ Combined to avoid disclosing individual company confidential data.

⁴ 10,953 cubic yards.

TABLE 11.—Mine production of gold, silver, copper, lead, and zinc in 1962 by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation.....	207	40			
Concentration and smelting of concentrates.....	18,004	4,198,844	183,007,100	9,017,800	59,554,700
Total.....	18,211	4,198,884	183,007,100	9,017,800	59,554,700
Direct smelting:					
Ore.....	5,096	314,566	164,100	1,229,800	1,693,900
Old tailings, mill cleanings, and assay rejects ¹	970	47,253	57,200	56,200	92,200
Old slag.....				1,938,200	14,015,200
Copper precipitates.....			4,813,600		
Total.....	6,066	361,819	5,034,900	3,224,200	15,801,300
Placer.....	110	11			
Grand total.....	24,387	4,560,714	188,042,000	12,242,000	75,356,000

¹ Combined to avoid disclosing individual company confidential data.

erous material containing 23.3 percent manganese to metallurgical users. Taylor-Knapp purchased 22 long tons of oxide ore containing 19.3 percent manganese from Ross Hayworth (Little Emma mine) and 311 long tons of ore (25 percent manganese) from Trout Mining Co.

A preliminary study of the extraction of manganese from low-grade dolomitic materials from the Philipsburg district was published.⁹

Silver.—Output of silver was the highest since 1957. The increased market price caused the value of production to rise 53 percent (\$1.72 million) compared to the quantity rise of 31 percent (1.07 million ounces) over corresponding figures for 1961. The increase in output was largely attributable to the beginning of production from the Badger State mine (Elm Orlu-Black Rock project) and shipments from the Emma stockpile and the purchased Government manganese stockpile. These three sources supplied 1,517,324 ounces. Production from the Butte Hill mines increased, whereas output from the Berkeley pit and Kelley mine declined.

Mines in Silver Bow County supplied 88 percent of the State total, Granite County contributed 8 percent, and the remaining 4 percent came from 16 other counties.

Steel.—The construction of a steel plant at Anaconda, Deer Lodge County, by Gulf State Lands and Industries, Inc., first proposed in 1959, was dependent upon securing adequate financing.

Thorium.—The Atomic Energy Commission announced in its annual report to the Congress that thorium reserves in the Lemhi Pass area of Idaho and Montana contained 100,000 tons of thorium oxide (ThO_2) and that the eventual development of much larger reserves was a possibility.

Tungsten.—Output declined sharply because of the February shut down of the Minerals Engineering Co. mill near Glen, Beaverhead County. Production from the company Calvert pit near Wise River was stopped in December 1961.

Uranium.—Production of uranium was the lowest since before 1956 and far below the 1961 output of 729 tons. All of the output came from the Swamp Frog property, Carbon County, operated by John Kummerfeld.

Zinc.—Output was 37,678 tons, an increase of 27,416 tons from the 1961 total. The increase was attributable to the start of production from the Badger State mine (Elm Orlu-Black Rock block-caving project) by The Anaconda Company. Company production from the Badger State mine and shipments from the Emma mine stockpile and the purchased Government manganese stockpile accounted for 76 percent of the State total. Nineteen percent of the State output came from old slag processed at the Anaconda slag-fuming plant adjacent to the American Smelting and Refining Company lead smelter at East Helena. Trout Mining Co. (Algonquin mine) and Taylor-Knapp Co. (True Fissure mine) produced 1,141 tons and 710 tons, respectively, from mines in the Flint Creek district, Granite County. Both silver-zinc mining operations were closed in September.

Production from the Badger State mine, which supplied the first zinc ore mined by Anaconda since 1960, began in February. The ore was milled and the concentrate roasted at the Anaconda Reduction Works, Anaconda, and shipped to the company electrolytic zinc

⁹ Sullivan, G. V., L. L. Brown, and R. G. Peterson. Extraction of Manganese From Low-Grade Dolomitic Materials by a Roast-Leach Process. BuMiner Rept of Inv. 6121, 1962, 24 pp.

plant at Great Falls. Resumption of zinc mining and concentrating provided 175 jobs at Butte and 75 at Anaconda.

The electrolytic zinc plant at Great Falls produced 133,462 tons of High Grade and Special High Grade zinc from domestic and foreign concentrates.

NONMETALS

Asbestos.—Zonolite Co. announced plans to build a pilot plant to recover short-fiber tremolite asbestos as a coproduct with vermiculite from the company operation at Libby, Lincoln County. The asbestos, to be separated from the vermiculite by a wet-milling process, was to be utilized by the company. Considerable quantities of short-fiber asbestos had been purchased for use by the company in past years.

Barite.—The quantity and value of barite sold or used by producers almost tripled compared with 1961 totals. The mineral was mined and ground near Greenough, Missoula County, by Baroid Sales Division, National Lead Co. Output was used primarily as a weighting agent in oil-well-drilling mud.

Exploratory drilling at a barite prospect discovered in 1960 near Eureka, Lincoln County, was a joint venture of the Montana Bureau of Mines and Geology, Great Northern Railway Co., and Pacific Power & Light Co.

Cement.—The quantity and value of cement shipments were slightly higher than in 1961. Construction of auxiliary facilities by Ideal Cement Co., Montana Division, the only producer of cement in the State, was completed at the Trident, Gallatin County, plant. Destinations within the State accounted for 75 percent of the cement sold. Shipments also were made to Utah, Wyoming, North Dakota, and Idaho.

Work began in April on the Permanente Cement Co. plant near the old mining town of Montana City, 3 miles south of East Helena, Lewis and Clark County. Completion of the 1.4-million-barrel-capacity, \$9.6 million facility was expected early in 1963. Thereafter, shipments of cement for the Yellowtail Dam on the Big Horn River were to begin. The company indicated that some of the plant output was to be marketed in Wyoming, Idaho, and North Dakota.

Clays.—There was a small increase in the output of miscellaneous clay, which contrasted with a decline of more than 50 percent in fire clay production compared with 1961 totals. No bentonite was mined.

Miscellaneous clay for making heavy clay products was mined in Fergus and Yellowstone Counties. Two companies in Cascade and Yellowstone Counties produced shale and expanded it for lightweight aggregate. The small output of fire clay came from Cascade and Deer Lodge Counties.

Fluorspar.—Roberts Mining Co., the only producer in the State, mined fluorspar at its Crystal Mountain open pit in Ravalli County and shipped it to the company-owned plant at Darby. The steel industry continued to be the major consumer. Fluorspar deposits in Montana were described.¹⁰

¹⁰ Sahinen, U. M. Fluorspar Deposits in Montana. Montana Bureau of Mines and Geol. Bull. 29, April 1962, 38 pp.

Gypsum.—The quantity and value of crude gypsum mined decreased 6 percent compared with the 1961 totals. Two mines in Fergus County furnished the output, most of which was calcined and sold as ground gypsum, and some of which was used to make wallboard and lath. Uncalcined gypsum was used as a retarder in portland cement.

On June 19, employees at the Hanover mine of Ideal Cement Co. completed 4,000 consecutive days without a lost-time accident. The last lost-time accident occurred in 1951.

Lime.—Output of lime dropped 12 percent and value increased 6 percent in comparison with 1961 totals. In Deer Lodge County, The Anaconda Company made quicklime for metallurgical use, and Elliston Lime Co. (Powell County) produced and marketed quicklime and hydrated lime. Three sugar-refining companies calcined limestone for use at four plants in Big Horn, Missoula, Richland, and Yellowstone Counties.

Phosphate Rock.—A decrease of 11 percent in the quantity of marketable phosphate rock produced was accompanied by a 4-percent increase in value. Mines in Beaverhead, Powell, and Silver Bow Counties contributed to the output, part of which was exported to British Columbia. Elemental phosphorus, phosphoric acid, and phosphate fertilizers were produced by processing the rock.

Rocky Mountain Phosphate Co., Butte, the only producer of defluorinated phosphate rock for use as animal feed supplement in the West, announced plans to construct a facility at Garrison. The main purpose for moving from Butte was to be closer to the source of raw material.

Sand and Gravel.—There was an increase of 3.8 million tons and \$4.1 million in the quantity and value of sand and gravel output. Totals were 18.5 million tons and \$17.6 million, compared with 14.7 million tons and \$13.5 million in 1961. Most of the advance was attributed to increased road construction and maintenance by the Bureau of Public Roads and the State highway department. Larger quantities of sand and gravel used at the Yellowtail Dam project of the Bureau of Reclamation also contributed to the increase.

Thirty-seven of the 56 counties in the State had sand and gravel production. Cascade County, with output in excess of 1 million tons, was the leading source of sand and gravel. Use distribution was road material, 91 percent; building, 5 percent; and miscellaneous uses including railroad ballast, 4 percent. Corresponding figures in 1961 were 92, 6, and 2 percent.

Stone.—Quantity and value of stone output dropped 34 and 8 percent, respectively, compared with the 1961 totals. Curtailed use of stone at projects of the Bureau of Public Roads, U.S. Forest Service, and U.S. Army Corps of Engineers accounted for the reduced production. Output of limestone, the principal stone quarried, was slightly lower than in 1961. Limestone was used mainly for making cement and lime. More sandstone and less basalt and granite were quarried than in 1961. Travertine for building and decorative purposes was produced and marketed by two companies in Park County.

Most of the limestone was quarried in Gallatin and Deer Lodge Counties; sandstone came from Missoula, Gallatin, and Beaverhead Counties; and Flathead County was the major source of basalt.

TABLE 12.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1961		1962	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building.....	863	\$1,116	949	\$1,373
Road material.....	1,029	964	599	538
Fill.....	97	90	233	264
Railroad ballast.....	114	85	(¹)	(¹)
Other ²	19	14	343	231
Total.....	2,122	2,269	2,124	2,407
Government-and-contractor operations:				
Building.....	73	145	57	147
Road material.....	12,482	11,068	16,157	14,978
Fill.....	9	10	118	93
Other ²	15	15	17	17
Total.....	12,580	11,237	16,349	15,235
All operations:				
Building.....	936	1,261	1,006	1,520
Road material.....	13,511	12,031	16,756	15,516
Fill.....	107	100	350	357
Railroad ballast.....	114	85	(¹)	(¹)
Other ²	34	29	361	248
Grand total³.....	14,702	13,506	18,473	17,642

¹ Included with "Other" to avoid disclosing individual company confidential data.² Sand and gravel used for miscellaneous and unspecified purposes, including items indicated by footnote 1.³ Data may not add to totals shown because of rounding.

Sulfur.—Production and shipments of high-purity elemental sulfur by Montana Sulphur & Chemical Co. were higher than in 1961. Hydrogen sulfide, the raw material used in recovery process, was furnished from two oil refineries in the Billings area, Yellowstone County.

Talc.—Output and value of talc were 17 percent higher and 4 percent lower, respectively. Four companies produced from eight mines—one in Beaverhead County and seven in Madison County. Most of the talc was processed at grinding plants at Barratts, Beaverhead County; Three Forks, Gallatin County; and East Helena, Lewis and Clark County. Out-of-State shipments for grinding were made to plants at Grand Island, Nebr.; Ogden, Utah, and Pomona and Los Angeles, Calif.

There was a significant change in the quantity of talc consumed in the paper and ceramics industries. Uses were as follows (1961 percentages are in parentheses): Paint, 47 percent (52 percent); paper, 34 percent (15 percent); ceramics, 14 percent (24 percent); and miscellaneous, including cosmetics, insecticides, rice polishing, textiles, and rubber, 5 percent (9 percent).

Vermiculite.—Output of crude vermiculite was 8 percent higher than in 1961. The Libby, Lincoln County, open-pit mine of Zonolite Co. continued to be the principal source of vermiculite in the United States. Most of the production was shipped out of the State to exfoliating plants, but some was expanded by a company at Great Falls, Cascade County. A proposed merger of Zonolite Co. with W. R. Grace & Co., a leading producer of chemicals with other inter-

ests, was announced late in the year. Vermiculite found use mainly for insulation purposes, lightweight aggregate, and soil conditioning.

MINERAL FUELS

Coal.—Output of bituminous coal and lignite was 382,000 tons, compared with 371,000 tons in 1961. Among the 19 active mines (16 underground and 3 open pit) in 8 counties, 14 produced bituminous coal and 5 yielded lignite. Nine mines in Musselshell County furnished most of the bituminous coal. Production also came from Carbon, Blaine, Rosebud, and Cascade Counties. Richland was the principal lignite-producing county followed by Sheridan and Custer Counties.

Peat.—Production of peat from deposits in Ravalli and Lake Counties increased substantially over the 1961 total.

Petroleum and Natural Gas.¹¹—Recovery of crude oil continued to increase. A record 31.6 million barrels (\$76.7 million) was produced; 1961 output was 30.9 million barrels (\$74.8 million). Petroleum represented 40 percent of the total value of mineral output in Montana. Thirty-nine percent of the crude oil was recovered from the Pine, Cabin Creek, and Elk Basin fields, each field exceeding 3 million barrels. Other fields yielding more than 1 million barrels were Sumatra, Cut Bank, Poplar-East, and Pennel. Six oilfields—Lookout Butte, Benrud-East, Wildcat, Musselshell, Whitlash-West, and Bascom—began producing.

Nine refineries processed 28.1 million barrels of crude oil, 4.2 million barrels more than in 1961. Montana wells furnished 40 percent of the total and Wyoming wells supplied most of the remainder. During 1962, 419 wells were drilled (417 in 1961); of these 190 yielded oil, 18 produced gas, and 211 were dry.

Marketed production of natural gas reached 30.0 billion cubic feet, compared with 33.9 billion cubic feet in 1961. The Cut Bank-Reagan field continued to be the major source of natural gas (8.6 billion cubic feet). Seven other fields that produced over 1 billion cubic feet were Cedar Creek, Bowdoin, Keith Block, Dry Creek, Whitlash, Bowes, and Cabin Creek.

Fifty years after the discovery of natural gas on the Cedar Creek anticline (Williston Basin), attention was again focused on the area. Major oil companies drilled in the Pennel and Lookout Butte fields, Fallon County; development took place in the Coral Creek unit at the southern end of the Lookout Butte field; and there was activity at the northwestern end of the anticline near Glendive, Dawson County, in the Seven Mile field. New production along the anticline came from depths of 6,500 to 10,000 feet.

A well drilled by McAllister Fuel Oil Corp., 17 miles northwest of the Brorson field, may be the most important wildcat in the Montana portion of the Williston Basin. Oil was recovered on a drill-stem test in the Devonian at about 10,000 feet; production from this horizon has been rare in this area.

¹¹ Montana Oil and Gas Conservation Commission. Montana Oil and Gas Statistical Bulletin and Annual Review, 1962.

A wildcat, near the Canadian border in Sheridan County and about 26 miles from the nearest production in the Outlook field, apparently struck oil in the Madison formation.

Humble Oil & Refining Co.; Texaco, Inc.; Phillips Petroleum Co.; and Union Oil Co. began large-scale water-flooding in the Cut Bank field, Glacier County. Humble's northwest unit of about 2,700 acres was formed as one of several proposed units for flooding Cut Bank sand. Seven producing wells were converted to injection wells. It was predicted that ultimately production could be doubled from the formation in the area to be flooded.

Montana Power Co. announced plans to drill a 2,000-foot well near Deer Lodge, Powell County, in an attempt to find a formation suitable for the storage of natural gas.

Oil and gas leases on the Northern Cheyenne Indian Reservation were open for bidding for the first time since 1956.

Effective July 1, the Montana Oil & Gas Conservation Commission reduced its tax on production of oil and natural gas by 50 percent. Early in 1962, the Commission also established 320-acre well spacings in the Brorson field area of Richland County. Split spacings—80 acres on the western edge and 160 acres on the eastern edge—were approved for the Pannel field, Fallon County, because of variations in the pay thickness of the producing horizons. For the Benrud field northwest of Tule Creek, Roosevelt County, spacings of 160 acres were approved.

REVIEW BY COUNTIES

Mineral production for 1962 was reported from 48 of the 56 counties. Silver Bow County accounted for 38 percent of the total mineral-output value. Only counties with significant metal, nonmetal, or fuels developments are discussed in the following review.

Beaverhead.—Mines in the county supplied 1,826 ounces of gold, 40,832 ounces of silver, 10 tons of copper, 154 tons of lead, and 23 tons of zinc. The five mines in the Argenta district yielded 73 percent of the value of production. Lead ore (1,269 tons) from the Maulden mine yielded 145 ounces of gold, 4,050 ounces of silver, 2 tons of copper, 153 tons of lead, and 22 tons of zinc. High-grade gold ore was mined at the Yellow Band property, which was the leading gold-producing mine outside of Silver Bow County, and 154 ounces of gold and 3,236 ounces of silver were produced from the Henry mine operated by Alumont, Inc. Gold ore was taken from the Cross mine, and part of the Midnight mine dump was shipped.

Spokane National Mines, Inc., continued exploration and development of the New Departure mine, Blue Wing district, and produced 4 ounces of gold, 4,446 ounces of silver, 1 ton of lead, and 2 tons of zinc. The company completed electrification of its mining and milling operations.

The largest silver output was from the Comet mine (Dick Tunstill), Elkhorn district, and the Hecla mine (Lively Mining Co.), Bryant district, yielding 9,262 ounces (30 ounces per ton) and 8,633 ounces (12 ounces per ton), respectively. A total of 481 tons of ore from the Polaris mine, operated by Ida B. Hand in the Polaris district, yielded 9 ounces of gold, 4,673 ounces of silver, and 1 ton of copper. Other

TABLE 13.—Value of mineral production in Montana, by counties¹

(Thousand dollars)

County	1961	1962	Minerals produced in 1962, in order of value
Beaverhead.....	(²)	(²)	Phosphate rock, tungsten, gold, silver, lead, talc, stone, thorite concentrate, copper, zinc, sand and gravel.
Big Horn.....	\$373	\$460	Sand and gravel, petroleum, lime, natural gas.
Blaine.....	611	429	Petroleum, natural gas, coal, sand and gravel.
Broadwater.....	157	175	Sand and gravel, iron ore, copper, gold, silver, lead, zinc.
Carbon.....	7,409	9,845	Petroleum, natural gas, stone, coal, uranium.
Carter.....	52	37	Petroleum.
Cascade.....	1,017	1,224	Sand and gravel, clays, coal, stone.
Custer.....	128	144	Sand and gravel, coal.
Dawson.....	3,462	4,597	Petroleum, sand and gravel, coal.
Deer Lodge.....	836	783	Lime, stone, sand and gravel, silver, copper, gold, clays.
Fallon.....	16,343	17,462	Petroleum, natural gas.
Fergus.....	391	728	Sand and gravel, gypsum, clays, gold, silver, zinc, lead.
Flathead.....	296	370	Sand and gravel, stone, silver, copper, gold.
Gallatin.....	(²)	(²)	Cement, stone, sand and gravel, mica.
Glacier.....	1,179	2,050	Petroleum, sand and gravel.
Granite.....	³ 1,683	1,505	Manganese, zinc, silver, gold, copper, lead, manganese ore, sand and gravel, stone.
Hill.....	64	50	Sand and gravel.
Jefferson.....	194	229	Stone, silver, gold, zinc, copper, lead, sand and gravel.
Judith Basin.....	124	44	Sand and gravel, lead, silver, zinc, gold, copper.
Lake.....	(²)	(²)	Sand and gravel, peat.
Lewis and Clark.....	1,651	2,128	Zinc, sand and gravel, lead, silver, gold, stone, copper.
Liberty.....	602	776	Petroleum, natural gas.
Lincoln.....	(²)	(²)	Vermiculite, sand and gravel, gold, lead, zinc, silver.
McCone.....	136	409	Petroleum.
Madison.....	³ 1,056	903	Talc, sand and gravel, gold, silver, stone, copper, zinc, lead.
Meagher.....	53	32	Lead, silver, zinc, copper, gold.
Mineral.....	(²)	65	Sand and gravel, copper, silver.
Missoula.....	193	465	Sand and gravel, stone, barite, lime, gold, silver.
Musselshell.....	4,557	4,110	Petroleum, coal.
Park.....	54	138	Stone, sand and gravel.
Phillips.....	340	249	Natural gas, sand and gravel.
Pondera.....	27	69	Petroleum, sand and gravel.
Power River.....	(²)	(²)	Coal.
Powell.....	(²)	(²)	Phosphate rock, lime, sand and gravel, stone, gold, lead, silver, copper, zinc.
Prairie.....	(²)	(²)	Sand and gravel.
Ravalli.....	(²)	597	Fluorspar, peat, sand and gravel, gold, silver.
Richland.....	715	920	Coal, lime, petroleum.
Roosevelt.....	7,675	7,254	Petroleum, sand and gravel.
Rosebud.....	6,142	5,866	Petroleum, coal.
Sanders.....	(²)	15	Lead, copper, zinc, silver, gold.
Sheridan.....	2,380	3,248	Petroleum, coal, sand and gravel.
Silver Bow.....	67,303	72,342	Copper, zinc, silver, manganese, lead, gold, phosphate rock, sand and gravel.
Stillwater.....	(²)	(²)	Sand and gravel.
Teton.....	34	35	Petroleum, sand and gravel.
Toole.....	1,638	1,422	Petroleum, sand and gravel, natural gas.
Treasure.....	32	53	Sand and gravel.
Valley.....	180	55	Do.
Yellowstone.....	1,474	1,519	Petroleum, sand and gravel, lime, clays.
Combined counties ⁴	³ 24,930	21,211	
Undistributed ⁵	³ 28,742	26,643	
Total.....	³ 184,233	190,656	

¹ No production reported in Chouteau, Sweet Grass, and Wheatland Counties.² Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."³ Revised figure.⁴ Petroleum and natural gas production from fields underlying two or more counties. See Combined Counties section.⁵ Includes value of mineral production that cannot be assigned to specific counties and values indicated by footnote 2.

gold, silver, and copper production came from the Three Aces mine, Dillon district; Quartz Hill mine, Quartz Hill district; and the Gray Jockey and Harrison mines, Vipond district.

Phosphate rock produced at the Canyon Creek and East La Marche mines of Victor Chemical Works was shipped to the company elemental phosphorus plant at Silver Bow. Talc was mined at the

Smith-Dillon property by Tri-State Minerals Co. Some of the output was ground at the company Barratts mill.

Big Horn.—Recovery of crude oil from the three fields in the county was 16,000 barrels less than in 1961. Natural gas withdrawals from the Hardin field remained at about 54 million cubic feet. Limestone was calcined for use at the Holly Sugar Corp. Hardin plant. Output of sand and gravel more than doubled compared with that of 1961. Work at the Bureau of Reclamation Yellowtail Dam project accounted for the increase.

Broadwater.—Ralls & Harris Bros. mined magnetite containing 45 percent iron from two mines in the Cedar Plains district near Radersburg.

The Hard Cash (Copper Queen) mine in the Cedar Plains district, operated by Wayne Miller, was the leading gold (31 ounces), silver (903 ounces), and copper (16 tons) mine. In the Park (Indian Creek) mining district, 33 tons of ore from the Alpha claim yielded 2 ounces of gold, 259 ounces of silver, 4 tons of lead, and less than 1 ton of zinc; a minor quantity of lead ore came from the Pioneer mine.

Gold ore was shipped from the Miller Slim Jim mine, Backer district, and the January and Stabler properties in the Beaver district. A small quantity of lead-zinc ore was extracted from the Silver Saddle mine.

Carbon.—The county ranked second in value of nonmetals and fuels output (\$9.9 million). Production increases were reported for petroleum, natural gas, stone, and coal. Recovery of crude oil from the Elk Basin field, the third ranking oilfield in the State, was 3.7 million barrels, about 1 million barrels more than in 1961. The Dry Creek field yielded 2 billion cubic feet of natural gas. Two bituminous coal mines were active.

Carter.—Production of crude oil from the Repeat field dropped to 18,000 barrels, 8,000 barrels less than in 1961.

Cascade.—According to The Anaconda Company annual report to shareholders, production of electrolytic copper at the Great Falls copper refinery was at the rate of 22.5 million pounds monthly, except during September and October when monthly production was reduced to less than 17 million pounds because of a labor strike at Butte. The electrolytic zinc plant was operated at 88 percent of capacity during the first half of 1962 and at 75 percent of capacity during the second half. Cadmium recovered as a byproduct of processing foreign and domestic zinc concentrates totaled 596 tons.

The county was the leading source of sand and gravel and clay in the State. A large increase in output of sand and gravel resulted from increased municipal and county work. There was a sharp decrease in the tonnage of fire clay mined at the Armington pit for refractory use at the Anaconda Reduction Works in Deer Lodge County.

Dawson.—Recovery of crude oil from five fields was 1.8 million barrels, an increase of 400,000 barrels over that of 1961. The Gas City field was the principal source. No output was reported from the Seven Mile field which began producing in 1961.

Deer Lodge.—Improvements in the copper smelting division of the Anaconda Reduction Works at Anaconda included the installation of a belt conveyor to carry a mixture of hot calcine and wet concentrate to

the reverberatory furnaces. Formerly the reverberatory feed was trammed in rail cars from the roasters to the furnaces. The No. 4 reverberatory furnace was rebuilt according to an improved design that included a tunnel to facilitate tapping the matte into kettles for conveying to the converters.

Dismantlement and rehabilitation of equipment to be transferred to the new Butte concentrator was begun in May. Milling of copper ore was to be continued at Anaconda until 1964. Zinc concentrate was roasted, and byproduct sulfur dioxide was used to produce sulfuric acid. As in 1960-61, the electrolytic zinc plant was not operated.

The Extractive Metallurgical Research Department of The Anaconda Company was recognized as a division of the company. Plans were announced for a new research laboratory to be constructed at Anaconda to facilitate metallurgical research and development for all company operations.

The Anaconda annual report to shareholders reported manganese nodule production of 32,247 short tons, the highest since 1958, and ferromanganese output of 10,758 short tons. Arsenic trioxide (white arsenic) was produced as a byproduct of smelting arsenic-containing copper ore.

Silver ore (1,207 tons) from the Cameron mine (T.M. Moe), Blue-eyed Nellie district, yielded 17 ounces of gold, 8,811 ounces of silver, and 2 tons of copper. Silver ore also was produced at the Champion mine, Orofino district, and a small quantity of gold ore was mined at the Gold Coin property, Georgetown district.

The United Steelworkers of America became the representative of approximately 1,700 employees of the Anaconda Reduction Works by defeating the International Union of Mine, Mill, and Smelter Workers in an election supervised by the National Labor Relations Board. Mine-Mill had represented employees at Anaconda for 61 years.

There was a slight decrease in the tonnage of limestone mined at Brown's quarry. Most of the output was calcined to quicklime for use at The Anaconda Company ore-processing and metallurgical operations.

Fallon.—Crude oil production increased from 6.6 million barrels in 1961 to 7.1 million barrels. The Cabin Creek field contributed 3.9 million barrels and the Pennel field 1.4 million barrels to the total. Lookout Butte, a new field, yielded 888,000 barrels.

Natural gas withdrawals, from three fields, were 7 billion cubic feet. Cedar Creek field, the second most productive source of natural gas, yielded 5.8 billion cubic feet, and Cabin Creek field produced over 1 billion cubic feet.

Fergus.—Two Warm Springs district mines—Black Bull (G.S. Abott) and Silver Dyke (Tom Downen)—supplied 8 ounces of gold and 106 ounces of silver.

Gypsum was mined near Heath by United States Gypsum Co. and near Hanover by Ideal Cement Co. Clay mined at pits near Lewistown was used by Lewistown Brick & Tile Co. to make heavy clay products. A sharp increase in production of sand and gravel resulted from an accelerated program of the Bureau of Public Roads.

Flathead.—The Anaconda Aluminum Co. Columbia Falls reduction plant was operated at capacity to meet the demand for aluminum from

other company plants and customers. Natural gas replaced electricity to heat boilers and casting furnaces at the plant.

Silver ore was mined at the West Flathead and Ole properties in the Hog Heaven mining district. A Star Meadow district mine—Sanko Creek—supplied a small quantity of copper ore.

A geologic study of the Kootenai-Flathead area was published.¹²

Gallatin.—Nonmetallic commodity production increased slightly compared with that of 1961. The Ideal Cement Co. plant at Trident continued to be the leading mineral industry operation in the county. The Trident quarry, the source of limestone used at the cement plant, led the State in stone production. Talc mined in Madison County was ground at the Three Forks plant of Sierra Talc Co. The only mica production in the State came from the vicinity of Gallatin Gateway.

Glacier.—Four oilfields yielded 794,000 barrels of crude oil, compared with 589,000 in 1961.

Granite.—Value of precious- and base-metal output was 18 percent below that of 1961, largely as a result of the shut down in September of the Flint Creek district Algonquin (Trout Mining Co.) and True Fissure (Taylor-Knapp Co.) properties. Trout produced 340 ounces of gold, 174,533 ounces of silver, 52 tons of copper, 190 tons of lead, and 1,141 tons of zinc. Taylor-Knapp Co., whose zinc ore was concentrated at the Trout company mill, mined 105,574 ounces of silver, 99 tons of lead, and 710 tons of zinc. Flint Creek district production also came from dump material shipped from the Bi-Metallic, Climax, Granite, and Potosi properties. Ross Hayworth produced 1,234 ounces of silver from the Little Emma mine and silver ore was mined from the New Seattle mine. Forty tons of lead-zinc rejects was shipped by the Montana Laboratory Co., Philipsburg.

In the Henderson district, John C. Bork & Sons produced 175 ounces of gold, 39,801 ounces of silver, and 23 tons of copper from the Black Pine mine. Gold-silver tailings were shipped from the Rumsey mine. Gold ore came from the Mickey and Gold Reef mines, and old tailings were shipped from the Jefferson property.

Production of manganese ore by Taylor-Knapp was reduced compared with the 1961 output. The halting of company zinc ore production was not accompanied by a cessation of manganese ore output.

In February, Trout Mining Co. was granted a \$77,610 OME contract to explore for silver, lead, and zinc in the county.

Jefferson.—The value of metal output increased 22 percent over that of 1961; production was from operations at 18 properties. The leading silver, lead, and zinc producer was the Lahey Leasing Co. (Alta-Custer mine) in the Colorado district. The leading gold output was from ore and old tailings from the Basin Jib property, Cataract (Basin) district. Gold-silver ore (335 tons) from the Mount Thompson mine, operated by Curtiss and W. Olson in the Cataract district, yielded 104 ounces of gold and 5,337 ounces of silver. Other production from the Cataract district came from the Boulder (lead), Comet (gold-silver), Crystal (gold-silver), Hope & Bullion (lead-zinc), Lincoln (copper), Silver Hill (gold-silver), Eidelweiss (lead), Uranium (silver), and

¹² Johns, W. M. Geologic Investigations in the Kootenai-Flathead Area, Northwest Montana. No. 4, Western Flathead County, Montana Bureau of Mines and Geol. Bull. 29, 1962, 88 pp.

Mineral Deposit properties (lead-zinc). Production also was from the Big Jim mine (lead), Amazon district; Nancy mine (gold), Elkhorn district; and Humboldt and Poor Boy mines (silver), Homestake district.

The effects of a Pleistocene ice sheet in the northern Boulder Mountains were reported.¹³

Judith Basin.—Two metal mines were active; 30 tons of lead-zinc ore was mined at the Block property and 49 ounces of silver and 3 tons of lead were produced from the Tiger mine.

Lewis and Clark.—Increased production of lead and zinc by The Anaconda Company at the slag-fuming plant, East Helena, was responsible for a 20 percent increase in the value of metal output. Production from old lead-smelter slag at the fuming operation was 969 tons of lead and 7,008 tons of zinc. Most of the fume was shipped to the company's electrolytic zinc plant at Great Falls for processing. Operations were not curtailed by the labor strike of company employees at Butte.

Production by Helena Minerals Co. from the Sam Gaty mine, Ten Mile district, declined to 66 ounces of gold, 5,528 ounces of silver, 56 tons of lead, and 2 tons of zinc. Old silver-bearing tailings were shipped from the Peck mill, Helena district, and 2 tons of gold-silver assay rejects came from the Goodall Bros. assay office in Helena. Gold ore was mined at the Humdinger, Madison Gulch district; Black Watch, Poorman district; Monte Christo and Woodrow Wilson, Rimini (Vaughn) district; and Jay Gould mines, Stemple-Gould district.

A small quantity of gold and silver was recovered from the Gruell Bar placer deposit, Helena district.

Liberty.—Recovery of crude oil from three fields in the county continued to increase. Output totaled 231,000 barrels, compared with 143,000 in 1961. Natural gas withdrawals declined to 3.8 billion cubic feet from 4.1 billion in 1961. Principal fields were Keith Block (2 billion cubic feet) and Whitlash (1 billion cubic feet).

Lincoln.—A small quantity of gold and silver was produced at the Gloria mine in the Libby district.

Madison.—Value of metal production declined 80 percent below that of 1961, largely as a result of the closing of the Mayflower gold property in the Renova district in 1961. Easton Pacific Mines produced 559 ounces of gold, 21,781 ounces of silver, and 2 tons of copper from the Easton Pacific mine, Virginia City district, before operations stopped in April. Exploration, development, and construction of new surface facilities were completed at the Virginia City district Pacific mine (Pacific Mines, Inc.); and 562 ounces of gold, 18,304 ounces of silver, and 1 ton of copper were produced. Output also was from the St. Lawrence (gold-silver), Brown's Gulch district; Cabin Lode (gold), Fairweather district; Strawberry (gold), Mineral Hill district; Leadora (lead), Rochester district; Red Pine (gold), Sheridan district; Amazon (silver), Stone Creek district; Black Ace (gold), Tidal Wave district; and El Fleeda (gold-silver ore and mill cleanings) and Kearsarge (gold) mines, Virginia City district.

¹³ Ruppel, E. T. A Pleistocene Ice Sheet in the Northern Boulder Mountains, Jefferson, Powell, and Lewis and Clark Counties, Montana. U.S. Geol. Survey Bull. 1141-G, 1962, pp. G1-G22.

Talc mining continued to be the principal nonmetallic mineral industry in the county. Four companies operated seven mines—Tri-State Minerals Co. (Regal, Smith Dillon, and Treasure State), Sierra Talc Co. (Yellowstone), American Chemet Corp. (Madison and Rebish-Ike), and Al Kingery (Granite Creek).

McCone.—Crude oil recovery from the Richey-Southwest field increased to 166,000 barrels, 109,000 barrels more than in 1961.

Meagher.—The 653 tons of ore mined by Hoco, Inc., at the Cumberland mine, Castle Mountain district, yielded 4 ounces of gold, 4,182 ounces of silver, 133 tons of lead, and 8 tons of zinc. A small quantity of copper ore was extracted from the Copperopolis mine, Musselshell (Copperopolis) district.

Mineral.—Copper ore (32 tons) taken from the Dutchman mine, St. Regis district, by Oliver General Contracting Co. yielded 10 ounces of silver and 1 ton of copper.

The Bunker Hill Co. continued the exploration and development of the Nancy Lee mine in the Keystone district near Superior. Work consisted of deepening the main shaft 400 feet, cutting new shaft stations on the 940 and 1,090 levels, and extending the 640 adit level approximately 1,200 feet. No ore was processed at the Nancy Lee mill. Production was planned for the last half of 1963, providing sufficient ore was developed.

East Coeur d'Alene Mines, Inc., and The Bunker Hill Co. completed an agreement concerning 102 mining claims and mineral rights to 280 acres of homestead land controlled by East Coeur d'Alene near the Nancy Lee property. Under the agreement, Bunker Hill was to perform required assessment work on the claims and receive 70 percent of any production profits.

Missoula.—Thirteen ounces of gold was produced from the Nine Mile mine (L. Allen and W. Lamon), Nine Mile district. Gold and silver production was reported from two other mines—Dixie and Susan.

Barite mining by Baroid Sales Division, National Lead Co. continued near Greenough. Limestone was calcined to quicklime by American Crystal Sugar Co. for use at its refinery.

Musselshell.—Crude oil recovery dropped from 1.8 million barrels in 1961 to 1.5 million barrels. Bituminous coal output from nine mines was 58,000 tons, 20,000 tons less than in 1961. The Roundup No. 3 mine (Roundup Mining Co.) was the principal source of bituminous coal in Montana.

Phillips.—OME announced that Northern Continental, Inc., Grand Junction, Colo., had been granted a loan to explore for gold and silver in the county. OME was to provide half of the \$76,300 contract.

Powell.—Metal output came from three mines—Hobby Horse (gold), Big Blackfoot district; Negros (lead), Nigger Hill district; and the Nancy Helen (gold), Ophir Gulch district. Placer gold was recovered by various producers in the Finn district.

Phosphate rock production was less than in 1961. Operations of Montana Phosphate Products Co. and George Relyea were active. Most of the output was exported to Trail, British Columbia, Canada, for manufacturing phosphate fertilizers by The Consolidated Mining & Smelting Company of Canada, Ltd. Limestone was calcined and marketed as quicklime and hydrated lime by Elliston Lime Co.

Ravalli.—A small quantity of gold ore came from the Larrigon mine. Hughes Creek Dredging Co., which operated a dragline dredge on Hughes Creek in the Overwich district, was the leading producer of placer gold in the State.

Richland.—Lignite production by Knife River Coal Mining Co. at Sidney increased moderately. Recovery of crude oil from the Sidney-Brorson field reached 75,000 barrels, compared with 48,000 barrels in 1961. Limestone was calcined to quicklime by Holly Sugar Corp. for its refinery.

Roosevelt.—Five oilfields yielded a total of 2.8 million barrels (2.9 million barrels in 1961) of crude petroleum. The county ranked third as a petroleum source. Initial production came from the Benrud-East field.

Rosebud.—Crude oil recovery was 2.4 million barrels, compared with 2.5 million in 1961. Sumatra was the leading field with an output of 2.3 million barrels. Initial production was reported from two new fields—Wildcat and Musselshell.

Sanders.—Lead-zinc ore was mined by lessees of the Jack Waite mine, Eagle district. Output was well below the quantity mined by American Smelting and Refining Company in 1961 before terminating its lease on the property. Six tons of copper, 97 ounces of silver, and 10 ounces of gold were produced from the Green Mountain mine in the Revais Creek (Dixon) district, and 10 ounces of gold and 20 ounces of silver came from the Montana Premier mine, Plains district. Raven Mines continued constructing a 50-ton-per-day flotation mill at the Raven mine property, and 31 tons of copper ore shipped to the Anaconda Reduction Works yielded 493 ounces of silver and 1 ton of copper.

Sheridan.—Oilfields in the county produced 1.4 million barrels of petroleum. This was 400,000 barrels more than in 1961. Output of 936,000 barrels from the Dwyer field, the leading producer in the county, was more than double the 1961 total of 444,000 barrels.

Silver Bow.—Output from The Anaconda Company mines continued to dominate metal-production statistics. Output of gold, silver, copper, lead, and zinc furnished 95.5 percent of the value of precious- and base-metal output in the State.

As in 1960-61, no manganese ore was mined in the county. However, ore from the Emma stockpile and the purchased Government low-grade stockpile was shipped to Anaconda, Deer Lodge County, for processing. Manganese carbonate (rhodochrosite) contained in the Badger State mine ore was not recovered.

Ore shipped from Butte to Anaconda by the Butte, Anaconda & Pacific Railway Co. was 12,164,484 tons, compared with 13,103,645 tons in 1961.

Highland Placers recovered a small quantity of gold at a washing plant in the Highland district.

Summit Valley (Butte) District.—Eight metal mines were operated. Copper ore from the Berkeley pit, Butte Hill mines (Mountain Con, Steward, and Leonard) and Kelley mine and zinc ore from the Badger State mine and two stockpiles supplied most of the State gold (73 percent), silver (88 percent), copper (99 percent), lead (70 percent), and zinc (76 percent) production. Output was reduced by a labor

strike which closed all mines for 2 weeks and idled the Berkeley pit operation from July 16 to September 21.

TABLE 14.—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 (thousand short tons)	Gold, lode and placer (troy ounces)	Silver, lode and placer (thousand troy ounces)
	Lode	Placer			
1953-57 (average).....	20	1	7,643	23,594	5,674
1958.....	22		10,745	17,374	3,308
1959.....	15	1	8,679	18,615	3,204
1960.....	11		12,169	21,819	2,918
1961.....	11	1	12,635	18,391	2,765
1962.....	9	1	11,654	17,657	4,027
1882-1962.....			(¹)	2,349,000	624,960
	Copper (short tons)		Lead (short tons)	Zinc (short tons)	Total value (thousands)
1953-57 (average).....	81,175		13,444	59,566	\$79,554
1958.....	90,557		5,492	26,580	57,942
1959.....	65,810		4,456	22,459	50,149
1960.....	91,754		1,889	4,755	63,980
1961.....	103,788		435	1,384	65,881
1962.....	93,845		4,319	28,636	70,176
1882-1962.....	7,739,000		402,000	2,314,000	3,626,232

¹ Data not available.

Three ore blocks were undercut at the Badger State block-caving operation (Elm Orlu-Black Rock project), and 769,074 tons of zinc ore was mined after production was initiated in March. The company announced that the planned ore production rate was to be 4,000 tons daily.

Although block-caving operations at the Kelley mine were to cease, sinking of the Kelley No. 1 shaft was continued. When completed to a depth of 4,816 feet, the shaft was to be used for centralized hoisting of copper ores from the deep levels of the Mountain Con, Steward, and Leonard mines. During 1962 the shaft was extended 810 feet. Over 32 million tons of ore had been mined from the Kelley since production began in 1952.

Other development projects in progress during the year included completion of the Steward subshaft to a depth of 4,785 feet, sinking of the Neversweat shaft from the 2800 level to the 4500 level to provide an exhaust airway for the lower levels of the Steward and Belmont mines, and preparatory work on the Kelley No. 2 shaft which when completed to the 3900 level would replace the High Ore shaft as the central pumping shaft for the Butte district.

Production from the Leonard mine was the first since 1957. The mine had been closed previously because its shaft and surface facilities were in an area to be caved by the Kelley operation. Ore production was to reach 1,400 tons daily in 1963.

The new concentrator being constructed at Butte by The Anaconda Company was to include six separate sections (units), and the building was to be large enough to permit the addition of another section if

warranted by future developments. Upon completion of a new section, equipment from a section of the old concentrator at Anaconda was to be moved to the new plant. This was to result in milling operations being carried out at both Butte and Anaconda during part of 1963 and 1964. The new concentrator was described.¹⁴

The Anaconda Company annual report to shareholders stated the following:

Ore production will probably be slightly lower in 1963 because of the transfer of equipment from the concentrator at Anaconda to the new concentrator at Butte.

High grade copper ores were mined from veins in the Mountain Con, Steward, and Leonard mines. Important new ore developments occurred on the lower levels of the Mountain Con and Steward mines.

The Bell air compressor plant was destroyed in July by an explosion and fire. The damage was covered by insurance. There was no interruption of production because service was maintained by reserve equipment. A new 40,000 cubic foot compressor plant to replace the Bell plant is being installed at the Kelley mine.

Anaconda announced plans to construct a zinc concentrator near the Badger State mine. The plant, which would have a capacity of 4,000 tons per day, was to receive ore by belt conveyor from the Badger State mine and by rail or truck from other zinc mines in the district.

Silver ore was mined from the Carlu-Pauline and Tuxedo mines, the only mines in the district not operated by The Anaconda Company.

Phosphate rock production from the Maiden Rock mine (Victor Chemical Works) near Melrose was lower than in 1961. Elemental phosphorus was produced at the company's Silver Bow plant. Production of sand and gravel for construction purposes increased substantially.

Stillwater.—The American Chrome Co. Mouat mine, mill, and pilot smelter remained idle, and most of the company-owned homes were sold.

Toole.—Four oilfields in the county yielded 623,000 barrels of crude oil, 55,000 barrels less than in 1961. Whitlash-West joined the ranks of producing fields. Natural gas withdrawals were 964 million cubic feet. Kevin-Sunburst continued to be the major gasfield in the county.

Yellowstone.—Recovery of crude oil from the two fields in the county totaled 275,000 barrels, 35,000 barrels less than in 1961. High-purity elemental sulfur was recovered by Montana Sulphur & Chemical Co. from refinery waste gases.

The county ranked second in the State in sand and gravel production. Shale was expanded to lightweight aggregate by a company near Billings. Locally mined clay was used by Lovell Clay Products Co. to make heavy clay products. Limestone was calcined to quicklime for use at The Great Western Sugar Co. refinery.

Combined Counties.—The following counties have been combined into areas as indicated because a major oilfield or gasfield underlies parts of more than one county and its production cannot be assigned to a single county:

Daniels and Roosevelt.—Crude oil recovery from the Bredette-North field was 7,000 barrels, 4,000 barrels less than 1961.

¹⁴ The Northwest. Concentrator Going Up at Butte Will Stabilize Mining. May-June 1962, pp. 6-7.

Dawson, Fallon, McCone, Prairie, and Wibaux.—The Pine (4.7 million barrels) and Richey oilfields yielded 4.8 million barrels of crude oil. Production from the Pine field in 1961 was 5.2 million barrels.

Garfield and Petroleum.—Crude oil output from the Cat Creek field decreased from 239,000 barrels in 1961 to 220,000 barrels.

Glacier and Toole.—Production from the Cut Bank field was 1.9 million barrels of crude oil, compared with 2.0 million barrels in 1961. Natural gas withdrawals from Cut Bank-Reagan, the leading source of natural gas in the State, totaled 8.6 billion cubic feet. This output was considerably lower than the 12.4 billion cubic feet reported in 1961.

Golden Valley and Stillwater.—Output of natural gas from the Big Coulee field reached 953 million cubic feet, a 62 million cubic foot increase over 1961.

Musselshell and Rosebud.—The Stensvad and Bascom fields yielded 901,000 barrels of crude oil. Output from the Stensvad field was 1.5 million barrels in 1961.

Pondera and Teton.—Crude oil production from the Pondera and Pondera Coulee fields was 467,000 barrels, compared with 496,000 barrels in 1961.