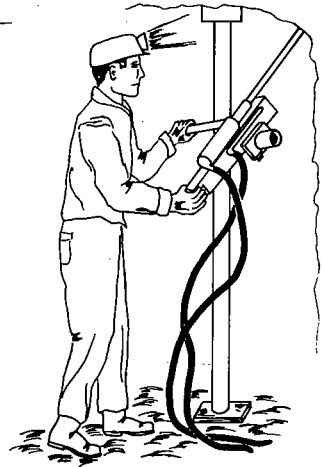


STATE OF SOUTH DAKOTA
Nils Boe, Governor

MINERALS REPORT 11

THE
MINERAL INDUSTRY
OF
SOUTH DAKOTA
IN 1963



by Carl L. Bieniewski, U.S. Bureau of Mines
and
Duncan J. McGregor, State Geologist

*South Dakota State Geological Survey
Vermillion, South Dakota
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The Mineral Industry of South Dakota

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

By Carl L. Bieniewski ¹ and Duncan J. McGregor ²

MINERAL production in South Dakota for 1963 established a new record of \$55.1 million, surpassing the previous record set in 1959 by \$5.6 million. For the 15th consecutive year, the State led the Nation in gold production. Record outputs were reported for sand and gravel, lime, uranium ore, and vanadium.

TABLE 1.—Mineral production in South Dakota ¹

Mineral	1962		1963	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Beryllium concentrate.....short tons, gross weight..	144	\$77	(²)	(²)
Cement.....thousand 376-pound barrels..	2,360	7,566	1,914	\$6,107
Clays.....thousand short tons..	249	690	315	1,968
Coal (lignite).....do..	18	77	16	62
Copper (recoverable content of ores, etc.)...short tons..	-----	-----	1	(³)
Feldspar.....long tons..	29,697	191	25,600	157
Gem stones.....	(⁴)	20	(⁴)	20
Gold (recoverable content of ores, etc.)...troy ounces..	577,232	20,203	576,726	20,135
Gypsum.....thousand short tons..	23	93	24	97
Iron ore (usable)...thousand long tons, gross weight..	34	113	-----	-----
Lead (recoverable content of ores, etc.)...short tons..	3	1	4	1
Mica:				
Scrap.....do..	210	6	(²)	(²)
Sheet.....pounds..	2,085	12	10,000	(³)
Petroleum (crude).....thousand 42-gallon barrels..	169	(²)	⁵ 187	(²)
Sand and gravel.....thousand short tons..	15,371	9,207	20,806	16,313
Silver (recoverable content of ores, etc.)				
.....thousand troy ounces..	113	123	117	150
Stone.....thousand short tons..	2,852	6,533	2,794	7,339
Uranium ore.....short tons..	29,452	370	72,088	1,931
Value of items that cannot be disclosed: Lime, lithium minerals, vanadium, and values indicated by footnote 2.....	-----	⁶ 505	-----	738
Total.....	-----	⁶ 45,787	-----	55,058

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

² Figure withheld to avoid disclosing individual company confidential data.

³ Less than \$500.

⁴ Weight not recorded.

⁵ Preliminary figure.

⁶ Revised figure.

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TABLE 2.—Mineral production in South Dakota, 1876-1963

Commodity	Earliest year of production	Quantity to date	Value (thousands)	Percent of grand total value
Metals:				
Beryllium concentrate..... short tons..	1914	4,964	\$1,654	0.1
Columbium-tantalum concentrate..... thousand pounds..	1905	188	197	(1)
Copper (recoverable content of ores, etc.)..... thousand pounds..	1889	216	38	(1)
Gold (recoverable content of ores, etc.)..... thousand troy ounces..	1876	29,963	830,292	65.6
Iron ore (usable)..... thousand long tons..	1893	158	631	(1)
Lead (recoverable content of ores, etc.)..... thousand pounds..	1889	1,008	72	(1)
Manganese ore..... short tons..	1891	295	4	(1)
Silver (recoverable content of ores, etc.)..... thousand troy ounces..	1876	11,875	8,948	0.7
Tin (content of ores and concentrates)..... thousand pounds..	1884	380	110	(1)
Tungsten ore and concentrate (60 percent WO ₃ basis)..... short tons..	1898	1,638	1,379	0.1
Uranium ore..... thousand short tons..	1952	453	7,053	0.6
Vanadium..... short tons..	1954	91	321	(1)
Zinc (recoverable content of ores, etc.)..... thousand pounds..	1889	530	56	(1)
Miscellaneous (antimony and arsenic).....	(2)		10	(1)
Total value of metals production.....			850,765	67.2
Nonmetals:				
Cement..... thousand 376-pound barrels..	1891	36,695	90,959	7.2
Clays..... thousand short tons..	1888	6,621	39,294	3.1
Feldspar..... thousand long tons..	1923	1,387	6,705	0.5
Gem stones..... weight not recorded..	1906		231	(1)
Gypsum..... thousand short tons..	1884	559	2,552	0.2
Lithium minerals..... do..	1898	107	3,930	0.3
Lime..... do..	1896	216	2,219	0.2
Mica:				
Scrap..... short tons..	1899	51,775	1,006	0.1
Sheet..... do..	1879	3,535	3,074	0.2
Pumice..... do..	1904	1,880	18	(1)
Pyrites..... long tons..	1903	3,108	13	(1)
Sand and gravel..... thousand short tons..	1889	259,888	134,322	10.6
Stone..... do..	1889	46,091	124,465	9.8
Miscellaneous (asbestos, graphite, flint lining, and flint pebbles).....	(3)		50	(1)
Total value of nonmetals production.....			408,838	32.3
Mineral fuels:				
Coal..... thousand short tons..	1895	1,356	3,208	0.3
Natural gas..... million cubic feet..	1899	1,183	102	(1)
Petroleum (crude)..... thousand 42-gallon barrels..	1954	1,232	2,720	0.2
Total value of mineral fuels production.....			6,030	0.5
Grand total value of mineral production.....			1,265,633	100.0

¹ Less than 0.1 percent.

² Earliest year of production for antimony, 1901; arsenic, 1924.

³ Earliest year of production for asbestos, 1895; graphite, 1903; flint lining, 1925; flint pebbles, 1926.

⁴ Includes preliminary figure for 1963.

TABLE 3.—Value of mineral production in constant 1957-59 dollars

(Thousands)

Year	Value	Year	Value
1952.....	\$33,917	1958.....	\$41,733
1953.....	35,157	1959.....	48,009
1954.....	38,970	1960.....	46,638
1955.....	41,387	1961.....	43,780
1956.....	41,836	1962.....	44,344
1957.....	40,241	1963.....	51,942

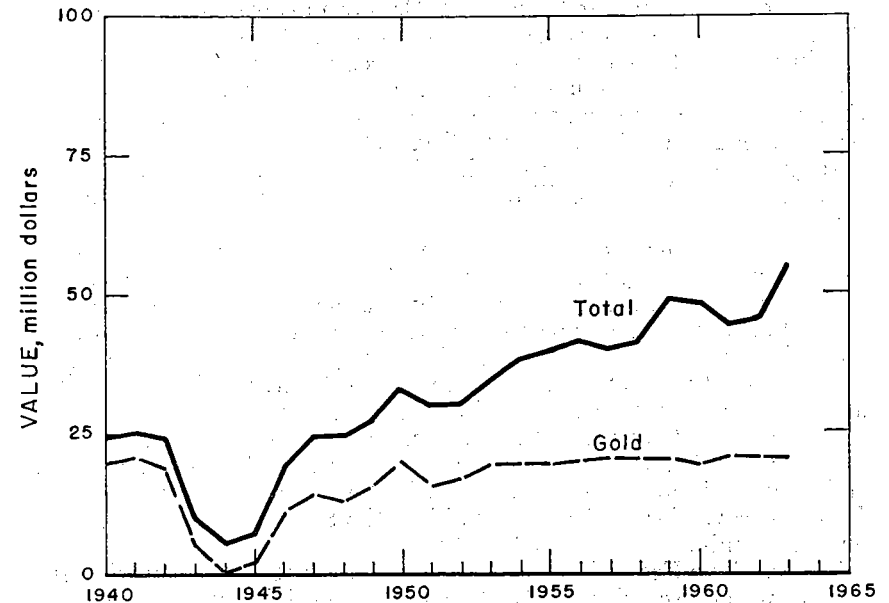


FIGURE 1.—Value of gold, and total value of mineral production in South Dakota, 1940-63.

The \$55.1 million was 20 percent greater than the State total value of mineral production reported for 1962. Substantial increases in production of sand and gravel and uranium ore accounted for the significant rise in total value.

Of the 67 counties, only Jones and Washabaugh had no reported mineral production. Butte, Custer, Grant, Harding, Lawrence, Minnehaha, and Pennington Counties were the only counties with production valued over \$1 million. The leading county was Lawrence, with \$20.8 million, representing 38 percent of the State total value of mineral production.

A constant dollar series has been prepared in which the bias caused by price level variations is reduced, thus showing more nearly the real change in the annual value of mineral production. The series is constructed by summing the constant dollar value of several mineral groups. These groups were converted to 1957-59 constant dollars by dividing the group current dollar value by the appropriate group implicit price deflator.

Government Programs.—Construction projects financed by Federal, State, county, and municipal funds accounted for a large part of the production of cement, sand and gravel, and stone. These raw materials were used mostly in highway construction projects. Contracts for such projects totaled \$60.4 million,³ an increase of \$25.9 million, or 75 percent over that of 1962. Slightly more than half of the money went for construction of roads in the interstate highway system. Of

³ Engineering News-Record. State Highway Contracts will Rise. V. 172, No. 13, Mar. 26, 1964, pp. 13-15.

the 679 miles⁴ designated for South Dakota in this system at yearend, 247 miles was open to traffic. Work (either in the construction, engineering, or right-of-way phase) was in progress for 389 miles, and only 43 miles had no work underway. During the year, heavy-construction work was completed on the missile complex centered around Ellsworth Air Force Base, Rapid City. Construction work continued throughout the year at the Big Bend Dam project near Fort Thompson. Closure of the 17-million-cubic-yard earth-fill dam took place in July.

The Pathfinder atomic powerplant, a cooperative venture of the U.S. Atomic Energy Commission (AEC) and Northern States Power Co., near Sioux Falls, was virtually completed at yearend. Initial criticality of the reactor was expected in early 1964, and power design operation of 58,500 net electrical kilowatts was expected by late 1964. The fuel for the reactor was expected to be slightly enriched uranium, and that for the superheater, highly enriched uranium.

The Federal Government made mineral payments to South Dakota totaling \$116,731 which represented 37.5 percent of bonuses, royalties, and rentals from mineral leases on Federal lands within the State. Bonuses, royalties, and rentals paid to the State from mineral leases on State lands amounted to \$236,540.

Water.—The Federal Bureau of Mines conducted a nationwide survey of water used during 1962 in the mineral industries. Table 4 presents data obtained for South Dakota.

TABLE 4.—Water used during 1962 in the mineral industry by type of operations

(Million gallons)

Type of operation ¹	New water	Recirculated water	Total water used	Discharged water	Consumed water	Gallons of new water per dollar value of production
Quarries and mills.....	3		3	3		0.52
Coal mines.....						
Metal mines and mills.....	3,302	1,050	4,352	2,666	636	158.05
Nonmetal mines and mills.....						
Sand and gravel operations.....	46	195	241	36	10	5.00
Total.....	3,351	1,245	4,596	2,705	646	
Oil- and natural-gas-well drilling.....			1			

¹ Water survey did not include cement plants, lime plants, metal smelters, metal refineries, petroleum refineries, natural-brine operations, sand and gravel operations using suction dredges without preparation plants, stockpile operations, and assessment work operations.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Cement shipments from the State-owned plant at Rapid City was 446,000 barrels or 19 percent less than that of 1962. Portland cement constituted 98 percent and masonry cement the remaining 2 percent. The average price for portland cement was \$3.16 per barrel

⁴ Bureau of Public Roads. Quarterly Report on the Federal-Aid Highway Program, Dec. 31, 1963. Press Release BPR 64-9, Feb. 7, 1964.

(376 pounds) which was 2 cents per barrel below that of 1962. The average price of masonry cement remained the same as in 1962, \$3.30 per barrel (280 pounds).

Two-thirds of all cement shipments was consumed within the State. Portland cement was shipped to Colorado, Minnesota, Missouri, Montana, Nebraska, North Dakota, and Wyoming. Masonry cement was shipped to the same States except Colorado and Minnesota. Highway contractors constituted the largest percentage of customers, purchasing 28 percent of the shipments of portland cement; however, these shipments were about half of those made in 1962. Ready-mixed concrete companies received 26 percent of the portland-cement shipments, building-materials dealers 23.5 percent, concrete-product manufacturers 12 percent, contractors other than highway 10 percent, and Governmental agencies and other customers 0.5 percent. The cement plant was operated at 72 percent of its annual finished-cement (portland) capacity of 2.6 million barrels. Electrical energy needed to operate the plant was 37.3 million kilowatt-hours, compared with 46.5 million kilowatt-hours needed in 1962 when the plant was operated at 88 percent capacity.

Clays.—Clays increased 27 percent in quantity and nearly tripled in value over the output of 1962. Greater output of bentonite, which had a much higher value than other clays produced in the State, accounted for the increases. The main uses for bentonite were as a refractory material and as a rotary-drilling-mud agent. Miscellaneous clay was produced and used to make cement, heavy clay products, and lightweight aggregates. Bentonite was produced in Butte County, and miscellaneous clay was produced in Butte and Pennington Counties. American Colloid Co. was the only bentonite producer; and Black Hills Clay Products Co. Lightweight Aggregates, Inc. and the South Dakota Cement Commission were the only miscellaneous clay producers.

Feldspar.—Output of feldspar was 4,107 long tons or 14 percent below the quantity produced in 1962. About 75 percent of the production came from mines in Custer County; the balance came from mines in Pennington County. Production was obtained from 29 mines, compared with 49 mines in 1962. Four mines accounted for about 75 percent of the total output. The Shamrock and Tip Top mines operated by International Minerals and Chemical Corp. (IMC), the Peerless by Northwest Beryllium Co., and the White Elephant by Briggs Manufacturing Co. were the only mines having production of 1,000 long tons or more. IMC ground crude feldspar at its Custer plant. Most of the ground feldspar was shipped to eastern manufacturers of glass, porcelain, or pottery products.

Gem Stones.—Agate, andalusite, beryl, calcite, carnotite, chalcedony, feldspar, graphic granite, hematite, jasper, lepidolite, mica, quartz, rose quartz, schist, sillimanite, and unidentified mineral specimens were gathered by various collectors, rockshop dealers, and members of gem societies. Most of the specimens were found in Custer and Pennington Counties.

Gypsum.—Production of crude gypsum by the only producer, the South Dakota State Cement Commission, was 1,000 tons more than in 1962; however, less crude gypsum was used as a portland-cement

retarder at the cement plant than in 1962. Excess production was stockpiled at the plant.

Lime.—Output of lime increased 38 percent over that of 1962. More quicklime was produced and used at the Utah-Idaho Sugar Co. plant at Belle Fourche for making a record quantity of sugar from sugar beets. At Pringle, quicklime for metallurgical uses was produced by Black Hills Lime Co., the only other lime producer.

Lithium Minerals.—Hough & Judson produced lithium ore containing amblygonite from the Hugo mine at Keystone.

Mica.—The termination of the Government domestic mica purchasing program in June 1962 resulted in an adverse effect on the mica mining industry. Production of mica was reported for only two

TABLE 5.—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	1962		1963	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building.....	527	\$510	598	\$597
Paving.....	163	167	317	304
Railroad ballast.....			(1)	(1)
Fill.....	11	5	44	29
Industrial:				
Molding.....	(2)	(2)		
Blast.....	(2)	(2)		
Oil (hydraulic).....	(2)	(2)		
Other.....	18	58	3	2
Total.....	719	740	982	932
Gravel:				
Construction:				
Building.....	139	201	390	421
Paving.....	2,855	1,677	1,898	1,813
Railroad ballast.....	45	33	52	40
Fill.....	40	24	58	34
Other.....	12	8		
Miscellaneous.....	22	15	139	79
Total.....	3,113	1,958	2,537	2,387
Total sand and gravel.....	3,832	2,698	3,499	3,319
Government-and-contractor operations:				
Sand:				
Paving.....	662	509	1,352	1,294
Fill.....	10	9		
Total.....	672	518	1,352	1,294
Gravel:				
Building.....	95	85	9	9
Paving.....	10,165	5,515	15,944	11,689
Fill.....	607	391	2	2
Total.....	10,867	5,991	15,955	11,700
Total sand and gravel.....	11,539	6,509	17,307	12,994
All operations:				
Sand.....	1,391	1,258	2,314	2,226
Gravel.....	13,980	7,949	18,492	14,087
Total.....	15,371	9,207	20,806	16,313

¹ Figure withheld to avoid disclosing individual company confidential data; included with "Fill."

² Figure withheld to avoid disclosing individual company confidential data; included with "Other."

mines; in 1962 eight mines had some production. Sheet mica of the lowest grade (punch-and-washer quality) was produced by one operator from a mine in Custer County, and scrap mica by another operator from a mine in Pennington County.

Sand and Gravel.—Production of sand and gravel of 20.8 million tons established a new record output by surpassing the previous record of 1959 by 3 million tons. The 20.8 million tons was 5.4 million tons or 35 percent greater than that of 1962.

Nineteen and one-half million tons or 94 percent of the sand and gravel was used for paving (road construction, including maintenance). Increased road construction was reflected in the additional 5.7 million tons used for this type of work. Sand and gravel for building construction totaled 997,000 tons. The balance, about 300,000 tons, of the output was used for fill, industrial uses, miscellaneous construction, and railroad ballast. Government-and-contractor operations accounted for 17.3 million tons or 83 percent of the total output. The balance, 3.5 million tons or 17 percent of the total output, was produced at commercial operations.

Of the State 67 counties, only Jones and Washabaugh did not have any sand and gravel production. Last year Pennington County was the only county having production over 1 million tons. Because of more highway construction work this year, Minnehaha, Pennington, and Turner Counties had a production of over 1 million tons.

TABLE 6.—Sand and gravel production in 1963, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Aurora.....	209	\$145	Jackson.....	77	\$69
Beadle.....	327	260	Jerauld.....	570	414
Bennett.....	19	13	Kingsbury.....	225	189
Bon Homme.....	191	178	Lake.....	294	242
Brookings.....	635	581	Lawrence.....	471	344
Brown.....	398	302	Lincoln.....	310	257
Brule.....	664	356	Lyman.....	555	417
Buffalo.....	282	166	Marshall.....	250	162
Butte.....	775	597	McCook.....	285	179
Campbell.....	22	17	McPherson.....	170	120
Charles Mix.....	133	92	Meade.....	489	481
Clark.....	140	118	Mellette.....	88	70
Clay.....	71	70	Miner.....	253	225
Codington.....	415	410	Minnehaha.....	1,827	1,268
Corson.....	522	319	Moody.....	340	284
Custer.....	486	610	Pennington.....	1,174	1,144
Davison.....	141	97	Perkins.....	261	180
Day.....	325	253	Potter.....	301	191
Dewey.....	130	106	Roberts.....	306	250
Douglas.....	74	46	Sanborn.....	50	39
Edmunds.....	536	326	Shannon.....	8	5
Fall River.....	106	70	Spink.....	235	205
Faulk.....	41	51	Stanley.....	44	34
Grant.....	195	157	Sully.....	63	63
Gregory.....	940	940	Todd.....	19	14
Haakon.....	176	124	Tripp.....	1	1
Hamlin.....	370	284	Turner.....	1,931	939
Hand.....	134	134	Union.....	96	95
Hanson.....	205	285	Walworth.....	407	303
Harding.....	10	10	Yankton.....	136	134
Hughes.....	282	188	Ziebach.....	66	37
Hutchinson.....	294	251			
Hyde.....	483	398	Total.....	20,806	16,313
	63	54			

Stone.—Stone decreased 58,000 tons or 2 percent in quantity and increased \$806,000 or 12 percent in value, compared with 1962 production. A greater average price for crushed stone and an increase in quantity of dimension stone, which is higher priced than crushed stone, accounted for the increase in total stone value.

About 2 million tons of crushed stone was used as aggregate for making concrete and roads. Crushed stone was also used as riprap

TABLE 7.—Stone sold or used by producers, by kinds

Year	Granite		Limestone		Sandstone ¹	
	Short tons	Value	Short tons	Value	Short tons	Value
1959	18,568	\$3,065,502	1,599,521	\$2,331,485	914,800	\$1,657,900
1960	17,915	3,002,488	1,578,618	2,501,216	1,081,524	1,855,179
1961	26,476	2,823,441	1,378,062	1,939,293	984,512	1,493,464
1962	25,928	2,442,181	1,572,300	2,184,374	1,119,655	1,779,639
1963	24,630	2,761,546	1,652,571	2,427,016	1,083,749	2,070,837
	Other stone		Total			
	Short tons	Value	Short tons	Value		
1959	187,696	\$187,696	2,720,585	\$7,242,593		
1960	520,945	550,469	3,149,002	7,909,352		
1961	417,391	385,953	2,806,441	6,642,151		
1962	134,056	126,373	2,851,934	6,532,567		
1963	82,618	79,310	2,793,568	7,338,709		

¹ Includes quartz and quartzite.

² Includes slate.

TABLE 8.—Stone sold or used by producers, by uses

Use	1962		1963	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough construction and rubble..... short tons	(1)	(1)	(1)	(1)
Rough architectural..... cubic feet	(1)	(1)	(1)	(1)
Dressed architectural..... do.	(1)	(1)	22,518	\$167,714
Rough monumental..... do.	(1)	(1)	(1)	(1)
Dressed monumental..... do.	122,572	\$1,644,297	170,511	2,482,407
Flagging..... do.	(1)	(1)	(1)	(1)
Other..... do.	93,925	800,634	71,900	134,652
Total (approximate, in short tons).....	18,457	2,444,931	25,430	2,784,773
Crushed and broken stone:				
Riprap..... short tons	313,753	404,891	184,140	238,984
Railroad ballast..... do.	183,280	234,302	(1)	(1)
Concrete and roadstone..... do.	1,693,440	2,479,787	1,929,070	3,325,693
Cement..... do.	593,557	890,335	416,642	624,963
Other..... do.	49,447	78,321	233,286	364,296
Total..... do.	2,833,477	4,087,636	2,768,138	4,553,936
Total stone (approximate, in short tons).....	2,851,934	6,532,567	2,793,568	7,338,709

¹ Figure withheld to avoid disclosing individual company confidential data; included with "Other."

² Approximately 1,824 short tons.

³ Approximately 9,926 short tons.

⁴ Approximately 13,813 short tons.

⁵ Approximately 8,531 short tons.

⁶ Approximately 9,793 short tons.

⁷ Includes stone used in filler, lime, and refractory.

⁸ Includes stone used in asphalt, filler, lightweight aggregate, lime, and refractory.

and railroad ballast, for making cement and lime, and for some miscellaneous purposes. The average price of crushed stone was \$1.65 per ton, an increase of \$0.21 per ton over that of 1962. Most of the crushed stone was produced in Hanson, Minnehaha, and Pennington Counties. Crushed limestone and crushed sandstone, mostly quartzite, accounted for nearly 2.7 million tons or 96 percent of the stone output.

Dimension granite was the most valuable stone produced; the output value, nearly \$2.8 million, represented 38 percent of the total value of all stone produced. Six companies operating quarries in Grant County produced the output of dimension granite. About three-fourths of the dimension granite produced at the quarries was made into dressed monumental stone. The balance was made into rough and dressed architectural blocks for use in buildings and rough blocks for making monuments. Dimension limestone used as flagging and rough construction stone was produced in Pennington County.

METALS

Beryllium.—Production of beryllium virtually ceased; only a small quantity of beryl was produced and sold from a single operation; 27 mines had production in 1962. The big reduction in output and in the number of mining operations was due to the loss of the principal market caused by the termination of the Government domestic beryl purchasing program in June 1962.

TABLE 9.—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)
1954-58 (average).....	2		1,722	555,759	\$19,452	146	\$132
1959	2		1,778	577,730	20,221	124	113
1960	2		1,767	554,771	19,417	108	98
1961	2		1,781	557,855	19,525	127	118
1962	2		1,869	577,232	20,203	113	123
1963	3	1	1,909	576,726	20,185	117	150
1876-1963.....	(³)	(³)	(³)	29,962,720	830,292	11,875	8,948
	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1954-58 (average).....							\$19,854
1959							20,334
1960	1	\$1					19,516
1961			(⁴)	(⁴)			19,643
1962			3	\$1			20,327
1963	1	(⁵)	4				20,336
1876-1963.....	108	38	504	72	365	\$56	839,406

¹ Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes re-treated, and ore or old tailings shipped directly to smelter during the calendar year indicated.

² Does not include gravel washed.

³ Data not available.

⁴ Less than 0.5 ton.

⁵ Valued at \$52.

⁶ Valued at \$493.

Copper.—Output of copper came from stockpiled ore mined by American Mining & Smelting, Inc., 2 years ago at the Blue Lead mine in Pennington County. This was the first year since 1960 that copper production was attributed to the State.

Gold and Silver.—With output of gold just about the same as that of 1962, the State, for the 15th consecutive year, continued to lead the Nation in gold production. The value of gold output accounted for 40 percent of the total production in the United States and 37 percent of the State total value of mineral production.

Silver production increased 4,249 ounces or 4 percent in quantity, and \$27,381 or 22 percent in value over that of 1962. The reason for the greater percent increase in value was that the average price increased from \$1.085 per ounce to \$1.279.

Except for 3 ounces of gold and 929 ounces of silver produced from two small operations (Sandra Sue mine in Pennington County and Silver Queen mine in Lawrence County), the gold and silver was obtained from ore mined at the Homestake mine of Homestake Mining Co. The Homestake mine at Lead was the Nation's largest gold producer, as it was in 1962.

Iron Ore.—No iron-ore production was reported, thereby ending consecutive output since 1960. The State-owned cement plant at Rapid City used iron ore from plant stockpiles as an additive in making certain types of cements. The State Geological Survey revealed discovery of three magnetic-high anomalies, two in Day County and one in Marshall County. Intensity readings compared favorably with those taken at the Mesabi Range in Minnesota.

Lead.—Output of lead came from ores produced by American Mining & Smelting, Inc., at the Silver Queen mine in Lawrence County and by Frank Sterling at the Sandra Sue mine in Pennington County.

Uranium Ore.—Output of uranium ore was $2\frac{1}{2}$ times as much as that of 1962: 72,088 tons was produced compared with 29,452 tons in 1962. The uranium ore averaged 0.31 percent uranium oxide (U_3O_8), whereas in 1962 it averaged 0.18 percent. The increase in tonnage and grade was due to production of uranium-bearing lignite in Harding County, the first production reported since 1960.

Production of uranium ore was attributed to 37 operations compared with 29 in 1962. Nineteen of the operations were in Fall River County, 14 in Harding, 3 in Custer, and 1 in Pennington.

In September, Susquehanna-Western, Inc., installed a portable burner near Buffalo for treating uranium-bearing lignite. Ore stockpiled at Buffalo and at mines before the installation and some ore mined after the installation were reduced to ash and then shipped for processing to the Edgemont mill of Mines Development, Inc., a subsidiary of Susquehanna-Western, Inc.

Kermac Nuclear Fuels Corp. mined and stockpiled uranium-bearing lignite ores from its properties in the Cave Hills area for treatment at the company permanent burning facility under construction at Bowman, N. Dak.

Vanadium.—Production of vanadium nearly tripled over that of 1962. Vanadium in the form of vanadium pentoxide (V_2O_5) was recovered from uranium ores processed at the Edgemont mill of Mines Development, Inc.

MINERAL FUELS

Coal (Lignite).—Production of coal (lignite) was 1,000 tons less than in 1962. The entire reported output of 17,000 tons came from the strip mine of Dewey County Coal Co. in Dewey County.

Petroleum.—Output of petroleum (crude) increased 18,000 barrels or 11 percent over that of 1962. Production was reported from 21 wells in the Buffalo field in Harding County and from 2 wells in the Barker Dome field in Custer County; in 1962 the number of producing wells for these fields was 19 and none, respectively. The two additional producing wells in the Buffalo field and one of the two wells in the Barker Dome field were drilled in 1963.

Drilling activity based on information furnished by the South Dakota State Geologist showed an increase over that of 1962: 18 wells, 7 development and 11 exploratory, were completed, compared with 11 wells in 1962. Five of seven development wells completed were successful; the other 2 development wells and all 11 of the exploratory wells were dry holes. The most significant activity was in Custer County; three of the four development wells completed in the county hit oil. No exploratory wells were drilled in Custer County. Harding County had one exploratory well and three development wells of which two were successful. Fall River County had three exploratory wells. Butte, Stanley, and Jackson Counties each had two exploratory wells. Ziebach County had one exploratory well. Footage drilled for the new wells totaled 87,095. The depths of individual wells varied from 1,385 to 8,759 feet. The shallower wells were in Custer County, the deeper ones in Harding County. An old well in Harding County was redrilled and deepened an additional 2 feet but was unsuccessful. At yearend two wells were being drilled in Custer County. All these wells were drilled with rotary tools.

Wyco Pipeline Co. completed construction of a 189-mile branch pipeline between Douglas, Wyo., and Rapid City and completed a pipeline terminal at Rapid City to handle about 1 million gallons of products annually from refineries at Casper, Wyo.

REVIEW BY COUNTIES

Of the 67 counties in the State, only Jones and Washabaugh had no reported mineral production. Table 10 shows the value of mineral output and the kinds of minerals produced in the counties. Only those counties with significant production are discussed in this review.

Butte.—The county mineral production exceeded that of 1962. Each of the three commodities produced—clays, sand and gravel, and lime—had substantial increases in output. Bentonite, mined by American Colloid Co. near Belle Fourche and in Crook County, Wyo., was processed at the company Belle Fourche plant. In June the company leased State-owned land west of Belle Fourche for mining bentonite; a previous lease had expired in 1962. At the Belle Fourche plant of IMC, only bentonite from the company operations in Crook County, Wyo., was processed. Black Hills Clay Products Co. mined clay near Belle Fourche for making brick and tile. Quicklime was made in the Utah-Idaho Sugar Co. sugar factory at Belle Fourche. A record

TABLE 10.—Value of mineral production in South Dakota, by counties

County	1962	1963 ¹	Minerals produced in 1963 in order of value
Aurora.....	\$32,100	\$145,000	Sand and gravel.
Beadle.....	81,290	265,973	Sand and gravel, stone.
Bennett.....	—	13,000	Sand and gravel.
Bon Homme.....	115,600	180,537	Sand and gravel, stone.
Brookings.....	289,700	(?)	Do.
Brown.....	272,107	304,836	Do.
Bruce.....	47,402	358,000	Sand and gravel.
Butte.....	62,940	166,000	Do.
Butte.....	725,209	(?)	Clays, sand and gravel, lime.
Campbell.....	170,347	17,000	Sand and gravel.
Charles Mix.....	164,778	95,773	Sand and gravel, stone.
Clark.....	196,831	118,000	Sand and gravel.
Clay.....	31,500	70,000	Do.
Codington.....	346,400	410,000	Do.
Corson.....	171,677	321,081	Sand and gravel, stone.
Custer.....	702,307	1,038,798	Stone, uranium ore, feldspar, sand and gravel, vanadium, lime, gem stones, petroleum, mica (sheet), beryllium concentrate.
Davison.....	98,900	97,000	Sand and gravel.
Day.....	129,900	253,000	Do.
Deuel.....	100,300	111,331	Sand and gravel, stone.
Dewey.....	101,510	107,872	Coal, sand and gravel.
Douglas.....	63,300	338,309	Sand and gravel, stone.
Edmunds.....	—	70,000	Sand and gravel.
Fall River.....	282,286	312,816	Uranium ore, vanadium, sand and gravel, stone.
Faulk.....	184,019	157,000	Sand and gravel.
Grant.....	2,437,093	3,692,773	Stone, sand and gravel.
Gregory.....	127,908	124,000	Sand and gravel.
Haakon.....	126,300	284,000	Do.
Hamlin.....	67,431	134,000	Do.
Hand.....	64,400	285,000	Do.
Hanson.....	617,228	617,204	Stone, sand and gravel.
Harding.....	(?)	2,211,875	Uranium ore, petroleum, sand and gravel.
Hughes.....	—	251,000	Sand and gravel.
Hutchinson.....	80,207	403,203	Sand and gravel, stone.
Hyde.....	48,840	54,000	Sand and gravel.
Jackson.....	68,966	69,005	Sand and gravel, gem stones.
Jerauld.....	14,000	414,000	Sand and gravel.
Jones.....	7,500	—	—
Kingsbury.....	292,237	189,000	Sand and gravel.
Lake.....	114,200	242,000	Do.
Lawrence.....	20,574,158	20,767,795	Gold, sand and gravel, silver, stone, lead, gem stones.
Lincoln.....	177,600	257,000	Sand and gravel.
Lyman.....	76,600	417,000	Do.
Marshall.....	277,700	162,000	Do.
McCook.....	1,250	182,194	Sand and gravel, stone.
McPherson.....	73,547	122,542	Do.
Meade.....	456,456	604,649	Do.
Mellette.....	43,100	70,000	Sand and gravel.
Miner.....	159,079	225,000	Do.
Minnehaha.....	1,807,880	2,784,878	Stone, sand and gravel.
Moody.....	149,200	234,000	Sand and gravel.
Pennington.....	11,016,445	9,361,442	Cement, stone, sand and gravel, clays, gypsum, mica (scrap), feldspar, lithium minerals, gem stones, copper, uranium ore, gold, lead, silver.
Perkins.....	174,821	180,000	Sand and gravel.
Potter.....	29,700	191,000	Do.
Roberts.....	269,851	265,240	Sand and gravel, stone.
Sanborn.....	9,300	39,000	Sand and gravel.
Shannon.....	—	5,000	Do.
Spink.....	258,186	205,000	Do.
Stanley.....	—	37,452	Sand and gravel, stone.
Sully.....	12,600	63,000	Sand and gravel.
Todd.....	—	14,000	Do.
Tripp.....	—	1,000	Do.
Turner.....	344,100	940,218	Sand and gravel, stone.
Union.....	44,600	95,000	Sand and gravel.
Walworth.....	116,500	303,000	Do.
Washabaugh.....	866	—	—
Yankton.....	77,300	134,000	Sand and gravel.
Ziebach.....	75,500	37,000	Do.
Undistributed ²	4 1,126,035	3,609,696	—
Total.....	4 45,787,000	55,058,000	—

¹ Value of petroleum is preliminary.² Figure withheld to avoid disclosing individual company confidential data; included with "Undistributed."³ Includes production of some sand and gravel and gem stones that cannot be assigned to specific counties and values indicated by footnote 2.⁴ Revised figure.

output of sugar at the plant resulted in a large increase in quicklime production. Output of sand and gravel went from 238,000 tons in 1962 to 775,000 tons, used almost entirely for road construction and maintenance.

Custer.—From among the 10 minerals produced within the county, stone, uranium ore, and feldspar had mineral production worth over \$100,000.

The most important mineral activity was petroleum production. During 1962 the only producing oil well in the county had been inactive. The well, which was the discovery of the Barker Dome field, was worked over by a new owner in 1963 and produced oil from April to the end of the year. Three of the four development wells drilled in the latter part of the year were successful; one of these three wells attained production before yearend.

The county output of feldspar—19,515 long tons valued at \$125,443, representing about three-fourths of the State output—was nearly 9,000 long tons and \$58,000 below that of 1962. Feldspar was produced from 24 operations, compared with 44 operations in 1962. Beryllium-concentrate production was obtained from 1 operation, whereas in 1962 there were 20 operations. Some punch-and-washer-grade sheet mica, mined before this year, was sold during 1963. The value of gem stones was about \$14,000, representing 70 percent of State total value of gem stones. Agate, chalcedony, and quartz were the most widely collected gem materials. Output of uranium ore was about one-third less than that of 1962; only three uranium operations reported production, compared with nine in 1962. However, more vanadium was recovered from the uranium ore than in 1962. The uranium mines were operated by Susquehanna-Western, Inc., and Wayne Sundstrom.

Hills Materials Co. started a new large crushed-limestone operation 6 miles south of Pringle. The new operation was responsible for a substantial increase in stone production. Limestone used as riprap was produced by a contractor of the Federal Bureau of Reclamation. Black Hills Lime Co. mined high-calcium limestone and made quicklime from the limestone at its operation near Pringle. About two-thirds of the sand and gravel produced was used for the road construction project of State Highway 89 between Pringle and Minnekahta. Some sand and gravel was used on construction projects of the Federal Forest Service and Federal Bureau of Reclamation.

Fall River.—The value of the four mineral commodities produced was \$312,816, an increase of \$30,000 over that of 1962. Greater outputs of uranium ore and vanadium offset the drops in production of stone and sand and gravel. The uranium ore and vanadium came from mines operated by Ray Bettenhausen, Black Hills Uranium Co., Walter L. McKenna, Wayne Sundstrom, and Susquehanna-Western, Inc. Mines Development, Inc., a subsidiary of Susquehanna-Western, Inc., operated its uranium mill at Edgemont. In addition to uranium ores, ash, obtained from burning uranium-bearing lignite, was processed at the mill. Crushed limestone was produced by Flyte Rock Products. One Government-contractor and three commercial operations produced the sand and gravel. Oil exploration continued; however, the three exploratory wells completed were unsuccessful.

Grant.—Although only stone and sand and gravel were produced in Grant County, their combined output value totaled nearly \$3.7 million, which was surpassed by only two other counties. The output value represented an increase of about \$1.2 million, or 52 percent over that of 1962. Sand and gravel production, increasing in value from \$12,900 to \$940,000, accounted for most of the change. Virtually all of the output of sand and gravel was produced by the Grant County Highway Department for road construction and maintenance. A small amount of gravel was produced by a commercial operator for use as fill. Dimension granite, valued at about \$300,000 more than that of 1962, accounted for about \$2.7 million, or three-fourths of the county value. The stone was quarried by Cold Spring Granite Co., Dakota Granite Co., Delano Granite Works, Inc., North Star Granite Corp., Robert Hunter Granite Co., Inc., and Steiner-Rausch Granite Co.

Harding.—Value of output of the three commodities—petroleum, sand and gravel, and uranium ore—totaled \$2.2 million, exceeding the \$1.0 million mark for the first time. Uranium-ore production, all from uranium-bearing lignite, was mainly responsible for the large county value; this was the first year since 1960 that such production was recorded for the county. The output of uranium ore came from 14 operations—9 of Kermac Nuclear Fuels Corp., 2 of Bryco Mining Co.; and 1 each of Joe Kalina, Fred Laffin, and W. L. Munkres. Near Buffalo, Susquehanna-Western, Inc., installed and operated a portable burner for reducing uranium-bearing lignite to ash for processing at the Edgemont mill of Mines Development, Inc. Output of sand and gravel was about twice that of 1962. The sand and gravel, produced by a contractor of the South Dakota Department of Highways, was used for road construction. Production of petroleum (crude) came from 21 wells in the Buffalo field; however, only 18 wells pumped throughout the year. One of the 21 wells produced only in January. Two of the three completed development wells were successful and had attained production in the last half of the year. The only exploratory well completed was dry. Zapata Petroleum Corp., which in 1962 had purchased the producing wells of Shell Oil Co., became part of Pennzoil Co.

Lawrence.—Mineral production, valued at nearly \$20.8 million, set a new county high for the State; the previous record, established in 1962 by the same county, was surpassed by about \$200,000. Although the values of gold and stone outputs were below those of 1962, the increases in value of silver and sand and gravel were large enough to more than offset those losses. Gold production, about 500 ounces less than that of 1962, accounted for 97 percent of the total county value. Except for 1 ounce of gold and about 1,000 ounces of silver, the county output of gold and silver was produced by Homestake Mining Co.

According to the Homestake Mining Co. 1963 annual report to the stockholders, an alltime record total of 1,909,261 tons of ore from the gold mine at Lead was treated at the Homestake mill. The value of bullion (gold and silver) produced was \$20,278,195, also a record. The recovered value per ton was \$10.62 compared with \$10.85 for 1962. Metallurgical recovery was 96.92 percent, 0.47 percent below that for 1962. Total direct operating costs increased 56 cents per ton, and general costs increased 12 cents per ton. Production from stoping

below the 4,850-foot level had reached 400 tons of ore per day by yearend. Tonnage from this area was expected to increase to 800 tons per day during 1964. Development of the West Ledge (the westernmost structure in the mine) on the 5,900-foot level had reached the area of mineralization projected from the 4,850-foot level. At yearend the new storage area contained more than 14,000 tons of crushed ore available to assure a more uniform milling rate when mine production temporarily fails to meet mill capacity.

TABLE 11.—Homestake mine ore milled, receipts, and dividends¹

Year	Ore milled (thousand short tons)	Receipts for bullion product		Dividends (thousands)
		Total (thousands)	Per ton	
1959	1,746	\$20,120	\$11.52	\$4,019
1960	1,767	19,465	11.02	4,021
1961	1,781	19,590	11.00	4,030
1962	1,869	20,271	10.85	3,242
1963	1,909	20,278	10.62	3,265

¹ From 1876 to 1963, inclusive, this mine yielded bullion and concentrates that brought a net return of \$758.2 million and paid \$221.4 million in dividends.

Source: Homestake Mining Co. annual report to stockholders.

Some gold, silver, and lead was obtained from ores shipped by American Mining & Smelting, Inc., from the Silver Queen mine. In November, Silver Security Mines, Inc., obtained a lease to operate the Silver Queen mine and purchased the Pioneer Tungsten Mines, Inc., mill located about 4 miles northwest of the mine. The mill was to be used for processing ore from the Silver Queen mine. New Era Mining Co. constructed plant facilities at its properties on Whitewood Creek about 1 mile downstream from Deadwood and expected to attain production in 1964.

Contractors for the Federal Forest Service, South Dakota Department of Highways, and Lawrence County Highway Department produced a total of 471,000 tons of sand and gravel for road construction and maintenance. The output of sand and gravel was 223,000 tons more than that of 1962. Stone production was about 14,000 tons below the 1962 output of 71,000 tons. Cole Construction Co. produced crushed limestone for road construction and for making lime. A contractor for the Lawrence County Highway Department produced crushed limestone for road construction. The balance of the stone was crushed granite used by the city of Lead. The only reported gem material collected was jasper, valued at \$50.

Minnehaha.—The county was ranked first in the State in production of sand and gravel. The output of 1.8 million tons, valued at nearly \$1.3 million, was twice that of 1962. Stone production, all consisting of crushed sandstone (quartzite), accounted for the balance of the county value of mineral production. Most of the sand and gravel and stone went into roadbuilding, especially for sections of Interstate Highways 29 and 90 under construction within the county.

Pennington.—Pennington County was again ranked second according to county value of mineral production. Fourteen of the nineteen mineral commodities produced in the State were recorded in this county. The value of this production was \$9.4 million, a decrease of \$1.7 million below the county value of 1962. The biggest drop in output was cement, whose production value was \$1.4 million below that of last year. However, the cement-production value of \$6.1 million accounted for about two-thirds of the total county value. The total State output of cement was produced at the State-owned cement plant in Rapid City. In conjunction with the operation of the plant, the South Dakota Cement Commission produced limestone, shale (clay), and gypsum. Stone production of 1.2 million tons was 288,000 tons below that of 1962. Limestone produced by the South Dakota Cement Commission for making cement was 177,000 tons less than output in 1962. Hills Materials Co., L. G. Everist, Inc., and Pete Lien & Sons produced crushed limestone. Some dimension limestone was quarried for use as rough building stone and flagging. Construction of a lime plant at Rapid City was about three-fourths completed at yearend. The plant, owned by Rapid City Lime Co., was expected to be in operation about mid-1964. Lightweight Aggregates, Inc., mined clay for lightweight aggregates. The output of feldspar from the six producing mines was 6,075 long tons, an increase of about 4,700 long tons over 1962 production from seven mines. In addition to feldspar, Hough & Judson obtained some lithium ore from the Hugo Lode. The output of scrap mica came from the Peerless mine operated by Northwest Beryllium Co. Gem material collected was valued at about \$5,000. The Blue Lead mine was credited with copper and lead production obtained from stockpiled ore. Uranium ore was produced by Walter Wilk from the Rube No. 1 mine. Sand and gravel production was 1.1 million tons, a decrease of about 200,000 tons from that of 1962. The output was produced from 4 commercial and 19 Government-and-contractor operations.

Turner.—Sand and gravel production went from 494,000 tons in 1962 to 1.6 million tons, which was the second highest county production for the year. The only other mineral production in the county was 1,200 tons of crushed stone. All of the stone and gravel and most of the sand were used in road construction; some sand was used for building construction.