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The World's Mining Industry in 1920:

The Metals

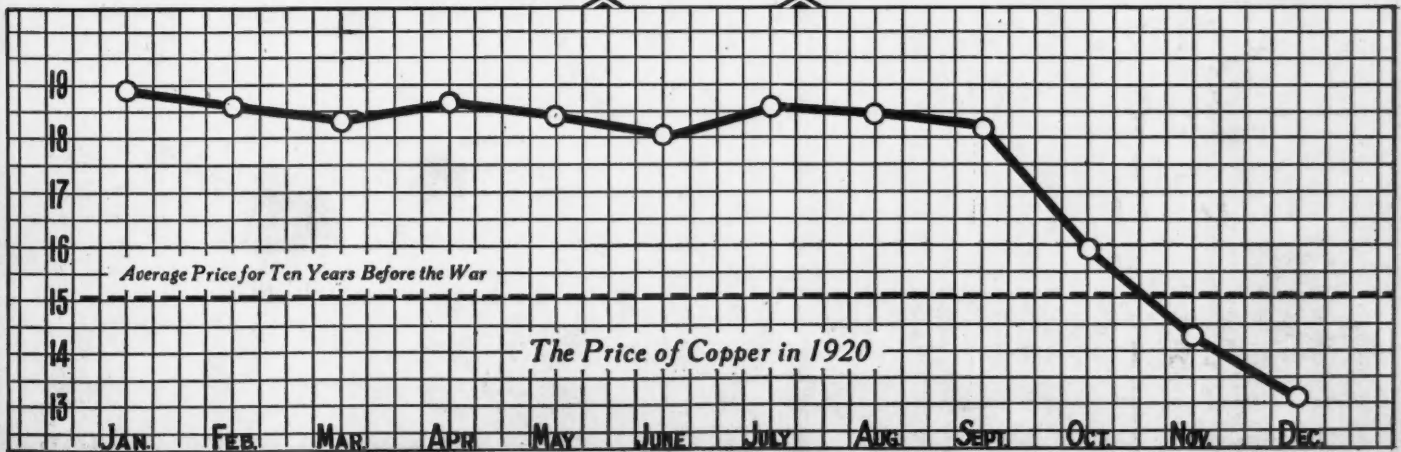
The Non-Metallic Minerals

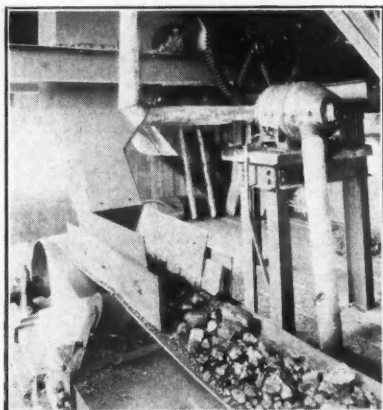
Mining in the United States

Mining in Foreign Countries

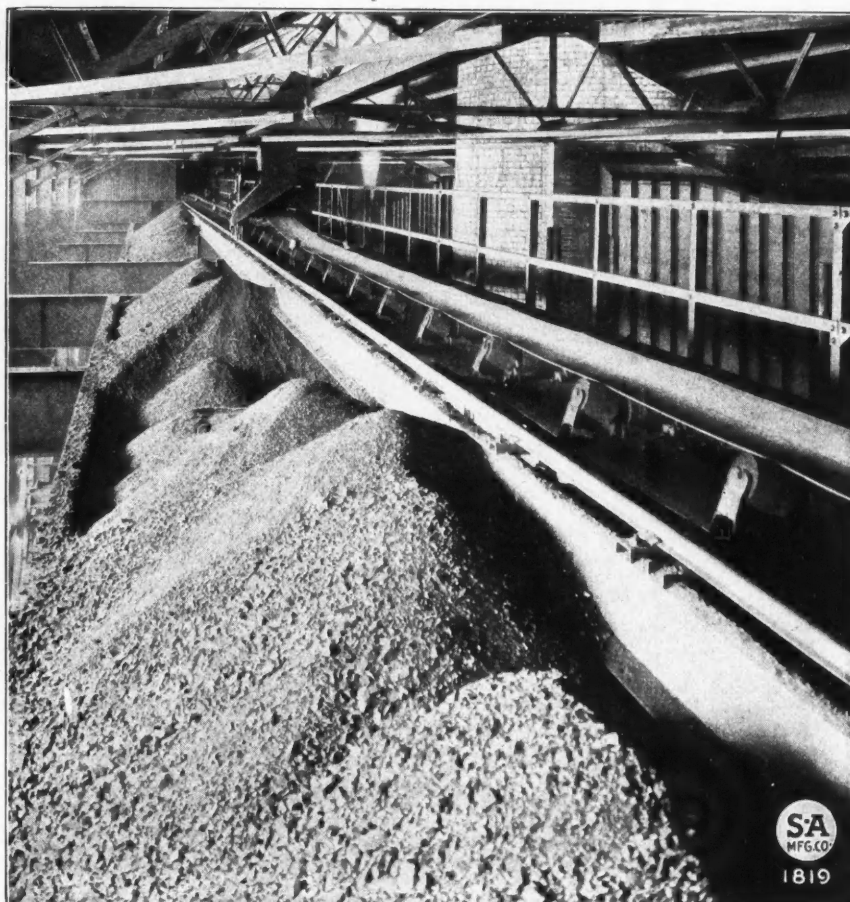
Progress of Metallurgy and Ore-Dressing

Metal Prices for 1920





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Number 4

The Mining Industry in 1920

NINETEEN TWENTY, the second year following the Great War, was naturally one of continuous readjustment. Looking back to the period of our annual review a year ago, general conditions in the world appear to have improved. The ominous rumblings that threaten a world revolution have become fainter. Especially in America, all classes, including the labor element, have given proof of a single Americanism and a determination for orderly methods of progress. In Russia, bolshevistic theories have changed and collapsed; and although the power of Russia's arms is great, and she is still ambitious to loot the world, no country seems anxious to follow her example, and suffer the corresponding demoralization and disaster.

The turning of products to legitimate uses, instead of wasting them in war, brought about during the year a surplus and a corresponding rapid reduction of the enormously inflated war prices, most marked in the United States, where the currency is soundest, because backed by most metallic reserve.

While the rapid deflation in the United States was the most gratifying sign of recovery from the fever of war, the immediate symptoms, such as the dropping of prices for commodities, and the closing down of plants, have been unpleasant. The mining industry has suffered with the rest. The lack of normal ability on the part of Europe to buy American copper, due to the low exchange (which results in part from Europe's depreciated currency) was one of the factors which resulted in the steady decline of metal prices during the year, in which copper fell from 19 to 12½c., and silver in the world market slumped from \$1.37 to 60c. Curtailment of metal production and reduction of wages, with the closing down of mines, have been the result. The "war-mineral" industries, of course, are sleeping—the same sleep that they were experiencing a year ago; and this is likely to be permanent unless they are heavily supported by special-interest legislation. The general deflation has been so rapid, and the resulting business depression so acute, that it is generally believed that only the Federal Reserve system has averted an unprecedented panic. The symptoms, altogether, are of the sub-normal temperature following the war fever; and, pursuing the figure further, this condition, with careful treatment, presages recovery. Conditions are bad: therefore, the general outlook for the future is very bright. Now is the time to prepare for the recurrence of business activity, and for the demand for metals which should normally follow. Never were metallic reserves of so great intrinsic value in the world's catalog of necessities as at the present time; and owners of metal mines may confidently look forward to far better times eventually.

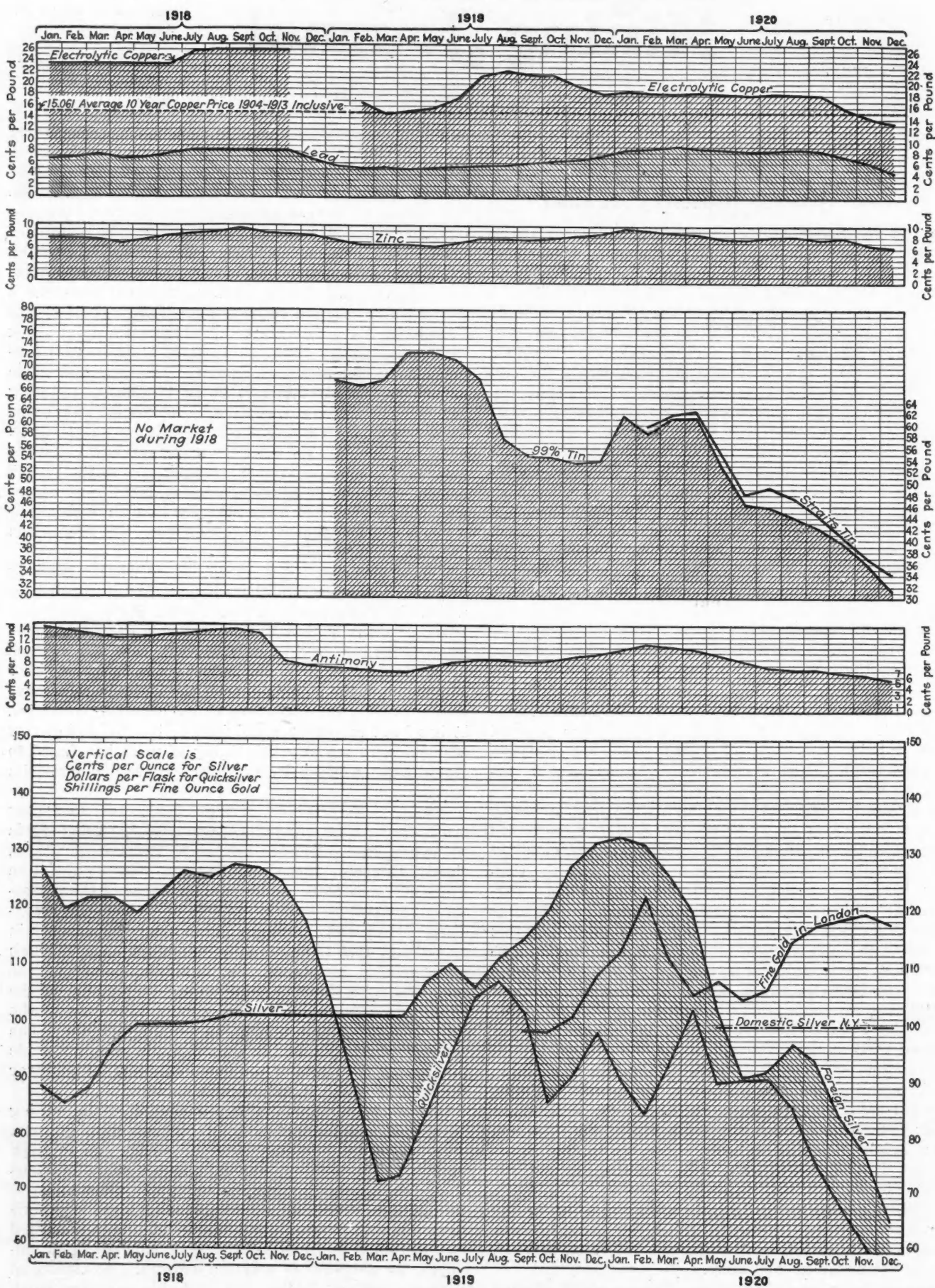
One of the factors of the world disorder which affected mining industries differently in various countries was the unprecedentedly low rates of exchange between the

United States and other countries. The dollar became the standard, instead of the pound sterling, and the exchange rates of most nations, including the main ones involved in the Great War, became greatly depreciated in relation to the dollar. This influenced the gold-mining industry very deeply, allowing the gold from South Africa and Australia to be marketed on a basis of the United States standard price, which, translated back through exchange rates, resulted in a substantial premium in pounds. This supported the Rand and made money for the Australian fields. Even Canadian mining industries, including not only gold but, early in the year, (and before the operation of the Pittman Act) silver, have profited in this way, Canadian exchange having been at a discount of from 8 to 18 per cent in the United States. The gold-mining industry of the United States was, therefore, taxed more severely than in other countries, although, under the conditions, the production has been surprisingly large.

The spectacular fall of silver in the world's markets brought into operation the Pittman Act, according to which the Government of the United States purchases silver produced within the country at a fixed rate of \$1 an ounce; and from the time that this law became operative, in May, with the fall of the world price below \$1 per ounce, the silver mines of the United States have had a great advantage over those of other countries. It has been remarkable and instructive, to students of economics, to see how this fixing of price has failed to stabilize the world price of silver, or even to arrest its collapse.

Mining enterprise in foreign fields has somewhat progressed. The campaign for new petroleum fields the world over has been pushed by various countries, chiefly England, the United States, and France, the enormous immediate economic significance of the possession of petroleum having come to be universally recognized. England, through her clear-sightedness in perceiving, also, immense strategic importance, through governmental assistance has obtained a start of the rest; and some discontent has arisen on the part of the French government, and also on the part of that of the United States, against England on this account. The new administration in the United States should include this among the items of the now long-deferred post-war agreements which it will negotiate.

One of the permanent valuable results of the mining depression has been a study of the reduction of costs through greater efficiency in organization, and through the introduction of mechanical improvements of various kinds. Mechanical loaders of the small type adapted to mining have been one of the devices largely experimented upon. In the United States the tendency toward a closer union and understanding of employer and employee, as a result of reaction from the world social turmoil, seems a distinct one, and this promises much toward raising efficiency and decreasing costs, thus promoting a higher living standard.



MONTHLY AVERAGE PRICES OF METALS

Chronology of Mining in 1920

JANUARY

Jan. 1—Primus Chemical Co. taken over by Vanadium Corporation of America.

Jan. 5—Mexico increased oil export tax 10 per cent; removed import duties from gasoline and other petroleum products.

Jan. 8—Bunker Hill & Sullivan's experimental mill burned down.

Jan. 17—British America Nickel Corp., Ltd., blew in new nickel-copper smelter at Nickelton, Ont.—President Carranza authorized temporary permits for oil-drilling in Mexico.

Jan. 29—Hearing of arguments in Utah Apex-Utah Consolidated suit began at Salt Lake City.

FEBRUARY

Feb. 1—Lake Superior mining companies advanced wages 10 per cent.

Feb. 2—Trial opened at Tombstone, Ariz., of 210 men indicted in Bisbee deportation cases.

Feb. 10—Bingham, Utah, underground miners struck.

Feb. 13—Tonopah-Divide mine operators' offer of 50c. more per shift and other concessions accepted by unions.

Feb. 16-19—A. I. M. E. held annual meeting at New York.

Feb. 17—Coeur d'Alene operators granted 50c. increase in wages effective March 1.

MARCH

March 1—Franklin K. Lane, Secretary of the Interior, retired.—Homestake Mining Co., Lead, S. D., put increased wage scale into effect.—U. S. Supreme Court decided U. S. Steel Corporation and subsidiaries are not an illegal combination.—Trojan Mining Co., in South Dakota, increased wages.—All Coeur d'Alene mining companies increased wages 50c. per day.

March 9—Ontario Mining Association organized at Toronto.

March 8-10—Annual meeting of the Canadian Mining Institute at Toronto.

March 12—President of Mexico issued decree authorizing ten-year concessions for developing oil lands on Mexican national territory.

March 15—John Barton Payne became Secretary of Interior.

March 18-20—American Association of Petroleum Geologists held fifth annual meeting at Dallas, Tex.

March 22—Representative L. T. McFadden introduced gold bonus bill.

APRIL

April 1—Bingham Canyon mine, mill, and smelter men given wage increase of 25c. per shift.—British Columbia opened Indian reservations to gold and silver prospecting and mining.

April 5—Overton vs. Presidio Mining Co. granted petition for rehearing by U. S. District Court of Appeals, San Francisco; the sixth rehearing in twenty years.

April 7—International Mining Convention at Seattle, Wash., opened.—Federal Trade Commission proceedings against Minerals Separation, Ltd., and other respondents began.

April 9—Leadville, Col., companies announced wage increase as of April 1.

April 16—Plymouth Consolidated Gold Mines, Ltd., Plymouth, Cal., granted wage increase of 50c. per day.

April 18—I. W. W. miners at Butte struck.

April 21—Fifteen I. W. W. members shot, one fatally, at Butte, Mont.

April 22—Walkout at Tonopah and Divide called by I. W. W.

April 26—Navigation on Great Lakes opened at Sault Sainte Marie.

April 28—U. S. Supreme Court refused Government a rehearing of anti-trust law case brought against U. S. Steel Corporation.

MAY

May 3—Severe windstorms caused damage in Joplin-Miami district.

May 5—Frederick G. Cottrell, assistant director, U. S. Bureau of Mines, nominated director, succeeding Van. H. Manning, resigned.

May 10—American Zinc Institute held second annual session at Chicago. Sudbury nickel district operators granted wage increase.

May 14—Governor of New York signed bill licensing engineers.

May 15—Winona mine at Houghton, Mich., finally suspended.

May 16—Spindletop oilfield, Texas, damaged by windstorm.

May 17—U. S. Circuit Court of Appeals, San Francisco, Cal., reversed decision in Federal M. & S. Co. vs. Star Mining Co. lawsuit.—Director of Mint announced standing order from Secretary of Treasury to buy silver at \$1 per ounce under Pittman Act.

May 18—First permit under general leasing act issued by Secretary of Treasury.

May 22—Secretary of Interior Payne approved phosphate land leasing rules and regulations.

May 26—Miami Copper Co. petitioned to file supplemental bill which would reopen Minerals Separation-Miami Copper Co. infringement suit to admit newly discovered evidence.

May 27—A. I. M. E. received endowment for Robert W. Hunt medal, and conferred first medal on Mr. Hunt.

JUNE

June 1—Calumet & Arizona Mining Co. took over Eighty-five mine at Lordsburg, N. M.—Judge Bourquin dismissed Minerals Separation, Ltd., proceedings against Butte & Superior Co. for contempt.

June 7—Miami Copper Co. cited before U. S. District Court at Wilmington, Del., to answer contempt charges brought by Minerals Separation, Ltd.

June 10—Secretary of Interior promulgated regulations for operating in oil lands under "Land Leasing Law."

June 12—Secretary of Interior declared void first leases of Welch Mining Co., on Indian-owned lands near Douthat, Okla.—Metals Extraction Corporation started new-process zinc oxide plant near Joplin, Mo.

June 15—Hearing of Minerals Separation, Ltd., contempt proceedings against Miami Copper Co. at Philadelphia, Pa.

June 18—U. S. Circuit Court of Appeals, Philadelphia, Pa., denied petition by Miami Copper Co. to reopen case with Minerals Separation, Ltd., to admit new evidence.

June 23—Lake Superior Prevention of Accidents Conference opened at Duluth, Minn.

June 24—Smuggler-Union Mining Co.'s new flotation mill at Pandora, Col., burned.

June 26—Kansas-Missouri-Oklahoma zinc mines shut down until July 10.

JULY

July 1—Golden experiment station of Bureau of Mines, relocated at Reno, Nev.—British Columbia's Placer Mining Act amendments went into effect.

July 6—Minerals Separation, Ltd., hearings before Federal Trade Commission resumed in San Francisco, Cal., continued to July 10.

July 13—Minerals Separation, Ltd.'s petition to hold Miami Copper Co. in contempt dismissed by Judge Morris, U. S. District Court, Wilmington, Del.—Minerals Separation, Ltd., hearings, adjourned from San Francisco, resumed at Salt Lake City.

July 19—Suit brought by R. S. Talbot, Spokane, Wash., against William H. Crocker, San Francisco, Cal., involving dividends of Northwest Magnesite Co.

July 20—International Mining Convention held for third time at Nelson, B. C.

July 27—Striking mine and oil workers of Mexico return to work at request of President Huerta.—American Smelting & Refining Co.'s sampling mill No. 4 at Murray, Utah, burned.

AUGUST

Aug. 2—Phelps Dodge's Burro Mountain branch started first unit of new mill.

Aug. 17—Ontario Mining Association held first general meeting, at Sudbury, Ont.

Aug. 23—Lake Superior Meeting of A. I. M. E. opened at Houghton, Mich.—Pedro Zamora, Mexican bandit, released Charles Hoyle and five other American and English engineers.

Aug. 24—Case of Northport Mining & Smelting Co. vs. Lone Pine-Surprise Consolidated Mining Co., opened at Spokane, Wash., before Judge Rudkin.—Public Utilities Commission of Utah refused increase in freight charges on coal and ore shipments.—Manganese ore from Brazil reached Mobile, Ala.

Aug. 26—Freight rates on lead bullion and blister copper from Salt Lake smelters to Atlantic seaboard raised 33½ per cent.

SEPTEMBER

Sept. 5—Miners at Virginia City and Gold Hill, Nev., struck.—Gold Canyon Dredging Co., Silver City, Nev., started dredging near Dayton, Nev.

Sept. 6—National Tax Association opened annual convention at Salt Lake City, Utah.

Sept. 9—International First Aid and Mine Rescue meeting opened at Denver, Col.

Sept. 13—Oklahoma State School of Mines, Miami, Okla., opened.

Sept. 16—U. S. Assay Office, New York, damaged by bomb explosion.

Sept. 20—Alexander McDougal vs. Oliver Iron Mining Co. suit for patent infringement came before Federal Court, Duluth, Minn.

Sept. 27—Ninth annual safety congress of National Safety Council opened in Milwaukee, Wis.

Sept. 28—Annual convention of Independent Oil Men's Association opened in Denver.

OCTOBER

Oct. 4—New Mexico chapter of American Mining Congress organized at Silver City, N. M.

Oct. 11—Lowell suburb of Bisbee, Ariz., partly destroyed by fire.—Miners of Asbestos Corporation in Quebec strike.

Oct. 12—Colorado Metal Mining Association asked old freight rates restored within state.

Oct. 15—Joplin, Mo., zinc ore producers voted shut-down for two weeks.—St. Louis Section of A. I. M. E. met in southeast Missouri "Lead Belt."

Oct. 18—Canada Copper Corporation's new 2,000-ton concentrator at Allenby, B. C., started.—Canadian iron ore producers ask bounty of Canadian Tariff Commission.—Subcommittee on standardization of petroleum specifications held open session at Washington, D. C.

Oct. 20—Utah Apex-Utah Consolidated suit decided in favor of former by Judge T. H. Johnson at Salt Lake City, Utah.—Question of ownership of Engineer group of claims in Atlin district, B. C., brought before courts.

Oct. 23—Judge Mining & Smelting Co., Salt Lake City, Utah, closed electrolytic zinc plant.—Increased power rates went into effect in Utah by order of Utah Public Utilities Commission.

NOVEMBER

Nov. 1—Interstate Commerce Commission opened hearings in Salt Lake City, Utah, concerning increases in intrastate freight rates on coal and ore.—Copper Queen at Bisbee, Ariz., laid off 350 steam-shovel men on Sacramento Hill.—Temiskaming Mine Managers' Association restored flat-rate (lower) wage scale.—United Verde Copper Co. reduced force.

Nov. 2—Walker Copper Co., Portola, Cal., laid off most of its miners.

Nov. 4—New Idria Quicksilver mine, California, closed larger plant.—Judge S. L. Pattee dismissed Bisbee deportation cases due for trial Nov. 8.

Nov. 8—Tom Reed Gold vs. United Eastern apex suit came to trial before Mohave County, Ariz., superior court.

Nov. 10—U. S. Court of Claims dismissed claim by A. S. & R. Co. against United States for additional payment of \$512,515 on 33,069 tons copper taken at 23¢ per lb. during war.—Quincy Mining Co., Hancock, Mich., started up new 6,000-hp. Nordberg hoist.

Nov. 12—Apex suit between Federal Mining & Smelting Co. and Hecla Mining Co. officially announced to have been settled.

Nov. 13—A circuit of mines in Grass Valley, Cal., district served by airplane carrying supplies.

Nov. 15—American Mining Congress' 23d annual session opened at Denver, Col.

Nov. 16—Calumet & Hecla reduced wages, closed down Osceola branch, and reduced forces at other mines.

Nov. 18—American Metal Co.'s coal mines in Monclova district, Coahuila, Mexico, seized by striking Mexican coal miners.

Nov. 19—American Engineering Council of Federated American Engineering Societies organized at Washington, D. C.; Herbert Hoover elected president of F. A. E. S.

Nov. 27—Tacoma smelter announced wage reduction.

Nov. 30—Last ore carrier cleared from Missabe docks at Duluth and Superior.

DECEMBER

Dec. 1—Quincy Mining Co. in northern Michigan reduced wages—Cleveland-Cliffs Iron Co. reduced operation at Ishpeming.

Dec. 9—Court of Appeals at Philadelphia affirmed ruling dismissing Minerals Separation's applications for supplemental bills against Miami Copper Co.

Dec. 10—Copper companies of Globe, Ariz., announce wage reduction effective Jan. 1.

Dec. 11—Canada Copper Corporation's mill shut down.

Dec. 13—Supreme Court sustained decree quashing indictments in Bisbee deportation cases.

Dec. 14—Bacon vs. Neill lawsuit over Premier mine opened in Spokane.

Dec. 15—I. C. C. examiner recommended freight rate on ores reduced between Plumas County points in California and Mason Valley smelter.—Arizona Commercial shut down.

Dec. 16—Butte companies announced wage reduction effective in thirty days.—Old Dominion cut wages.

Dec. 17—Utah Copper Co. posted notice of wage reduction effective Jan. 1. (Other Utah companies took similar action at or about this time).

Dec. 22—Karl Eilers denied writ of mandamus ordering American Smelting & Refining Co.'s books opened.

Dec. 23—National Lead and Eagle Picher companies accused of price fixing.

Dec. 28—G. M. Colvocoresses appointed receiver for Consolidated Arizona Smelting Co.

Dec. 31—President signed mine assessment work bill giving six months' grace to claim holders.

Base and Precious Metal Production By States in 1920

PRELIMINARY ESTIMATES

Compiled From U. S. Geological Survey Reports

State	Gold	Silver, Ounces	Copper, Pounds	Lead, Pounds	Zinc, Pounds
Arizona	\$4,943,000	6,098,251	559,235,000	14,000,000	1,457,000
1919	4,506,413	5,266,605	538,100,844	10,203,078	1,717,000
Montana	\$1,839,200	13,583,164	176,600,000	32,144,000	203,953,000
1919	2,229,588	12,541,181	169,981,288	34,437,764	168,763,823
Alaska	\$7,856,000	792,751	71,000,000	1,760,000	.....
1919	9,036,000	488,034	56,534,992	1,128,000	.....
California	\$14,305,300	1,513,495	12,934,900	5,071,600	1,572,500
1919	16,695,955	1,107,189	21,732,507	3,568,267	472,990
Colorado	\$7,613,400	5,572,407	3,600,000	44,600,000	42,000,000
1919	9,867,927	5,639,516	3,310,675	35,859,090	51,445,429
Idaho	\$465,300	7,531,253	2,203,000	254,662,000	28,309,000
1919	713,238	5,579,056	3,122,763	182,341,898	15,994,229
Utah	\$2,076,400	11,564,155	117,000,000	134,000,000	6,000,000
1919	2,159,471	11,649,961	124,061,807	123,829,051	4,431,024
Nevada	\$3,554,900	7,392,689	55,790,000	19,510,000	9,100,000
1919	4,541,502	6,863,580	52,331,175	15,349,370	9,004,698
New Mexico (a)	\$463,400	764,586	54,000,000	2,600,000	11,840,000
1919	595,700	712,791	60,377,320	2,836,000	8,000,000
South Dakota	\$4,201,400	84,351	.....	.....	.....
1919	4,862,586	115,522	.....	.....	.....
Oregon	\$965,100	182,558	2,300,000	.....	.....
1919	980,845	111,121	2,215,000	.....	.....
Washington	\$148,800	183,437	2,394,000	5,079,000	.....
1919	252,862	259,384	1,676,576	2,146,157	.....

(a) Eleven months plus estimate for one month.

Imports and Exports of Metals And Ores

IMPORTS and exports of metals and ores for the first eleven months of 1920 and the corresponding period in 1919, according to the Department of Commerce, are as follows:

IMPORTS, TOTAL FOR ELEVEN MONTHS, 1919, 1920

(In Pounds, Unless Otherwise Stated)

	1919	1920
Antimony ore, contents	727,462	1,250,504
Antimony matte, regulus or metal	13,180,753	23,164,796
Copper		
Ore, contents	47,004,525	49,822,251
Concentrates, contents	33,582,354	43,056,650
Matte, Regulus, etc., contents	38,932,453	17,236,685
Imported from (in part):		
Canada	26,264,861	28,049,600
Mexico	53,769,203	31,831,992
Cuba	15,851,905	17,257,896
Chile	14,402,182	17,432,942
Peru	1,098,487	2,053,444
Unrefined, black, blister, etc.	241,767,442	212,121,652
Refined, in bars, plates, etc.	34,102,257	108,326,211
Old, etc., for remanufacture	4,119,803	11,299,360
Composition metal, copper chief value	355,982	2,866,494
Brass, fit only for remanufacture	14,767,923	42,875,000
Lead		
Ore, contents	18,403,822	28,223,586
Bullion, contents	102,165,220	88,553,013
Imported from (in part):		
Canada	9,763,131	7,072,372
Mexico	105,072,199	97,152,620
Chile	4,635,514	1,894,502
Pigs, bars and old	8,849,348	62,428,494
Manganese ore, long tons	296,968	542,189
Imported from (in part):		
Cuba, long tons	33,820	8,218
Brazil, long tons	219,852	374,873
British India, long tons	3,800	63,988
Tungsten ore, long tons	7,858	1,668
Pyrites, long tons	359,387	311,634
Imported from:		
Spain, long tons	257,826	188,234
Canada, long tons	84,224	95,272
Tin ore and oxide, long tons	15,376	28,895
Tin bars, blocks, pigs, etc.	76,758,266	120,144,762
Imported from (in part):		
United Kingdom	18,119,019	23,818,760
Straits Settlements	50,214,145	72,231,742
Dutch East Indies	3,988,950	3,374,540
Hongkong	68,558	12,594,868
Zinc		
Ore, contents	31,160,293	44,037,978
Imported from:		
Canada	6,971,821	3,513,782
Mexico	20,375,864	29,101,835
Blocks or pigs and old	138,333	29,055

EXPORTS OF COPPER, LEAD AND ZINC

(In Pounds)

Copper		
Ore, contents	507,846	248,712
Concentrates, contents	134,321	191,381
Unrefined, black, blister, etc.	1,450,411	1,730,994
Refined, in ingots, bars, etc.	402,998,239	514,231,583
Exported to (in part)		
Belgium	24,698,082	24,698,082
France	78,038,396	112,930,832
Germany	1,478,200	78,457,805
Netherlands	.....	31,740,047
United Kingdom	101,803,324	89,403,574
Canada	18,063,427	28,687,930
Composition metal, copper chief value	350,842	438,362
Old and scrap	438,470	480,237
Pipes and tubes	5,576,062	4,288,254
Plates and sheets	12,957,177	21,748,310
Wire, except insulated	52,550,908	38,974,369
Lead		
Pigs, bars, etc		
Produced from domestic ore	20,869,543	5,270,759
Produced from foreign ore	79,805,532	31,140,396
Exported to (in part)		
United Kingdom	45,956,068	3,813,748
Canada	4,083,200	3,464,078
Argentina	6,237,203	2,600,658
Japan	23,127,710	7,056,080
Zinc		
Dross	10,245,093	5,621,963
Produced from domestic ore	199,786,487	148,085,823
Produced from foreign ore	23,952,174	56,262,876
Exported to (in part)		
United Kingdom	98,752,407	135,017,175
Canada	4,161,315	391,375
Mexico	125,590	469,026
Japan	34,554,778	4,737,785
In sheets, strips, etc.	37,075,091	22,881,016

Copper*

By H. A. C. JENISON

Geologist, U. S. Geological Survey, Washington, D. C.

THE salient features of the domestic copper industry in 1920 were a subnormal and hesitant market; a decreased production; labor troubles, and the failure of exports to improve conditions.

Early in October producers realized that they would have to reduce prices. Throughout the month repeated slight reductions of prices were made. In November the price was reduced from 15 to 13.5c., a decline that aroused considerable interest among buyers but did not result in the expected business, because, under the existing conditions, consumers could not utilize the normal amount of copper. The only large buyers were probably those who could afford to buy at the low prices quoted and hold their purchases in stock until consumption should become normal. Probably a small part only of the copper bought from the producers will be consumed immediately. Owing to the cautious progress of industrial reconstruction, and the consequent poor trade conditions, the consumption of copper is considerably below normal.

MONTHLY AVERAGE PRICE OF COPPER

Month	New York Electrolytic		London Standard		Electrolytic	
	1919	1920	1919	1920	1919	1920
January	(a) 18.918	16.763	92.238	118.095	106.619	123.238
February	18.569	18.331	78.700	120.188	95.700	126.950
March	18.331	15.246	76.821	109.533	82.071	118.348
April	18.660	15.246	77.300	103.025	82.200	111.500
May	18.484	15.864	77.767	96.750	81.227	109.200
June	18.065	17.610	83.062	87.864	85.900	101.909
July	18.576	21.604	99.576	90.148	103.046	106.455
August	18.546	22.319	97.300	93.935	106.429	111.143
September	18.144	21.755	100.767	96.381	.....	111.905
October	15.934	21.534	103.418	93.327	.....	104.905
November	14.257	19.758	98.894	84.807	.....	94.614
December	13.188	18.295	103.708	75.702	.....	85.905
Year	18.691	17.456	90.796	97.480	.....	108.839

(a) No market. New York, cents per pound. London, pounds sterling per long ton of standard copper.

Early in 1920 the conditions of trade in general, and of the copper market in particular, forced producers to realize that they must curtail production. All the larger producers reduced their output, and many of the smaller discontinued operations. By July some large producers had reduced operations to about half of the rate maintained in 1918, and many were confining their activities to the least expensive workings and to essential development work. The marked decline in the copper market in November and December, however, forced a still further curtailment of production, and secondary copper and copper alloys, which were offered in large quantities, particularly by the Government, at low prices, unfavorably affected prices and output.

The first half of 1920 was marked by large exports, which reacted favorably on the industry, but in July the exports fell off materially, and it soon became evident that Europe could do little more to improve the market for American copper. The rate of exchange remained so low that European buyers could not easily take over large quantities of American copper without an extension of credit. An extension of credit was handicapped by the facts that European buyers had no export market for manufactured copper and that only a fraction of the quantity normally consumed in Europe could at present be utilized in its domestic industries. Consequently the European countries that have usually consumed large

quantities of American copper bought little more than was needed for essential replacements.

Furthermore, besides the unfavorable conditions of exchange, exportation, and consumption in Europe, European consumers of copper have had on hand great stocks of old copper, as well as of brass and other copper alloys. It is reported that in England alone one firm salvaged at least 300,000,000 lb. of copper from brass, copper shell bands, and other articles, and this copper is now available at low prices. The present low price of copper may, however, make it profitable for European buyers to absorb and hold in stock considerable amounts of American copper until industrial conditions become normal.

TABLE I. PRODUCTION, STOCKS, IMPORTS, EXPORTS, AND CONSUMPTION OF COPPER, 1918-1920.

	(In Pounds)		
	1918	1919	1920
Smelter output from domestic ores	1,908,500,000	1,286,000,000	1,235,000,000
Refinery production of new copper from domestic and foreign ores	2,432,000,000	1,768,000,000	1,573,000,000
Stocks at the end of the year, at smelters and refineries	742,600,000	904,000,000	(a) 873,000,000
Imp rts.	575,805,115	429,387,594	(b) 407,437,515
Exports	747,689,580	516,627,775	(c) 543,695,851
Apparent domestic consumption	1,662,000,000	877,000,000	(c) 911,000,000

(a) Amount contains 683,000,000 lb. of refined copper and 190,000,000 lb. of blister copper. (b) Total for ten months ending Oct. 31, 1920, from records of the Bureau of Foreign and Domestic Commerce. (c) Estimated.

TABLE II. EXPORTS OF COPPER DURING THE FIRST HALF AND FOLLOWING FOUR MONTHS ENDING OCT. 31, 1920. (a)

Country	(In Pounds)	
	January to July, 1920	July to November, 1920
United Kingdom	67,740,054	26,904,251
Belgium	15,713,683	7,359,995
Denmark	7,885,976	1,289,500
France	57,445,271	42,641,354
Germany	58,773,179	15,243,495
Italy	1,944,405	241,770
Netherlands	29,047,830	7,005,686
Norway	4,897,619	2,373,635
Switzerland	1,058,208	223,954
Other Europe	25,499,675	13,551,833
Canada	20,902,644	9,693,127
Japan	82,930,908	37,256
Other countries	38,509,374	4,781,169
Totals	412,348,826	131,347,025

(a) According to the Bureau of Foreign and Domestic Commerce.

Until the last quarter of 1920 the copper industry undoubtedly received a considerable amount of artificial support. Prices were held up despite diminished sales and a relatively small reduction in stocks. It was hoped that a general decline in copper prices and in the shares of the companies could be averted until a reaction set in and copper returned to its normal place. However, the great stocks on hand became too much of a burden, and the producers were forced to make considerable reduction in prices to dispose of the stocks. These reductions in prices undoubtedly eliminated the artificial support, so that the industry is now assuming its proper relations to trade and industry in general.

The present status means, of course, temporary curtailment of production, closing down of mines, and considerable losses, but it undoubtedly puts the industry in a healthier position than it has occupied at any time since the war. It is unlikely that there will be further accumulation of stocks; unprofitable mining will be discontinued; and when the present stocks of new and secondary copper and copper alloys are actually absorbed

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by industry (not held in stock by the consumers), copper producers will be in a sound position.

Undoubtedly, in the near future, great hydro-electric developments, electrification of railways, and other large copper-consuming enterprises will be undertaken, but little such work can now be attempted, on account of the high cost of labor and materials other than copper.

There is, however, no question that the industrial demand for copper will soon be greater than it has ever been before. Until that time there must be a little patient waiting and readjustment, and it must be remembered that the European situation is the greatest factor in the present condition of the country in general and the domestic copper industry in particular.

Pig Lead

BY A SPECIALIST IN LEAD

TO OBTAIN a comprehensive view of the 1920 price movement in pig lead it is necessary to go back to Nov. 11 and 12, 1919, when the peak of the upward trend for 1919 apparently had been reached. The *Engineering and Mining Journal* quoted on these two days \$6.85 per 100 lb., New York. By the first of December the New York price had declined \$2 per ton, and the St. Louis price \$4.50, and the domestic demand had greatly slackened. It was just at this period, however, that the position of the lead market changed completely. Although on Oct. 1 the London price was £25 12s. 6d., by Dec. 5 it had advanced to £40 per ton, and the market for lead had become a world market.

As the London price advanced, the Mexican production was sold in London instead of in New York, and the price in the latter city rose to a peak of 9.37½c. per lb. in March, and in August to a lower peak of 9c.

MONTHLY AVERAGE PRICE OF LEAD

Month	New York			St. Louis			London		
	1918	1919	1920	1918	1919	1920	1918	1919	1920
January	6.782	5.432	8.561	6.684	5.316	8.300	29.00	37.227	47.095
February	6.973	5.057	8.814	6.899	4.784	8.601	29.00	28.675	50.256
March	7.201	5.226	9.145	7.091	4.992	8.894	29.00	27.952	46.054
April	6.772	4.982	8.902	6.701	4.722	8.618	29.00	24.888	39.225
May	6.878	5.018	8.576	6.704	4.773	8.352	29.00	23.852	38.488
June	7.611	5.340	8.323	7.511	5.070	8.169	29.00	22.544	34.330
July	8.033	5.626	8.338	7.750	5.408	8.283	29.00	23.457	34.960
August	8.050	5.798	8.687	7.750	5.583	8.725	29.00	24.750	36.304
September	8.050	6.108	8.177	7.750	5.853	8.160	29.00	25.330	35.452
October	8.050	6.487	7.070	7.750	6.249	7.018	29.00	28.473	35.238
November	8.050	6.808	6.159	7.750	6.649	6.127	31.20	34.731	32.489
December	6.564	7.231	4.727	6.324	6.955	4.717	40.00	41.202	24.089
Year	7.413	5.759	7.957	7.222	5.530	7.830	30.10	28.590	37.832

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

On March 11, the London price, translated into United States currency at the current rate of exchange, amounted to 8.35c. per lb. It was on this date that the long downward trend in London started, and the price steadily fell until in December, 1920, it reached 3.35c. per lb., a drop of 5c. per lb. during the nine months.

The price in the United States, after reaching its peak early in March, gradually followed the London price down, until July 10, when the active domestic demand not only advanced the price in New York, but also caused a marked strengthening of quotations in London. At this time, in a short period of two or three weeks, probably 20,000 tons of pig lead was bought for shipment to American consumers and distributors, and for the first time in years large lots of lead could be and were purchased for shipment to the United States from Mexico, England, Australia, France, Germany, and other countries at a price which, with duty and freight added, was less than the market ruling in New York.

During the second half of August, transportation in the United States improved markedly. Though at least 45,000 tons of pig lead was on the rails on Aug. 15, by Sept. 15 there was probably less than half this amount. It was just at this time that the great activity in the automotive industry stopped abruptly, and the storage-battery companies were obliged to reduce their orders

for the immediate future by more than 50 per cent, and in some cases to cancel all shipments for a period of from thirty to ninety days.

The arrivals of pig lead in the United States during the first eight months of 1920 averaged less than 5,600 long tons per month. In September, the reported arrivals were 17,195 long tons, and in October 10,760 long tons, an average monthly increase of over 8,000 long tons.

In the face of adverse conditions in almost every lead-consuming industry, the New York price rapidly fell from 8.90c. per lb. on Sept. 8 to 4.50c. per lb. on Dec. 15, so that the close of the year ended the important post-war price movement which had lasted from May, 1919, to the end of 1920.

Although it may be true that the world price in the early months of 1920 was materially increased by speculation, many other important factors influenced the market. England imported from Spain, during the first ten months of 1920, about 36,000 gross tons, almost exactly the same amount as in 1919, but, during the first four months of 1920, imports from Spain aggregated 6,700 long tons, as against 16,000 for the same period in 1919. The Australian production was greatly curtailed by strike conditions. During the first ten months of 1920, England received slightly less than 50,000 long tons from Australia, as against 85,500 for the same period in 1919. The United States production was below normal, due largely to labor shortages in the mining districts. These conditions, combined with the congestion of transportation in the United States, were mainly responsible for the high prices during the first three quarters of 1920.

PRODUCTION OF LEAD (REFINERY STATISTICS) (a)

	(In Tons of 2000 Lb.)				
	1916	1917	1918	1919	1920
Domestic					
Desilverized	330,189	319,015	284,733	226,085	236,912
Antimonial	22,819	16,265	18,658	14,864	8,992
S. E. Missouri	206,105	205,861	189,207	158,182	206,836
S. W. Missouri	33,128	40,575	63,635	55,790	29,004
Totals	592,241	581,716	556,233	454,921	471,744
Foreign					
Desilverized	17,832	50,962	98,596	61,380	51,700
Antimonial	3,304	2,991	2,083	1,547	2,197
Totals	21,136	53,953	100,679	62,927	53,897
Grand Totals	613,377	635,669	656,912	517,848	525,641

(a) These figures include the lead derived from scrap and junk by primary smelters.

One of the interesting results of the heavy importations of pig lead was the change in the relationship between the New York and the St. Louis markets. The competition of foreign lead forced the New York price down to a level with the St. Louis price, so that the market for pig lead in cities in the Central Freight Association territory was higher than in New York City.

Production—The production of pig lead in the United States has declined since 1916, when the peak of 592,241 tons was reached.

The decline in 1919 was by far the most important. There was a slight increase in production in 1920, but it would seem that unless large new lead deposits are discovered in this country the production will never equal that of the years 1916 and 1917.

Consumption—The peace-time demand for lead products has increased greatly since January, 1919. As heretofore, the paint industry has been the greatest outlet for pig lead, and most of the corrodors enlarged their plants during 1920, in some cases by 100 per cent. The storage-battery industry was second in importance. The third largest demand came from the manufacturers of lead-incased cable. During the first half of the year, there was a fair-sized demand from manufacturers of sheet lead and lead pipe, and a large demand for sporting ammunition, bearing metals, solder, caulking lead,

type metals, lead foil, and other commercial applications.

The three most important industries undoubtedly consumed a tonnage of lead in 1920 equal to the entire domestic production in the United States. That a greater shortage of lead did not occur was due to the heavy importation of lead and to the extraordinary tonnage of reclaimed lead made available.

In 1919, it is estimated by the U. S. Geological Survey that over 122,000 tons of secondary lead was produced. In 1920, it is probable that over 150,000 tons of secondary lead was made available for consumption, the increase being attributable in a large measure to the heavy tonnage of shrapnel balls, small-arms ammunition, and sheet lead which was reclaimed by the United States and other countries and shipped to the market in New York, where it could be paid for in dollar exchange.

Zinc—Market and Metallurgy

BY W. R. INGALLS

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THE zinc industry suffered from the general economic conditions of 1920. Early in the year production was maintained at a high rate, although much below the maximum during the war. In view of the bad situation as to zinc production in Europe it was anticipated that the United States would be called upon to export at least 100,000 tons of spelter during 1920. In fact, buying for export began as was expected, and for several months continued on a large scale, but at about the midyear this ceased, and Europe began presently to resell to us our own spelter. Following this the price, which had risen to about 8c., as the maximum for the year, declined, about 5½c. being quoted at the end of November. The contraction in domestic demand was such that in spite of greatly curtailed production unsold stocks accumulated.

MONTHLY AVERAGE PRICE OF ZINC

Month	St. Louis				London			
	1917	1918	1919	1920	1917	1918	1919	1920
January.....	9.449	7.661	6.922	9.133	48.329	54.000	56.045	58.643
February.....	9.875	7.639	6.273	8.708	47.000	54.000	46.150	61.338
March.....	10.130	7.286	6.150	8.531	47.000	54.000	38.500	53.467
April.....	9.289	6.715	6.114	8.184	54.632	54.000	36.188	47.388
May.....	9.192	7.114	6.079	7.588	54.000	54.000	35.477	45.088
June.....	9.201	7.791	6.551	7.465	54.000	54.000	36.763	41.193
July.....	8.473	8.338	7.523	7.720	54.000	54.000	41.815	41.886
August.....	8.190	8.635	7.439	7.835	54.000	54.000	39.338	41.220
September...	7.966	9.092	7.160	7.661	54.000	54.000	40.955	39.690
October.....	7.813	8.451	7.473	7.150	54.000	54.000	43.630	39.756
November...	7.672	8.141	7.827	6.247	54.000	54.100	46.588	35.028
December...	7.510	7.813	8.350	5.824	54.000	56.050	53.101	27.762
Year.....	8.730	7.890	6.988	7.671	52.413	54.180	42.879	44.372

St. Louis, cents per pound. London, pounds sterling per long ton.

The production of zinc in Europe in 1920 was small in comparison with pre-war figures, but it became clear that the European ability to buy spelter was greatly inferior even to the sharply diminished supply. This situation, combined with the high cost of production and general inefficiency that were prevalent, produced deep gloom in the zinc industry.

The conditions in zinc smelting in the United States in 1920 are well reflected by the following figures from a well-managed works: As compared with 1915 the man-days of labor required to smelt a ton of ore had increased by 7½ per cent. The hourly rate of wages had increased 2½ times. The metallurgical loss of zinc in the process had increased nearly 50 per cent. In other words, the smelting of a ton of ore in 1920 required

more labor than in 1915, the labor was paid an immensely increased rate of wages, and, whereas it had previously obtained 88 per cent of the zinc in distillation, the extraction had fallen to about 82 per cent.

The increase in the cost of coal was of the same order as the increase in wages. As for the total cost of smelting, if the figures of \$10 to \$12 per ton of ore were representative of 1915, the corresponding figures of 1920 were \$25 to \$30. In spite of this, zinc was sold largely during the first half of 1920 at 7½c. per lb.; which is comparable with 5½c. as a pre-war normal

ZINC PRODUCTION, 1918-1920, BY QUARTERS
(In Tons of 2,000 Lb.)

Reports of Ore Smelters Only

	1918			
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Illinois.....	34,848	34,829	36,445	35,686
Arkansas.....	6,156	5,603	7,618	7,373
Kansas-Missouri.....	10,284	5,016	7,198	9,336
Oklahoma.....	37,751	35,261	35,036	35,323
Electrolytic.....	8,094	9,407	11,049	10,335
Others (a).....	36,881	36,265	35,481	34,075
Totals.....	134,014	126,381	132,827	132,128
	1919			
Illinois.....	34,018	27,694	29,344	27,575
Arkansas.....	7,622	7,082	8,196	8,496
Kansas-Missouri.....	11,303	10,819	10,617	10,608
Oklahoma.....	36,142	27,484	25,829	29,999
Electrolytic.....	10,446	12,370	3,146	
Others (a).....	37,024	36,050	30,467	29,353
Totals.....	136,555	121,499	107,599	106,031
	1920			
Illinois.....	31,551	31,406	24,949	21,577
Arkansas.....	7,900	7,500	9,000	5,566
Kansas-Missouri.....	7,389	6,432	6,749	4,561
Oklahoma.....	27,971	25,283	22,105	22,331
Electrolytic.....	11,659	15,208	17,098	13,476
Others (a).....	46,014	44,233	36,945	32,869
Totals.....	132,484	130,062	116,846	100,380

(a) With the exception of ore plant in Colorado, these are all Eastern works. Through the courtesy of the American Zinc Institute, the 1920 figures have been compared with the summary of the Institute.

price. This apparent paradox is explained by the ability of the relatively new mines of Oklahoma to produce concentrates from their comparatively rich ore at substantially pre-war prices, notwithstanding the immensely higher costs for mining.

The first half of 1920 saw the climax of evil conditions in the zinc industry. The demands of labor were then insatiable, and strikes among the smelters were common occurrences. With the unmistakable turn of the indus-

trial tide about Oct. 1, however, a change in the attitude of labor became manifest, the first evidence of it being improvement in efficiency.

Without any doubt the most important thing in the metallurgy of zinc in 1920 was the thorough proving of the electrolytic process. When this process was first introduced in 1916 I prophesied its success and its enormous influence on zinc production, but I foresaw its limitations to especially favorable conditions. My forecast has been exactly verified by experience. In the meanwhile great improvements have been made in the

PRODUCTION OF ZINC 1915-1920

	(In Tons of 2,000 Lb.) By Ore Smelters Only					
	1915	1916	1917	1918	1919	1920
Arkansas.....		7,637	25,701	26,750	31,396	29,966
Colorado.....		8,984	8,908	7,735	3,897	2,779
Illinois.....	161,665	181,495	176,071	141,808	118,631	109,483
Missouri-Kansas.....	111,052	154,396	86,505	31,834	43,347	25,131
Oklahoma.....	111,405	169,064	204,587	143,371	119,454	97,690
Electrolytic.....		10,963	27,245	38,885	25,962	57,441
East and others (a).....	114,036	147,555	154,567	138,805	130,115	158,379
Totals.....	507,142	680,018	682,411	525,350	471,684	479,772

(a) Includes Anaconda and other electrolytic production in 1915.

process. For example, it has become possible so to roast the ore that no sulphuric acid is required for the lixiviation of the zinc. The removal of impurities interfering with the electrolysis has become much more easily manageable. And so on. In the light of these developments the limitations of the electrolytic process do not seem to me to be so severe as they did four years ago. In other words, I can now see the electrolytic process as a more powerful competitor of distillation. However, the factors remain that the electrolytic process must be con-

ducted on a large scale and the cost of plant per unit of capacity is greater than that of the ordinary plant.

The roasting of zinc ore for the electrolytic process is done generally in furnaces of the MacDougall type. These are built now for such conservation of heat and such transferal of heat by the circulation of air through the furnace as I showed should be the case in my U. S. patent No. 786,567 of April 4, 1905. Carrying out these ideas, with the addition of some others of ingenious nature, the Wedge Mechanical Furnace Co. is now building a furnace in which it expects to dead-roast zinc blende without the assistance of any extraneous heat. Theoretically this is possible.

In the distillation process the improvements have continued to be in details only. This is natural, for the process is one that comprises a multiplicity of details.

Electrothermic smelting has continued to be practiced successfully at one works in Norway and at another in Sweden. A third plant, at Glomfjord, Norway, was put into operation in the latter part of 1920. In all of these works the gangue of the ore is fused and drawn off as a slag, as in lead smelting. Prof. C. H. Fulton, in this country, has experimented on a large scale with electrothermic dry distillation, so to speak. His ideas seem to me to possess more merit than do the Scandinavian.

In the production of zinc oxide there have been noteworthy improvements. The New Jersey Zinc Co. is burning in its Wetherill furnaces a briquetted charge. This has been found to increase the extraction of zinc and reduce the requirements for coal and labor, at only a relatively small expense for briquetting.

Tin

BY J. H. LANG

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COMMODITY markets usually display considerable uniformity of movement, regardless of special circumstances affecting them individually. This was more than ordinarily the case in 1920; so much so that it is hardly necessary to describe them separately or in detail. The story is the same in all cases. Like the populations of the countries at war, markets were gathered up by forces stronger than themselves, and swept like leaves before the wind to a common destina-

MONTHLY AVERAGE PRICES OF TIN IN 1918, 1919 AND 1920

Month	New York			Straits	London		
	1918	1919	1920 99%		1918	1919	1920
January.....	85.500	67.702	61.596	293.227	248.557	376.512	
February.....	92.000	66.801	58.466	311.525	223.963	395.750	
March.....	(a)	67.934	61.037	61.926	318.875	236.843	
April.....	(a)	72.500	61.120	62.115	329.905	225.275	
May.....	(a)	72.500	53.230	55.100	364.217	234.398	
June.....	(a)	71.240	46.125	48.327	331.925	238.263	
July.....	(a)	68.000	45.798	49.154	360.347	253.272	
August.....	(a)	57.226	43.856	47.620	380.900	273.625	
September.....	(a)	54.482	41.940	44.465	343.905	280.102	
October.....	(a)	54.377	39.310	40.555	335.543	279.239	
November.....	(a)	53.307	35.667	36.854	323.550	283.556	
December.....	(a)	53.870	31.135	34.058	267.736	314.113	
Year.....	(a)	63.328	48.273	49.101	330.138	257.601	

(a) No average computed.

New York in cents per pound; London in pounds sterling per long ton.

tion. Whether it was copper, tin, lead, or spelter, silver, rubber, sugar, silk or wool, wheat, corn, cotton or leather, the results were the same—the money market dominated all other markets. Divide goods into money and the result is the price. As credit contracted, prices inevitably declined.

As may be imagined, tin was no exception to the rule.

This erratic and 'exotic' commodity, like Abou Ben Adhem, "led all the rest." There was no dizzy pinnacle of price that it could not climb nor any descent so steep that it hesitated to come down. Everything combined to give range and latitude to its gyrations. Always a favorite medium of speculation, it was in excellent position to start when the boom began in the summer of 1919. There was then the smallest visible supply on record—almost invisible in fact. There was plenty of tin, but the governments of the Federated Malay States and the Dutch East Indies were carrying it—15,000 tons, more or less. Even after they had transferred the load to the public, the market, like a certain beverage now absent but not forgotten, was still "going strong."

From a price of about £270 in September, 1919, tin had risen in February, 1920, less than five months later, to the record figure of £420 per ton. Then evidence of weariness and over-speculation began to appear. The financial strain began to tell, and first one market and then another began to crack. Whether America was the original "deflationist," and set or merely followed the fashion, is immaterial. It soon became universal. Even far-off China and Japan were not immune, and disgorged among other things large quantities of tin to add to the burdens of a market already overloaded.

With restricted business, consumers found themselves over-extended, and there was no support from "bears." Except for occasional flurries and reactions the decline was almost perpendicular, and in the short space of

another five months, that is, in June, 1920, the market was below prices prevailing when the boom started. Standard tin in London on June 15 touched £235, and futures £239. From this low point the market advanced about £50, the reaction reaching its height on Aug. 5, at £284 and £289. Then the great recession in business, which had occurred by this time, and tight money put a period to the advance, and a fresh decline occurred, carrying the price down to new low levels for the year.

TABLE I. TIN MARKET IN 1920—CLOSING PRICE END OF MONTH

1920	Silver in London, Pence per Ounce	Demand Sterling Exchange, New York Dollars	Spot Standard Tin, London, £ per Ton	Spot Straits Tin London, £ per Ton	Currency Equivalents in New York, Straits Tin, Cents per Lb.	Spot Market New York, Straits Tin, Cents per Lb.
January.....	83	3.5025	383. 5.0	388. 5.0	60.707	59.50
February.....	83.125	3.4025	400. 0.0	400. 0.0	60.759	60.25
March.....	72.625	3.9025	348. 0.0	348. 5.0	60.672	63.00
April.....	64.50	3.82625	345. 0.0	345. 0.0	58.931	60.50
May.....	57.625	3.875	274.10.0	275. 0.0	47.573	51.50
June.....	52	3.94375	246. 0.0	258.10.0	45.512	47.75
July.....	56.625	3.725	268. 5.0	283. 0.0	47.061	48.25
August.....	58.75	3.5625	272. 0.0	280. 0.0	44.531	46.75
September.....	59.375	3.4625	268. 0.0	270. 0.0	41.735	42.75
October.....	52.50	3.4425	267. 5.0	270. 5.0	41.533	40.25
November.....	43.875	3.48125	207.10.0	208. 0.0	32.326	33.25
December.....	40.875	3.53	205.10.0	210.10.0	33.172	35.00

TABLE II. TIN—COMPARATIVE STATISTICS (RICARD & FREIWALD) (In Tons of 2,240 Lb.)

	Year Ended, Nov. 30, 1920	Year Ended, Nov. 30, 1919	Year Ended, Nov. 30, 1918
Visible supply beginning of period.....	20,495	8,546	16,408
Supplies:			
Straits.....	49,826	48,693	54,752
Australian.....	3,200	2,300	3,345
Banca and Billiton.....	15,671	11,779	11,104
Standard.....	13,843	7,971	9,364
Total.....	82,540	70,743	78,565
Deliveries:			
United Kingdom.....	21,589	18,306	16,905
Continent.....	5,751	10,965	12,127
U. S. A.....	57,714	29,523	57,395
Total.....	85,054	58,794	86,427
Visible supply end of period.....	17,981	20,495	8,546

At this juncture the Straits Government came forward with a stabilization plan under which it offered to buy all ore not marketable elsewhere at a price equivalent to about £229 for refined tin f.o.b. Singapore. The price at which it pegged the market on Jan. 6, 1919,

was about £235, f.o.b. Singapore (£242 c.i.f. London), in spite of which the price declined in London during February, 1919, to £200, and it was not until several months later that the pegged price became firmly established in the open market and the Straits Government was enabled to liquidate.

How far history will repeat itself in this respect remains to be seen. I rather expect a somewhat similar state of affairs in 1921; that is, that temporarily under present adverse conditions we shall see lower prices; but if, as is generally anticipated, and as occurred in 1919, business improves, then the market must rise to the level fixed in the Straits. At best there is small comfort for "bears" in this development, especially as a similar policy seems to have been adopted by the government of the Dutch East Indies in regard to Banca tin. Even assuming that the government of the Federated Malay States undertakes to buy only ore mined in the Straits or tin produced therefrom (as distinguished from tin smelted in the Straits from foreign ores), it will control something like 35,000 tons, and the Dutch about 15,000 tons, equal to about 45 per cent of the world's production, which is sufficient to control the market.

The drastic fall in silver has been a handicap to tin, because of its effect on the Chinese market, and locally the dollar price is affected by fluctuations in exchange. Details of these markets will be found in accompanying tables. Latest available statistics of production, deliveries, visible supply, and related data are also presented. These latter do not show the output of the various producing countries, but only the shipments therefrom, but doubtless reflect conditions with fair accuracy, and the situation so far as may be judged by these figures is entirely sound. The year 1920 closed with less visible supplies than were on hand at the beginning of the year, while prices were much lower—practically back to pre-war levels in fact. Invisible supplies, though not meager, are certainly no larger than a year ago. Given easier money and the improved business which is sure to follow, we have every reason to expect higher prices for tin in 1921.

Gold

BY H. N. LAWRIE

Chief, Precious Metals Division, the American Mining Congress

FROM a world's gold production in 1919 of \$365,200,000, it is estimated that the production for 1920 will be \$339,400,000, a decrease of \$25,700,000, as compared to the decline from 1918 of \$18,400,000. Of the total decline, \$10,300,000 is estimated as the decrease in the production of the United States, which is more than twice the estimated decline of South Africa of \$5,000,000.

The decline in the world's gold production has been continuous since 1915, when the production was \$470,500,000. The total decrease in production during this five-year period has been \$131,100,000, or 28 per cent. The decrease in the production of the United States amounted to \$51,000,000, or nearly 40 per cent of the total world's decline, and the decline in Africa was \$28,800,000, or nearly 22 per cent. The decrease of \$27,400,000 in the production of Australasia nearly equals that of Africa, and yet Australasia produced but \$49,400,000 in 1915, as compared to Africa's production of \$217,600,000.

The disintegration of Russia accounts for \$18,600,000 of the total European decline of \$19,400,000. The Transvaal contributed \$19,400,000 and Rhodesia \$7,400,000 to the total African decline of \$28,800,000 since 1915. Other comparisons may be made from the table on p. 142.

GOLD AND SILVER PRODUCTION OF THE WORLD FOR TWENTY YEARS

	Gold	Ounces Silver (a)		Gold	Ounces Silver (a)
1901.....	\$260,877,429	173,011,283	1911.....	\$459,377,300	226,192,923
1902.....	298,812,493	162,763,483	1912.....	474,333,268	224,310,654
1903.....	329,475,401	167,689,322	1913.....	462,669,558	223,907,845
1904.....	349,088,293	164,195,266	1914.....	451,582,129	168,452,942
1905.....	378,411,754	172,317,688	1915.....	473,124,590	184,204,745
1906.....	405,551,022	165,054,497	1916 (a)...	454,176,500	168,843,000
1907.....	411,294,458	184,206,984	1917 (a)...	419,422,100	174,187,800
1908.....	443,434,527	203,131,404	1918.....	380,924,700	198,168,408
1909.....	459,927,482	212,149,023	1919.....	365,166,077	174,517,414
1910.....	454,213,649	221,715,763	1920.....	338,000,000	159,000,000

(a) As reported by the Director of the Mint. 1920 Estimated.

The South African production for the same period decreased 13.2 per cent. The rate of decrease was therefore four times as great in the United States as in South Africa. This results partly from the fact that the South

African fields were more remotely situated from the center of war and did not feel the effect of rising costs so soon, and partly from the fact that the American

GOLD PRODUCTION OF THE WORLD
Calendar Years

	Millions of Dollars				Increase (+) or Decrease (-)	
	1915	1918	1919	1920	1919-1920	1915-1920
United States....	101.0	68.6	60.3	50.0	-10.3	-51.0
Canada.....	18.9	14.5	15.9	17.1	+ 1.2	- 1.8
Mexico.....	6.6	16.8	15.2	13.2	- 2.0	+ 6.6
Total North America.....	126.5	99.9	91.4	80.3	-11.1	- 46.2
Central America..	3.0	3.4	3.3	3.0	- 0.3	0.0
South America....	14.3	14.1	14.1	14.0	- 0.1	- 0.3
Russia.....	28.6	12.0	12.0	10.0	- 2.0	- 18.6
Balance Europe..	1.6	0.7	0.8	0.8	- 0.0	- 0.8
Total Europe..	30.2	12.7	12.8	10.8	- 2.0	- 19.4
Australasia.....	49.4	30.8	26.1	22.0	- 4.1	- 27.4
British India.....	11.5	10.0	10.5	9.4	- 1.1	- 2.1
Balance Asia.....	17.9	15.5	13.1	11.1	- 2.0	- 6.8
Total Asia.....	29.4	25.5	23.6	20.5	- 3.1	- 8.9
Transvaal.....	188.0	174.0	172.2	168.6	- 3.6	- 19.4
Rhodesia.....	18.9	13.1	12.3	11.5	- 0.8	- 7.4
Balance Africa...	10.7	9.9	9.3	8.7	- 0.6	- 2.0
Total Africa...	217.6	197.0	193.8	188.8	- 5.0	- 28.8
Total for World	470.5	383.6	365.2	339.4	-25.7	-131.1

Years 1915-1918-1919 from Report of the Director of the United States Mint. The 1920 estimate is by H. N. Lawrie.

producer could not benefit by the exchange premium, the United States dollar retaining its par position with respect to all other currencies. Although gold from a monetary standpoint is an international problem, the

production of gold in this country is a domestic problem, and demands a domestic solution.

The decline in the gold production of the United States, as great as it has been during the last five years, does not reflect fully the present serious condition of the gold-mining industry.

The purchasing power of the gold ounce in the United States has averaged during this last five-years period \$13.85, as compared to \$20.67 in 1914. The McFadden Bill now before Congress restores the lost purchasing power of the ounce for the next five years, which will enable these properties to continue operation. Even with this constructive relief, it will be three years before the gold-mining industry may expect to recover a large part of its pre-war normal output. If no Congressional relief is provided, an extensive tonnage of proved gold ore resources will be a total loss and unreclaimable at a later date and the production of new gold will rapidly approach the vanishing point.

Since 1865, a large yardage of placer gravel and tonnage of siliceous gold ore have been removed. Active prospecting now, even if made most profitable, would probably not yield new deposits to replace those now lost and about to be abandoned for lack of governmental action. The process of price recession and credit deflation cannot take place rapidly enough to save the remnants of the gold-mining industry from extinction. The future of the industry in the United States therefore depends largely upon the timely action of Congress in applying a constructive remedy.

Silver

BY PARKER D. HANDY

Handy & Harman, New York

AT THE CLOSE of 1920, general economic conditions throughout the world were unsettled. Silver mined in America and silk spun in China are common sufferers in the decline of prices. As silver is not only a commodity but a metallic measure of values among millions of people in the Orient, the keen interest taken in its fluctuations claims more than ordinary attention. The world is a spectator. Many vital interests are involved.

TABLE I. MONTHLY AVERAGE PRICE OF SILVER

Month	New York			London		
	1918	1919	1920	1918	1919	1920
January.....	88.702	101.125	132.827	44.356	48.438	79.846
February.....	85.716	101.125	131.295	42.792	48.027	85.005
March.....	88.082	101.125	125.551	43.260	48.171	74.194
April.....	95.346	101.125	119.779	47.215	48.886	68.848
May.....	99.505	107.135	102.585	48.980	52.104	60.010
June.....	99.500	110.430	90.957	48.875	53.896	51.096
July.....	99.625	106.394	91.971	48.813	54.133	53.736
August.....	100.292	111.370	96.168	49.077	58.835	59.875
September.....	101.125	114.540	93.675	49.500	61.668	59.476
October.....	101.125	119.192	83.480	49.500	64.049	54.197
November.....	101.125	127.924	77.734	48.969	70.065	50.952
December.....	101.125	131.976	64.774	48.492	76.432	41.845
Year.....	96.772	111.122	100.900	47.516	57.059	61.590

New York quotations, cents per ounce troy, 999 fine silver; London, pence per ounce sterling silver, 925 fine.

At the beginning of 1920, the question of bimetallism was revived, although generally with a view toward demonstrating the unfitness of silver for remonetization. The peak price of silver in November, 1919, \$1.37½, was above coinage parity, and the continued high prices in January and February, 1920, gave grounds for considering a possible silver emergency. The possibility of melting fractional silver attracted the attention of governments, and as early as December,

1919, the Treasury, in co-operation with the Federal Reserve Banks, made arrangements to release standard silver dollars, against other forms of currency, to be employed in regulating our exchange with countries having a silver monetary standard. A total of 13,000,000 dollars of silver went to the Orient up to May, 1920, under these arrangements. By the middle of April, however, silver prices started downward, and the emergency was over. From the year's high price in New York of \$1.37 on Jan. 12, commercial bar silver of foreign origin dropped to 59½c. on Dec. 10, despite the deterring effect of Government purchases under the Pittman Act. A similar violent reaction has taken place in the London market.

Market fluctuations have been more frequent than ever before, the rapid fall in 1920 having been of even greater extent and abruptness than that of the early 90's. The average monthly official price of commercial bar silver in New York and London is given in Table I.

Purchase of domestic silver under the Pittman Act began in May, at the rate of \$1 per oz., 1,000 fine. A practical working arrangement was soon effected, and by Nov. 30 approximately 26,500,000 oz. had been purchased according to the terms of the act. Monthly purchases have averaged 4,000,000 oz., and if the silver market does not rise above \$1 and domestic production proceeds at its present rate it will require about three and one-half years for the Government to replace the 208,900,000 oz. contained in the silver dollars broken up.

Although it was undoubtedly thought that the purchase of American silver at \$1 per fine ounce would

stabilize the market at considerably higher prices than have prevailed, it cannot be said with fairness that the current year's operation of the Pittman Act has had no influence whatever. The general economic conditions resulting in lower silver prices and the continued sales in London of large amounts of melted silver coin from Europe would without doubt have brought about a more severe reaction if the world's supply had not been reduced by the 30,000,000 oz. already absorbed by the United States Government.

The fundamental factors in the silver situation are the demands of India and China. The major portion of the annual silver output must be disposed of in the market centers of these two countries at the best prices obtainable. It is the court of last resort.

Although China for the last two or three years has been a large purchaser of silver to replace an estimated amount of 77,000,000 standard ounces sold to India in the years 1914 to 1917, it has apparently reached the point of saturation for the present.

Usually a favorable balance of trade makes India a creditor country. According to statistics, the export trade of India for the period from 1914 to 1919 was £744,000,000, and the imports were £492,000,000. Partial settlement of the indebtedness has been invariably made by importations of gold and silver, the latter playing a prominent part in cancelling the obligation. In this connection Council Bills, drafts drawn by the Secretary of State on the Indian government, have also been freely sold. Bills have been marketed ordinarily at 1s. 4½d. per rupee, a figure corresponding to the gold export point. If the rupee fell below this figure, or if the trade balance against the mother country was satisfied, then in order to correct the weakness of the financial position a resort was made to the sale of Reverse Council Bills (the sale in India of bills on London against the Gold Standard Reserve, an accumulation of funds from the profits of the rupee coinage). During 1920, the trade balance being unfavorable to India, the sales of Reverse Council Bills from Jan. 1, 1920, to Dec. 1, 1920, totaled £55,000,000. Notwithstanding the strenuous efforts of the government, reaction following the aftermath of peace brought about the wildest fluctuations in the price of silver of which there is any record.

A summary of the causes of the sudden rise and fall of silver prices follows:

AS TO THE RISE

Heavy demand for Indian currency since 1914.

Enormous bullion purchases by the English government on India account.

Large excess of merchandise exports from Bombay, Calcutta, and other Eastern ports.

Huge military expenditures in India, Egypt, Mesopotamia, and Palestine.

Embargo on silver imports on private account.

AS TO THE FALL

Cessation of bullion purchases on government account in 1919.

Unfavorable balance of trade against India for the last six months, as shown by the large amount of Reverse Council Bills sold.

Unfavorable monsoon or lack of rain during the last summer and autumn.

The substitution of paper money in place of the silver rupee.

Serious famine in five important provinces of China. Dullness of export trade during 1920, owing to limited resources and low prices.

Statistics of Production—According to the Director of the Mint's report, the world production of silver for 1919 was 174,517,414 fine ounces, but from available statistics, the 1920 production will be but 159,000,000 fine ounces. The United States 1920 output will probably not exceed 50,000,000 ounces. Canadian production has also declined, owing to the gradual exhaustion of the richest veins in the Cobalt field, but the Mexican mines give no evidence of diminishing returns due to exhaustion of natural resources.

Our estimate of the world's production of silver during 1920 follows:

	Ounces
United States.....	50,000,000
Mexico.....	56,000,000
Canada.....	13,000,000
South America, Central America and West Indies.....	17,000,000
Europe.....	5,000,000
Australia.....	8,000,000
Asia and Africa.....	10,000,000
Total.....	159,000,000

Table II is an endeavor to show the distribution of the foregoing amount of new silver, but also includes the 27,000,000 oz. of melted coin silver received from the Continent in the London bullion market:

TABLE II. DISTRIBUTION OF SILVER PRODUCED IN 1920

	Ounces
Home consumption in the arts.....	23,000,000
United States Mint purchases under the Pittman Act.....	30,000,000
Mexican government purchases.....	9,500,000
English consumption in the arts.....	4,000,000
English mint — for medals.....	2,000,000
Shipments to India from England.....	14,000,000
Shipments to India from United States.....	200,000
Shipments to China and the Far East from United States.....	70,000,000
Shipments to China and Far East from England.....	18,000,000
United States Mint purchases for subsidiary coinage and other buyers, distribution unknown.....	15,300,000
Total.....	186,000,000

Exports of fine bullion from the principal shipping ports of North America during the past twelve months are approximately given in Table III.

TABLE III. SILVER EXPORTS DURING 1920

	Ounces
New York to England.....	5,000,000
New York to India.....	200,000
San Francisco to China, including Hongkong.....	62,900,000
San Francisco to Japan.....	4,600,000
San Francisco to French East Indies.....	2,100,000
Halifax to England.....	3,800,000
Vancouver to China and Far East.....	4,400,000
Total.....	83,000,000

Prediction for the immediate future trend of bullion prices is impossible, as the outlook for India and China is so full of uncertainty and no definite conclusions concerning their 1921 inquiries can be drawn. The situation, however, does present one possible feature of future strength. The disappearance of silver currency and reserves in Europe should only be a temporary condition. Eventually the millions of ounces obtained from melted coins and shipped from London to India and China are likely to be replaced, and it is inevitable that recourse must be made to silver as well as gold as international commerce is re-established with nations of the Eastern Hemisphere. But without considering the time or extent of this future demand for replacing coins melted abroad, a falling off in production, due to lower prices for silver, and an improvement in trade conditions and value of exchanges would undoubtedly advance bullion values above present levels. According to the *British Board of Trade Journal*, a return to a more normal balance of trade in India is admitted, and the general Indian situation gives cause for some optimism in viewing the future.

North American Smelting Works

IN VIEW of the fact that practically no enlargements or additions have been made in the list of smelters during the last year, we are omitting publication of the customary tables showing names and capacities.

Several copper smelters included in the list published in the *Engineering and Mining Journal*, Jan. 17, 1920, did not operate during 1920 or are now closed down. These include the Clifton smelter, formerly owned by the Shannon Copper Co.; the plant of the Calaveras Copper Co. at Copperopolis, Cal.; the Benson works of the Arizona Smelting & Power Co.; the smelter of the Canada Copper Corporation at Greenwood; the Granby

plant at Grand Forks; the Ladysmith smelter; the Mason Valley smelter at Thompson, Nev.; the Ouray furnaces in Colorado; the plant of the Penn Mining Co., at Campo Seco, Cal.; the Phelps Dodge smelter at Morenci; the Mammoth Works at Kennett, Cal.; the Mountain Copper Co.'s smelter at Martinez; and the blast furnace plant at Cooke, Mont. The Mexican smelters in general operated intermittently in 1920. The British American Nickel Co.'s smelter and refinery was blown in and operated at fractional capacity.

Among the silver-lead smelters, the Globe plant of the A. S. & R. at Denver is now closed down, as is also the Ohio and Colorado Smelting & Refining Co.'s Works at Salida.

Many of the zinc smelters are either closed down or working at greatly reduced capacities.

Iron Mining in the United States

BY D. E. A. CHARLTON

Managing Editor *Engineering and Mining Journal*

A REVIEW of iron mining in the United States naturally should begin with a summary of operations and conditions in the Lake Superior district, but inasmuch as the data concerning the various Michigan and Minnesota ranges are incorporated in separate articles dealing with mining in those states, (on pp. 163 and 179, respectively), as is also a résumé of conditions in the Alabama field (p. 180), the following paper considers the remaining states from which it was possible to secure information on iron mining.

According to figures prepared by the *Iron Trade Review*, the total shipments of iron ore from Lake Superior districts during 1920 were 60,227,226 tons, so that a rough estimate would place the total iron ore mined during the year in the United States at 72,000,000 tons. Total production of coke and anthracite pig iron for the year, according to *Iron Age*, was 36,414,114 tons.

In New York, Witherbee, Sherman & Co. operated at their Old Bed, Harmony and New Bed deposits at Mineville, producing about 950,000 tons. There was little or no change in methods of mining or concentration, and little equipment was added. Labor conditions were good, and the semi-contracting system, introduced last year, brought about the best labor efficiency ever produced in the district, enabling the company to retain the older and better men. The Port Henry Iron Ore Co. conducted operations at its mines in the same district. The Chateaugay Iron & Ore Co., at Lyon Mountain, completed a new hoisting shaft and also a new separator. Much development work has been done in the last two years, and considerable effort has been made to concentrate operations on the surface and avoid surface transportation from a number of pits by connecting by drifts on the lower levels. The Fort Montgomery Iron Co. operated its Forest O'Dean mine, eight miles west of West Point, and made considerable improvement in the local housing conditions. At this property the ore is sorted and is taken by rail and ropeway from the mine to Fort Montgomery, on the Hudson, where it is placed on barges for shipment. Considerable development work was done at the Sterling mines of the Ramapo Ore Co., at Sterlington. A new vertical shaft was sunk to the 400-ft. level of the Scott mine, a separator has recently been completed, and modern equipment has replaced that formerly used. Although there was little demand for hematite ore in

the state, the Clinton Hematite mines continued operations in Oneida County, but most of the work done was development.

In New Jersey, the North Jersey Steel Co. took over the mining properties known as the Beach Glen, Misel, and Cobb tracts, and after a considerable examination, consisting of diamond drilling, unwatering the old Beach Glen mine, and taking samples of the ore shoots as exposed in the old workings, began actual development at the Beach Glen mine on May 1. An air compressor plant, blacksmith and machine shops, supply house, and offices have been erected, and a concentration mill with a capacity of seventy-five tons of crude ore per hour was about half completed. It is expected that this mill will go into operation on Feb. 1. The combined properties have estimated ore reserves of 5,000,000 tons of assured ore and 10,000,000 tons of probable ore. Other producing mines in the district are: The Mount Hope mine, at Mount Hope, and the Oxford mine, at Oxford Furnace. Both these belong to the Empire Steel & Iron Co. of Catasauqua, Pa., and were in full operation during 1920. The Richard mine, near Wharton, N. J., belonging to the Thomas Iron Co. at Hokendauqua, Pa., was operated during the first six months of 1920, and in June the property was shut down. The reason for the shut-down was that the mine was operated under the same union as the Mount Hope and Oxford mines, but it was found at the Richard mine that closed-shop conditions made the operation unprofitable, so the mine was closed down indefinitely or until open-shop conditions will obtain. The Replogle mine, near Wharton, N. J., belonging to the Wharton Steel Co., operated all through 1920. This mine produces a bessemer iron ore, which is concentrated. The mine is operated under open-shop conditions, the labor situation being very good. The Ringwood mine, at Ringwood, N. J., is owned by the Ringwood Co. of Ringwood. This mine produced about 100,000 tons of iron ore this year. There was a small operation at the Pequest furnace, near Oxford.

During 1920 iron ore (magnetite) was mined, in Pennsylvania at Cornwall, Lebanon County, French Creek, Chester County, and at Rittenhouse Gap, Berks County. Operations at Cornwall were on a somewhat large scale than for some years, the output of the Cornwall "Ore Banks" exceeding 700,000 tons for the year. The greater part of this ore was shipped to the

concentrator at Lebanon, the remainder being sent to the Robeson Iron Co.'s furnace at Robeson, Pa. The concentrator capacity at Lebanon is now being enlarged by the addition of six Greenawalt sintering pans, three of which should be ready early in 1921. This will call for a monthly tonnage for 1921 of probably 85,000 to 90,000 tons of ore. Operations at Cornwall are all in open cut with steam shovels. Preparations for sinking an inclined shaft to increase output are now under way. An enlarged stripping program has been mapped out, and a Model 300, Marion electric revolving shovel has been purchased, together with additional locomotives and 20-yd. air dump cars. At French Creek mines, an underground operation, development work continued during the year. Shipments, however, were slowed down, owing to the destruction of the sintering plant at Birdsboro by fire. This plant has been rebuilt on improved lines, and, business conditions permitting, the mine should make record shipments in 1921. The Rittenhouse Gap mines opened up several years ago, and continued to produce in a small way during 1920. The ore, principally from development work, is concentrated in a small mill at the mines.

The Low Moor Iron Co. at Low Moor, Va., carried on development at its Dolly Ann mine in 1920. At this mine the shaft is at an angle of 60 deg., the vertical depth being 60 ft. A feature, which is unique for the district, is the installation of a washing plant that is set up on the headframe of the skipway. The plant consists of two double-paddle 18-ft. steel logs, electrically operated. The skips dump into a chute, and the material discharges directly into the logs. The capacity of the plant is 200 tons in ten hours.

According to Joseph Hyde Pratt, director of the North Carolina Geological and Economic Survey, several of the iron mines of North Carolina were producers during 1920. The Cranberry iron mine, at Cranberry, Avery County, was operated by the Cranberry Furnace Co., whose headquarters and furnace are at Johnson City, Tenn. The company is the largest producer of iron ore in North Carolina, and is working a deposit of magnetic iron ore. The mine has been worked, by underground methods, continuously since 1876, the ore consisting of immense lenses of magnetite. Limonite ores of Cherokee County were also worked rather extensively during 1920. The mining is largely open cut and pit work. These iron-ore deposits have been worked spasmodically since 1840, but during the war and with the increased price for pig iron, many of the mines were reopened and have been steady producers since the summer of 1917. The mines are in the vicinity of Andrews, Marble, and Murphy. These limonite ores run from 44.75 to 56 per cent iron. The ore is shipped to furnaces at Middlesboro, Ky., and Lafollette, Tenn. In Ashe County, there are lenses of magnetic iron ore similar to those at the Cranberry deposit in Avery County. These ores, which for many years have been inaccessible, are now available to railroad transportation by reason of the construction of the railway by the Norfolk & Western to West Jefferson, Ashe County. The production of iron ore in North Carolina during 1920 approximated 40,000 tons.

The Sunrise mines of the Colorado Fuel & Iron Co. at Sunrise, Wyo., were closed down from Sept. 22, 1919, until March 1, 1920, owing to the steel strike at Pueblo. On March 1 operations were resumed with full force. Practically all the old force of men returned. The employees operated under the Rockefeller Industrial

Plan, which has proved very satisfactory with respect to industrial and social relations. The fourth level is being opened, and an elaborate system of concrete loading pockets at the hoisting shaft is being installed. The shaft was also concreted to this level. All ore production was shipped to the Minnequa works at Pueblo.

The only iron property which has been operated in Colorado for many years is the Orient mine, near Villa Grove, in Saguache County. This mine belongs to the Colorado Fuel & Iron Co., although it has not been operated on company account for many years. It was closed down early in 1919, and remained idle until May 1, 1920, when it was operated by lessees and produced about 400 tons per month.

With one exception there are no iron mines operating in Washington. Several good-sized deposits of iron ore are, however, known to exist in the state, and during the last several years there has been considerable talk of building a modern steel plant on Puget Sound. The Neutral mine, situated near the town of Chesaw, in northern Okanogan County, has been supplying the Northwest Magnesite Co. with 1,500 to 2,500 tons of magnetite yearly, which is used in the manufacture of ferromagnesite. The Northwest Magnesite Co. has now arranged to secure a byproduct iron from the Dupont Powder Works in California, and the Neutral mine recently closed down.

No iron mining operations were carried on in California during 1920, although for the last two years a syndicate of California bankers and business men has been engaged in studying the possibilities of developing an iron and steel industry on the Pacific Coast.

In Utah, a small amount of low-grade iron ore was mined and shipped from the Tintic district in 1920, for use as a flux at the smelters in the Salt Lake valley. This came principally from the Dragon Iron mine, at Silver City, although some was produced by the Milford Copper Co. and by the Iron King Consolidated Mining Co.

The Bessemer Consolidated Mining Co., in Ormsby County, Nev., made a small shipment during 1920. This is the only property operated solely for iron ore in the state.

Manganese*

BY W. R. CRANE

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A MARKED reaction in 1920 followed a year of stagnation in the domestic manganese industry. The price of ore made a near approach to that of war times. Simultaneously, the imports of foreign manganese ore rose steadily, except during January and July. Though figures for domestic production are not available, the relatively small amount would undoubtedly show an increase similar to that of the imports.

Domestic production of manganese ore of 35 per cent and above, for 1918 and 1919, was 305,869 and 58,085 long tons.¹ The 1919 figures represent shipments of stocked ore as well as that mined during the year, and do not, therefore, give the actual production. Though it is not possible to estimate the production for 1920, it is probable that 50,000 tons would be a fair estimate.

Imports of manganese ore for 1919 were 333,344 long

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¹U. S. Geological Survey.

tons, and those for 1920, up to and including September, totaled 423,012. With the increase in imports came an increased demand for domestic ores, a rather unusual situation, but it was the direct result of depleted reserves and increased demand at a time when conditions were far from normal.

The high cost of producing manganese ore during the war still continues. Marked decline in the cost of certain supplies was noticeable in 1920, but the cost of rail transportation increased, particularly in the United States and Brazil, though ocean freights declined somewhat. The cost of transportation of ores is therefore more favorable to foreign than to the domestic supply.

The average pre-war cost of delivering manganese ore in American ports was 17.3c. per unit for Brazilian, Indian, and Russian ores, being 17.2c., 17.1c. and 17.6c. per unit, respectively. Some time will probably elapse before such cost of delivery will again obtain, and meanwhile the present high cost of transportation on American railroads will seriously curtail domestic production.

The interest in domestic manganese deposits following the sudden rise in price was both prompt and extensive, and although not of material importance except in a few favored localities, it demonstrated that despite the loss sustained during the war period, many are still disposed to try their fortunes in the business of producing manganese under reasonably favorable conditions. The mining of manganese from domestic deposits will without doubt be continued indefinitely in such old producing localities as Batesville, Ark., and Butte and Philipsburg, Mont., and the manganiferous iron producing districts of Colorado, Minnesota, and Nevada.

Tungsten Market

BY CHARLES HARDY

Charles Hardy & Ruperti, Inc., New York

THE year 1920 was a most unsatisfactory one for the tungsten miner, tungsten converter, tungsten user, and even for the importer, and I do not believe that the prospects for 1921 will be any better unless all concerned work harmoniously together for the protection of the whole industry. The year started with an accumulation of tungsten ore in the warehouses in New York, Pittsburgh, and on the West Coast variously estimated at between 10,000 and 12,000 tons. The withdrawals from warehouse and the shipments abroad were far below normal. It was estimated toward the latter part of 1919 that the maximum consumption of tungsten in 1920 would amount to about 4,500 tons.

Assuming importations during the year from all quarters, up to and including the month of October, amounted to 1,636 tons, the visible ore supply in warehouses (not taking into consideration the material on hand at buyers' works) was estimated to be approximately 10,000 tons at the close of 1920. This is a formidable tonnage, and it would require, even under normal conditions, at least two years to dispose of this amount, provided no new importations come in. The imports, however, of ferrotungsten and tungsten metal powder have been heavy, and of course every ton of this material prevents the American consumer from using the local accumulation of ore. The foreign exchange situation has helped considerably to encourage these imports at prices which are far below those at which domestic converters could possibly produce the metal or the powder. Steel containing tungsten has

also been brought in, and I do not think I am too pessimistic in stating that the whole tungsten mining and using industry is disorganized.

The price situation on tungsten varied during 1920 with the hopes or disappointments of the people interested in tungsten on the question of the tungsten tariff bill. Early in the year the tungsten bill before Congress was strongly recommended by the committee, and the price of \$7 per unit for Chinese ore, with which quotation the year started, was fully maintained with slight alterations from this figure. However, when Congress adjourned early in June, the Senate had not acted upon the tungsten bill, and as no action on the tariff could possibly be looked forward to during 1920, prices took a considerable slump. At the end of July a price of \$5 per unit was reached for Chinese ore. For a little while the market remained at \$5 per unit, but when general slackness in business became apparent, when steel plants began shutting down, and when the number of possible buyers of tungsten ore became less and less, the market settled down to a purely nominal figure, and at this writing I doubt whether sales could be effected at even \$4 per unit. The price quoted, in view of the present low rate of exchange, makes the New York equivalent only \$3.25 per unit and short ton.

Though conditions do not look hopeful, I believe that the revival of business in general, which cannot be much longer delayed, together with the buying orders for railroad equipment and construction, will in its turn have a helping influence on the tungsten situation in the United States.

Tungsten Mining

BY F. W. HORTON

Mining Engineer, New York

DURING 1920 practically no tungsten was mined in the United States. Forced sales of ore in a heavily overstocked market and continued imports reduced prices far below the cost of production of even the most fortunately situated tungsten mines in this country. In consequence, tungsten mining virtually ceased, and only a nominal production from development work was made by three or four companies. Notwithstanding the low prices, there was little demand for ore.

At no time in the entire decade preceding 1914 have the present low prices been equaled. In fact, they have never been attained in the entire history of the tungsten industry except during the period from 1900 to 1903 inclusive, when tungsten mining was beginning and the value of the element in steel was not generally recognized. Even during this period, the lowest price was \$1.75 per unit, f.o.b. mines, and the average price was above present quotations. The average price of tungsten ore from 1898, when it was first sold in this country, to 1914 inclusive, was slightly over \$6 per unit. Present prices are far below the cost of production, not only of all domestic mines but also of most foreign tungsten properties. In fact, it is doubtful if there are more than a half dozen mines in Burma or China, the countries where tungsten ore is produced most cheaply, that could deliver ore in New York at a profit at prevailing prices.

Tungsten mining as an industry in this country has ceased to exist, and the few domestic makers of tungsten powder and ferrotungsten still in business are operating only sporadically. Our tungsten mines cannot compete

with the production of ore by the cheap labor of the Orient, and they must remain closed until such time as the United States Government sees fit to grant them a protective tariff on ore. Such a tariff must, of course, also apply in proper proportion to tungsten in any of its forms.

Chromite

BY SAMUEL H. DOLBEAR

Consulting Mining Engineer, San Francisco, Cal.

THE rapidity with which pre-war trade channels are being reopened is fairly indicated by the chromite situation during 1920. Domestic production, which rose to 82,430 tons in 1918, decreased to 3,900 tons in 1919, and in 1920 had almost ceased, only scattering carloads being shipped. Final statistics are not yet available, but it is believed that the deposits in San Luis Obispo County, Cal., were the only ones operated in that state in 1920, and the total shipments from California, Oregon, and Wyoming will not exceed a few hundred tons.

Markets of the world were supplied largely in 1920 by the deposits of New Caledonia, Rhodesia ranking second. There was little activity in Asia Minor, owing chiefly to labor and transportation difficulties. The United States continues to import chrome ore from Cuba, but in less amounts than in the last two years. The ores of this country are reported to present some difficult metallurgical problems. The deposits are controlled by American capital. Deposits in Costa Rica have been mined during the last year, yielding high-grade ore, and regular shipments are made to the United States. The operations are controlled by interests allied to the United Fruit Co., whose steamers touch the ports of this country. The deposits are said to be large, and plans have been made for increasing production.

Prices during 1920 ranged from 50c. to 70c. per unit (1 per cent Cr_2O_3) f.o.b. Atlantic seaboard for ore or concentrates containing 50 per cent chromic oxide. Some domestic ore of lower grade changed hands at concessions to these figures. The outlook for domestic production in 1921 is not bright. Deposits in Western States will likely be able to compete locally only in supplying the small requirements of steel plants situated chiefly in California and Colorado. The falling in price of ferrochrome will prevent much Western production of that product.

Nickel

BY THOMAS W. GIBSON

Deputy Minister, Ontario Department of Mines, Toronto, Canada

THE year 1920 was not a prosperous one for the nickel industry. The deposits at Sudbury, Ontario, Canada, which supply 85 per cent of the world's requirements, were drawn upon to maximum capacity during the war period. The ore raised in 1918, the peak of production, was 1,643,040 tons, and about the same quantity was smelted. The nickel contents of the matte product were estimated at 45,886 tons, and the copper contents at 23,843 tons. When the war closed, the demand fell off sharply, and subsequently almost entirely ceased. Large stocks of matte and refined nickel had been accumulated by the Allies, and the year 1919 by no means saw this entirely absorbed. As a result, operations were greatly curtailed, and, in 1919, the quantity of ore raised fell to 614,955 tons.

The pre-war scale of production was resumed for a considerable part of 1920, but subsequently fell off considerably. Ore raised for the first nine months of 1920 amounted to 925,378 tons, and for the full year to about 1,100,000 tons. Of this, approximately 1,000,000 tons was smelted into matte, representing about 28,000 tons of nickel and 14,500 tons of copper.

Two companies, the International Nickel Co. of Canada, Ltd., and the Mond Nickel Co., Ltd., have long been the sole occupants of the field, but during the year a third, the British American Nickel Corporation, Ltd., came into production. This company has opened up the old Murray mine, which was found to contain large reserves of ore; has put up smelting works at the mine, and erected a refinery at Deschenes, Quebec, where a sufficient supply of electric power is available. This makes two nickel-refining works in Canada.

An unusual feature in the metallurgy of nickel is that there are three methods of refining. The British American company uses the electrolytic process invented by Hybinette. The International company employs the Orford salt-cake process, both at Port Colborne, Ontario, and Bayonne, N. J. The Mond works, in Wales, are operated on a process invented by and called after Dr. Mond, the original founder of the company.

The Sudbury ores carry appreciable quantities of gold, silver, and metals of the platinum group. In 1919, a total of 1,770 oz. of the platinum group metals was recovered, which included 642 oz. of platinum, 842 oz. of palladium, 227 oz. of rhodium and 76 oz. of osmium, iridium, and ruthenium. These were obtained from the International Nickel Co.'s mattes. From the Mond Nickel Co.'s mattes, about 3,078 oz. of platinum was obtained in 1915, 5,474 oz. of palladium, and 917 oz. of iridium and rhodium. In 1916, 1917, and 1918 the recovery of platinum amounted to 3,372 oz., 4,719 oz. and 4,958 oz. respectively.

The nickel deposits of New Caledonia, idle during the war period, are again being worked, but on a reduced scale. Ore of the Sudbury type is said to have been found in the Province of Manitoba, at the Bear and Oiseau rivers, these points being ten or fifteen miles distant. It is considered possible that the occurrences indicate the existence of a belt of norite, but no developments have yet taken place.

Undoubtedly the stimulus of war has greatly expanded the capacity of existing companies for producing nickel. The companies for the moment feel, in the language of the lady in the old song, "all dressed up, but nowhere to go." It may be hoped that when normal conditions are once more firmly established, this useful metal will come into its own.

Molybdenum

BY W. NORMAN BRATTON

Climax Molybdenum Co., New York

THE future of molybdenum is in the steel industry, and producers can hope for no change until the merits of molybdenum steel are sufficiently recognized by users of alloy steel. As soon as the miners can convince the consumer of the merits of molybdenum, mines will resume operation.

During 1920 Professor Arnold, of Sheffield, experimented with a molybdenum high-speed tool steel containing about 5 per cent molybdenum, and presented a paper on the subject that created world-wide discussion.

This steel has not been favorably received in the United States, although reports from England seemed to indicate that it met approval there.

Steel metallurgists in the United States are working with fractional percentages of molybdenum in producing steels in which the average content of molybdenum is about $\frac{1}{2}$ per cent, and results are surprising. The applications of this steel are now well established in the automotive industry and are continually branching out into other uses, notably for railway springs. In the mining industry, reports are noted that molybdenum has commercial advantages in steel balls for grinding mills and rock-drill steels, and further investigation in this field may provide an output.

Molybdenum Market

BY CHARLES HARDY
Charles Hardy & Ruperti, Inc.

THE short space available is more than ample to report the happenings in molybdenum in 1920, which was a year of practically "no business at all." Nearly all mines producing molybdenite in the United States and in Canada were shut down; the stocks with which this country found itself at the beginning of the year are still in warehouse; no inroads have been made thereon to speak of; importations of molybdenum-bearing ores into the United States have stopped entirely; offers from abroad on ferromolybdenum and molybdenite were far below domestic quotations, due mainly to the exchange situation, yet these low figures did not bring about any business of consequence.

The market started in January with sellers quoting 75c. per lb. MoS, for 90 per cent concentrate, with buyers at approximately 60c., and this rate of price difference kept up all through the year. The little business done was generally at a compromise figure.

Platinum and Palladium*

BY JAMES M. HILL
Geologist, U. S. Geological Survey

STOCKS of platinum and palladium at the beginning of 1920 were 29,228 troy oz. and 10,235 troy oz. respectively, and were somewhat below normal, which resulted in a continuation of the high prices prevailing for the metals through the first two months of 1920. Increased imports from Europe and continuation of the receipts from Colombia, South America, had a tendency to lower prices, which was accentuated by the strike of jewelry workers in the East, so that by June the price of platinum had reached \$82 and palladium \$72 per ounce.

Imports of platinum for the first nine months of 1920 were approximately 58,700 oz., indicating a total for the year of nearly 78,300 oz., which is about 23,800 oz. more than the total imported in 1919. Palladium imported for consumption during the first six months of 1920 was 4,798 oz., predicating a total for the year of approximately 9,500 oz. or nearly three times the imports in 1919. Near the close of 1920, platinum-group metals were apparently being received from abroad in larger quantities than during the earlier months.

With the resumption of jewelry manufacture in

*Published by permission of the Director of the U. S. Geological Survey.

"Platinum and Allied Metals in 1919," p. 13, 1920; U. S. Geological Survey, "Mineral Resources of the United States."

August, the demand for platinum increased to such an extent that the price rose to \$117 per oz. by the latter part of September. Since that time, apparently due to slackened demand caused by more difficulties with jewelry makers, the prices steadily declined to \$75 per oz. for platinum and \$75 per oz. for palladium at the end of the year.

There seems to be little question that small lots of Russian platinum will continue to come out through various channels, and it is even conceivable that there may be receipts of rather large lots, providing financing can be arranged. It is believed that with the increased output from Colombia, which can be reasonably expected from the larger and more efficient operations in that country, the market will be well supplied with platinum metals during 1921. Prices, however, can hardly be expected to be as low as the pre-war figures until the Russian fields are again on a producing basis. It is believed, however, that the prices of both platinum and palladium will be lower than those during 1920.

Quicksilver in California

BY FLETCHER HAMILTON
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San Francisco, Cal.

THE quicksilver production of California for 1920 was approximately 9,770 flasks (75 lb. each). This is the lowest yield in the history of the state since 1850. The previous bottom level was in 1914, when the output declined to 11,373 flasks. The low-point price in 1914 was \$37 per flask. Since the war, prices have again declined, so that during the last two months of 1920 the quotations ranged around \$50 to \$65 per flask. However, even at those figures, which were below cost of production, the sales of domestic metal were so limited for several months that on Nov. 1 all of the principal operators in California closed down their

AVERAGE MONTHLY PRICE OF QUICKSILVER
(Per Flask of 75 Lb.)

Month	New York			
	1917	1918	1919	1920
January.....	\$81.04	\$126.77	\$105.50	\$90.192
February.....	120.90	119.89	89.84	84.432
March.....	113.30	121.63	71.56	92.611
April.....	115.64	121.87	72.94	102.192
May.....	105.98	118.97	83.12	89.560
June.....	84.34	122.66	93.25	90.154
July.....	107.80	126.63	104.68	90.333
August.....	115.00	125.56	107.08	83.806
September.....	112.21	127.81	102.52	75.000
October.....	100.94	127.18	86.35	67.200
November.....	102.50	124.91	90.74	58.417
December.....	115.90	117.70	98.27	49.577
Year.....	\$106.30	\$123.47	\$92.15	\$81.123

plants. This included the New Idria, Cloverdale, and Oceanic mines. On June 20, the New Idria plant was wrecked by fire; but the company proceeded to rehabilitate it, and had two of the five rotary furnaces again in operation, when compelled to close on account of market conditions. Importations in 1919 amounted to 10,635 flasks, and in 1920 to 16,131 flasks up to Dec. 1.

There is plenty of ground, even in California, in addition to what may be in Nevada and Texas, that will warrant development if only a fair price can be assured that will justify exploitation. The domestic quicksilver industry is in danger of complete extinction, if not soon given adequate protection against foreign importations. Manufactured mercurials should also be included in the dutiable tariff list, as a protection to American detonator and drug manufacturers, which would in turn further assist the domestic mines.

Antimony

By K. C. Li

President, Wah Chang Trading Corporation

DURING 1920 the market for antimony in China was not a question of cost of production or consumptive demand. Price fluctuations were based chiefly on Chinese exchange. Chinese miners and smelters are paid for their product in gold, and have to pay for their labor and raw materials in silver, in the form of taels. Partly as a result of the business collapse in Japan early in the year, China has entered a period of depression, with great distress to her industries, especially affecting those whose products are not consumed at home, such as antimony.

During 1920, the exchange value of the tael fell almost 60 per cent. In February, bar silver reached a high of 90d. per ounce in London, and the Shanghai tael exchanged for about \$1.67. By May, the tael had fallen to \$1.11, and in December to 70c. The fall in the price of antimony during the year was not because the Chinese miners or smelters were able to reduce their prices in Chinese money, but chiefly due to exchange. An important point is also that the lowest price of antimony "regulus" c.i.f. London was £22 per ton in 1914. At the then rate of exchange £1 averaged 7.5 taels. Thus one ton of antimony would exchange for 165 taels c.i.f. London to the Chinese smelter, or 155 taels, c.i.f., Shanghai. Today the smelter receives below 100 taels, c.i.f., Shanghai. As conditions are today in China any improvement in demand should immediately create a stronger market.

VERAGE MONTHLY PRICES OF ANTIMONY IN CENTS PER POUND

Month	Ordinary Brands				
	1916	1917	1918	1919	1920
January	42.45	17.29	14.28	7.43	10.58
February	44.31	29.80	13.82	7.17	11.59
March	44.75	32.89	13.09	6.80	11.06
April	42.06	34.04	12.54	6.79	10.50
May	31.60	25.20	12.85	7.66	9.66
June	20.05	19.51	13.06	8.44	8.29
July	14.70	15.83	13.20	8.99	7.50
August	11.53	15.06	14.00	8.96	7.18
September	11.81	14.94	14.15	8.63	7.11
October	12.70	14.75	13.32	8.71	6.72
November	13.84	13.91	8.77	9.11	6.11
December	14.59	15.06	7.92	9.62	5.53
Year	25.37	20.69	12.58	8.19	8.49

The strong tone with which the New York market closed the year 1919 continued into 1920, with supplies scarce and a strong demand. January opened with ordinary brands selling at 9.75c., the price advancing steadily through the month to 11½c. and this advance continuing during February to 11½c., at which price March opened; but heavy arrivals from the East during this month depressed prices to 10½c. at the close. Although not evident at the time, this was the beginning of a decline which continued steadily throughout the year.

April closed at 10c., decline being aggravated by Japanese business troubles. During May the light demand and more abundant supplies brought prices down 1½c., and, these same conditions continuing into June, the closing price for the first six months was 7½c. During June the drop was rapid, due to a heavy fall in the price of silver from 99½ to 80c. Prices in the Orient were considerably above the New York market. During July and August the market declined to 7c. It continued steady into September, but heavy offerings of war scrap, shrapnel balls, and similar material, both from foreign governments and our own, were a depressing influence, and after a light month, with little interest

in future deliveries, the market became decidedly weak in October, falling to 6½c. This decline continued during November to 5½c. and at the end of December, partly owing to liquidation for inventory purposes, but chiefly because of the absence of consuming orders, spot metal could be bought for less than 5½c. This is the lowest price recorded for antimony in over six years, and marks a decline from the beginning of the year of over 46 per cent in the price of the metal.

Imports of antimony ore for the first nine months of 1920 were 1,360 gross tons, containing 1,146,461 lb. of antimony. This compares with 754 tons and 709,378 lb. in the corresponding period of 1919. The antimony contents of matte, regulus, and metal imports during the same period of 1920 were 21,188,568 lb., compared with 10,200,608 during 1919 and 20,788,681 in 1918. On Dec. 31, 1919, the stock of antimony in bonded warehouses was returned by the U. S. Bureau of Statistics as 1,073 long tons. On Oct. 31, 1920, this stock was 1,561 tons, comparing with 1,489 tons the same date, 1919.

Arsenic

By A. E. Wells

Metallurgist, New York

THE demand for white arsenic in 1920 was even greater than in 1919, when 10,000 tons was consumed in this country. The increase has been due to increased requirement of the mineral for the making of insecticides. Production in this country was entirely inadequate to supply the demand, and consequently prices were very high, white arsenic being quoted up to 15 and 16c. per lb. during the spring of the year. With the general curtailment of industries and the seasonal slacking up in demand, the price fell, and during the last several months arsenic sold for 11 and 12c. per lb. One company supplied a large contract over the year at less than 10c. per lb. It is estimated that the domestic production was approximately 6,000 tons, and that between 3,000 and 4,000 tons was imported from Canada and Mexico.

The principal producers are the American Smelting & Refining Co., from the Globe plant, at Denver, and the plant at Tacoma, Wash.; the United States Smelting Co., at Midvale, Utah; and the Anaconda Copper Mining Co., at Anaconda, Mont. The arsenic from the above-named plants was produced primarily as a byproduct from lead- and copper-smelting operations. Because of the high prices and heavy demand, the first two companies made special efforts to obtain high arsenical ores and to smelt as large a percentage of these as possible with their regular furnace charges. The Globe plant of the American Smelting & Refining Co. treats the high arsenical dust and fume obtained in the baghouses and Cottrell apparatus at several of the other Western plants of that company. The United States Smelting Co. has begun to produce calcium arsenite at Midvale, Utah, and is experimenting with the production of other arsenical products. The production at Anaconda gradually increased during 1920, and in 1921 the Anaconda production should be an important factor in the market. When running at normal smelting rate, the Anaconda plant has a potentially large arsenic productive capacity, but the probabilities are that with the great increase in the demand for that material, there will be no serious overproduction.

Bismuth

BY J. A. SAMUEL

Phillipp Brothers, Inc., New York City

THE production of bismuth in the United States is confined to a few lead and tin refineries, chiefly of the American Smelting & Refining Co. and the U. S. Smelting, Mining & Refining Co., by which companies it is obtained as a byproduct. Production figures are not available. Refined bismuth is produced abroad principally in England, Australia, and Germany from ores mined in China, Australia, and Bolivia. The greater part of this production is controlled by an English syndicate, which naturally is in a position to control the market. Domestic production is probably sufficient to supply domestic requirements, but, nevertheless, some metal is imported from England and Australia.

The market abroad remained unchanged during 1920 at 12s. 6d. per lb., the market here fluctuating with sterling exchange. Early in 1920 quotations were around \$2.65 per lb. in 500-lb. lots. At present bismuth may be obtained at from \$2.10 to \$2.25 per lb. The metal is difficult to refine, and to be readily salable must be at least 99.9 per cent pure and absolutely free from arsenic.

It is understood that there are large stocks of bismuth abroad, and it is not improbable that the price may recede. There are now undisposed stocks of Australian bismuth in the United States. The principal features of 1920 were the comparatively heavy shipments of bismuth ores produced in China as a byproduct in tungsten mining, and the Australian shipments.

[A careful investigation leads us to believe that domestic production in 1920 was smaller than that in 1919, the figures being approximately 320,000 and 250,000 lb. respectively.—EDITOR.]

Cobalt

BY C. W. DRURY

Professor of Metallurgical Research, Queen's University, Kingston, Ont.

THE rapidly increasing demand for cobalt metal and its products continued during 1920. The chief uses of cobalt are in the manufacture of stellite (cobalt-chromium-tungsten alloy) and in the ceramic and drying-oil industries. Cobalt oxide is used in the ceramic industry and cobalt salts in drying-oil industries.

The production of cobalt from the mines of Cobalt, Canada, continued during 1920, most of the shipments being made to the cobalt smelters in Ontario. A recently published report¹ describes briefly a cobalt deposit in Australia. The cobalt ore occurs associated with diorite and schistose rocks.

The smelting of cobalt ores by the Missouri Cobalt Co., Fredericktown, Mo., has proved a success, and the Missouri company has produced a considerable portion of the cobalt consumed in the United States. The price of cobalt rose toward the latter part of 1920, owing to the increased costs of raw materials, chemicals, and general supplies. In the process of recovering cobalt from its ore, many complicated chemical reactions appear to be necessary to remove the large quantities of impurities, especially sulphur, arsenic, iron, copper, and nickel, which are in the ores at Cobalt.

Cobalt until a few years ago was considered one of the rarer metals, but owing to the various properties which it imparts, the metal and its products are finding new applications. With certain metals it increases the resistance to corrosion, in steels it gives cutting hardness, and with iron it forms an alloy which possesses remarkable magnetic properties.

Uncommon Ores and Metals

BY H. C. MEYER

Vice-President, Foote Mineral Co.

Cadmium

THERE are no distinct ores of cadmium, the metal being obtained as a byproduct in the refining of certain zinc ores. In such ores it occurs in a ratio of about one part to 200 parts of zinc. Nearly all commercial zinc carries a small percentage of cadmium, as this element resembles zinc closely in its metallurgical behavior. The demands for the metal are small, and if they could be stimulated, the total production could be brought up to as much as 400 to 500 tons annually. Its greatest use is in the manufacture of low-fusing alloys employed in automatic sprinkler systems for fire protection. During the war it was proposed as a substitute for tin in solder, but this use was never fully developed. A new commercial application of the metal is for testing storage batteries. Cadmium sulphide is used in the ceramic and glass industries. Mixed with selenium it produces beautiful orange and red enamels used in the manufacture of glass beads, and also, in conjunction with selenium in the glass industry, it is used in the manufacture of so-called ruby glass employed for railway signal lights.

During the first half of 1920 the price of the metal ranged from \$1.45 to \$1.50 per lb. In the last half of the year the price dropped to \$1.40 per lb. During the

early months of 1920 the sulphide sold for \$1.50 per lb., but in the last quarter it dropped to \$1.25 to \$1.35 per lb., depending on quantity. No statistics are available as to the actual tonnage produced. During 1919, according to the U. S. Geological Survey, 99,939 lb. of metal and 31,197 lb. of sulphide were produced.

Cerium

IMMEDIATELY following the armistice the demand for ferrocium began to decrease, and during 1920 the market for this alloy contracted still further, owing to foreign competition. Prior to 1915, Germany and Austria had a monopoly on ferrocium as well as cerium mixed metal. When the United States entered the war, the Welsbach patents covering the manufacture of ferrocium were seized by the Alien Property Custodian, and several American manufacturers were duly authorized to produce this alloy, under license.

France during 1920 became a large purchaser of cerium compounds, used for the production of cerium mixed metal. This was subsequently alloyed with iron to produce the ferro-alloy. Approximately 100 tons of cerium carbonate, rare-earth hydrates, and other miscellaneous cerium compounds were exported to foreign

¹Can. Min. Jour., Vol. XLI, No. 47, p. 981, 1920.

countries during 1920. The value of these compounds ranged from 18c. per lb. for the carbonate up to 75c. per lb. for such salts as the oxalate and the oxide.

No statistics are available as to the total production of ferrocerium in the United States during 1920, although it is estimated that it ran from 2,000 to 3,000 lb. per month during 1919. There were no important fluctuations in the price of ferrocerium during the year, which ranged from \$10 to \$14 per lb., depending on quantity. Cerium mixed metal carrying approximately 95 per cent cerium, lanthanum, and didymium metals and 5 per cent iron ranged in price from \$6 to \$8 per lb. in ingot form.

Selenium

PRIOR to the discovery of the use of selenium as a decolorizing agent in glass, the element was more or less of a chemical curiosity and the production of no significance.

There were no important price fluctuations throughout 1920, the value of the material ranging from \$1.80 to \$2.10 per lb., depending on quantity. Figures are not yet available on the 1920 production. The U. S. Geological Survey reports 60,025 lb. produced during 1919.

Tellurium

TELLURIUM still remains the black sheep among the elements. Although efforts to discover new uses have been made by the Government in co-operation with metal refineries which have accumulated large stocks of tellurium, no important commercial applications have yet been developed. It has been used in a small way in high-resistance alloys, for coloring porcelain and glass, staining silver, in medicine, and in the manufacture of certain special dyes. However, all of the above uses represent only a very few hundred pounds per year. No figures are available as to the production, but it is understood that it could be produced in very much larger quantities than selenium.

Titanium

ONLY two known deposits of rutile have been worked on a large commercial scale, one in Virginia and one in southern Norway. The Norwegian deposits produce an exceptionally high-grade product, carrying from 93 to as high as 98 per cent titanium dioxide.

A new use, as a paint pigment, has recently been developed for pure titanium dioxide. Prepared grades of titanium dioxide for ceramic purposes and for the coloring of porcelain and artificial teeth were in limited demand throughout 1920.

The price of ilmenite during the year ranged from \$8 to \$20 per ton. This was for concentrates carrying a minimum of 45 per cent TiO₂. Imported rutile was quoted during the first half of the year at 15 to 16c. per lb. in carload lots, and during the last half at 12 to 13c. per lb. in carload lots.

Zirconium

AN INCREASED demand for zirconium ore (zirkite) was noted during 1920. This product, which is the natural oxide of zirconium imported from Brazil, is now recognized as one of the so-called super-refractories for high-temperature work.

Ferrozirconium is still in an experimental stage. Alloys containing from 25 to 35 per cent zirconium metal were produced during the war, but carried an objectionably high percentage of silicon and aluminum. Recent improvements in the metallurgy of zirconium

have resulted in a lowering of the price of zirconium metal powder, which closely resembles tungsten powder in appearance. It is expected that zirconium metal powder will be produced on a semi-commercial scale and sold at a price of about \$12 per lb. for a product running over 95 per cent pure.

The price of zirkite during the first half of 1920 ranged from 4½ to 7c. per lb. in carload lots. Dead-burnt zirkite in grain or powdered form sold at 8 to 11c. per lb. Zirkite bricks in standard shapes sold at 65 to 90c. each in carload lots. The last half of 1920 witnessed a drop in prices, zirkite selling at 3½ to 4c. per lb., dead-burnt at 6 to 8½c. per lb., and bricks at 60 to 85c. each. The pure oxide sold during the first half at \$1.10 to \$1.20 per lb. During the last half, the price dropped to 75c. to \$1 per lb., owing to cheaper methods of production.

Uranium and Radium*

BY RICHARD B. MOORE

Chief Chemist, U. S. Bureau of Mines

DURING 1919, especially toward the end of the year, the production of radium slowed up considerably. The war demand had ceased, and a considerable amount of radium was thrown back on the industry. It took practically the whole of the year 1919 to clean up this material, although some of it held over until the early part of 1920. During the latter part of 1919, a decided increase in interest in the use of radium for cancer treatment was shown by physicians.

No notable extension of the present known carnotite fields occurred during 1920. There was little development in connection with the new deposits in Grant County, N. M. However, some development is to be noted at Lusk, Wyo., where a moderate amount of ore has been mined and shipped, putting the deposit at this locality for the first time in the class of a regular producer. The average of the ore now mined is not more than 1.5 per cent U₃O₈.

Ore prices are considerably higher than they were two or three years ago. The rise is due largely to the fact that vanadium has been in great demand, and the price of ferrovanadium has been quite high. The following will give an idea of what ore of various grades is worth at the present time:

Price per Pound U ₃ O ₈		Price per Pound V ₂ O ₅	
Grade Per Cent	Price	Grade Per Cent	Price
1.00-1.24	\$1.00	4.0 to 4.99	\$0.75
1.50-1.74	1.50	6.0 to 14.99	.90
2.00-2.50	2.25		
2.50-2.99	2.50		
3.00-3.49	2.75		

Prices f.o.b. railroad

Another firm offers as a basic price \$70 per ton for ore containing 1½ per cent U₃O₈ and 3 per cent V₂O₅. For every additional 1/100th of 1 per cent U₃O₈ present, 80c. is added. For 1/100th of 1 per cent below 1 per cent U₃O₈, \$1 penalty is assessed. For every 1 per cent V₂O₅ over the original 3 per cent, \$15 is added. Not very much ore is sold on any basis, as the larger part obtained is mined by half a dozen operating companies, the small miner having been largely eliminated.

One new company, the Tungsten Products Co., of Boulder, Col., has gone into the radium business. One company, the Carnotite Reduction Co., of Chicago, dur-

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ing 1920 ceased the production of radium, and has been lately winding up its affairs.

The production of radium during 1920 was the largest in the history of the industry, totaling approximately 35 gm. of radium element. This one year's output is probably greater than the total European production up to date from ores mined in Europe.

Prices of radium did not vary much during 1920. In the early spring one sale of over two grams of radium element was made at \$89,000 per gram. Several bids received on this material were around \$100,000 per gram. The average price on smaller lots, however, has been from \$110 to \$120 per milligram.

Test quotations obtained during December were as follows: One firm, \$110 per milligram of radium element; two firms \$120 per milligram of radium element. This shows a tendency toward the stiffening of prices, and it is even possible, if the present situation as regards vanadium which developed in November and December continues, that the prices may go up still further.

Vanadium*

BY RICHARD B. MOORE

Chief Chemist, U. S. Bureau of Mines

THE larger part of the vanadium made and sold as ferrovanadium in the United States is produced by the Vanadium Corporation of America. This company, after acquiring the interests of the American Vanadium Co., took over the holdings of the Primos Chemical Co. late in 1919, and with the exception of the vanadium produced as a byproduct in the manufacture of radium from carnotite ore, the company produces practically all of the vanadium used in the world at present. The Vanadium Corporation has pushed the production of vanadium on its properties much more vigorously than did the American Vanadium Co. It has gradually increased its production, until on Sept. 1, 1920, the monthly production was about six times the average during the last few years. The principal properties of this company are situated at Minasragra, Peru, at an altitude of over 15,000 ft. It is stated by the company

that the orebody is holding up well, and that there is a large reserve of ore in sight. The average grade shipped is from 22 to 25 per cent V_2O_5 . The ore is treated at the Ridgeville, Pa., plant, and converted directly in the electric furnace into ferrovanadium. The Vanadium Corporation operated a plant at Newmire, Col., originally owned by the Primos Chemical Co., all of 1920 until Nov. 1, at which time operations were closed, as it was thought best by the Vanadium Corporation to shut this plant down, as all demands can be met at present from the South American ores.

A considerable amount of vanadium concentrates, principally in the form of iron vanadate, has been put on the market as a byproduct in connection with the recovery of radium from carnotite. In a few cases a low-uranium high-vanadium carnotite ore has been treated mainly for the vanadium, the radium and uranium being byproducts. Prices allowed for the vanadium content of these ores are given under "Uranium and Radium."

There has been some small development in connection with vanadinite in Arizona. The ores are concentrated, and a small tonnage of concentrates has actually been treated for the recovery of the vanadium. There have been no commercial developments in connection with the descloizite mines of Nevada, although some experimental work has been carried on by the Bureau of Mines in connection with the treatment of this ore.

Prices for vanadium remained fairly constant during 1920: \$6 per lb. was practically the average price for vanadium metal in ferro. On the other hand, the price at times rose as high as \$6.50 and in the case of low-silicon and low-carbon ferro as high as \$7. It has been stated that in a few cases small lots of specially high-grade ferro sold for even a higher figure.

The total production during 1920 was probably more than four million pounds, figured as vanadium pentoxide. The demand for ferrovanadium was extremely strong all year until October, when the market showed some weakness, and this developed during November and December, until at the end of the year it was extremely difficult for independent producers to sell vanadium either as concentrates or as ferro.

Petroleum

BY FREDERICK G. CLAPP

Consulting Geologist and Petroleum Engineer, New York

THE last year has been in some respects unlike any previous year in the history of oil production, as there was a critical interval of intense production, so far as the United States is concerned, and a culmination of a period of numerous incorporations and of the combination of numerous companies of large capitalization and holdings, with a subsequent severe decline in the market value of oil securities. In addition, there was the passing of the upward curve of oil production by a still faster rising consumption curve, the consequent serious diminution in the amount of oil in storage, and a rapid increase of American oil investments and holdings in foreign fields, tending to offset to some extent the bugaboo of British control. Together with these developments, there has been a continuation of the ascendancy of the so-called Royal Dutch Shell interests, aided to

some extent by a knowledge of the acquirement of a substantial interest in that company by the British government, which became public news during 1920. To summarize, the year was one of semi-panic concerning the future of oil production, as well as one of limited safe and sane measures toward assuring a future supply.

TABLE I. APPROXIMATE RELATIVE RANK OF OIL-PRODUCING STATES AT CLOSE OF 1920

California	Ohio
Oklahoma	Pennsylvania
Texas	New York
Kansas	Indiana
Louisiana	Montana
Wyoming	Colorado
Illinois	Tennessee
Kentucky	Arkansas
West Virginia	

At the end of 1920 the rank of the oil-producing states was as given in Table I. California took the place of Oklahoma late in the year and Colorado gave place to Montana.

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The total production for the year has been estimated by several authorities to be about 445,000,000 bbl., or about 12 per cent in excess of the 1919 production. In foreign countries little change is noted, as no new fields of importance were discovered. Hence, the order of importance of foreign nations apparently continues as I have represented in Table II.

TABLE II. APPROXIMATE RELATIVE RANK OF OIL-PRODUCING COUNTRIES AT CLOSE OF 1920

United States	Peru
Mexico	Japan (including Formosa)
Russia	Trinidad
Dutch East Indies (together with British North Borneo)	Egypt
Rumania	Argentina
Persia	Germany
India	Canada
Poland	Venezuela

It is seldom that two substantially non-producing states attain a position among the producers in any one year, but such was the condition in 1920. Both Montana and Arkansas, heretofore only infinitesimal producers, opened up one or more fields. Arkansas has produced natural gas for many years from fields of Carboniferous age in the vicinity of Fort Smith. Little drilling has been done elsewhere in the state. In April, 1920, a great gas well was completed at Eldorado, in western Union County, not far from the Louisiana line. The daily production of this well was reported all the way from 10,000,000 to 100,000,000 cu.ft., and it sprayed barrels of oil per day. The excitement caused by the well was increased in August by the announcement of an oil well opened up in southwestern Ouachita County, with a production variously estimated up to 100 bbl. per day.

Considerable testing is being done in the same general province of Arkansas, where the surface formations are of Tertiary age, underlain by Cretaceous sediments similar to those of northern Louisiana. Unofficial geological accounts emanating from southern Arkansas tell of fine structures, and more conservative geological advice emphasizes the great caution necessary in accepting without further confirmation conclusions as to structure in that region. The fundamental conditions are undoubtedly similar to those in northern Louisiana, and with more careful geological studies in the future by geologists familiar with such formations, a number of fields may be opened in Arkansas.

In Montana, gas has been produced in relatively small amounts for years, and oil in small quantity was known. The first real oil field seems, however, to have been discovered in Musselshell County in 1920. As the geological formations and types of structure are similar to those of Wyoming, Montana may be expected to become an important producing state, although careful geological explorations will be necessary, as in other oil regions.

No other states have entered the producing list, although tests are being made in New Mexico, Mississippi, Florida, and Washington, with some chances of success; wells are being sunk in search of oil in Georgia, Missouri, and elsewhere, and wildcatting continues in Tennessee and Arizona as well as in the producing states.

No year passes without new pools being opened in Oklahoma, and 1920 witnessed the usual number, including, among others, several small pools in Stephens County, the Weeleetka and Okemah pools, in Okfuskee County; a new deep-sand pool south of Muskogee, and another near the Garfield-Noble county line. Osage County has also had several important discoveries. In Kansas the new pool near Florence, in Marion County, is important.

Early in the Ranger excitement in central Texas, persons familiar with that region realized that in time the Bend limestone fields of lower Pennsylvanian or upper Mississippian age would be extended to some extent into the surrounding counties of Stephens, Callahan, Coleman, Brown, and Comanche. This extension has taken place, and during the year Callahan County at least has been added to the producing list from the Bend limestone. During the same period, Stephens County has replaced Eastland as of paramount interest and greater production. The peculiar conditions existing in the central Texas fields, involving the porosity of the limestone "sands," the water conditions, and in some localities the disastrous close-drilling of wells, have caused a rapid decline in production in nearly every pool not long after its discovery. Though this is by no mean distinctive of the Texas fields, it has had a noteworthy effect, because some of the largest operations in those fields are certain on that account to be unsuccessful. With a few exceptions the profits have been far less than those predicted by the promoters.

As an after-boom statement, one may call attention to the way in which every favorable factor in an oil field is magnified during the boom, and even the layman can now realize the part played by advertising, both legitimate and illegitimate, in the great oil booms. During the latter part of the year, the weekly statistics recorded fluctuations from loss to gain and back again to loss in production of the north-central Texas fields considered as a whole.

One result of the central Texas boom, extending over a series of years, has been the spread of leasing and wildcatting through the state, the potentialities of which had not properly been appreciated previous to the Ranger excitement. Some great gas wells have at last been drilled in the vicinity of Amarillo, in the Panhandle, and though few in number, they are so widely spaced and on such extensive geological structures that a general belief prevails that oil will be found somewhere in the same region. Unless the Permian and underlying Pennsylvanian sediments are too greatly altered by metamorphism, an oil field or fields are to be expected, as the conditions appear similar to those at Cement, Duncan, and Healdton, Okla., where oil is found in the base of the Permian or in the underlying Pennsylvanian series in many sands distributed through a great vertical thickness.

Another portion of Texas where wildcat activities have been carried on is the Edwards Plateau and Trans-Pecos region. Considered collectively, and regardless of the failures drilled during the year in Edwards, Pecos, Valverde, and Crockett counties, and of the unimportant shallow showing in Reeves County, some chance exists of discovering new and important fields in that great region.

Many of the Gulf Coast salt domes require many years to mature as producing fields, on account of small relative area and because of their having such sharp structures that a number of wells are necessary to prove them, whereas in many other oil fields a single well is sufficient. Thus it was only in October, 1920, that Fort Bend County became an important oil producer, with an initial production reported as 5,000 bbl. per day from the first well. Attention must be called to the fact that the West Columbia pool, in Brazoria County, known for several years as an oil field, took a notable spurt in 1920, when the Texas Company drilled a well with authentic production of over 30,000 bbl. per day, being, with the

possible exception of the Lake View gusher of California, the greatest well ever drilled in the United States.

In Kentucky and Wyoming some new pools have been discovered. The effect of the Public Land Leasing Bill, which was passed by Congress and signed by the President, seems to have been disappointing, both to companies that were expecting an immediate distribution of the impounded assets resulting from their drilling during the last few years and also to individuals who have gone to trouble and expense in finding favorable territory on the public lands, and were hoping to be awarded leases, some of which might have been tested during the year.

In the auction sales held by the Government for the Indians in Osage County, Okla., better success has been attained, and persons well informed in the oil business have been surprised at the high bonuses bid and paid for acreage. The policy of the Government in selecting the tracts for every sale in such a manner that maximum prices could be obtained has certainly been a success from the Indians' point of view, if not from that of the oil operators. Something of the demand for Osage leases can be judged by the fact that in the last sale in 1920 (on October 12) the average price paid was \$100.36 per acre for 30,959 acres.

For a number of years American geologists have been calling attention to the opportunities in prospective foreign oil fields, but had received little encouragement from companies which were in the best position to enter these fields. The first signs of change in this situation took place in the interval from 1913 to 1916, when one of the largest oil companies in the United States made extensive explorations in Asia and South America, and subsequently several important expeditions entered foreign countries. Attention was called to Colombia in a practical way in 1918, when the Tropical Oil Co. (consolidated in 1920 with the International Petroleum Co.) drilled a 1,000-bbl. well on its concession 350 miles up Magdalena River in the interior of that country, and since that time various companies have acquired interests, culminating in 1920 in what might be termed an oil rush to Colombia.

Oil operators were temporarily discouraged by the passage of a law by the Colombian government modeled somewhat on the Mexican oil law. The new law has been generally objected to by American companies. Although not retroactive, like the Mexican law, it has some objectionable provisions. During the time when the Tropical and some other companies were exploring Colombia, the General Asphalt Co. and its subsidiaries were conducting similar explorations in Venezuela, with the assistance of several of our foremost geologists. As a result an average of 10,000 bbl. per day is said to be now shipped from one field alone in Venezuela. A large interest in General Asphalt has been acquired by the Royal Dutch Shell combine.

Much new exploration work has been done in Mexico since the downfall of the Carranza government; and there are indications that the difficulties between the Mexican government and American oil companies are near a satisfactory settlement. All is not yet harmony, but sincere efforts seem at last to be in progress on both sides, which cannot be said of efforts under the previous régime. The greatest disappointment in Mexico is the entrance of salt water in large quantities into the principal fields of the Vera Cruz Province and the consequent drowning of many of the greatest wells, so that several of the pools are now practically

abandoned, and the end of production in that region appears to be in sight unless new pools are opened.

It is my belief that this country will not be in the background when future discoveries of petroliferous substances are made. American enterprise is as energetic as ever, and it is now realized—what many enthusiasts did not appreciate twenty-five or fifty years ago—that oil fields are rapidly exhaustible. The lesson of 1920 seems to be not to restrict the nation to any single plan for the future. The American petroleum industry should avail itself of every means at hand to protect present and to assure future petroleum supplies, including greater efficiency in production, recognition of oil-shale possibilities, discovery of vegetable substitutes for gasoline, and the prosecution of the most scientific and systematic campaign for foreign development in those countries where conditions are now known to be favorable, so that in coming generations the United States may control its equitable share of the world's petroleum.

Abrasives

BY J. VOLNEY LEWIS

Professor of Geology, Rutgers College, New Brunswick, N. J.

ABRASIVES were in great demand during the greater part of 1920, but the general slump in business in the last quarter brought the industry to its lowest ebb for many years. Prices changed little during the year, but there was a slight tendency toward higher quotations for natural abrasives and manufactured products than during 1919. There is a universal feeling that the present depression is only temporary. Prices will doubtless be reduced, but producers say this is possible to only a slight extent, as abrasive prices have never been advanced from pre-war levels in a degree commensurate with other commodities.

Emery and Corundum.—The total production of American emery for 1920 will be about the same as in 1919, possibly not over 1,000 tons. Imports for the year are much smaller than in 1919. Grecian and Turkish emery have been scarce, owing to the disturbed conditions in those countries and the continued inactivity of the mines. Prices are higher than in 1919, but the volume of business has been less.

The total production of garnet from the Adirondacks for the year 1919 is estimated at about 6,000 tons. The figures for 1920 will be lower. During the first half of 1920, the business in artificial abrasives exceeded all previous records. There was a severe decline, however, in the later months of the year, and by December the electric furnaces were producing only about 25 per cent of their capacity. There were no price changes of consequence in 1920. Manufacturing costs advanced sharply, owing chiefly to higher freight rates. The production of aluminous abrasives, adapted to a wide range of uses, has gradually monopolized the abrasive field, due to the attainment of a higher degree of uniformity than is possible with natural materials.

Imports for ten months of 1920: Crude artificial abrasives, 56,584,065 lb., valued at \$1,429,182; emery ore, 4,590 tons, valued at \$154,957; corundum ore and grains, 2,522 tons, valued at \$270,905; rottenstone and tripoli, 791 tons, valued at \$14,370; all others, \$328,928. Exports for nine months of 1920 of grinding wheels and other abrasives totaled \$4,895,560 as compared with \$4,427,745 for the corresponding period of 1919.

Asbestos*

BY OLIVER BOWLES

Mineral Technologist, U. S. Bureau of Mines

THE United States produces only a small proportion of its requirements of asbestos. With the exception of a small output by the John D. Hoff Co. in California, the entire domestic production of spinning fiber comes from Arizona. The Arizona Asbestos Association is the chief producer, but active operations were conducted also during 1920 by the Regal Mine, the American Ores & Asbestos Co., the Colorado Arizona Asbestos Mining Co., and the Alene Asbestos Association. According to U. S. Geological Survey statistics, the 1919 production for Arizona was only about 420 tons. The 1920 production probably exceeded 1,000 tons. A plant is now being equipped to resume long-suspended operations in the Vermont asbestos area.

In the Quebec field, which is America's chief source of supply, production was low during the severe winter months, but later increased greatly. Advancing costs, decreased production, poor transportation, and heavy demand for asbestos pipe coverings led to a remarkable price advance, Crude No. 1 rising from about \$1,800 per ton in 1919, to \$3,000 early in 1920, and the price holding at \$2,000 to \$2,400 toward the end of the year. Acute car shortage early in 1920 resulted in stocking of warehouses, and shipment largely of high-grade fiber, with an ensuing shortage of lower grades in the hands of American manufacturers. Twice during the year shipments were made by barge from Quebec via Lake Champlain. Total importations from Canada, for the first nine months, of 124,614 tons, as compared with a total of 135,861 tons for 1919, indicate that shipments were rapidly returning to normal during the last six months. Curtailment in automobile manufacture resulted in a decided falling off in orders for brake-band fiber, which, however, had little effect on prices.

South Africa is becoming an important factor in the asbestos situation. Imports for the first nine months amounted to about 3,450 tons, practically all of which was of spinning grade. Much of the African fiber requires special treatment, but this difficulty is being gradually overcome. Cape blue is now being fiberized and prepared for manufacturers in America by a New Jersey company using a process that is especially efficacious in the treatment of this type of asbestos.

Barytes

BY J. B. PIERCE, JR.

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THE barium industry at the beginning of 1920 evinced every indication of a good year. Especially was this true of the crude ore, barytes, and, to a lesser extent, of the entire list of manufactured barium products. Good-grade washed barytes sold for approximately \$10 per long ton, and some small tonnage is reported to have been sold as high as \$12. Until the last quarter of the year, when the demand slackened off, good ore was almost unobtainable unless contracted for during the last of 1919 or the first of 1920.

A great deal of prospecting and new development in the Appalachian barytes field was carried out in 1920. Most of this work did not lead to the opening up of new

mines of consequential output, but the trend of the prospecting seemed to be away from the Cartersville district, in Georgia, the heaviest producer in the Appalachian field since 1916, toward the Tennessee fields, particularly in and around Sweetwater; also, into the North Carolina fields, especially in the vicinity of Stackhouse and Hot Springs. At the former place the Rollin Chemical Corporation opened a new mine adjacent to the old Stackhouse mine, on the French Broad River.

It is impossible at the time of writing to give authentic figures for the production of barytes for 1920, but the total production for that year should be close to 200,000 short tons. The barium products business was active over the greater part of 1920, with a good volume of trade and good prices. The closing down of the rubber industry during the late summer had a depressing effect on the blanc fixe business. The production of lithopone, blanc fixe, and barium carbonate will be maintained at about recent past levels and may even increase slightly. Ground barytes, barium chloride, barium peroxide, and other barium chemicals will doubtlessly show a slight reduction.

During 1920 there were no technical changes or advances of note in the industry, which was seriously depressed during the last quarter of the year by small importations of foreign goods. The depression was rendered more acute by reports of larger importations to follow, which were supposedly going to be offered at large price concessions. Therefore the barium industry is watching with great interest the tariff situation, as it is vital for its survival that adequate protection be given it.

Bauxite and Aluminum*

BY JAMES M. HILL

Geologist, U. S. Geological Survey

THE output of bauxite during 1920 was considerably larger than in the previous year, being estimated at nearly as much as the record output of 1918, which was 605,721 long tons, and close to double the output of 1919. This increased production was largely from the Arkansas fields, as operations in the eastern fields slackened in 1920. In the Bauxite, Arkansas, field, the Republic Mining & Manufacturing Co. installed steam shovels working on heavy overburden and ore. Mining there resembles the open-pit work in iron and copper mines.

Imports of bauxite for the first six months of 1920 were 5,707 long tons, and it is believed that nearly 15,000 tons was received during the year from South America. It is rumored that the Sollers Point project of the Aluminum Company of America has been abandoned, and that South American bauxite will be sent to East St. Louis for its preliminary treatment.

There is little information concerning the domestic aluminum-making industry. Apparently, the Badin plant, in North Carolina, is nearly at full production, and it is believed that the total output of aluminum in 1920 will be considerably larger than in 1919, in which year production was curtailed, owing to large accumulations of metal that were not used during the war.

Imports of crude aluminum and scrap metal for the nine months ended Sept. 30, 1920, were 32,533,000 lb., valued at \$9,796,600, and manufactured articles valued at \$1,488,000. This is more than twice the quantity

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imported in 1919. Exports of aluminum for the first nine months of 1920 were 6,823,000 lb. of ingot metal and alloys; 1,579,000 lb. of plates and sheets; and manufactured articles valued at \$1,699,000. The total value of all exports was \$4,350,000, or nearly \$1,000,000 more than for 1919.

Apparently the aluminum industry is in a healthy condition, and should be in a position to make a considerable increase in output now that the domestic and South American sources of bauxite are in condition to supply almost unlimited quantities of ore and hydro-electric installations are nearing completion. In Europe the aluminum situation will in the future be controlled by the Compagnie d'Alais, as it recently absorbed the Société Electrometallurgique Française. The new organization controls 90 per cent of the aluminum-producing capacity in France, besides the works in Norway and an interest in the Italian works.

Borax

BY GEORGE J. YOUNG

Western Editor *Engineering and Mining Journal*

BORAX is produced by the mechanical and chemical treatment of colemanite, which is mined from comparatively extensive deposits in the Furnace Creek area in the Death Valley region of California and from minor deposits in southern California. The most important company of the industry is the Pacific Coast Borax Co., which controls the Furnace Creek deposits. The Sterling Chemical Co. also mines colemanite.

During 1920 the American Trona Corporation produced borax from fractional crystallization of concentrated brines obtained from Searles Lake. The borax is a byproduct obtained in the separation of potash from the brines. Fertilizer requirements necessitate the removal of borax from the potash. As a consequence, a considerable amount of the borax byproduct from this region must compete in a market which is already well supplied.

Both Chile and Asia Minor supply the borax market of Europe, and there is therefore little outlet for surplus production in this direction. At Searles Lake, the Solvay Process Co. made no borax production during 1920. The West End Chemical Co., which installed a plant for the production of potash, stated in its report of April, 1920, that facilities for the manufacture of borax would be constructed as soon as potash production begins.

Although the production of borax is closely controlled, prices did not greatly rise during the war period. The average wholesale price for 1920 was approximately 8c. per lb. for sodium tetraborate, powdered. During the period since 1916, wages have advanced 198 per cent and coal and cost of supplies 100 per cent at the borax mines. In 1919, a total of 28,518 tons of borax, valued at \$4,351,891, was produced, as against 26,673 tons in 1918, valued at \$3,909,565. The 1920 production will probably not exceed that of 1919.

Operations of the Pacific Coast Borax Co. at Ryan continued throughout 1920. Labor was inadequate in amount and quality, but the labor situation became more satisfactory toward the close of the year. Housing facilities and dormitories were erected by the company. A 500-hp. Diesel engine was put in and some additions were made to the calcination plant at Death Valley Junction.

Fluorspar*

BY RAYMOND B. LADOO

Mineral Technologist, U. S. Bureau of Mines

THE production of fluorspar, which showed a decided drop in 1919, from the peak reached in 1918, apparently recovered somewhat in 1920. The tonnage mined by a group of producers in the Illinois and Kentucky fields, which furnished 70 per cent of the output in 1919, showed an increase in 1920 of about 10 per cent over the production for the previous year. Other mines in this field which mined little or no ore in 1919 were again producers in 1920.

In Colorado, conditions were reported to have been much better than in 1919, and a considerable increase in tonnage probably resulted. In New Mexico, where production has never reached capacity, there has been much activity, and the output probably exceeded that of any previous year. The open-hearth steel industry, which normally consumes about 83.5 per cent of the fluorspar produced, in the form of gravel spar, was very active during 1920, and probably consumed 140,000 to 145,000 tons. From all the available data it would thus appear that the total production was in excess of 145,000 tons and possibly over 150,000 tons.

Imports of fluorspar were much larger in 1920 than in any year since 1913, and they were increasing during the latter part of the year, being over 4,000 tons in September and October. Total imports probably were over 20,000 tons, of which more than 75 per cent came from England and about 20 per cent from Canada. The average declared value of English spar for the first half of the year was about \$10 per ton and of Canadian spar about \$15 per ton.

Prices on gravel spar were somewhat lower in 1920 than in 1919, a reduction of \$5 in the base price being noted. The price of 85 per cent gravel spar, f.o.b. Kentucky and Illinois mines, was \$22.50 to \$27 per ton, with an average of \$25. New Mexico spar averaged \$15 per ton, f.o.b. shipping point, a net increase of \$1 per ton, due to lower freight rates to the East. Acid-lump spar was greatly in demand at prices from \$50 to \$60 per ton. At the end of the year, many smaller mines were closed, because of lack of orders, but larger companies were working to capacity on old contracts.

The market is now dull but prices are firm.

Fuller's Earth in Georgia

BY S. W. MCCALLIE

State Geologist, Atlanta, Ga.

UNUSUAL activity in the fuller's earth industry of Georgia is to be recorded for 1920. Considerable money was expended in prospecting in Stewart and Decatur counties. In the latter county the Atlantic Refining Co. was successful in locating a large deposit of high-grade fuller's earth suitable for the refining of mineral oils, and the company erected a refining plant which produced its first output in October, 1920. The maximum daily production of the plant is 200 tons. The thickness of the deposit of fuller's earth now being worked varies from 3 to 7 ft.

The plant of the Georgia Reduction Co., situated on the Dublin & Savannah R.R. fourteen miles south of Macon, was seriously handicapped by lack of labor and coal during the early part of the year. In the last two

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months, however, labor at reduced wages has been plentiful and the coal supply has been satisfactory. The output, used almost entirely for refining vegetable oils, is materially increasing from year to year. This is due to domestic fuller's earth replacing the English earth, which prior to the World War was used extensively in this country.

[Production statistics for fuller's earth for 1920 are not available. In 1919 the U. S. Geological Survey estimates production in the United States as 106,000 short tons, valued at \$2,000,000, or \$18.87 per ton. Florida produced 90 per cent of the entire production in 1919. Imports in 1919 were 13,873 tons, valued at \$189,711. According to our information both domestic production and imports in 1920 exceeded those of 1919. Florida still occupies the position of leading producer, and there have been no new developments of importance in states other than Florida and Georgia. Prices remained steady at the close of 1920. Continued prosperity is closely related to the prosperity of the lubricating oil industry.

—EDITOR.]

Graphite Industry

BY BENJAMIN L. MILLER

Professor of Geology, Lehigh University, Bethlehem, Pa.

A GAIN the graphite producers of the world report a disastrous year. Indeed, there was greater depression during 1920 than in 1919. Although graphite is used in a large number of articles, the greater portion of the production has gone into the manufacture of graphite crucibles, for which only the best grades are suitable. Graphite from Ceylon has long held the field.

When the armistice was signed, the principal manufacturers of graphite crucibles had on hand large quantities of high-priced graphite, and the producers likewise had large supplies ready for shipment. The demand for crucibles diminished, and there still remain available large amounts of graphite produced under war conditions. The inevitable result was a fall in the market prices to a point below the cost of production. At present there remain unsold thousands of tons of Ceylon, Madagascar, and domestic graphite, and until this accumulated surplus has been absorbed there is little chance of general revival of the industry.

The Alabama graphite industry is practically stagnant. Several companies operated for short periods during the early part of 1920, but at the close of the year only the Superior Flake Graphite Co., of Clay County, and the Ceylon Co., of Coosa County, were in operation. In addition, the mill of the Flaketown Graphite Co., of Chilton County, was rebuilt and will soon begin operations. Similar conditions prevailed during the year in the graphite districts of New York, Pennsylvania, Texas, and Montana. Some graphite for paint was mined at L'Anse, Mich. Rhode Island continues to produce an impure variety for foundry facings.

In the opinion of persons familiar with the situation, the domestic flake-graphite industry cannot prosper unless Congress levies an import tax on the graphite of foreign countries.

Foreign Countries—The Black Donald Graphite Co., at Calabogie, Ontario; the Quebec Graphite Co., and the Consolidated Graphite Mining & Milling Co. of Buckingham, Quebec, operated during 1920. These mills have installed the Callow flotation system, with excellent

results. They are producing graphite for other than crucible purposes, and the Quebec Graphite Co. is entering the field as a manufacturer of greases, stove polish, paints and other articles. The amorphous graphite deposits of Sonora, Mexico, were worked during 1920. This material is used for pencils, foundry facings, and like applications. There was practically no mining of graphite in either Madagascar or Ceylon in 1920, on account of the large supplies on hand and the prevailing low prices.

Prices—There was no market of consequence for graphite during 1920. Lump Ceylon graphite sold in Colombo for 7c. per lb. and in New York for 8½c. Madagascar flake of 85 per cent C sold in New York for 4c. per lb., and there are reported to be from 35,000 to 40,000 tons still stored in Madagascar, in Marseilles, and in New York. There has been no regular market for domestic flake, but sales have been made for 6c. per lb. and less, probably in almost every case at a price less than the cost of production.

Gypsum

BY FRANK A. WILDER

Southern Gypsum Co., North Holston, Va.

THE gypsum industry made more progress in 1920 than in any previous year in its history. When tonnage figures are compiled, they will undoubtedly show the largest output that has yet been attained. The steadily rising production before the war was disturbed by the war-time drastic regulation of building operations. Most of the gypsum mined is made into plaster, and, as plaster is one of the last of the materials used in a building, the gypsum industry does not respond to initial building operations, and, conversely, it does not feel the effect of a building depression as soon as most other building materials. It was midsummer of 1919 when the gypsum industry responded to the building revival, and it did not experience the depression that came in the fall of 1920.

Considerable additional capital came into the industry through the combination of the American Cement Plaster, the Best Wall Board, and the Beaver Board companies. This group of interests is well fitted to push the use of gypsum plaster board and gypsum wall board, and the way for such development was prepared by the remarkably satisfactory showing made by gypsum boards when tested by the Government during the war.

The outstanding feature of 1920 in relation to the gypsum industry was the publication by Reimer, in Oregon, of the results of careful experimentation with gypsum, or calcium sulphate, and sulphur, as fertilizer for alfalfa and other legumes. Reimer's work was, during the year, supported by other agricultural chemists, and the importance of gypsum as a fertilizer again seems to be winning recognition. When used with finely ground raw phosphate, a fertilizer is formed which has more available plant food at less cost than is obtained in acid phosphate.

In 1919, according to the U. S. Geological Survey, 2,430,000 tons of crude gypsum was mined in the United States. In order of importance the principal producing states are New York, Iowa, Michigan, Ohio, Texas, and Oklahoma. Production from western states is not differentiated. About 1,397,000 tons of stucco, plaster of paris, wall plaster and Keene's cement were made from calcined gypsum in 1919.

Magnesite*

BY R. W. STONE

Geologist, U. S. Geological Survey, Washington, D. C.

THE quantity of domestic magnesite mined in 1920 exceeded that mined in any previous year except 1917. Despite the contention of domestic producers in 1919 that without a tariff the eastern market would be supplied with European magnesite and that companies having large investments in magnesite deposits and plants in California and Washington would be forced out of business, no tariff legislation was enacted, and the industry has not suffered.

Preliminary figures reported by the U. S. Geological Survey indicate that the production of crude magnesite in Washington was about 225,000 short tons, as compared with 106,200 tons in 1919. Practically all was dead-burned and was sold as refractory material to steel companies and manufacturers of refractory products east of Chicago. The figures for California are not yet available, but the output of crude magnesite in the state was about 60,000 tons. California and Washington are the only producing states, and the total output for the United States was therefore probably between 275,000 and 300,000 tons.

The imports from Jan. 1 to Sept. 30, 1920, amounted to 20,730 tons of crude and 10,439 tons of calcined magnesite, as compared with 6,381 tons crude and 9,471 tons calcined entered in 1919. Estimated as crude magnesite, the imports for the first nine months of 1920 were about 41,600 tons, as compared with 25,300 tons in 1919. The imports in 1920 probably amounted to about 50,000 tons of crude magnesite, or double those of 1919.

On Jan. 13, 1920, the Senate Finance Committee held a hearing at which users and importers of foreign magnesite presented their objections to a tariff on magnesite. An investigation of the relations of time, temperature, and size of particles in the decomposition of magnesite was made during the year by the Bureau of Mines in co-operation with the Northwest Magnesite Co. at the mining experiment station at Berkeley, Cal. An electrically heated rotary furnace was used for the experiments in calcination. Experiments show that Washington magnesite is suitable also for use as plastic material, and preparations are being made to calcine it at the mines near Valley, Wash., for use in cement.

The Mica Industry

BY J. VOLNEY LEWIS

Professor of Geology, Rutgers College, New Brunswick, N. J.

THE mica industry was prosperous during the first three quarters of 1920, but the year did not end with the promise with which it opened. With the general industrial decline during the last quarter demand rapidly fell off, surplus stocks (both domestic and imported) accumulated, and prices dropped 10 to 20 per cent in the various grades.

Importations of mica increased in 1920, reaching in the first ten months of the year 1,375,927 lb. of uncut mica, valued at \$1,206,443, or nearly double that of the corresponding period of 1919. Cut mica was imported to the value of \$1,656,182 in the same period. Good mica is coming not only from India but in increasing

amounts from Brazil and Argentina, and some also from South Africa, China, and several other countries. Excepting in India, standard methods of grading and preparation for market have not yet been established, and hence the product is at a disadvantage in competition with mica from India. Exports of mica during the ten-month period were valued at \$242,381, about 10 per cent of the value of imports.

Despite the depressed condition of the industry as the year closed, there is a note of optimism in many quarters. A gradual resumption of suspended industrial activities is expected within the next few months, and with it a revival of the demand for mica in its numerous applications. Some even go as far as to predict a decided increase in domestic production and imports in 1921, compared with 1920. A more conservative view is that 1921 will do well to equal 1920.

DECLINE IN PRICES OF DOMESTIC MICA AT FRANKLIN, N. C. IN THE LAST QUARTER OF 1920.

Sizes	1st Three Quarters	Last Quarter	Sizes	1st Three Quarters	Last Quarter
2 x 2	\$1.15	\$0.85	3 x 5	\$2.75	\$2.50
2 x 3	1.65	1.25	4 x 6	3.75	3.50
3 x 3	2.10	1.75	6 x 6	6.50	6.00
3 x 4	2.50	2.25			

Monazite

BY H. C. MEYER

Vice-President, Foote Mineral Co.

THE two important commercial sources of monazite sand are those along the coast of Brazil from Victoria north to Bahia, and the deposits along the sea-coast of Travancore, in southern India. The purification of the sand is effected on concentrating tables and finally by electro-magnetic separators. By this means, practically all the quartz, zircon, ilmenite, garnet, and other impurities are eliminated, and a product is secured which contains over 90 per cent monazite, a cerium-lanthanum-didymium phosphate.

Monazite sand is the only important commercial source of thorium. Brazilian sand carries from 4½ to 6 per cent of the oxide and Indian sand runs from 8 to 9 per cent. At one time there were numerous small producers scattered through the states of North and South Carolina, but such deposits have not been worked for many years. An extensive source is said to exist near Pablo Beach, Florida, and an attempt has been made to work the deposits on a commercial scale.

It has been estimated that the world's consumption of monazite is approximately 3,000 tons per annum, all of which is used for its thorium content, which is converted into the nitrate. The only commercial use of thorium nitrate is in the manufacture of incandescent gas mantles.

The rumor that the British government intends to return the Indian deposits of monazite to Germany may have a decided influence on the price of the nitrate, which remained firm throughout 1920. Case lots containing 144 lb. of nitrate sold at \$3.75 to \$4 per lb., depending on quantity. Monazite sand, guaranteed minimum 6 per cent thorium oxide, ranged from \$25 to \$30 per unit, duty paid. So far as is known no Indian monazite was offered in 1920 on the open market in this country. Enormous quantities of cerium, lanthanum, and didymium are obtained as byproducts in the manufacture of thorium nitrate, but only a small portion of these so-called cerium residues are utilized in the manufacture of ferrocerium.

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Nitrates

PREPARED BY EDITORIAL STAFF

AT THE close of 1920 there were considerable stocks of nitrate in the hands of producers and dealers, due to the delay of purchases until the actual consuming season. Prices declined during the year, being quoted in February at \$3.85 per cwt. and in December at \$3. The decline has tended to hold off consumers from the market and has made curtailment of production probable. The deliveries in the United States for the last half of 1920 are estimated from advices abroad at 545,000 tons, compared with 105,000 tons for a similar period in 1919. Total supply in sight on Dec. 31 was estimated 2,241,000 tons (of which 1,340,000 tons is the stock in Chile), compared with 2,134,000 tons on the same date in 1919. The prospects of a large increase in consumption are doubtful because of the uncertain economic situation.

Chile supplies practically the entire world with nitrates, and has a Nitrate Producers' Association, consisting of about 97½ per cent of the producers, which negotiates the sales. Since its inception on Jan. 10, 1919, it has sold 3,285,000 tons. About 620,000 tons was sold outside the organization during the same period. Cost of production, due to a drop in the price of coal and bags and lower exchange, has fallen appreciably. Germany prohibits the importation of Chilean nitrate and relies entirely on domestic production of synthetic nitrates, which is greatly encouraged through financial arrangements. It is estimated that German synthetic nitrogen production will amount to 1,250,000 tons for the year ending June, 1921.

Phosphate Rock*

BY R. W. STONE

Geologist, U. S. Geological Survey, Washington, D. C.

THE notable feature of the phosphate-rock industry in 1920, according to the U. S. Geological Survey, was the increase in production in the Western States. Shipments from Idaho ran from 2,000 to 3,500 tons per month in the early part of the year, but were more than 8,000 tons in a single month after midsummer. About 20,000 tons was shipped before July—more than in any previous entire year. The total output of the Western States in 1920 is estimated at 65,000 tons, in comparison with 17,000 tons in 1919.

Early in the year reports were published that a contract had been made for large shipments of Idaho phosphate rock to Japan. Several hundred tons were shipped from the Idaho field to Yokohama in March, May, and June, but regular shipments were not continued. A large part of the Idaho output was sent to points on San Francisco Bay, and a few shipments were made to Chicago and farther east. Several thousand tons was sent to Anaconda, Mont., for conversion into acid phosphate at the new fertilizer plant of the Anaconda Copper Mining Co., built in connection with its smelter. Shortage of freight cars hampered the industry in Tennessee, but the production of the old and some of the new companies was probably considerably greater than in 1919. Operations in Florida phosphate were pushed throughout the year. The shipments from the pebble field were probably more than 2,000,000 tons, and it is estimated

that the total shipments from the state were as great as those in the peak year 1913, and may even have surpassed them. The demand for phosphate for exportation was good, and many shipments were made to northern Europe.

Total production of phosphate rock in the United States in 1920 was about 3,265,000 long tons, as compared with 2,249,000 tons in 1919.

Phosphate lands in the Western States are now open for leases and permits, which will be issued by the General Land Office. The minimum royalty is 2 per cent of the gross value of the output, and a rental of 25c. an acre will be charged for the first year, 50c. an acre from the second through the fifth year, and \$1 per acre thereafter. No leases will be given for more than 2,560 acres.

Potash

BY FREDERICK W. BROWN

Secretary, U. S. Potash Producers' Association, Washington, D. C.

MOST of the American potash plants operated continuously in 1920. Importations of German and French material were heavy during the first six months, and though the official figures are not available, they will undoubtedly show a total close to 220,000 tons K₂O. This is to be compared with 270,000 tons in 1913. The price of the foreign salts held up to a level permitting American competition until November, when price-cutting by both French and Germans resulted in cancellations of many contracts with American plants by the fertilizer companies.

Complete figures of American production during 1920 are not available, but it will probably amount to about 40,000 tons K₂O. This is considerably below the normal capacity of the plants, which is at present close to 75,000 tons. In Nebraska, the weather for the first time since the plants were established proved unfavorable for maximum summer production. The same climatic conditions also hampered the Utah companies using solar evaporation.

At Searles Lake two companies produced continuously throughout 1920, but not at full capacity, owing to changes of equipment being installed. A third company, which will use solar evaporation and a seasonal process, has about completed its plant, and should market its first "crop" of potash in 1921. The large plant being constructed at New Brunswick, N. J., to recover potash from greensand, will start up early in 1921, but will not come into full operation for several months.

With the uncertainty as to the future of the industry, new development has been limited. Several companies which planned to produce from alunite in Utah are waiting for more stable conditions, and operations on Texas brines have not progressed beyond the acquisition of the lakes, either by lease or purchase. There has been no extension of the industry in cement mills, blast furnaces, sugar factories, or molasses-distillery plants, although many companies in these industries have made all preliminary investigations and are waiting to install potash-recovery apparatus as soon as it appears that American potash is to be protected in some way against the German syndicate. Every effort is to be made to bring the situation of American potash before Congress, so that proper action to encourage the development of the industry may be taken. American producers feel more than ever convinced that, with a brief period of protection, the industry can be put on a basis where it need not fear competition from any foreign source.

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Precious Stones

BY GEORGE F. KUNZ
Gem Expert, New York

THE mining and search for diamonds and other precious stones was actively pursued in 1919 and in the first half of 1920, the extraordinary demand offering the greatest possible encouragement. In 1919 the imports of precious stones and pearls reached the enormous total of \$105,273,543. In 1920 heavy imports continued, the total for the first nine months being \$63,185,739, a higher figure than for any similar period except that of 1919. The decrease applied to diamond and pearl imports only, the value of other precious stones showing an increase of nearly \$4,000,000.

The South African diamond mines were successfully worked in 1920. Several new areas have been opened up, notably in the Postmastburg region, about 140 miles west of Kimberley, where several productive "pipes" have been discovered during the last two or three years. Thlaping farm, on Taung's Reserve, Bechuanaland, proved disappointing, as only 7,207 carats of diamonds had been secured up to the end of June. The South-west African fields, formerly exploited by Germany and now under English control, have been worked by the new owners, the Consolidated Diamond Mines of South-west Africa, an enterprise in which some Americans have an interest.

In the Belgian Congo, in 1920, the development in the Kasai diamond fields by the Forminiere Co. was pushed, but no attempt was made to increase the diamond production. About 215,000 carats of diamonds were produced. The company directed with satisfactory results the development work of six associated companies in their respective concessions. One of these companies operating in Angola, or Portuguese West Africa, in 1920, produced approximately 100,000 carats.

Pike County, Ark., was exploited for diamonds in 1920, and mining for diamonds in the United States has actually begun. The preliminary work brought to light about 3,000 stones, averaging four-tenths carat in weight. British Guiana produced 18,159 carats of diamonds in 1920.

Sapphires have been much favored, and command higher prices than ever before. In the last twenty years as much as \$2,000,000 worth of sapphires has come from the Montana fields. Queensland, Australia, and Burma have also produced many sapphires. The Burmese mines continue to supply the bulk of the world's rubies. Two new gem minerals are of interest. Scapolite, yellow, transparent, and of gem quality, has lately been found by Lacroix, together with beryl, euxenite, and monazite, in a potash-pegmatite at Tsarasaotra, Madagascar. Fibrolite (sillimanite), susceptible of being cut into gems, has been found in Burma and Ceylon, and is described by L. J. Spencer. A new and interesting find of precious turquoise has recently been reported from Argentina. Jade, the rich green variety of jadeite from Burma, has been mined to a greater extent in the last year than previously. California produced a number of the minor gems, such as tourmaline, kunzite, and beryl. A new and promising opal field was discovered in 1915 at Stuart's Range, South Australia, and in 1920 still another good field has been found in Tintenbar, not far from Sydney, New South Wales. The opals from Nevada, having a large water content, are chiefly of value as mineralogical specimens.

Strontium

BY J. B. PIERCE, JR.
Chief Chemist, Rollin Chemical Corp., Charleston, W. Va.

THE strontium industry was practically at a standstill during 1920, both as regards the crude ore, celestite, and the manufacturing of strontium products. So far as can be ascertained at the moment, there was no development or production of celestite in this country in 1920.

It is reported that a small amount of strontianite was mined in California. A small quantity of celestite was imported from England, which was used to manufacture strontium nitrate, which was the only strontium product manufactured in the United States in the year under review. No figures are available for 1920 production.

Sulphur and Pyrites

BY ARTHUR E. WELLS
Metallurgist, New York

THE use of brimstone for the manufacture of sulphuric acid was even more widely practiced in 1920 than in 1918 and 1919, and present indications are that all acid plants situated at any distance from the seacoast will continue for several years at least to find brimstone the more economical material. Any general competition between brimstone and Spanish pyrites which was active during the first half of 1920 will probably be confined to the sea-coast districts. After some months of active competition with brimstone, the delivery of Spanish pyrites was greatly hindered and nearly completely eliminated during the latter half of the year, because of strikes and transportation difficulties in Spain. As these conditions are gradually being remedied, it is expected that the Spanish pyrites will make its reappearance early in 1921, in even larger tonnage than during the first part of 1920.

To meet the price of brimstone during 1920, Spanish pyrites has been sold at seaboard for as low as 12 and 13c. per unit of sulphur contained, which approaches closely the pre-war price for that material and is equivalent to \$16 to \$18 per ton of brimstone. Most of the domestic pyrites producers in the East have not been able to meet the low prices at which brimstone and Spanish pyrites have been sold, and operations have been greatly curtailed or in many cases completely stopped. The present outlook for the domestic pyrites producer is not encouraging, for only in a few special cases where high-grade lump pyrites can be produced cheaply and immediately adjacent to inland acid plants is there any field for the domestic pyrites in competition with the cheap and at present plentiful brimstone, or the potentially enormous supply of cheap Spanish pyrites.

As producers of brimstone, the Texas Gulf Sulphur Co., at Matagorda, Tex., has taken the lead, maintaining a steady output, averaging more than 2,500 tons per day, and accumulating a stock of approximately 800,000 tons. The Union Sulphur Co., at Sulphur, La., was practically closed down during many months of 1920, and on resuming operations later in the year, experienced some difficulties in production, and has not as yet returned to a pre-war normal production. In filling orders during 1920 the Union Sulphur Co. shipped from its accumulated stock, which in 1918 and 1919 amounted to over 1,000,000 tons. The Freeport Sulphur Co., at Freeport, Tex., has been producing 700 tons per day.

The prices for brimstone have been irregular, averaging around \$14 at the mines, though considerable tonnages were sold for much less, even as low as \$10 per ton. With these prices, the sulphuric-acid industry, except for some sea-coast plants which have extensive pyrites burning equipment, will probably continue largely on a brimstone basis.

Talc and Soapstone*

BY RAYMOND B. LADOO

Mineral Technologist, U. S. Bureau of Mines

THE talc industry was active in 1920. Preliminary estimates for the year indicate a production of over 200,000 tons, valued at more than \$2,200,000, which will exceed that of any previous year, both in tonnage and in value. Imports of talc were heavy, and probably totaled over 24,000 tons, with a value in excess of \$475,000. The largest total of imports in any previous year was 18,882 tons, in 1916, and the largest value was \$269,497, in 1917. About 70 per cent of the imported talc came from Canada, about 20 per cent from Italy, about 8.5 per cent from France, and the remainder from England, Austria, British West Indies, Denmark, Germany, and Sweden.

In the United States, Vermont easily leads in tonnage

and possibly in value, with a production of over 94,000 tons, valued at over \$830,000. New York stood second; but, although no figures are available, it is probable that production was not much larger than in 1918, when about 71,000 tons, valued at about \$900,000, was mined. Though Vermont production is increasing, that of New York seems to be declining. Talc production in California was probably the largest ever reached. Several companies have been operating to capacity, and one company reports production increased from 3,200 tons in 1919 to 8,000 tons in 1920. Production in the South was small, but may show some increase over 1919.

Prices on the average increased 10 to 15 per cent, individual companies reporting from 0 to 25 per cent increases. Demand was strong until November, with orders unfilled owing to car shortage. Little new business was booked after November, many consumers withdrawing from the market and withholding contracts for 1921. Producers are now either stocking finished talc or working part time. Although some mill expansion is under consideration, the outlook for 1921 is uncertain.

Soapstone—Little information on production is available, but probably there was some increase over 1919, due to the large volume of building construction during the early part of the year. At the close of 1920 the demand was poor.

Arizona

BY CHAS. A. MITKE

Consulting Mining Engineer, Bisbee, Ariz.

IT HAS BEEN estimated that Arizona produces over 40 per cent of the copper mined in the United States. Over one-half of this amount comes from the low-grade or so-called porphyry deposits. Most of the silver and gold is derived from copper ores, and may, therefore, be classed as byproducts.

At the beginning of 1920, sales of copper metal were fairly satisfactory, and it was hoped that production, which approximated 50 to 70 per cent at that time, might possibly be increased to normal by the end of the year. Unfortunately, reversal of economic conditions necessitated further curtailments and reductions in wages, and many of the small producers were forced to close down.

Practically all of the larger companies have from one to six months' production of unsold copper on hand, which in some instances has required the borrowing of considerable sums of money in order to continue operating. As most of this copper was produced under conditions of high wages and high costs of supplies, the present market price of the metal is inadequate to balance the cost of production.

Labor conditions in the state during 1920 were satisfactory. The recent advances in freight rates will involve an appreciable increase in the net cost of copper, so much so that relief is being sought through the proposed construction, by a company representing a number of the copper interests in the state, of a railroad from the town of Ajo to a port on the Gulf of Lower California. This line would be a continuation of the present railroad from Gila Bend (on the main line of the Southern Pacific) to the mining town of Ajo, where the New Cornelia Copper Co. is situated, and would

offer water transportation from the proposed port, through the Panama Canal, to the refineries in the East. A local powder factory is under construction at Land Station, eleven miles southeast of Benson, and connected with the E. P. & S. W. It is proposed to obtain a large proportion of the necessary sulphuric acid from an acid plant which this same company is erecting near the Calumet & Arizona smelter at Douglas.

Under new construction work may be placed the new concentrator which the Copper Queen branch of the Phelps Dodge Corporation is building for the treatment of the company's Sacramento Hill ores. This is to have a capacity of approximately 4,000 tons per day, and will be completed within 1921. During 1920 the Iron Cap Copper Co. at Copper Hill also completed the construction of a 400-ton mill. The exceptional feature about this mill is the high recovery attained, at times averaging over 90 per cent.

A large percentage of the big companies in the state are engaged in shaft work. The Copper Queen is deepening, enlarging, and concreting its Dallas shaft, with the purpose of ultimately making it the main hoisting shaft for the entire group of Copper Queen mines. The company has also completed sinking operations on its C. & C. shaft, which work was undertaken with the object of developing an abundant water supply for the new mill. The Calumet & Arizona is sinking the Junction shaft to the 2,300-ft. level and continuing the sinking and concreting of the new Campbell shaft. The mines along the Old Dominion lode, that is the Old Dominion, Arizona Commercial, and Iron Cap Copper Co., have all been engaged in deepening their shafts, with a view to exploring the vein at lower levels.

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In the Miami district, the Miami Copper Co. is completing its new crushing plant at its No. 5 shaft, which will then become the main hoisting shaft. Considerable construction work has also been done by the United Verde Extension at its smelter at Clemenceau, and also by the United Verde Copper Co. at Clarkdale.

Progress has been made in exploratory work in the various mines in the Jerome district. A steam-shovel plant was in operation during 1920 at the United Verde, by which the overburden and slag dump over the old fire district is being removed, with the object of reaching the high-grade, as well as lower-grade, ores which are sealed within the old fire districts. The United Verde Extension has been exploring its 1,500 and 1,600 levels to develop the confines of the ore on these horizons.

Steam-shovel operations at Sacramento Hill, Bisbee, have been carried so far that the waste capping is nearly all removed, so that ore could be mined during

operations in 1921, upon the completion of the mill.

Worthy of inclusion among the achievements of 1920 is the successful mining of the ore in the Coronado mine, of the Arizona Copper Co., under mine fire conditions. Even though a large fire exists in the timbered mat, through the use of the pressure system of mine ventilation the mine has been kept in continuous operation. Exploration work is also being carried on in the deeper workings of the Magma Copper Co., Superior & Boston, Inspiration, Ray Consolidated, Miami Copper Co., and, indeed, in a majority of the larger companies of the state.

Considerable experimental work has been done by the Miami Copper, Inspiration Copper, Arizona Copper Co., and the New Cornelia Copper Co. in the treatment of mixed ores. Satisfactory results have been obtained through the use of a combination of leaching and flotation.

Montana

BY F. A. LINFORTH

Assistant Geologist, Anaconda Copper Mining Co., Butte, Mont.

DURING 1920 the copper mines of Montana were operated at 40 to 50 per cent of their normal production, and the silver mines generally operated at full capacity, but most of the gold mines were forced to close. Butte was the center of activity, as usual. Although harassed by labor difficulties and unfavorable market conditions, the copper mines were worked through the year.

The Anaconda Copper Mining Co. operated at an average of 50 per cent capacity and mined 1,800,000 tons of copper ore, 435,000 tons of zinc ore, and 65,000 tons of manganese ore. Development work on all levels was carried on as usual, and shaft sinking reached a new depth of 3,950 ft. at the Steward mine. High-grade copper ore consisting of chalcocite and bornite was encountered at the 3,850 point, which is a significant discovery in that there is no change in mineralogical relations after an increment of 650 ft. below good ore on a relatively deep level.

At the Washoe reduction works, at Anaconda, a fifty-ton experimental plant for treating phosphate rock was built and is now operating. The Anaconda company's plant at Great Falls operated its zinc refinery throughout the year, as well as the rod and wire mill. There was also some production of ferromanganese.

The North Butte company operated its Granite Mountain and Speculator shafts throughout 1920, developing and mining at about 75 per cent of its normal rate. Work was done on all the deeper levels down to the 3,400, and further extension of the 3,600 will be undertaken. The company also continued the extensive development program at its east side property. Long crosscuts were run from the Sarsfield shaft on the 900 level, and some raising was done. The East Butte company operated the Pittsmtont mine at about two-thirds normal rate, producing about 10,000 tons per month. Development work was done largely on the 1,500 and 1,800 levels. The smelter treated the company's own ore, together with the entire output of the Davis-Daly company's Colorado mine, making a total of 1,500,000 lb. of copper per month, or about 75 per cent of normal production.

Operations at the Black Rock mine of the Butte & Superior company were curtailed to about two-thirds of normal capacity, but the usual grade of zinc ore was mined throughout 1920. New development work extended to the 2,300 level, and the shaft is now being sunk to the 2,600. The Elm Orlu Mining Co. operated its Elm Orlu mine at the rate of 750 tons per day, or about 75 per cent of normal, throughout 1920. Work was done on all deeper levels to the 2,600. The ore was largely zinc, but some copper was mined, all of which was treated at the Timber Butte mill, together with a large tonnage of copper tailings, so that the mill had an active campaign for the year. This company also sank the Travona shaft to the 1,500 level, and explored the "ancient vein" at this depth.

The Davis-Daly company reached the 2,700 level at the Colorado mine, and crosscut to the orebody which has been developed and mined on levels above. Drifting is now in progress at this point, and regular shipments are still being made to the East Butte smelter. The Tuolumne Copper Co. mined and made shipments of about 100 tons of copper ore per day from levels between the 800 and 1,200. Development work was actively carried on during the first half of the year, but not much was done during the latter part. However, the Main Range shaft is now being sunk from the 1,200 to 1,600, where crosscuts and drifts will be driven. The Tuolumne company has installed the first successful heavy-duty centrifugal pumping plant in the state. The installation consists of a ten-stage machine which raises 500 gal. per minute against a 1,200-ft. head.

For a portion of 1920, the Barnes-King Development Co. operated its North Moccasin, Piegan-Gloster and Shannon mines, together with exploratory work. In May, however, the Piegan Gloster was forced to close. It is significant that this mine, probably the most important gold mine in the state, could no longer stem the tide of increasing costs. The North Moccasin property ceased to operate in September, but was put in the hands of lessees at that time, and is now being worked by them. At the Shannon mine, about 2,500

tons per month was mined and treated throughout the year. The total dividends of the Barnes-King company to date amount to \$440,000.

Clancy District—This famous old high-grade silver-mining district enjoyed a period of considerable activity in 1920, and nearly all the mines were worked to capacity. The Liverpool made regular shipments of silver ore from its 750 level. The Free Coinage mine of the Amalgamated Silver Mines Co. sank its shaft from the 250 to 350 level and opened new drifts there. It shipped high-grade silver ore throughout the year. The Little Nell mine is sinking its shaft from the 450 level. Development work was carried on at several other small properties. The Legal Tender mine was not operated during the year, but undoubtedly will be as soon as new financing can be arranged. The ore from the Clancy district consists of lead and zinc sulphides with silver content from 125 to 150 oz. per ton. Ore is mined from narrow fissures, and even outside the limits of the main ore shoots assays from 25 to 35 oz. silver.

Neihart District—The principal operators at Neihart were the Cascade Silver Mines and Mills and the Ripple mine. The mill at the Cascade property worked nearly all the year treating silver ore. The Ripple mine shipped chiefly the broken ore left in the stopes by early operators, but it is closed now.

Basin-Wickes-Corbin—There was considerable activity in the old silver mines of this district. The famous old Alta mine has installed a new electrically driven compressor, and has done development work which reaches points 500 ft. below the old openings. Drifting is now in progress at this depth. The Corbin Copper King has prepared to start active operations about April 1 of next year. The Jib mine, at Basin, worked throughout the year on levels down to the 300. Its ore is a complex sulphide, but has exceptionally good gold content in short shoots. Probably the most important development in this district is the Mount Washington mine of the Angelica Mining Co. A large tonnage of lead and zinc sulphides, with satisfactory silver content, has been developed. A mill will be built this spring.

The Boston & Montana Development Co. had an active year at its property at Elkhorn. The company completed a twenty-six-mile narrow-gage railroad from Divide to the mine and is building a 500-ton mill. The development work on the mine was carried on throughout the year.

The Champion mine, in the Oro Fino district, near Deer Lodge, cut a vein in its long tunnel which contained 600 oz. silver ore in a short shoot. Further development has disclosed considerable milling ore, and a 150-ton mill is being built.

Mining in Michigan

BY D. E. A. CHARLTON

Managing Editor *Engineering and Mining Journal*

DESPITE several handicaps, including strikes, transportation difficulties, and fuel shortage throughout 1920, iron-ore shipments from the Michigan ranges were higher than in 1919 and constituted a little over one-third of the total iron ore produced in the Lake Superior district.

The principal item of interest on the Marquette Range was the purchase by Henry Ford of the holdings of the Michigan Land & Iron Co., the lands being distributed over Marquette, Iron, and Dickinson counties. The only proven mine of the concession is the Imperial, formerly operated by the Cleveland-Cliffs Iron Co. and situated at Michigamme. The Ford interests, which are now preparing to operate this property, which has been idle for some time, have established an office at Iron Mountain.

Operations at most mines on the Marquette Range were normal, excepting the Breitung properties, which curtailed to a considerable extent and toward the later part of the year were reorganized as the Marquette Ore Co., with John W. Dougherty as president. The Rolling Mill mine of Clement K. Quinn & Co. has become one of the large operations of the district. Shipments approximating 300,000 tons were made during the season.

The mines of the Cleveland-Cliffs Iron Co. were worked to capacity during the greater part of 1920, the Negaunee mine being the largest producer. The Maas and the Athens increased their production and the South Jackson pit produced over 60,000 tons of low-grade ore, mined by steam shovel. The Maas mine put in a large storage sump, and the Negaunee mine built a new pump house, which was lined with metal lath covered with "gunite." The Athens mine completed

the shaft pockets, which are on alternate levels, ore from intermediate levels being transferred to the pockets through raises near the shaft. The Holmes mine increased its production and the Salisbury and Angeline mines maintained about the same output as in 1919. In the Gwinn district, the Austin mine remained idle, and the Princeton mine has been practically closed while changes are being made in hoisting equipment. A new hoist and engine house are being erected and a second skip will be put in the shaft. The Stephenson mine, which was unwatered in December, 1919, was reopened in 1920. The Gwinn, Francis, and Gardner-Mackinaw mines maintained their usual production, but operations were curtailed in December. At the Republic mine, at Republic, hoisting at the Pascoe shaft has been discontinued, and all ore is now taken out through No. 9 shaft. The usual production was maintained, and new ore was developed.

During 1920 the Gogebic Range shipped its record tonnage, which was about eight million. Some exploration was done—principally by the Jones & Laughlin company, on the eastern end of the range—but development was largely confined to the mining of orebodies previously discovered. The McKinney Steel Co. completed a general office building near the Ironton mine at Bessemer, and also completed and put into operation one of the most modern engine houses in the Lake Superior district. The plant is electrically equipped with a 1,300-hp. Ilgner set, with a 40-ton flywheel which serves the ore skips and a 1,650-hp. hoist motor which serves the cage. The Oliver Iron Mining Co. has finished thirty-five of the fifty new dwellings at its Puritan mine and has also completed the new "H" Pabst vertical shaft to the 26th level—a depth of 2,040 ft.—

and erected a permanent steel headframe. Automatic stokers of the Westinghouse-Taylor type have been installed at the Pabst mine power house, and from the same power plant transmission lines have been laid underground in conduit to all of the Oliver properties west of the Pabst. A surface transmission line on steel towers has been completed east of the Pabst to the Davis and Puritan mines. The Yale mine of the Charcoal Iron Co. at Bessemer cut wages 20 per cent on Dec. 1. The Steel & Tube Co. laid off a total of 200 men from its Anvil and Newport mines. The No. 1 shaft at the Windsor mine of Pickands, Mather & Co. has been shut down, although all men laid off have been transferred to other mines of the same company or employed by other companies.

Little attempt was made during 1920 to discover ore on new properties on the eastern end of the Menominee Range. However, the Escanaba Exploration Co. did some drilling near Escanaba and encountered an iron-bearing formation about twenty-five miles east of Waucedah, which is the most easterly point at which mining has been done on the Menominee Range. No ore was discovered. The Peninsular Power Co., finding that its plants at Iron Mountain and Florence were inadequate to supply the demands placed upon them, is building a new plant on Pine River, a few miles southeast of Florence. The electrification of the Aragon mine has been completed, and all equipment, with the exception of the hoist, is now operated by electricity. At the Loretto mine an electrically driven compressor and hoist were installed.

The Iron River-Crystal Falls district was active in 1920, owing to a good demand for the ores produced, which are generally high in phosphorus and desirable for the manufacture of foundry iron. Owing to the car shortage during the first part of the season, shipments were held up to such an extent that many of the mines were unable to clean up their stockpiles. There was a distinct labor shortage during the first eight months of 1920, but the supply remained ample during the rest of the year. The Cleveland-Cliffs Iron Co. reopened its Spies mine and also acquired a lease to the Virgil mine, an adjoining property owned by the Wickwire Mining Co. Shaft sinking was in progress at the following mines: Homer, Davidson, No. 2 and No. 4 shafts; Chicagon, Cardiff, Hiawatha, Dober, Zimmerman, and Berkshire. The Cardiff mine installed electrical equipment and erected a steel headframe, and at the Rogers mine electrical pumps were placed underground. Pickands, Mather & Co. reopened their Baltic and Fogerty mines and also took over the Amasa-Porter mine, formerly controlled by the Nevada Mining Co. The McKinney Steel Co. electrified its equipment at the Richards and Tobin mines, at Crystal Falls.

In a review of copper mining conditions in Michigan during 1920, James MacNaughton, vice-president and general manager of the Calumet & Hecla Mining Co., writes as follows:

"It is with unintentional irony that the editor of the *Engineering and Mining Journal* asks that the review of the copper industry of the Lake Superior district be limited to sixteen hundred words. Ours requires no such length, for this year it is 'the short and simple annals of the poor.'

"The history of the district for the last two years is most graphically portrayed in the report of the Mine Inspector. In the Houghton County mines for the year

ending Oct. 1, 1918, there were employed underground an average of 12,650 men. In 1919 this had dropped to 7,865, and in 1920 to 6,082, being just three-eighths of the number employed in 1916. That production has not fallen proportionately is due to the lack of exploration and development and to the continuous introduction of labor-saving devices, beginning with the one-man drill and extending to power tramping, and more recently to the installation of power scrapers and other loading devices.

"One by one the weaker companies have succumbed to scarcity of labor, carrying with it decreased production and increased costs, all in the face of a lowering copper market and decreasing demand. The increase in the cost of coal alone has added a burden of over 1 cent per pound of copper produced, and the sharp falling off in price of copper in October has wiped out any possible profit for the companies other than Champion, Ahmeek, and Mohawk.

"The most hopeful development in the way of saving labor and reducing costs has been in the use of mechanical scrapers for bringing the ore down the stopes into the tram cars. Mechanical loaders of various types have been experimented with for some years, and with varying degrees of success, but the weight and the initial cost were such as to make their extensive installation problematical, allowing for the most favorable development with use. The scraper seems to meet the problem nicely. It is easily transported from place to place, is simply rigged, requires no skill to operate, and makes possible as laborers a class physically incapable of the former work of the trammer. It is being installed as rapidly as possible in all mines where the dip of the lode requires handling of the "rock" in the stopes, and when the copper market improves the normal output can be resumed with decidedly fewer trammers. The old type of trammer required physical qualifications such that the supply has been decidedly limited in recent years, and the big hope for the scraper, whether it reduces costs or not, lies in the widening of the field of available labor.

"Other developments underground have not been noteworthy. The plans of the Quincy and of the Calumet & Hecla for working at great depth are being carried forward with an apparent optimism not, in my judgment, warranted by present conditions. Values at depth are not falling rapidly, but operating costs are mounting steadily, and the point where outlay will overtake income is hard to establish in advance because of the multitude of fluctuating conditions.

"The mills and smelters of the district have introduced no startling features. Neither leaching nor flotation has been extended. The Mass, Franklin, Lake, and Osceola stamp mills are shut down and the old Tamarack has been demolished. In its place is being erected a plant to treat the accumulated conglomerate sands by the process developed at the Calumet & Hecla plant at Lake Linden.

"As 1920 closes, the industry is facing the worst crisis in its history. The richer mines are increasing production to lower their costs, and the leaner ones are either closing down entirely or radically reducing their non-producing forces. Wages have been lowered, but high-priced supplies, particularly coal, must be reckoned with for at least six months more. If the district is to hold its place as one of the important producing centers, the results must come through an increased price for the commodity."

Alaska

BY GEORGE J. YOUNG

Western Editor, *Engineering and Mining Journal*

ALASKA is recovering from the conditions imposed by the war. Experienced miners and common labor have been short, but labor conditions are improving. The white population is gaining. Despite depression, the gold-mining industry is active in south-eastern Alaska. Long a bureaucratic football, there is a hope that the change to a more direct and sympathetic control of Alaska's internal affairs is close at hand. Steps to secure legislative authority for an Alaska Development Board have been taken, and the President has appointed an interdepartmental Alaska committee.

The visit of Secretary of the Interior John Barton Payne, and the Secretary of the Navy, Josephus Daniels, resulted in the approval of the report of the Alaska Advisory Committee, which recommended lowering freight and passenger rates and improvement of transportation and mail service; concentration and co-ordination of Federal control of Alaskan lands and resources under an Alaska Development Board; co-ordination of Federal road construction and the development of plans for a comprehensive system of roads and trails; investigation of the commercial feasibility of a copper smelter; and immediate development of a wood-pulp industry. Oliver C. Ralston, of the U. S. Bureau of Mines, reported in November adversely upon the location of a copper smelter in Alaska under present conditions, and recommended concentration mills or hydrometallurgical plants at the mines as the logical solution of existing difficulties.

The U. S. Geological Survey reports the value of the 1920 mineral production as: Gold, \$7,856,000; copper, \$12,400,000; silver, \$900,000; platinum and allied metals, \$80,000; tin, \$20,000; lead, \$142,000; coal, \$380,000, and miscellaneous, \$148,000; or a total of \$22,070,000, against \$19,620,913 in 1919. Gold production from placers is estimated at \$3,630,000, as against \$4,970,000 in 1919. In 1920, twenty-two gold dredges operated, of which seventeen were in the Seward Peninsula. In lode mining fifteen mines and five prospects were operated, which produced 3,270,000 tons of ore, from which \$4,360,000 gold and 106,000 oz. of silver were recovered, slightly less than for 1919. Total silver was 792,751 oz. (488,034 in 1919), lead 880 tons (564 in 1919), copper 71,000,000 lb. (56,534,992 in 1919).

Alaska Gold Mines Co. continued to operate throughout 1920. The first two quarters of the year showed recoveries of 68 and 66c. per ton, respectively; operating expense 79c. per ton and operating losses of 11c. and 13c. per ton. The position of this mine changed little during the year. More definite plans for a paper mill adjacent to its property were made by the Alaska Gold Mines Co.

For the first eight months of the year, Alaska-Juneau reports gold assay value of \$1.15 per ton for 589,270 tons. Gold recovery was 85.55c. per ton; mining cost 20.48c., milling cost 45.37c., general expense 5.54c., total operating cost 71.39c., leaving an operating gain of 14.16c. per ton. In addition, silver and lead approximate 5 to 10c. per ton. The milling cost is being made a special study, and improvements are under way that it is believed will bring this cost down to 20c.

The Alaska Treadwell Mining Co. is seeking a new property, and believes that it has one on Nixon's Fork, a branch of the Kuskokwim near McGrath, a wireless station eleven miles north of the Kuskokwim River. The ore shoots occupy a contact between limestone and granite. The ore contains gold and silver associated with chalcopryrite. The prospects have been attractive, but so far the ore shoots are small in size. A vigorous development campaign is in progress with the objective of developing tonnage. The district is not a bad one to operate in. Living conditions are good and navigation is open for five months in the year. In the district contiguous to McGrath, placers have been successful, a shipment of placer gold having been made and a dredge successfully operated by the Union Construction Co., of San Francisco. The same company is planning to put in another dredge on Gains Creek. The Kuskokwim region was the most active in prospecting inland.

On Chicagoff Island, the Chicagoff mine, which has been operating steadily for ten years, continued operations with its twenty-stamp mill on high-grade gold ore. North of the Chicagoff mine small high-grade gold-bearing veins have been discovered. Much prospecting and development are in progress. The El Nido and two or three small properties are mining high-grade gold ore.

In the Copper River country, Kennecott Copper acquired control of the Mother Lode properties. As far as can be ascertained these are developing satisfactorily and showing similar characteristics to the chalcocite orebodies of the Kennecott. At the Kennecott, shipments of copper continued practically throughout 1920.

In 1919, petroleum production was limited to the Katalla field. In this field the output has increased and there was great activity throughout the Gulf of Alaska region. According to Colonel Alfred H. Brooks, the Katalla field is a region of shallow pumping wells, the petroleum coming from sands at depths of 300 and 800 ft. A superior grade of gasolene and distillate is being produced and supplied to a local market, which absorbs the entire production. The favorable leasing conditions as well as the occurrence of geological horizons considered to be promising have caused applications for 380,000 acres to be filled in Juneau since the passing of the new leasing regulations. The applications aggregate 175 in number. Somewhat less than half the acreage lies in the Cold Bay district. Other districts are Katalla, Yakataga, Chitina Bay, Seward, and Wasilla. Colonel Brooks calls attention to the fact that geologic conditions are particularly good for the occurrence of oil at a number of places in Alaska.

Most of the first 260 miles of the Alaska Government Railroad has been completed, as well as the last 100 miles. The total length is to be 468 miles, leaving 108 miles to be completed. Development of coal for local and railroad use continues in the Matanuska field under the direction of the Alaska Engineering Commission. During the year, the U. S. Geological Survey dispatched seven field parties to Alaska.

This report was compiled from interviews, published statements by the U. S. Geological Survey, and news notes appearing in *Engineering and Mining Journal*.

California

BY GEORGE J. YOUNG

Western Editor, *Engineering and Mining Journal*

MINING in California in 1920 faced a number of difficulties, among which were a pronounced water shortage that resulted in curtailment due to lack of power in the last part of the year, a restricted supply of fuel oil, and labor scarcity. Mining costs increased, and there was a marked tendency among the gold mines to suspend operations temporarily. Copper production was almost entirely restricted to the Engels and Walker properties. Quicksilver mines were in difficulties. Nevertheless, a number of older properties were unwatered, and much prospecting and development that should bring good results in the ensuing year was accomplished.

Advance production estimates for 1920 by Charles G. Yale, of the U. S. Geological Survey, are as follows:

	1920	1919
Gold.....	\$14,305,300	\$16,695,955
Silver, ounces.....	1,513,495	1,107,189
Copper, pounds.....	12,934,900	21,732,507
Lead, pounds.....	5,071,600	3,568,267
Zinc, pounds.....	1,572,000	472,990

Alluvial Mining—It is difficult to estimate accurately the number of gold dredges in operation in 1920, but thirty-five or thirty-six were probably working, as compared to my estimate of forty-three in 1919. The Yuba Consolidated Gold Fields operated eight dredges.

The Natomas operated ten dredges. The American Gold Dredging Co. operated four dredges. The Yukon Gold Dredging Co. operated four dredges. The Valdor Dredging Co. operated its dredge in Trinity County; the El Oro Dredging Co. operated its dredge at Yreka up to April. Marysville Dredging Co. operated one dredge near Marysville. The Estabrook put a 20-cu.ft. dredge in operation in Trinity County. It was shut down temporarily in October. In the latter part of the year the Yankee Hill Gold Mining Co. put a dredge into operation between Oakdale and Knights Ferry. There were other dredges in operation in northern California, but specific information was not received from them. Cost of supplies generally did not diminish, although there were slight reductions in some items. Increase of wages and increased cost of power more than counterbalanced such reductions. As a whole there will be less gold from dredging in 1920 than there was in 1919.

The prevailing water shortage resulted in a short water season, and there will be less production from desultory placer and hydraulic operations. There was some activity during the year, both in the Yuba-Feather River region and northern California, in hydraulic and drift mining.

Mother Lode—At Jackson, both the Kennedy and Argonaut were in operation at the beginning of 1920, the former with twenty-five to sixty stamps, and the latter with sixty stamps, operating continuously. In April the Kennedy was flooded to stop fires which had persistently broken out. The Argonaut proceeded to unwater both properties. By the middle of October the 2,800 level of the Kennedy had been recovered. It is expected that mining will be resumed in both properties early in 1921.

The Carson Hill Gold Mining Co., the most important new operation in the Mother Lode, was formed to take over the Carson Hill Gold Mines, Inc., which

controlled 160 acres of important mining ground, together with the Morgan, Union, and Kentucky claims. The Melones property is under option, and by independent agreement all the plant and facilities of the Melones property are used by the company. In the Morgan tunnel a strong lead was followed, resulting in the discovery of a high-grade orebody. This orebody was developed to the surface and below the tunnel level down to the 1,350-ft. level, which is now being stoped. Preparations are being made for stoping on the 1,600-ft. level. The 1,750-ft. level is being extended northward. On the 1,200-ft. level another orebody has been opened up. In addition to these two, there are two more orebodies, both important.

In the Tuolumne region, 1920 opened with moderate activity, but during the last half many properties closed and activity almost ceased. The Eagle Shawmut operated seventy to eighty stamps and employed 150 men until September, when work was suspended.

In Mariposa, the Mountain King struck good ore on its 1,800 level, and is deepening its shaft to 2,000 ft. Fifty men are employed, and 1920 was more successful than 1919. The White Gulch Mining Co., near Bagby, operated, as did other small properties.

At Plymouth the Plymouth Consolidated Gold Mines, Ltd., since July 30, 1914, has mined 800,000 tons of ore, from which a gross recovery in excess of \$4,000,000 and a profit in excess of \$1,000,000 were made. The orebodies gave out just below the 2,400-ft. level, and for a time the outlook of the mine was blue; but sinking and development to the 2,900 level brought improvement, and the 3,050 level is considered to be the best level ever opened in the mine. A winze is being sunk from the 3,050 to the 3,200 level, pending the sinking of the shaft. It will probably be some time in 1921 before the property reaches the dividend stage again. The Plymouth is another example of the necessity of sinking below the barren zones which have almost universally occurred in Mother Lode mines. Credit is due W. J. Loring for his persistent work.

Grass Valley and Nevada City—The Empire Mines continued in 1920 to be the most important operation in the Grass Valley district. The addition to the mill was completed, resulting in concentrating milling operations in one plant. By the middle of the year the largest tonnage in the history of the mine was being treated. New ground below the 4,500-ft. level was being opened up satisfactorily, and the working force was increased. In July, a new wage scale was put in force. Owing to power shortage 150 men were laid off early in September, but in October restrictions were removed, and operations increased to normal. The North Star curtailed operations in May owing to high costs and leaner ore at depth. Instead of laying off men due to power shortage, surplus men were transferred to other jobs. A new tailings dam was constructed on Wolf Creek. At the Idaho-Maryland unwatering was completed and sinking of the shaft to 2,500 ft. and lateral development were planned. Station pumps were installed on the 1,000-ft. level. A fifteen-stamp mill was erected. Power shortage also interfered with the operations of this property. Allison

Ranch prospected its tenth level. The Alcalde (Kenosha) reported a sensational strike of high-grade ore. During the year its milling facilities were increased. Norambagua began deepening its main shaft to 1,500 ft. and installed a twenty-stamp mill.

Nevada City mines were inactive during 1920. The Champion mine plant was dismantled and sold. In contiguous areas the Penn-California Mining Co. acquired a number of gravel properties and drove a tunnel to tap the channel under Harmony ridge.

At Alleghany the Sixteen to One acquired the property of the Twenty-one, and litigation was thus ended. The Alleghany Mining Co., owner of the Tightner mine, took over the Gold Canyon mine, unwatered the shaft, and made preparations to sink. There were other minor operations in small lode, drift, and hydraulic mines.

Copper Mining—Of the three copper-producing areas, the Shasta, Plumas, and Copperopolis, the Plumas County mines, and of these the Engels and Walker properties principally, made practically the only copper production of 1920. In this area twenty mines and prospects were in operation. The Engels Copper Mining Co., employing 450 men, added to its reserves over 500,000 tons in the year. Its flotation mill operated continuously. In the mid-year the Walker Mining Co. completed its eight-mile wire-rope tramway and shipped accumulated concentrates. Two hundred tons per day was treated in the mill. In November, high cost of power, freight rates and labor caused most of the working crew to be laid off, and work was confined to development through the winter. The Gruss Mining Co. completed and put a 200-ton mill in operation. The Mason Valley Mines Co. acquired the Blue King group of claims and started development.

In the Shasta region the Bully Hill Copper M. & S. Co.'s group of mines was taken over by Hayden Stone & Co. and the Shasta Zinc & Copper Co. formed with D. C. Jackling as managing director. A zinc-oxide

plant and reverberatory are under construction, and operations are expected to begin in March, 1921. The Balaklala smelter was torn down, and the steel will be used in the construction of the new plant at Bully Hill. At the Mammoth mine of the U. S. Smelting, Refining & Mining Co. operations were restricted to development during 1920, 100 men being employed. The smelter at Kennett was not operated. Ore reserves were increased. Mountain Copper Co., Ltd., operated its Hornet mine steadily throughout the year, producing pyrites. Its copper properties were idle. Early in 1920 operations by the Afterthought Copper Co. were indefinitely suspended. At Copperopolis the Calaveras Copper Co. restricted its operations to development work.

Southern and Eastern California—At Randsburg, California Rand Mines Co. continued shipments to the Selby smelter, and was reported to be paying dividends of \$25,000 per month. The Slate Range Minerals Co., northeast of Trona, operated a flotation mill and made shipments of crude lead-silver ore and concentrates. At Masonic, the Pittsburgh Liberty was reported sold and the Golden Gate bonded for the twelfth time. In Inyo and San Bernardino counties numerous small properties were reported as active.

Miscellaneous—Magnesite mining was active in the vicinity of Porterville. Levy, Gilman & Moore, of Oakland, are reported to be developing a barite deposit near Lowell Hill. The General Petroleum Corporation leased 320 acres on Otay Mesa, and expects to mine soapstone. The U. S. Borax Co. bought borax claims near Mohave. American Trona made extensive improvements at Searles. West End Chemical Co. acquired control of the West End Consolidated Mining Co.'s operation at Searles Lake. The property consists of 220 acres of the Searles deposit. A plant has been established on the western edge of Searles Lake, at a point known as Westend, and the company expects to produce potash and borax in 1921.

Colorado

BY GEORGE E. COLLINS,

Consulting Mining Engineer, Denver, Col.

AFTER four disastrous years, the close of 1920 finds the mining industry of Colorado in a more depressed condition than at any time in its history, though during the last month some signs of improvement have become apparent. For the first time since 1916, there is a surplus of skilled labor. If the labor surplus persists during the winter, as all anticipate, the industry will, by next summer, have regained something like the degree of efficiency that prevailed in 1915. Wages will not fall to quite the same level, but this is of less relative consequence than regained efficiency. The costs of most materials also show a tendency to drop, and there is fair reason to hope that in 1921 the average costs of mining may be reduced to something like 30 per cent in excess of those ruling in 1915.

At Cripple Creek, the Portland has suspended its regular dividend payments, in order to accumulate a cash reserve. It is understood that the developments in the deepest levels, below the Roosevelt drainage adit,

are favorable. The Cresson, which also passed its last dividend, maintains a large output, but is no longer a bonanza. The Vindicator has exhausted its reserves, and reduced the scale of work, but just in the nick of time has developed a new orebody of some promise. The Modoc has opened up good orebodies, and expects to be an important producer during 1921. The falling off in production from this district has been marked, and it would have been more so but for the generous policy of the Golden Cycle plant in maintaining the former rate schedules. A rather romantic enterprise, which must be considered a forlorn hope, is being backed by several local operators, headed by the Vindicator management. W. H. Trask, a Denver banker and student of geology, advanced the hypothesis that the northeastern end of the Cripple Creek volcanic neck has been covered by a huge rock slide. A series of boreholes is being drilled to test this hypothesis. It is not claimed that the enterprise is anything but a one hundred to one shot, but the great importance of adding

to the life of the district by opening additional territory is considered to justify spending money on the chance.

Leadville and vicinity are exceedingly depressed. The Down Town mines, the Yak, and Ibex are the principal producers. A considerable tonnage of low-grade pyrite is being shipped from Kokomo, and some high-grade ore from the London and Dolly Varden, near Alma. The Hilltop, in the same vicinity, is producing considerable lead-silver ore. At Aspen, the Smuggler is maintaining a considerable output, and prospecting in the district is yielding promising results. At Creede, the American Smelting & Refining Co. has abandoned its work below the adit level on the Amethyst vein. Considerable shipments of siliceous silver ore are being made from surface deposits in this district. The zinc properties at Red Cliff controlled by the Empire Zinc Co., and which are believed to contain orebodies of the first magnitude, remain practically closed down, awaiting better market conditions. Meantime the zinc-oxide plant at Canon City is being enlarged. At Breckenridge, the Wellington resumed production, as foreshadowed in my last annual review; but in October the increase in freight rates and the unfavorable spelter market together decided the management to close the mill again.

In the Silverton district, the Gold King was operated for a short time during the summer of 1920, when glowing reports were circulated of the opening of rich orebodies, which have not been confirmed. A considerable production is maintained from the Iowa and other properties which are being operated under lease, but in general the district was not active, with the exception of the Sunnyside. Owing to the increase in freight and treatment rates, and the recent fall in metal prices, it is doubtful whether even this property can continue in operation much longer, without some substantial relief.

At Telluride, the Tomboy maintains a large production, but, according to the last annual report, the profit margin has been changed into a loss. The year's results at the Liberty Bell, on a new vein discovered toward the end of 1919, just as preparations for closing were completed, have been disappointing. This great mine must be considered as finally exhausted, and will probably soon close down. At the Smuggler-Union, just as the prospects began to look brighter than for many years, the sheer ill-luck which has so often dogged the steps of this enterprise once more came into play, and a disastrous fire in July destroyed the office and flotation plant. These are being replaced with all possible speed, but in the meantime production is greatly curtailed. Around Ouray a considerable amount of prospecting was done in 1920 and some steady shipments were made by leasing companies, but there is not at present any important producing mine. It is reported that in the Camp Bird some good ore was cut in driving west at the new adit level, but for the present the financial condition has necessitated suspension.

Gilpin County has perhaps suffered as much as any county in Colorado and the output has fallen to a low point. Around Georgetown, the increased activity which a year ago seemed to be under way has been arrested. In the Idaho Springs district, few of the lessees are making more than a bare living. The most important operation is the Gem, which has been taken over by Canadian interests, which have also, it is understood, obtained an option on the Argo Tunnel and the Argo mill at the mouth of the tunnel. In Boulder County lead production has practically stopped and the

gold mines are mostly closed down awaiting the advent of lower costs, and tungsten mining is out of the question at the present price for that metal.

The only remaining lead-smelting plants in the state are the Pueblo, Leadville, and Durango plants of the American Smelting & Refining Co., which have, with few changes, continued the high-treatment schedules announced toward the end of 1919, and even increased them to an extent proportionate to the latest increase in freight rates on coal, limestone, and other materials. As might have been expected, the result was a considerable profit at first, followed by reduced production of ore and consequent disappearance of the profit margin. The general opinion among those best qualified to judge is that the smelting industry cannot become remunerative without increased output, and that this can be secured only by a considerable reduction in treatment costs, direct and indirect, with resulting increase in the present low percentage of the gross value of the ore returned to the miner. A bold change of policy on the part of the American Smelting & Refining Co. seems the only hope in this direction.

An attempt is being made to reopen the Salida smelter in connection with the Rawley mine, at Bonanza, which contains considerable reserves of silver-bearing lead-copper ore, and certain producers in the territory adjacent to Salida are being approached with a view to assisting in the financing of the project. Unfortunately, owing to the heavy losses which the industry has suffered during the last three years, but few of them are in a position to make the attempt.

It is now generally recognized that the oil-shale industry will eventually reach immense proportions, and even that some favorably situated deposits may be profitably worked in the near future. So far, little progress has been made in the actual production, under commercial conditions, of marketable products, but it may be confidently asserted that the problems of local oil-shale technology have now been specifically defined, and it is hardly credible that in the course of the next year or two Western inventiveness will be baffled. It is not improbable that, even now, the solutions of these problems have been worked out in their essential features, and that what is required is the sifting out of the sound grain from the chaff—a process for which the trained engineering mind is better fitted than the abilities of the inventor and promoter, who now occupy the field.

Idaho

By ROBERT N. BELL

Late State Mine Inspector of Idaho, Boise, Idaho

DURING 1920, for the first time in the history of Idaho, non-metallic minerals received more attention than metal mining. Lead-silver mining in the Cœur d'Alene district had made rapid strides back to normal when the slump in metal prices and the increase in railway freight charges in the last part of the year again slowed up production.

Estimates of the year's production indicate a gross yield of 250,000,000 lb. of lead and 7,500,000 oz. of silver for Idaho, all of which, except approximately 15,000,000 lb. of lead and 1,000,000 oz. of silver derived from the producing mines of Boundary, Blaine, Custer, and Lemhi counties, will be credited to the Cœur d'Alene district.

In the Cœur d'Alene district, owing to labor scarcity and high operating costs, development was restricted, but the larger mines, such as the Bunker Hill & Sullivan, Hecla, Morning, Tamarack & Custer, Hercules, and Callahan, continued to develop their lower levels with satisfactory results. In the principal operating mines of the outlying districts, especially at the Continental mine, in Boundary County; the Ramshorn mine, in Custer County, and the Pittsburgh-Idaho mine, in Lemhi County, encouraging results were obtained from development operations. The Idaho Bureau of Mines and Geology completed a geological survey of territory in Idaho bordering the Snake River Canyon, including a detailed topographic and economic survey of the Seven Devils quadrangle. Efforts are being made to have the work continued in co-operation with the states of Idaho, Oregon, and Washington.

A number of properties in the Yellow Pine quicksilver district of central Idaho continued prospecting work in 1920. Several interesting copper-ore deposits in the Pre-cambrian formations of the Salmon City district in Lemhi County were actively developed and ore shipments made. The Bradford volatilization process was given an experimental run at the Pope-Shenon mine, where a 100-ton plant is under construction.

The phosphate fields in the southeastern corner of the state in Bear Lake and Caribou counties were the center of activity. During the year the Western Phosphate Co., at Paris, completed a three-mile railway spur and a 500-ton mill. An adit tunnel on the company's principal 7-ft. vein was extended to 2,000 ft., and stoping started at this point at a rate of 250 tons per day. On the opposite side of Bear River Valley in Montpelier Canyon, four miles above Montpelier, the San Francisco Chemical Co. installed a substantial com-

pressor plant to facilitate further development, which has already reached a depth of 800 ft. The company has shipped 100 tons of crude phosphate rock per day for the last six months. The Neibly-Newhouse Co. has driven a 1,000-ft. adit and is making an output of fifty tons of crude rock a day. A 500-ton mill has recently been completed on this property. The mines are four miles from Montpelier, the nearest railroad point. The rock is delivered to this station by auto trucks at a cost of \$1.25 per ton. A railway spur to be jointly constructed by the two companies is under consideration.

At Soda Springs, thirty miles further west, on the Oregon Short Line, the Anaconda Copper Mining Co. has started upon extensive development of its phosphate deposit. The company has just completed the construction of a nine-mile railway spur, including yardage, tracks, and sidings. A crosscut adit, 9 x 9 ft. in the clear, has been driven several hundred feet. A compressor has been installed. The adit, when completed, will be 9,000 ft. long. Steel and concrete storage bins and a milling plant of 3,000 tons' daily capacity have been designed, and the mill machinery for the first 500-ton unit is already on the ground. This, it is expected, will be completed and in operation by early spring. The company's plans include a model mining town. A large part of the crude phosphate will be treated by a chemical process that will enable the phosphoric acid to be shipped in a highly concentrated condition. Most of the phosphate rock shipments have gone to the Pacific Coast to supply the Hawaiian and Oriental trade, as well as the coast. Increased freight rates interfere with shipments into Mississippi Valley points. There is a growing demand for Idaho phosphate rock and the future of this industry is promising.

Utah*

BY EDWARD R. ZALINSKI
Mining Engineer, Salt Lake City, Utah

MINING in Utah in 1920 was abnormally poor for the producer, owing to increased freight rates, decreased efficiency, high cost and scarcity of labor, and, in the latter part of the year, declining metal prices. The operation of the Pittman Act alleviated the situation somewhat, and Utah probably suffered less than most states.

Production—According to preliminary figures of the U. S. Geological Survey, the 1920 output of Utah was 6,900,000 tons of ore, containing gold, silver, copper, lead, and zinc to a value of approximately \$46,000,000, or a slight increase over 1919. Gold and copper decreased, silver decreased slightly, and lead and zinc increased as compared with 1919. Approximate figures for 1920 are: Gold, \$2,076,400; silver, 11,564,155 oz.; copper, 117,000,000 lb.; lead, 134,000,000 lb.; zinc, 6,000,000 lb. Utah mine dividends amounted to \$11,447,327, as compared to \$11,682,838 in 1919.

Bingham Canyon—The output of Bingham Canyon was about 50 per cent of normal. Utah Copper continued at 50 per cent capacity, as compared with 1919. The average tonnage per day was 14,877 in the first quarter, 16,905 in the second, 18,632 in the third, and

the fourth quarter was approximately the same as the third. Total production for 1920 was approximately 105,000,000 lb. of copper.

Underground mines at Bingham increased wages 25c. per shift on April 1. Lead-silver ore was mined and shipped by the Utah-Apex, Utah Consolidated, U. S. Smelting and the Utah Metal & Tunnel companies. Utah-Apex shipped 100 to 150 tons of lead ore per day and the concentrates from 300 to 325 tons of ore milled per day as well as occasional cars of lead-copper ore. The shaft was sunk to the 2,400 level. Utah Consolidated began the construction of a 1,000-ton flotation mill for the treatment of copper ores. The mill is on the Tooele side above the International smelter. The decision in the Utah-Apex suit was adverse to the Utah Consolidated, and on Oct. 20 the Utah Consolidated company stopped mining lead ore on the dip of the Highland Boy limestone, under Utah-Apex territory, and turned the workings in dispute over to the Utah-Apex. Shipments of lead and copper ore were stopped Dec. 1, and about one hundred men retained on development work. Utah Metal & Tunnel shipped eighteen to twenty tons of lead ore per day during the favorable lead market. U. S. Smelting

*Greatly condensed from original manuscript.

shipped 100 to 150 tons of smelting ore and 300 tons mill ore per day to its plant at Midvale. Total output of lead ore ranged from 14,000 to 17,000 tons per month up to December. Total ore tonnage shipped during 1920, including copper ores, was 6,400,000 tons, compared to 6,086,739 tons in 1919.

Park City—Park City did not suffer as much as some parts of the state, owing to the silver content of the ores. Approximate output for 1920 was 99,864 tons of ore and concentrates, as compared to 75,623 tons in 1919. The metal content was 3,702 oz. gold, 2,535,000 oz. silver, 850,000 lb. copper, 25,290,000 lb. lead, and 4,646,000 lb. recoverable zinc. Labor conditions were poor for ten months, and then improved. The most important producers were the Judge Mining & Smelting, Silver King Coalition, Ontario Silver, Daly West, Daly, and Park-Utah. The abrogation of power contracts caused the Judge electrolytic zinc plant to be temporarily closed down Oct. 23, pending final adjustment of the difficulty. Interests closely allied to the Judge Mining & Smelting acquired the Daly mine. Development was active at the Ontario and Silver King Coalition. The Three Kings, north of the Silver King, did diamond drilling on the lowest level. The Naildriver shipped ore and made arrangements to work through the Ontario mine at depth.

Tintic—The output compared favorably with 1919 and amounted to 311,000 tons, exclusive of iron ores, by forty-two shippers, as compared to 296,832 tons in 1919. The largest producers were the Chief Consolidated, Tintic Standard, Eagle & Blue Bell, Mammoth, Iron Blossom, Grand Central, Dragon, Victoria, Centennial Eureka, Gemini, and Bullion Beck. The Chief Consolidated completed its concrete-lined shaft to the 1,900-ft. level. The total output was slightly less than 100,000 tons.

Alta and the Cottonwoods—Alta was handicapped by labor shortage. The principal shipper was the South Hecla, which markets silver-lead ore, mostly carbonate. The downward extension of the Rustler orebody on this property was cut at a depth of 1,100 ft. The Columbus-Rexall was the next largest shipper, sending an excellent tonnage of carbonate silver-lead-copper ore to the smelters. The Emma Silver and the Michigan-Utah made shipments. The Wasatch Mines put its mine into shape for production, and ore was produced by lessees.

The Sells shipped silver-copper ore containing lead and bismuth. The Alta Consolidated made two shipments, the Louise one, and the Albion Consolidated developed and extended its adit. The West Toledo, Native Copper and Peruvian did development work. The total production of the camp was about 10,000 tons.

Miscellaneous Camps—In Beaver County, the Horn Silver, at Frisco, was the principal producer, all other properties being engaged in development work. In Tooele County, in the Ophir-Stockton district, the Ophir Hill, Bullion Coalition and Hidden Treasure were the principal producers. The approximate output of the district was 33,000 tons of silver-lead and zinc ores. The Western Utah Copper Co., at Deep Creek, shipped lead ore and a good tonnage up to 200 or 250 tons per day of a hydrous iron arsenate ore to the Valley smelters for arsenic recovery. In Box Elder County, the Vipont Silver Mines Co. operated its 100-ton flotation plant on a silver-gold ore. The Silver Reef Mines, in Washington County, were acquired by the McQuatters Corporation, of New York, and a power line and hoisting equipment installed. A mill will be built in the spring of 1921. The Deer Trail mine, at Marysvale, Piute County, shipped lead ore and concentrates from its 100-ton flotation and cyanide mill. The Mineral Products Co. treated alunite near Marysvale and shipped potassium sulphate. Good shipments of carnotite ores were made from Thompsons, including the Grand and San Juan County fields, up to October, when inquiries fell off and shipments declined.

Smelting Conditions—Increased freight rates and relatively limited tonnages made a poor year for the smelters. Excepting one, all smelters operated at reduced capacity toward the end of the year, and stockpiled ore for winter was conspicuous by its absence. The A. S. & R. at Murray had five, six, and seven lead furnaces in blast; three on lead ores, three on siliceous ores, and one on low-grade iron arsenate ores. The Garfield plant of the A. S. & R. operated three reverberatories at 40 per cent capacity on copper ores and concentrates from the Utah Copper. The International, at Tooele, operated three and four lead furnaces, and about the middle of November temporarily shut down its copper plant. The Utah Zinc Co. erected a new plant for zinc-oxide production from lead-free carbonate zinc ores.

Nevada

BY EDITORIAL STAFF

THE high price of silver in 1920, sustained by the operation of the Pittman Act, helped silver mining in Nevada. There was more activity in prospecting and looking for likely properties than in any other of the Western States. Labor troubles at Tonopah and Virginia City interfered somewhat, but less than in 1919. The U. S. Bureau of Mines moved the rare-metals station from Colorado to the Mackay School of Mines, at Reno.

Copper mining was almost entirely confined to the Nevada Consolidated, which operated at about one-half capacity. Somewhat over 7,000 tons per day was mined, three-quarters from steam-shovel pits and one-quarter from the Ruth mine. A new orebody of 7 per cent copper that was found upon the lowest level (700 ft.) of the Ruth mine was the most significant

event of the year. Extensive improvements were made at the McGill plant.

Consolidated Copper Mines, in the Robinson mining district, restricted its operations to development, and in the Mason Valley district there was only incidental development. The Thompson smelter was idle. Late in the year favorable freight rates from copper-mining centers in Plumas County, Cal., to Thompson were in prospect and, if finally allowed by the I. C. C., two reverberatories are to be erected at this plant.

Tonopah easily maintained its lead. Labor troubles interfered for a time, but throughout 1920 there was a pronounced shortage of underground workers, although top men were plenty. A miner's mercantile store operated by the companies sold necessities to the miners at cost. Local mills operated regularly.

The Tonopah Mining Co. reopened its mill at Millers, and preparations were made by the Tonopah-Belmont to re-treat tailings at its old plant at Millers.

Tonopah-Belmont produced about 400 tons per day by reworking old stopes and faulted segments and extensions of its principal veins. Production was decreased by scarcity of labor that prevailed over half the period, but was increased in the second half. Operating costs, supply costs and freight were higher, and the average price of silver was slightly lower. Production is estimated for the year at 128,000 tons of ore, from which 13,876 oz. gold and 1,345,000 oz. silver are expected to be recovered. Total output, including custom ores, is estimated at 19,200 oz. gold and 1,789,500 oz. silver. Mine development was satisfactory.

A plant for treating concentrates formerly shipped to smelters was installed during the year. Tonopah Extension deepened its Victor shaft to 1,930 ft., and preparations were being made at the close of the year to cut a station on the 1,885-ft. level. The Merger and Murray veins were crosscut on the 1,780 level. The McKane shaft was retimbered. It is to be sunk from the 1,100 to the 1,540 level and connected with the Victor shaft. Development of the company's western territory will be carried out from this shaft.

The Victor shaft is the deepest in the Tonopah district, and at the 1,780 level development showed vein structure and assays consistent with higher levels. The year's production is estimated to be 80,000 tons, of a total value of \$1,225,000. West End ore production caught up with mill capacity, and the amount of custom ore treated in its mill became negligible. Scarcity of miners caused ore shortage later in the year. Under agreement with the Tonopah "76" this company's ground is being prospected on the 800 level of the Ohio Tonopah. In its own operations from the Ohio shaft, development on south-dipping veins was encouraging, as such veins showed characteristics identical with those shown by north-dipping veins.

At Virginia City, Whitman Symmes, long a constructive element in Virginia City mining affairs, retired, and Alex Wise became superintendent of the North End group. Outside of the working of a comparatively rich shoot below the 2,150 level, there is little to record for the North End mines. Up to Sept. 1 production exceeded 117,000 oz. silver and 6,898 oz. gold. The Middle Mines, under H. W. Slosson, Jr., explored with diamond drill and in other respects marked time. Gold Hill mines were brought under the control of Bulkeley Wells, who has his engineers now engaged in constructing a mine adit and preparing the foundations for a 2,000-ton cyanide plant, preparatory to working low-grade ores and old stope fills. Under Bulkeley Wells' control, the Gold Canyon Dredging Co. started on Sept. 5 a steel, 9½-cu.ft. dredge about half way between Silver and Dayton. Both enterprises are well managed, and should make important production.

The Rochester Silver Corporation, under date of July 31, 1920, reported 26,570 tons of ore milled. Average silver was 12.91 oz. and gold 0.153 oz. per ton. Total costs were \$9.23 per ton. Recoveries were 92 per cent of gold and 81.3 per cent of silver, yielding a net operating profit of \$151,614.77 for the six months. Development reached 4,871 ft. Operations

were hampered in the latter part of the year by power shortage. The Nevada Packard went into the hands of a receiver with \$55,000 owing. The Nenzel Crown Point Mining Co. was foreclosed and ordered to be sold at public auction. Minor operations were carried on by other companies.

The Divide district failed to reach expectations, although a few properties reported development of milling ore in moderate amounts. At Candalaria, the Candalaria Mines Co. actively developed its holdings on Lucky Hill and prepared plans for a mill.

The Pioche district was prosperous throughout 1920 and made large shipments of low-grade iron-manganese ores to Salt Lake smelters. Assurance by railroad officials that fair treatment would be given in impending freight-rate increases prevented anything more than a nominal interference with operations.

The Louisiana Consolidated Co. completed a 125-ton lead smelter, a power line, and a flotation addition to its mill. The Bull's Head Mining & Smelting Co. did not operate its smelter. The Spruce Monarch mine, also at Spruce Mountain, made steady shipments to Murray. At Goodsprings, the Yellow Pine Mining Co. investigated, in co-operation with the U. S. Bureau of Mines, the volatilization of lead and zinc as chlorides from zinc carbonate concentrates. The Eureka district was active in prospecting, developing and shipment of ore. Arrowhead was the center of much prospecting, and activity was reported at Austin and Broken Hills. The Simon Silver-Lead Co., east of Mina, developed in excess of 500,000 tons of ore and extended development to the seventh level, 565 ft. deep. A milling unit of 100 to 125 tons' capacity is being designed, and it has been stated that the U. S. Smelting will advance funds for its construction and has contracted for the concentrates. Other properties near by were active.

Jarbidge, toward the close of 1920, had exceeded 1919 production. Elkoro, Jarbidge-Buhl and the New York Jarbidge mining companies are the important operators. From the Long Hike mine the Elkoro had milled up to Nov. 1, 104,469 tons, which yielded in bullion \$1,181,900, with a net operating profit of \$555,229. This profit has been expended in completion of plant, development, and other expenses. A minimum estimate of probable ore in the different claims is stated to be 100,000 tons, with promise of more.

At Gold Circle, the Elko Prince maintained its production of sixty tons per day. Other mines were also active. At Tule Canyon, W. J. Loring prospected and developed the Silver Hills Nevada Mines with varying but encouraging results. Birch Creek, Searchlight, Spanish Belt, Rye Patch, Rawhide, Willard, Denio, and Pioneer were active.

At Round Mountain, placer and lode mining continued, with encouraging returns. The White Caps, at Manhattan, extended its development, discontinued milling, and during 1920 shipped 1,496.4 tons of ore to the Tacoma smelter. Arsenic content was 669,392 lb. and gold \$38,146 in value. The main shaft was deepened to 1,000 ft., and a station cut on the 800-ft. level. Goldfield operations were restricted by difficulty in securing capital. Both the Goldfield Development and Goldfield Deep Mines, under the leadership of A. I. D'Arcy and H. G. McMahon, conducted minor operations.

New Mexico

BY JAMES P. PORTEUS
Lordsburg, New Mexico

MINING operations in New Mexico during the first three quarters of 1920 were fairly steady. The production of copper, notwithstanding adverse market conditions, showed a gradual increase up to October. In the last quarter, however, there was a pronounced "tapering off," which movement culminated in December in a severe shrinkage in all operations. The price of silver, maintained by the Pittman Act, caused a number of old mines to be reopened. No great production developed, but in some operations, as at Lake Valley and Central, considerable ore was profitably shipped. A number of new silver developments look promising. Gold mining was not altogether neglected.

The Mogollon mines were consistent producers throughout 1920, and both Steeple Rock and Pinos Altos districts showed some activity. The production of zinc increased in the Hanover district, but decreased elsewhere, total output for the state being less than last year. Manganese in the vicinity of Deming and fluorspar at Lordsburg and in the lower Rio Grande Valley attracted attention. Iron shipments were quite regular, and ferromanganese ores moved briskly from June until the increase in freight rates put a stop to the business.

The general advance in freight rates has operated most severely against the mining industry of the state. Most low-grade shipments have ceased. An increase in smelter charges, forced by the same conditions, together with a plan for partial settlements on copper ore shipments, balance to be paid when, as and at the prices prevailing at the time of sale, stopped much tonnage that otherwise would have moved. There is an indication that old rates on all low-grade ores will be restored, as it is clearly in evidence that this must be done if the traffic is to move at all. The labor situation has been reasonably satisfactory. Mexican miners are employed to a very large extent.

The Chino Copper Co. continued to be the largest producer of copper in the state in 1920. The output for January was 3,081,937 lb. of crude copper, and output increased steadily to September, when it reached 5,161,000 lb. The total for the year is estimated to be 43,000,000 lb. During November production was cut to approximately 40 per cent, but up to December no change had been made in the general wage scale, although a part of the working force had been laid off.

At Tyrone, the Burro Mountain branch of the Phelps Dodge Corporation built a new 2,000-ton concentrating mill, and carried on development work at a rate of about 10,000 ft. per month. The first 1,000-ton unit of the new mill was started on Aug. 2 and the second unit a few weeks later. The production of crude copper for that month was 92,000 lb., the new mill showing an increased recovery of 10 per cent. The Austin-Amazon was inoperative throughout the year. At Pinos Altos the U. S. Copper Co. lost office and shafthouse by fire. The Calumet-New Mexico operated a sixty-ton mill until the zinc market dropped, but after a limited shutdown milling was resumed on custom ores from the surrounding district. The Cora Miller mine, in the Mangas Valley, west of Tyrone, was reopened after lying idle for many years. Silver

ores in paying quantities were developed and a fifty-ton cyanide mill was built and is in operation.

The total tonnage of ores shipped from the Lordsburg district up to December amounted to 53,620, of an approximate value of \$800,000. On June 1, the Calumet & Arizona Mining Co. took possession of the Eighty-five mine by purchase. The price paid is believed to have been over \$1,000,000. A year previous to June 1, the production had been approximately 7,000 tons monthly. Since that date production has been 4,500 tons per month. These ores, like those of the Bonney and Miser's Chest, are highly siliceous copper sulphides, carrying gold and silver, and are very desirable for fluxing purposes. When taken over, the property was developed to the 750-ft. level. The new owners have carried the work to the 1,050-ft. level and intersected the vein at 950 ft., where it is strong and of excellent grade.

The Bonney mine has done a large amount of successful prospecting outside of its main vein. The Octo mine has operated steadily since June. A large amount of development work has been done and strong veins of low-grade ore have been opened. Buildings have been constructed, and a 500-hp. steam-power plant has been purchased to be installed at an early date at No. 3 shaft, which is in ore. The Miser's Chest mine was taken over by a syndicate of Tyrone and Silver City people, who shipped twelve cars of good copper ore and extended the main shaft to 450 ft. in depth. The Co-operative Mining Co. completed a 50-ton flotation mill and shipped 190 tons of high-grade ores and concentrates. Development work has reached the 200-ft. level. On the Monte Rico property, a number of veins giving good assays in silver-lead have been opened.

The Great Eagle fluorspar mine was operated for about five months by the owners, then leased for four months, and then sold to Michigan capitalists, who are erecting a 200-ton mill, intending to turn out an acid-grade product. Production up to November was 1,500 tons. A number of other fluorspar prospects have been opened in this vicinity, but none of them has as yet produced commercially.

At Hanover, the Empire Zinc Co. worked practically its full force through the year. In May, the company bought the Republic mine for \$500,000 cash. The Hanover-Bessemer, notwithstanding the increase in freight rates, maintained steady shipments of iron ore to the Colorado Fuel & Iron Co. The new mill of the Grant County Copper Co. continued to turn out a good grade of zinc concentrates. The Mogollon Mines Co. operated both mine and mill full time throughout 1920. The mill output was increased, new orebodies were opened and a substantial addition was made to the ore reserves of the company. Through good management a satisfactory working force has been built up.

South Dakota

BY OTTO ELLERMAN
State Mine Inspector, Lead, S. D.

THE production of gold in South Dakota for 1920 will be somewhat less than \$5,000,000, or about the same as for 1919. The high cost of supplies and the scarcity of labor were responsible for the low yield during the last two years. Only two gold producers operated in the Black Hills in 1920. The labor situation was greatly relieved in the last two months

of the year, and in a short time the producers will be operating all their departments at full capacity. Continued high costs will prevent numerous small concerns from resuming work. The year 1921 will show an increase in the precious-metal output, but the normal pre-war production cannot be looked for yet.

The Homestake continued active, with 840 stamps dropping for the greater part of 1920. The company's plant at Terraville was placed in operation on Dec. 2, and 920 stamps are now being used. The remaining 100 stamps will be utilized early in 1921, and the production for this year will be nearly normal.

The Trojan was active during 1920, and in addition to the regular production, the sinking of the new shaft was continued. This had reached a depth of nearly 300 ft. when work was temporarily suspended on Dec. 1. The gold production from the mine will show a decrease during the year as compared with 1919. The Cutting continued the sinking of its main shaft to a depth of 500 ft. Laterals were driven at several levels, but all work was stopped in October, owing to the large amount of water encountered. New pumps are being installed, and the further development of the property will be started soon after the first of 1921. In the Carbonate district, the Elder tunnel was completed and tapped the old Iron Hill workings at a distance of 1,385 ft. The mine was unwatered through this drainage tunnel, and some development work is now being done.

The Ofer property at Lead was merged with the property of the Reliance company during 1920 and that of the old Dakota company. The Reliance cyanide plant will be enlarged and the railroad will be extended to the property. The combined properties contain a large acreage of mineral ground in the Bald Mountain district and extensive work will be started in 1921 under the name of the Ofer company.

The Echo, at Maitland, did some development work, but operations were suspended early in 1920. The New Silver Queen, at Galena, made shipments of lead-silver ores, and late in the year completed the installation of electric equipment, which will greatly increase the production from this property. The Golden Crest was sold to James Hardin, of Deadwood, and associates, and work has been started to place the mine in condition for regular production. The Anaconda company has erected buildings for employees, and mine work will be started soon.

The National Tin Corporation continued the development of its properties near Hill City. The concentrator was placed in operation during the summer, but operated only for a short time. All work was suspended early in the fall. The First National Co. took over the Golden Summit mine, near Hill City, under bond and option, but did only a few months' development work. The Maywood Chemical Co., at Keystone, made regular shipments of lithia ore during the summer months. Shipments of gypsum products were made by the U. S. Gypsum Co., at Piedmont, and the Dakota Plaster Co., at Blackhawk, and the Refinite Co., at Ardmore, made an increased production of water softener. Small amounts of mica, tungsten, and placer gold were recovered by individuals, but the quantity was negligible. One oil well at a depth of 700 ft. was brought in early in December on the Slocum lease, two miles southwest from Edgemont. In this and other districts test wells are being drilled.

Oregon

BY HENRY M. PARKS

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THE most distinctive single feature of the mining industry in Oregon for 1920 was the development of iron ore both in important quantity and of good quality in Columbia County. The ores, as far as developed, are all limonites, the larger part of them analyzing 50 per cent or better in iron (dry analysis). They are very low in sulphur and carry but 0.3 to 0.5 per cent of phosphorus.

The Oregon mining industry was, in common with that of most mining states, hampered in 1920 by conditions caused by the war. The shortage of labor was greater in mining than in other industries. In addition, the gold producer could purchase less labor and supplies for his gold than before the war. In most operations it has cost more than \$20.67 to produce an ounce of gold, so that operations were conducted at an actual loss at the majority of gold mines. The great increase in the cost of supplies, made still greater by the two raises in freight and express rates, added materially to mining and milling costs. The high freight rates have added to the cost of marketing concentrates and to smelter rates, and consequently reduced the net smelter returns to a marked extent.

Notwithstanding decidedly adverse conditions, a considerable amount of new work was done in 1920. The Waldo Corporation, operating the Logan hydraulic placer mine, at Waldo, Ore., completed its 1,650-ft. tunnel. This tunnel obviates the necessity of hydraulic elevators. The gravel is now flumed through the tunnel. The water formerly required by the hydraulic elevators is used in washing the gravel, thus increasing the output and efficiency of the plant. The Old Channel Mine, another well-known placer mine, which had been idle for some years, now has a force of men working on the property under the management of J. R. Harvey. Renewed activity is reported at the Almeda copper mine, at the Sylvanite gold-tungsten mine, and at a few other properties in southern Oregon.

In eastern Oregon extensive development work is being done on the properties of the Cornucopia Mines Co. at Cornucopia. The two cyanide mills are being operated twelve hours daily. The E. & E. mine, at Bourne, which completed a twenty-stamp mill and flotation concentrating plant last spring, is in operation, with John Arthur as manager. The Ben Harrison mine completed its flotation plant and operated one shift daily during the summer months of 1920, but closed down in October because of labor conditions and high operating costs. The manager, W. C. Fellows, stated that when normal conditions return full scale operations would begin.

The Empire Dredging Co., at John Day, was operated steadily throughout 1920, and the gold dredges of the Powder River Gold Dredging Co. and the Sumpter Dredging Co. have been operated since May 15, having been idle during the winter of 1919-20, owing to a shortage of electric power caused by the unusually light rainfall the previous year. Several other mines were closed for the same reason, the Eastern Oregon Light & Power Co. having been unable to furnish the necessary power.

The Iron Dyke copper mine, at Homestead, was operated steadily throughout 1920. Development at the

Gem mine, at Susanville, was continued through the year, and additional equipment was placed there last fall, and the owners are now planning on the erection of a mill on the property in 1921. The La Belleview mine partly completed a mill at its property northeast of Granite. The Buffalo mine, which has been shipping silver ore for several years, closed down late last fall, owing largely to troubles within the leasing company operating the mine.

The rapid drop in the price of materials and supplies; the change from a shortage of labor to a surplus; the clearing up of the freight situation with assurances of prompt delivery are decidedly encouraging to the gold miner. The year 1920 was a most difficult one for the mining industry, but operators are confident that there will be a considerable revival in 1921, especially in the development of gold and silver properties.

Washington

BY ERNEST N. PATTY

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THE 1920 mineral production of Washington will total approximately \$20,000,000, with coal, cement, magnesite, metals, and clay products ranking, in the order named, as the major mineral industries.

The total value of the metal-mine production during 1920 will exceed that of 1919 by 30 per cent and almost equal the \$1,500,000 production made during 1918.

Approximately fifty properties shipped ore during 1920, but 80 per cent of the metal production came from eight mines. The copper came principally from the Sunset mine, in the Cascades, and the United Silver-Copper mine, in northeastern Washington. The Electric Point mine, in the Northport district of Stevens County, produced the major portion of the lead. Silver came principally from the United Silver-Copper mine, just mentioned; the Arlington mine, of Okanogan County, and the gold ores from the Republic district. A recent discovery of high-grade zinc carbonate in the Northport district gives an appreciable production of that metal for 1920. The Republic district, in Ferry County, produced most of the gold ore, which it shipped crude to the smelters as a siliceous flux. It is declining rapidly under present gold-mining conditions. Its ultimate rejuvenation is contingent upon the economic solution of cer-

tain metallurgical problems which will make the lower-grade ores commercial, and, of course, on a decided betterment in the gold situation. There are several excellent gold properties in the Mount Baker district of northwestern Washington which will resume operations when the mining of gold again becomes profitable. A gold dredge was put in operation a few months ago in the Swauk Basin of west-central Washington. If this operation proves successful the gold production will be saved from a decided decrease during 1921.

The present metal market discourages the opportunity for an increased copper and lead production during 1921. The copper and lead mines of the state cannot operate profitably under present costs with copper at 13c. and lead around 5c. If such conditions continue most of the major producers will be closed down. The silver production for 1921 will receive a decided increase with the Pittman Act operative. A large part of the 1921 production should come from the Nighthawk and Ruby-Conconully districts of Okanogan County.

This has been a prosperous year for the magnesite industry of Stevens County. Just at the close of 1920, the long-feared importations of Austrian magnesite were appearing in formidable shipments. The domestic producers with their mines in Washington and California and the markets in the eastern United States are so severely handicapped by the costly transcontinental freight haul that they cannot hope to compete on an even basis with magnesite mined in Austria by cheap labor and shipped to this country as ballast. The American Mineral Co. announced the suspension of operations Jan. 1, 1921. Investment in machinery and equipment in Washington magnesite mines exceeds \$2,000,000, and several hundred men are employed.

The copper smelter at Tacoma operated continuously throughout 1920, as also did the lead smelter at Northport. The Bilrowe electric smelter, at Tacoma, operated four electric furnaces throughout the year, and produced approximately ten tons of ferromanganese daily to supply foundries and steel works along the Pacific Coast.

A number of oil companies are drilling on the west coast of the Olympic Peninsula, in the northwest corner of Washington, but so far no oil has been brought in. The Standard Oil Co. has one well down over 1,500 ft., and is starting a second hole.

Joplin-Miami District

BY JESSE A. ZOOK

Correspondent *Engineering and Mining Journal*

SHIPMENT of blende from the zinc-lead mines of Oklahoma, Kansas, and Missouri in 1920 exceeded 500,000 tons, an excess over 1919 of 90,000 tons. Lead increased 16,570 tons, and the value of all ores is over \$10,000,000 greater.

Oklahoma gained 52,280 tons blende and 16,610 tons lead. Kansas gained 49,320 tons blende and 6,760 tons lead. Missouri lost 15,050 tons blende, 1,930 tons calamine, and 1,300 tons lead. The year was wholly unparalleled in production of zinc and lead, and the value returns are the greatest recorded. Oklahoma zinc shipments were lightest during the last half-year, Kansas loaded heaviest in the last half-year, and Missouri slowed down during the last half.

The Oklahoma-Kansas group of mines extends north

and northeast from the point of origin, four miles north of Miami, Okla., the northward trend passing into Kansas north of Picher. The northeast swing of operations has made no alignment of contiguous development, but produced several splendid mines, with intervening undeveloped territory, leading toward the Chanute Spelter Co.'s great Hartley mine in Kansas. The older Oklahoma mines in the vicinity of Lincolnville, nearly due south of the Hartley mine, made some progress during the year. To the northward group in Oklahoma belongs the credit of heaviest lead production, the Barr mine of the Vinegar Hill Co. being the largest lead producer in the Kansas portion of this area.

Discovery a few years ago of a mine of promise west of Waco, Mo., has, with subsequent development, en-

larged the Waco area well across the state line in Kansas, until there are several mines producing zinc blende from an ore level as richly mineralized with zinc as the Picher area, but lean in lead, yielding a splendid zinc for rolled-zinc products. The increase in 1920 of the Waco area was from the Kansas side of the Missouri-Kansas state line, with development on the Missouri side neglected. The older Missouri mines producing blende, aside from Oronogo, are a negligible quantity as regards output and the calamine mines are making a lower record each succeeding year.

TABLE I. SHIPMENTS OF ZINC-BLENDE, CALAMINE AND LEAD CONCENTRATES IN THE JOPLIN DISTRICT, 1920, WITH VALUES

	Blende, Pounds	Calam'ne, Pounds	Lead Concentrates, Pounds	Values
Oklahoma				
Ottawa County	792,688,810		120,117,920	\$25,026,620
Kansas				
Cherokee County	254,126,970		44,028,510	8,154,190
Missouri				
Jasper County	76,523,580	1,790,750	10,830,160	2,357,070
Newton County	2,369,680	16,481,540		371,120
Lawrence County	1,944,030	1,146,900		64,180
Other counties (a)	451,720	243,110		16,030
Missouri totals	81,289,010	19,662,300	10,830,160	\$2,808,400
1920 District totals	1,128,104,790	19,662,300	174,976,590	35,989,210
1919 District totals	937,745,880	23,516,360	141,944,470	25,392,340
Increase	190,358,910		33,032,120	10,596,870
Decrease		3,854,060		

(a) Includes ores brought by Joplin purchasing agencies in Greene, Barry, Ozark, Wright and Howell counties. Two cars each of blende and calamine from Arkansas are not included.

TABLE II. MONTHLY AVERAGE PRICES OF BLENDE, CALAMINE AND LEAD CONCENTRATES IN 1920, IN THE JOPLIN DISTRICT (Per Ton of 2,000 Lb.)

	Blende	Calamine	All Zinc Ores	Slab Zinc (a)	Lead Concentrates	Pig Lead (a)
			Zinc Cents	Zinc Cents		Cents
January	\$53.90	\$31.02	\$53.35	9.265	\$94.39	8.154
February	51.82	36.00	50.69	8.737	85.33	8.533
March	52.15	36.75	51.27	8.691	102.18	9.87
April	51.22	38.20	51.11	8.356	107.09	8.666
May	46.45	37.98	46.34	7.679	105.67	8.381
June	47.04	37.17	46.90	7.834	101.93	8.437
July	43.47	35.59	43.33	7.72	98.85	8.283
August	45.99	38.35	45.64	7.824	101.35	8.686
September	46.55	37.42	45.12	7.763	101.99	8.47
October	44.89	36.93	44.53	7.277	90.05	7.169
November	44.66	38.13	44.52	6.448	84.67	6.373
December	36.00	30.00	35.00		70.00	
Year	\$47.01	\$36.16	\$46.49		\$95.71	

() Monthly averages drawn from weekly averages of daily quotations in the Engineering and Mining Journal.

TABLE III. ORE PRICES IN THE JOPLIN DISTRICT FOR TWELVE YEARS (Per Ton of 2,000 Lb.)

	Zinc Ores		Lead Ores	
	High	Average	High	Average
1909	\$55.00	\$41.08	\$60.50	\$54.56
1910	52.00	40.42	58.00	51.98
1911	51.00	39.90	64.00	56.76
1912	67.00	53.33	68.00	56.60
1913	59.00	42.26	58.00	52.52
1914	54.00	40.46	54.50	46.55
1915	138.90	79.30	80.00	55.08
1916	131.70	84.72	104.84	84.07
1917	101.95	67.70	135.50	98.00
1918	78.70	51.33	106.00	88.98
1919	57.60	43.08	89.00	66.43
1920	61.50	46.49	112.50	95.71

The large reserve stock in the bins at the end of 1919, from lack of transportation-facilities, was carried on advance buying throughout three-fourths of 1920, as shippers could obtain few cars except on a showing of tonnage purchased. Box cars were unobtainable, and shipments were made in cattle and coal cars. Following the initiation of increased freight rates, cars began arriving, until at the close of November a mile of empty cars were reported on side tracks in the three mining counties.

Prices—Prime Western grades of zinc blende opened 1920 at \$57.50@55, holding through January, closing February at \$52.50, March at \$47.50, then opening April at \$50 and closing at \$45, the price varying from \$45

down to \$42.50, until the end of June, when \$45 was resumed, up to \$47.50 through July and August, receding to \$45 the end of September, and from here declining to \$30 with the advent of December. Premium grades generally were \$1 higher and fines \$2.50 and slimes \$5 lower all of the year.

Zinc calamine established a new record, the strong demand bringing a price level far above a generally conceded parity with blende. Only by maintaining a high basis was there a possibility of continuing production sufficient to meet the unusual strength of demand. The basis price was \$35 and \$36 ten months, showing the first weakness in November, receding to no demand at the year end.

Lead advanced from \$92.50 at the opening of 1920 to \$110 basis in April, fluctuating around \$100 to \$110, until at the end of August purchases were made on \$112.50 basis. Then the price dropped to \$80 at the end of September, to \$65 at the end of October, to \$55 at the end of November, and the metal was weak in demand in December, on \$50 basis. Settlements were made on \$110 basis, for ore contracted in August, up to December.

Average prices for both zinc and lead ore appeared disproportionate to basis prices during October and November, as the averages were derived from settlements on contract ores. Zinc blende was \$27.50 per ton lower at the close than at the opening of 1920, and lead receded \$62.50 per ton from the high level in August.

Southeast Missouri Lead District

BY H. A. WHEELER
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THE pig-lead output of the Southeastern or disseminated lead belt in 1920 was about 158,000 tons (December production estimated). This is about 3 per cent greater than 1919, but is about 20 per cent below the record year of 1917, when lead reached the peak price of 12c., as the result of war conditions. Had there not been a continuous shortage of labor throughout 1920, the output would have been considerably larger, despite decreased efficiency.

The year 1920 was marked by violent changes in the lead market. Labor was paid the maximum war rates throughout the year, but beginning Jan. 1, 1921, a reduction of 20 per cent was made where the wage exceeded \$4 per day and 9 per cent upon less than \$4, with a minimum of \$3. In the Joplin district, which experienced low prices for zinc ore, a horizontal reduction of \$1 per day has been made recently.

Several shafts and two mills have been shut down in St. Francois County, which produced almost the entire output in 1920. The Missouri Cobalt Co., in Madison County, closed its plant in October. A small amount of lead is produced by this company as a by-product from four to five tons of copper and about three tons of nickel and cobalt products per day from the former North American property at Fredericktown. The St. Joe company found a new orebody two miles west of Leadwood, and is sinking a new shaft on the old Donnelly tract in Flat River. It is also erecting an additional electric power plant at Rivermines, which will enable the entire property to be oper-

ated by electricity. Its Crawley, or No. 8, shaft will connect underground with the 6,000-ton mill of the former Doe Run plant, thus supplying this mill entirely through mine haulage and doing away with surface transportation over the M. R. & B. T. R.R. The old Mine la Motte property, in Madison County, remains closed down through litigation, and no lead is being produced in the county. The Picher Lead Co. has optioned the Schulte tract, near Fredericktown, and is doing additional diamond drilling. The Einstein tungsten property, on the St. Francois River, remains closed, but some prospecting for tungsten in the granite is being carried on in the neighborhood. In the neighboring counties of Washington, Franklin, and Jefferson only small amounts of lead were produced from shallow "diggings" in 1920, with no attempt to prospect for the deep disseminated lead.

Zinc in Wisconsin

BY J. E. KENNEDY

Correspondent *Engineering and Mining Journal*

THE tonnage of zinc ore shipped in 1920 from the Wisconsin district decreased 35 per cent from that of 1919, as shown in the table. The gross tonnage of zinc ore shipped from mines to smelters without and to separating plants within the district decreased 25 per cent.

Ore Prices—Market conditions were unstable throughout 1920. The margin between premium and Prime Western grades of blende, both bought on a basis of 60 per cent zinc, was practically eliminated. Buyers of the higher grade, formerly well represented in purchases, made little or no effort to buy. A larger percentage of the tonnage was sold under contracts, and weekly open-market quotations were not always obtainable. The base price for January was \$60 to \$61 per ton, and this was the highest level attained throughout the year, the average base approximating \$50, with the year-end price at \$40 and lower.

WISCONSIN ZINC ORE SHIPMENTS
(In Short Tons)

	Net to Smelters		Gross from Mines	
	1919	1920	1919	1920
Highland.....	8,112	2,551 ^(a)	8,112	2,551 ^(a)
Lunden.....	56	50	865	1,869
Miffhin.....	89	316	20,874	29,405
Mineral Point.....	29,097	25,592		
Platteville.....	1,859	1,887	1,993	1,887
Dodgeville.....			190	
Cuba City.....	24,581	18,289	6,887	11,278
Benton-New Diggings.....	33,439	14,372	82,516	50,501
Hazel Green.....	80		9,836	4,467
Shullsburg.....	2,742		8,585	3,024
Galena, Ill.....	80		24,873	17,966
Totals 1919 and 1920.....	100,135	63,057 ^(t)	164,731	122,948 ^(b)
1918.....	120,854		189,058	
1917.....	148,766		247,993	
1916.....	133,035		219,118	
1915.....	104,670		163,916	
1914.....	84,836		134,362	
1913.....	76,017		105,887	
1912.....	99,409		119,280	

(a) Crude unmilled carbonate. (b) Totals to Dec. 11, 1920.

A total of thirty-two concentrating mills and five separating plants operated at various times during 1920, as against forty-two mills and five separating plants in 1919. High labor and material costs stimulated effort toward increased efficiency. The U. S. Bureau of Mines established a substation at the Wisconsin State Mining School, at Platteville, to carry on research and experimental work. A change in milling practice initiated in 1920 by D. I. Hayes, of the Wisconsin Zinc Co., reduced tailings losses. Little new construction and development work was undertaken. The Vinegar Hill

Zinc Co. completed its mill on the Fields-Meloy property. The Wisconsin Zinc Co. moved one of its milling plants to the east end of the Champion tract, where it utilized the Blackstone shaft. The Connecting Link Co. completed its No. 1 mill. A Chicago company was sinking a shaft and completing a mill on the Nightingale lease at Benton at the year end. The Mineral Point Zinc Co. wrecked its last mill at Highland, which fact indicates the apparent depletion of practically the only remaining zinc carbonate deposits of this district. The National Zinc Ore Separating Co. purchased and completed the Government's partly finished acid plant at Cuba City, making a high-grade sulphuric acid.

Tennessee

BY WILBUR A. NELSON

State Geologist of Tennessee, Nashville, Tenn.

THE year 1920 in Tennessee was a remarkable one in the mining industry. Starting out with all mines working at full capacity, and with an excess of advance orders and upward revision of wages, the year ended with many mines working part time and others shut down, and substantial cuts in wages have been made in some of the districts.

Phosphate Mining.—In the phosphate district of middle Tennessee, new plants have been constructed at Wales by the International Agricultural Corporation, with a capacity of 300 tons per day of brown rock; at Toomey, by Armour & Co., for mining, crushing, and drying blue rock (capacity 100 tons per ten hours); and by the Tennessee-Illinois Fertilizer Co., which has erected a 100-ton plant for grinding brown rock. Methods have been improved by the introduction of settling devices such as Dorr thickeners and Allen cones for the saving of fine sands formerly wasted. There have been no strikes in the district. A 50 per cent reduction per day in all wages went into effect in the Centreville district on Nov. 1. In the other districts there were no changes, except that the efficiency of labor about doubled. Little rock is being stored by producers.

Iron Mining.—All the iron furnaces and ore mines were operated at full capacity for the first nine months in the year. In the last part of 1920 the pig-iron market dwindled so that all the furnaces in the state shut down temporarily.

Copper Mining.—The copper industry at Ducktown was limited in the last part of the year, and the company put into effect wage reductions of 10 per cent, as well as reducing the number of men employed.

Clay.—The ball clay mines in west Tennessee operated continuously during 1920. During the first ten months of the year there was a 50 per cent labor shortage, but this has disappeared. There have been no strikes and no reductions of wages. The large producers have improved their operations by adding new equipment and machinery and additional steam shovels. The Mandle Clay Mining Co., of Whitlock, Tenn., is building a forty-ton plant for the reduction and preparation of clays. Small stocks of the different grades of ball clay are on hand for winter use.

Petroleum.—Small oil production was obtained in 1920 from three counties, Scott, Sumner, and Pickett. The Scott County field is situated around the town of Glenmary, where oil is obtained from the St. Louis limestone at a depth from 1,200 to 1,300 ft. The few producing

wells in this area have a capacity of about ten barrels each. In Sumner County four wells are producing on the Miller farm, 1½ miles northwest of Sugar Grove. Oil is found at about 300 ft. This is an extension of the Allen County, Ky., field. There is considerable wildcatting in this section. In Pickett County one small well on the Parris farm, near the mouth of Eagle Creek, on Obey River, has produced oil at a depth of 247 ft. Much wildcatting is now going on in this region, and several good structures are being drilled. Additional wildcatting is going on in nearly every county on the middle Tennessee Highland Rim.

Illinois

BY L. A. MYLIUS
Geologist, Urbana, Ill.

EXCLUDING coal, raw mineral products in Illinois, in their order of commercial value as closely as it can be estimated were in 1920: Petroleum, sand and gravel, limestone, fluorspar, lead and zinc, clay, quartz, and tripoli. Petroleum, with an approximate value of \$41,500,000 in 1920, has nearly four times the total value of all the other raw products.

Petroleum—Oil production in 1920 will total approximately 10,750,000 bbl., about 12 per cent less than the production in 1919, and but one-third of the annual production in the years from 1908 to 1912 inclusive. The price of oil reached \$3.77 per barrel in April, and held that price to the end of the year. The average price of Illinois oil in 1919 was \$2.50 per barrel and in 1920 was \$3.66 per barrel. This increase of 45 per cent over 1919 prices gives a gross value for Illinois oil of \$40,300,000. The value of gasoline extracted from natural gas was approximately \$1,300,000. The total value for 1920, \$41,600,000, is \$10,000,000 in excess of any previous year's production.

The increased value of petroleum stimulated somewhat prospecting for new production. Approximately 381 holes were completed during 1920, of which 110, or 30 per cent, were dry. Of these completions 350 were in Clark, Crawford, Cumberland, and Lawrence counties; sixteen were in eastern Illinois north of Clark County; and fifteen in the remaining parts of the state.

The profitable horizon in the Trenton and its possibilities attracted attention during the year. Six producing wells and two dry holes were drilled in the Trenton in Parker Township, Clark County; four dry holes were drilled to this sand over an area of 120 square miles north of Clark County; and one test southwest of Robinson, Crawford County, was dry. Several small wells were brought in near Borton, Edgar County, in shallow Pennsylvanian sands, and wells to the "Corniferous" in Coles County gave encouraging "shows" of oil, but no production. At Waterloo, Monroe County, the doming has proved productive, but its commercial importance has not been ascertained. East of Gillespie, Macoupin County, a Pennsylvanian pay horizon was discovered at slightly over 600 ft., and five wells were completed.

Sand and Gravel—The increase of road work during 1920 strengthened the demand for this material. With improved conditions, the outlook is good.

Limestone—The limestone quarries should show an increased production over 1919, and several plants are being enlarged. Road making and other demands are strengthening this industry. As the capacity of the

quarries is at least 7,000,000 tons per year, and as the car shortage and labor conditions have already improved, the outlook is favorable, and a considerable increase in production is expected.

Fluorspar—The production of fluorspar in 1920 will probably show an increase over 1919, due in part to the depletion of stocks held by the steel companies when the armistice was signed. The price obtained for gravel spar, the principal product, was about \$4 per ton lower than in 1919. The prices obtained for ground spar and acid lump were in excess of 1919 prices. At present, the market is dull, but prices seem firm. Most of the small mines are shut down. The large producers are working at about capacity. Preparations are under way to open a new mine of considerable size, and 1921 should see the opening of a mill to treat ores of high zinc content.

Lead and Zinc—The production of lead and zinc in Illinois shows a decrease in 1920. The average price of the lead concentrate throughout 1920 was considerably in excess of the 1919 quotation, but the price of zinc concentrate was about \$1 less for the first eleven months of 1920 than in 1919. In November and December the depression in prices became acute. Only two mines of any size are operating in Illinois. No new activity is expected before the summer of 1921.

Arkansas

BY JIM G. FERGUSON
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INDUSTRIAL conditions following the war had a depressing effect upon mining in Arkansas in 1920, but in coal and bauxite this depression was only temporary. Coal production has again reached normal, and the bauxite output for 1920 promises a substantial increase. In the mining of zinc, lead, and manganese there has been a decided slump, from which it is feared a return to former prosperity will not take place until there has been advance in prices.

Should the recent rate of production of bauxite be maintained, the total production of Arkansas by the American Bauxite Co., the Republic Mining & Manufacturing Co., the Globe Bauxite Co., and one or two small, independent producers will be approximately 500,000 long tons for 1920.

Arkansas produces 90 per cent of the bauxite mined in the United States. In 1919, all of the bauxite used in the United States in the manufacture of aluminum came from Arkansas, as did 28,981 long tons used in the chemical industries, 31,180 long tons applied in the manufacture of abrasives and 1,059 long tons consumed by the makers of refractories.

On account of the initiation of a \$100,000,000 road-building program in Arkansas, an unusual impetus has been given to the crushed-rock industry. The largest plants in the state, situated near Little Rock, have had an unprecedented year. Clay production for the manufacture of brick, tile, and pottery was about normal in 1920. The future outlook for this industry is encouraging, as it is also for the production of building stone, marble, and granite, large deposits of which are found in Arkansas. The production of antimony, slate, and whetstones was nominal in 1920.

More capital was invested in Arkansas during 1920 in oil and gas development than in all other mining activities combined. It is estimated that 100 prospect

wells have been drilled or are in process of being drilled in the state. In the proved natural-gas district contiguous to Fort Smith, the daily production has been increased to 240,000,000 cu.ft. One well has a record of 24,000,000 cu.ft. per day, and is rated one of the largest gas wells in the United States. The present production is in excess of the immediate needs of the cities and industries dependent upon natural gas for fuel, but is estimated to be only about 10 per cent of the capacity of this field. What may prove to be a new gas field, situated in south-central Arkansas, was discovered during the summer of 1920 while drilling for oil on the Constantin leases, near El Dorado. A considerable production of natural gas was developed, and is now being piped to El Dorado for consumption. Other wells are being drilled in the vicinity, and the extent and character of the field will probably be determined.

During 1920 Arkansas made its first commercial production of petroleum, from the Hunter well, near Stephens, in Ouachita County. The output of this well is only ten barrels per day, but it has demonstrated that south Arkansas has oil and has stimulated development in that district.

Recently, some of the large oil development companies formed a million-dollar syndicate for a thorough and systematic exploration of the area favorable for oil production in Arkansas and obtained the technical services of Dr. John C. Branner, former State Geologist of Arkansas and later president of the Leland Stanford Junior University in California.

Kansas

BY RAYMOND C. MOORE
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THE mineral resources of economic importance in Kansas are: Petroleum, natural gas, coal, lead, zinc, cement, salt, gypsum, sand, gravel, limestone, sandstone, clays, and pumice. Of these, petroleum is of greatest importance, both for the total value of the yearly production and the interest which attends prospecting for new fields. Including estimates for the month of December, the total value of the mineral products for 1920 will amount to nearly \$170,000,000, exceeding considerably the figure for 1918, \$158,684,000.

With estimates for December, 3,075 wells have been drilled in Kansas during the last year, of which 2,250 have yielded petroleum in commercial quantities. The total production is estimated at 33,920,000 bbl., of a total value of \$118,720,000. The largest oil-producing fields are in the south-central part of the state, in Butler and Marion counties, where the El Dorado and Augusta districts continue to furnish a large proportion of the oil from the state. The development in 1919 which resulted in the important Peabody and Elbing production north of the El Dorado field was extended in 1920 northeastward to the vicinity of Florence. The Covert-Sellers, Florence, and Urschel pools contain good producers, and, on account of their geological situation with reference to the well-known buried granite in central Kansas, are of unusual interest. It is probable that other pools will be found under geological conditions similar to those of the new 1920 fields of Marion County. Shallow field production in the southeast part of the state has been large, the most important new production being obtained in Elk, Chautauqua, and Linn counties.

Natural-gas production declined somewhat in 1920, but there was an increase of more than 100 per cent in the number of natural-gas gasoline plants within the state. Total value is estimated at \$6,000,000.

Operations in the lead and zinc district in the southeastern part of Kansas were active, especially considering the difficult conditions arising from the low prices offered for zinc concentrates.

A mine at the northwest edge of the Picher-Treece extension is working good ore at a depth of 285-320 ft., the deepest in this part of the district. New discoveries of deep ore at Galena indicate possible development in this area. In the Kansas portion of the Waco-Lawton district, and in the Badger-Crestline area, new mills have been built, and with higher prices there will be extensive operations. At Waco, ore has been found to a depth of 419 ft. with a continuous face of ore more than 300 ft. in thickness. The estimated value of lead and zinc marketed from Kansas in 1920 is \$9,100,000.

Oklahoma

BY C. W. SHANNON

Director Oklahoma Geological Survey, Norman, Okla.

AMARKED activity in the development of the principal mineral resources of Oklahoma was shown in 1920. Petroleum stands at the head of the list with 103,087,400 bbl., an increase of 14,127,800 bbl. over 1919, and a value for 1920 of \$347,355,400, an increase of \$190,842,500 over 1919. During 1920 there were approximately 9,100 completions of wells, of which about 75 per cent were productive of either oil or gas.

Drilling for oil and gas has been done or is now being carried on in every county in Oklahoma, and thirty-six of the seventy-seven counties of the state are to be classed as oil and gas producers. At present 30,000 wells in the state are producing either oil or gas or both. The Hewitt field, in Carter County; the Empire pool, in Stephens County; the Beggs pool, in Creek and Okmulgee counties; the Deaner pool, in the northeastern corner of Okfuskee County, and a few other immediate areas, such as Osage County, are responsible for the increased production. Other important pools showed active development, and a large number of wells throughout the various centers of activity, with initial productions from 500 to 15,000 bbl., were brought in. Numerous wildcat wells were drilled, but the percentage completed and showing production of either oil or gas will be lower than that for 1919, in which year 60 per cent of the wildcats proved productive.

The oil and gas producing area of Oklahoma, according to the new map which has just been completed by the Oklahoma Geological Survey, is divided into 170 pools, each of which bears a specific name. Among the miscellaneous wells drilled and the wildcat wells, several are deep tests, and among these in the western part of the state are two or three wells at depths of approximately 3,000 ft. which were drilled into granite and abandoned, thus discouraging development in that section of the state, although the surface structures are favorable. From a geological standpoint the wells in the Beggs district being drilled to the Wilcox sand are of much interest, as this production is known to come from rocks older than those of Mississippian age. The proving of production below the Mississippian has created considerable interest in the re-drilling and

deeper drilling of considerable areas in the older oil fields of the state.

The amount of commercial gas produced in Oklahoma in 1920 was in excess of 70,000,000,000 cu.ft., having a value at the well of \$10,500,000. The use of gas for manufacturing and smelting purposes is being largely curtailed, that the supply for domestic use may be bettered.

The lead and zinc district of northeastern Oklahoma has been one of the most active of the lead and zinc regions of the country, and though prices have fluctuated and at times have been too low to give an incentive to development, the production for 1920 shows a good total. More than 100 mines and mills are operating in the district. The total zinc shipped during 1920 was approximately 6,275,560,500 lb., with a total value of \$17,350,000. The total lead shipped was 130,950,500 lb., with a total value of \$7,250,500. The total value of lead and zinc for 1920 was in excess of \$24,500,500.

The total mineral resources of Oklahoma for 1920 will have a value of approximately \$400,000,000 as compared with \$260,000,000 in 1919.

Interest was considerably revived in the clay and shale resources of the state, and asphalt, of which there is an enormous supply, has been investigated to a large extent, and development of some of the deposits is now under way. Other mineral resources such as glass sand, portland cement materials, gypsum, and building stone received as much attention during 1920 as general conditions warranted.

Minnesota

BY D. E. A. CHARLTON

Managing Editor *Engineering and Mining Journal*

THERE were several interesting developments on the Mesabi Range during 1920, all of which exerted considerable influence on the increase shown in the iron-ore shipments as compared with those of the year previous. The trend toward the use of heavier machinery in the open pits and the increasing use of mechanical devices were particularly noticeable. Among the former may be mentioned the following: Spreaders for use on the stripping dumps, electrically operated 300-ton shovels; 30-cu.yd. stripping cars; small revolving shovels, supplied with caterpillar propelling gear; 100-lb. rails and 75-ton ore cars in place of the 50-ton cars which have been used for some time. Underground, the use of ore loaders and small hoists with slushers has increased. A development of interest at some of the mines where top-slicing is done is the substitution of wire fencing for the cull lumber formerly used in boarding up the stopes.

State legislation is particularly absorbing to the iron-ore operator in Minnesota, and the events of 1920, as concerning attempts to "put across" a tonnage tax, indicate that the result appears inevitable, as Governor-elect J. A. O. Preus was elected on a platform favoring the enactment of a "just and equitable" tonnage tax on iron ore. Two bills have been prepared for introduction at the coming session of the Legislature at the suggestion of the Minnesota Tax Reform Association; one taxing royalties, and the other taxing "unearned profits" on iron ore shipped out of the state.

Three new washing plants were erected during 1920. The Cleveland-Cliffs Iron Co. placed its Hill-Trumbull plant at Calumet in operation in August, the Bove-

Burke Co. has completed a 1,000-ton washer at its Mariska mine, at Gilbert, and the Interstate Iron Co. recently began the operation of its plant at the Hill-Annex mine near Calumet. At the Warren mine, near Hibbing, the Tod-Stambaugh interests completed a crushing plant which has a capacity of 1,400 tons in ten hours.

Among the new properties opened on the Mesabi are the Boeing mine of the Cleveland-Cliffs Iron Co. and the Sergeant mine of the Wisconsin Steel Co. Considerable stripping was done at both of these properties, the former being handled under contract by the Winston Dear Co. Stripping was also in progress at the Scranton, Sweeney, and Webb mines, at Hibbing, and at the Bovey-Judd, at Bovey.

The development of greatest interest in the entire Lake Superior district is the work being done by the Mesabi Iron Co. at Babbitt, on the eastern end of the Mesabi Range. Within another year high-grade iron ore from the company's plant should be going forward to the furnaces, and there seems to be little doubt in the minds of Lake Superior operators that the plans of the company for the concentration of finely disseminated low-grade magnetite ores will be carried out successfully. The success of this enterprise has caused no little speculation and some experimentation in the direction of developing processes which will make possible the utilization of siliceous low-grade hematite ores which are not now marketable.

Little exploration was done on the Cuyuna Range, and this condition may be said to be generally true of the other Minnesota districts. It is worthy of mention that the attitude of the tax commissions, in both Minnesota and Michigan, in valuing—at such rates that the ordinary explorer cannot afford to hold it—all reserve mineral that has been discovered has been somewhat detrimental to prospecting. Although less than half of the mines which were developed on the Cuyuna were operated during 1920 the production increased over that in 1919 and was slightly less than in 1918.

The only new development was at the Maroco mine of the Marquette Ore Co., where a shaft was sunk, a washing plant built, and stripping was started. The Portsmouth mine of the Gordon Mining Co. entered the shipping list for the first time, although this property was stripped in 1918-19. Shafts were sunk to deeper levels on the Armour No. 2 of the Inland Steel Co., the Meacham mine of the Rogers Brown Ore Co., the Bonnie Bell mine of the Liberty Mining Co., and the Ironton mine of the American Manganese Manufacturing Co.

The underground mines in the manganiferous ore belt to the north of Ironton and Crosby were uniformly closed in 1920, with the exception of the Merritt mine, which opened up for a while during the summer. All of the stockpiles of manganiferous ore were shipped during the year, and a considerable tonnage of manganiferous ore was produced by the three open pits operating on this grade of ore, viz., the Portsmouth, Sagamore, and the Mahnomen.

Approximately 950,000 tons was shipped in 1920 from the Vermilion Range, which occupied a less spectacular position than either of the other two Minnesota ranges. One property change of note was the transfer of the Enith mine, which has been operated for a number of years by the Oliver Iron Mining Co., to the Pickands, Mather & Co. interests. It is reported that the Phoenix Mining Co. has given up the lease to the property obtained from Thomas Walsh at Mud Creek.

Alabama Iron Mining

By Y. A. DYER

Mining Engineer, Birmingham, Ala.

NOTWITHSTANDING the fact that since Nov. 1 1920, several blast furnaces in Alabama were blown out for the purpose of making needed repairs—with the accrued advantage of curtailed output to offset, in a measure, the contraction in demand for "spot" iron and requests for "hold-up shipments"—iron-ore production of the state for 1920 reached approximately 6,398,000 tons. Production figures distributed as to kinds of ore mined and relative production percentages are given in Table I.

TABLE I. KINDS AND RELATIVE PRODUCTION OF IRON ORES IN ALABAMA IN 1920

	Tons	Per Cent
Red Mountain, self-fluxing red-ore groups.....	4,750,000	74.25
Red Mountain, non-self-fluxing red-ore groups.....	440,000	6.88
Gadsden-Attalla semi-self-fluxing red-ore groups.....	290,000	4.53
Woodstock-Champion brown-ore groups.....	590,000	14.34
Appalachian range brown-ore groups.....	153,000	
Russellville brown-ore groups.....	175,000	
	6,398,000	100.00

It is a notable fact that the entire self-fluxing iron-ore tonnage was mined from territorial workings approximating an area of six square miles along the crest of Red Mountain, starting at a point about five miles southwest from the center of the city of Birmingham, and located within the minimum raw-material freight-rate zone of twenty-five miles. It is also a fact that one large company mined, at its three divisions on the mountain, 57 to 60 per cent of the total self-fluxing ore tonnage for 1920.

The twin-slope "Shannon" red-ore mine of the Gulf States Steel Co., in Shades Valley, about 14,000 ft. southeast of the portal of No. 7 "Fossil" outcrop mine of the Tennessee Coal, Iron & Railroad Co., has been entirely concreted from the surface to the depth of the ore, a distance of 2,600 ft. A small amount of ore, which was mined and removed from the mine to accommodate the erection of a depressed inside skip bin, has been shipped to the blast furnace, at Alabama City. Considerable "heading" and "neck-work" has been done, thereby supplying additional ore for shipment to the furnace. Total shipments in 1920 were negligible.

The mine is reached and served by the main line of the Louisville & Nashville R.R., which enters Shades Valley by way of Graces Gap through Red Mountain and parallels it for a distance of five miles to a point where it emerges into the Cahaba Valley by way of Brocks Gap through Shades Mountain. The Shannon slope was opened by the Gulf States company on the showing made by a single diamond-drill core obtained at a depth of 1,900 ft., which revealed 9 ft. 6 in. of the upper bench Big Seam ore, analyzing 39.54 metallic iron, 14.10 calcium oxide, and 13.14 per cent insolubles. Since that time an additional drill hole was put down about 1,800 ft. to the southeast of the slope. At this point there was a net difference of about 475 ft. in the depth of hole over the original one, and the ore analysis practically checked that of the first, or original ore log. The ore at the foot of the slope dips between 16 and 17 deg., compared with 25 to 30 deg. at the outcrop.

Machinery for the 13 x 22 x 1,400-ft. five-compartment steel and concrete shaft of the Woodward Iron Co., approximately 8,000 ft. southeast from the outcrop at Muscoda division mines, has been ordered for installa-

tion. This mine is reached by a spur leading from the main line of the Atlanta, Birmingham & Atlantic R.R. which parallels considerable accessible territory between the crest of Red Mountain and Shades Valley by way of Readers Gap through Red Mountain, and emerges into Cahaba Valley by way of Brocks Gap through Shades Mountain. Three diamond-drill holes were put down on the section of land on which this shaft is situated, showing following average thickness of upper bench Big Seam and ore analysis: Thickness, 9 ft. 2 in.; iron, 35.66 per cent; insolubles, 13.72 per cent; lime, 17.44.

The sinking of the shaft has marked the introduction of the vertical shaft-mining method in the Birmingham district, which will make possible the winning of millions of tons of high-grade self-fluxing red ore underlying the various strata of Red Mountain, Shades Valley, Shades Mountain and extending far into the Cahaba Valley. The tonnage of self-fluxing ore conservatively estimated by the engineers of the district to be fairly well proved by prospects, and which can be economically won by shaft exploitation, is approximately 1,000,000,000 tons.

During the year 1920 there was a persistent tendency on the part of certain iron-producing companies in the district to prospect in the self-fluxing and non-self-fluxing ore areas of the Birmingham district for reserve ore tonnages. Probably the most persistent efforts were made in the non-self-fluxing areas, due to the fact that practically all desirable ore acreage within the so-called 35,000-acre, or fifty-four square mile, self-fluxing area has been acquired and is now the property of strong companies. At present, diamond-drilling operations are in progress at points east of Graces Gap and as far as Irondale. Between Irondale, or Gate City, and Morrows Gap, the present northeastern extremity of Red Mountain ore operations, numerous drill holes have been put down in the valley southeast of the outcrop. No developments, as to improvement in quality of ore over outcrop ore, have been reported thus far. In many instances the cores have shown very siliceous ore.

Brown-ore operations for 1920 recorded considerable improvement over recent previous years, due to the fact that several furnace stacks in the Gadsden-Anniston-Talladega district were put in blast. One new ore mine in the Rock Run district has been opened and is producing a very high-grade low-phosphorus high-manganese ore.

Considerable interest is being manifested in a virgin deposit in the Blue Mountain section east of Anniston, Ala. Prospecting work is also being carried on in the Alpine section west of Talladega, Ala., and prospects are exceedingly fair for the discovery of an excellent deposit. Much interest has naturally centered in brown-ore operations, due to the fact that with the approach of normal conditions in the pig-iron market it is expected that the foundrymen, in general, will become more insistent in their demands for a uniformly high-grade pig iron of rigid specification. The furnacemen realize that such conditions can be best met by the manipulation of brown-ore mixtures. As a consequence a consistent supply of such ores is assured a ready market.

New York

EDITORIAL CORRESPONDENCE

MINING operations in New York in 1920 were normal, labor conditions in general being fair. Witherbee, Sherman & Co., continued the largest producer of iron ore, with 950,000 tons. Other operations included those of the Port Henry Iron Ore Co., the Chateaugay Iron & Ore Co., the Fort Montgomery Iron Co., the Ramapo Ore Co., as well as those at the Clinton Hematite mines. The Nipissing Mining Co., of Cobalt, Ont., took over the Croton magnetite mines at Brewster. Salt production will probably be about that of the last two years, when it approximated 2,000,000 tons. Other non-metallics of importance that were produced in 1920 included talc, gypsum, marble, limestone, natural cement, graphite, and garnet. There was also some production of pyrites.

North Carolina

BY JOSEPH HYDE PRATT

State Geologist, North Carolina, Chapel Hill, N. C.

DURING 1920 there was a decidedly increased interest in the mining industry of North Carolina, both on the part of the consumer of the products mined and on that of the capitalist. There was also a decided increase in the production of many of the minerals, particularly mica, feldspar, barytes, structural materials, and clay products.

Notwithstanding the high cost of labor and the lack of sufficient cars, 1920 shows a gratifying development of the mining industry of the state, and a considerable increase in the quantity and total value of its mineral production is expected. The impetus which the iron-ore industry received during the war has continued, and investigations of the state and Federal bureaus have interested capital to the extent that North Carolina may probably become in the near future a producer of iron ore in considerable quantity.

Although the non-metallic minerals are of greatest importance, there is still much interest shown in gold and copper ores. Recent investigations show the probability of a large body of good-grade copper ore in the Ore Knob mine, in Ashe County. During the last year several companies have been purchasing the old tailings and dumps at many of the gold and copper mines. These tailings and dumps are being treated, and in some instances the coarser waste material is being used for road construction, so that the entire dumps are being utilized. Tin ores have received some attention, and it is probable that during 1921 tin ore will be added to the minerals produced in this state. Another interesting development in the mining industry is the mining of certain mica schists to be used in the production of ground mica.

Georgia

BY S. W. MCCALLIE

State Geologist, Atlanta, Ga.

THE mining industry in Georgia during the first part of 1920 was seriously affected by labor shortage; but at present the trouble has been largely remedied and the mines and quarries are gradually resuming normal production.

The clay industry, and the fullers' earth and cement industries, have been quite active, and in many instances the production has run far short of the demand. The same condition also prevails in the broken-stone industry. This was brought about by the unusual activity in highway and concrete construction.

The iron-ore and manganese mines were not as active as during the war period. This is due largely to unsatisfactory prices. The activity in the barytes, coal, ocher, and talc industries is rapidly approaching normal.

The pyrite mines, owing mainly to the competition of cheap sulphur, are practically shut down. One or two of the larger mines are considering the erection of acid plants and will go into the production of fertilizers so that they may continue to operate their mines. This plan has already been adopted by the Tennessee Copper Co., that is just completing a large fertilizer plant in Atlanta, where much of the acid made at Copper Hill will be manufactured into fertilizer.

Gold mining has been very inactive, and as a result the output has been meager, smaller than for any years since 1834, the earliest date for which there are reliable statistics. Increased cost of labor and diminished purchasing power of gold are the causes.

New Jersey

BY HENRY B. KUMMEL

State Geologist, Trenton, N. J.

THE production of zinc ore in New Jersey in 1920 will be 12 to 15 per cent less than in 1919, and during the latter part of the year the mines were run on part time. Iron ore is estimated at 485,700 tons, about 83,000 more than 1919, with prices from 90c. to \$1 per ton better. A six-months' strike, closing the Richard mine; the successful location by diamond drill of the Replogle orebody at a depth of 1,250 ft., and the reopening of the Beech Glen mine, where a new 7-ft. vein of low-phosphorus ore has been uncovered, are the most noteworthy developments in this industry during the year.

Raw clay, brick and tile, pottery, sand and gravel, and crushed stone industries will show increased production, although in certain lines there may be slight decreases. Raw clay sold is estimated at \$1,100,000; pottery and brick and tile, \$21,000,000 or more; sand and gravel, approximately \$2,750,000, and stone \$2,500,000 to \$3,000,000. Other mineral products include zinc and lead pigments, portland cement, peat, mineral waters, fuel briquets, coke, lime, ground quartz, and greensand marl. A large plant is being erected for the extraction of potash from the greensand marl and manufacture of sand-lime brick from the residue, and will be in operation the spring of 1921.

For several years New Jersey has ranked third among all states in the per square mile value of its mineral products. Total value for 1920 is estimated at upward of \$50,000,000. Following were prices in November: Crushed limestone, \$1.60 to \$2.25; crushed trap, \$1.50 to \$2.35; glass-sand, washed, \$2.50; dried, \$3; run-of-bank sand, 50@75c.; washed gravel, \$1.40; molding sand, \$1.90 to \$2.10 per ton.

British Columbia

BY ROBERT DUNN

Secretary to Minister of Mines, British Columbia

A SURVEY of 1920 in all of British Columbia leads to the conclusion that, in development and in output, the record of the year will not be found far behind that of 1919. Labor conditions are improving, and as soon as metal prices increase the mining industry of British Columbia, now depressed, will revive with a bound. Development everywhere is making rapid strides, and prospecting activity is increasing.

There will be a decline in output of gold for 1920, in comparison with the previous year. Whether this will be true for placer mining is doubtful, because there has been considerable activity in the Cariboo and in sections further north and northeast. Much of the work, however, has been preliminary, so that the results may not accrue until next season. In 1919, British Columbia produced 14,325 oz. of placer gold. Lode mining will not equal the previous year in output, as the Rossland mines, Consolidated Mining & Smelting Co. of Canada, Ltd., are not on the working scale of a few years ago, and the Nickel Plate mine of the Hedley Gold Mining Co. had been restricting operations prior to the final closing of the plant over three months ago.

Copper is expected to attain last year's production, 42,459,339 lb. During the first nine months of 1920, the larger companies maintained their output at a high level, but there was a slump in the last three months of the year. The Britannia Mining & Smelting Co., Ltd., milled in nine months as many tons of ore as it did throughout 1919. Production was cut down when copper reached 14c. in New York. The Granby Consolidated Mining, Smelting & Power Co., at Anyox and Hidden Creek, passed through a similar cycle. The returns of this company will not show a decline in production for any but the closing months of 1920. As at the Britannia, there has been a reduction in the force employed at the smelter and the mines. The Consolidated Mining & Smelting Co. of Canada, Ltd., is not a large producer of copper, although it is entering to a greater extent into that industry, its copper refinery capacity having been increased not long ago. The company is, however, not likely to show much increase in its copper output for 1920.

The construction of concentrating plants at the "Old Sport" group of claims, Quatsino Sound, Vancouver Island, and at the "Sunloch" copper mines, Jordan River, Vancouver Island, had been planned by the company for 1920, but costs of labor, supplies, and machinery were too high as compared with the average price of the metal, and the projects were permitted to stand. A start on these plants may be looked for during 1921. Development has, however, continued, the tonnage of available ore exposed having been materially increased.

The Tidewater Copper Co., operating the "Indian Chief" group of crown-granted mineral claims, Sidney Inlet, west coast of Vancouver Island, blocked out in 1919 and 1920 sufficient tonnage to furnish 300 tons of ore daily for two years. The output will be handled by a reconstructed mill. "Peterson" flotation cells and an electrical plant have been installed at the mill, which has been in operation since September. The Kamloops district, by reason of the closing down of the "Iron Mask" mine, will show a pronounced decline in copper

output for 1920. Since April, work has been concentrated upon the installation of a water system and in improvements to the mine and plant.

A distinct falling off in silver output in 1920 is to be expected. The coast and Boundary districts should produce about the same as in 1919. There has been much development in the coast district, but comparatively little actual shipping. The Dolly Varden mine, at Alice Arm, is one of the most important of the producers. Probably it will be found to have done better than in 1919. The Premier mine, on Salmon River, Portland Canal, did some shipping, but only of ore that was transported over the snow during the winter of 1919-20, and which can be so handled this winter. The work so far done consists for the most part of development. The 1920 output of silver from the Boundary district is likely to be somewhat better than that of the previous year. There have been important developments of a portion of the Summit Camp silver-lead ores near the head of Tulameen River, and many new high-grade silver veins have been discovered on Wallace Mountain, Beaverdell, Greenwood Mining Division.

During 1919, the northern coast, which includes the Dolly Varden and Premier, as well as many small mines and prospects, produced 920,413 oz. of silver, the Boundary-Yale districts 231,599 oz., East Kootenay 274,134 oz., and West Kootenay 1,799,229 oz. The total for the province was 3,403,119 oz.

The lead production for 1920 will probably be equal to that of 1919. Much depends upon the output of the Sullivan mine, Kimberley, B. C., Consolidated Mining & Smelting Co. of Canada, Ltd. The mine has been extensively developed and its yield has increased. The 1919 production shows that of a total output of 29,475,968 lb., 29,218,254 lb. came from East and West Kootenays.

A substantial increase will be shown in the amount of zinc produced in 1920. The Sullivan mine produces the greater part of the zinc. In 1919, East Kootenay produced 46,460,705 lb. of the total, 56,737,651 lb. The Slocan and contiguous territory contributed something over 10,000,000 lb., which almost accounts for the entire amount. A reduction is likely in the Slocan production, but heavy shipments from the Sullivan will more than overcome this expected decline.

Manitoba

BY R. C. WALLACE

Commissioner of Northern Manitoba, The Pas, Man.

DURING 1920 the demand for structural materials in Manitoba did not perceptibly stimulate the building stone, gypsum, portland cement, and brick industries in the province, but indications now are that before another year elapses a considerable activity in those industries will take place.

An option for one year was taken on the Flin Flon property, in Northern Manitoba, in March, 1920, by the Thompson interests, of New York, and the Mining Corporation of Canada. Shafts were sunk 500 ft. apart, and the orebody has been crosscut at the 100

and 200-ft. levels, and will probably be cut at the 300-ft. level before the work done under the option is completed. The underground work has checked up closely the figures obtained by diamond drilling, and the holders of the option feel satisfied that the orebody contains at least 16,000,000 tons of ore. Assurance has been practically given that the option will be taken up. The preliminary survey for the railway from The Pas to the property has begun. At the next session the Legislature of Manitoba will decide on financing the railway and leasing it to the Canadian National Ry. for operation. Mining in northern districts will be stimulated by these developments.

The final shipments of ore from the Mandy mine to Trail were made in the summer of 1920 and there now remain approximately 200,000 tons of lower-grade ore

in the mine. The smelter returns show that ore to the value of over \$2,000,000 has been mined from this property.

There has been considerable activity in gold mining in the Rice Lake and Herb Lake districts. In the former area, there is an average of 200 ft. of underground workings on eleven properties and many shallower workings. The district will probably reach the producing stage in 1921. In the Herb Lake district the Rex mine is operating steadily, and further production of gold and of silver from silver-galena discoveries may be expected in 1921.

An interesting and probably very important discovery in the Bear Lake district has disclosed a norite of the Sudbury type associated with copper and nickel sulphides.

Ontario

BY G. C. BATEMAN

General Manager, La Rose Mines, Ltd., Cobalt, Ont.

MINING in Ontario during 1920 can be divided into two periods. During the first period, which lasted from January to September, there was an acute shortage of labor. During the latter part of the year there was a shortage of power in Cobalt, Kirkland Lake, and Porcupine, which resulted in a curtailment of operations and a surplus of labor.

Production for the first nine months of 1920 was \$35,920,418, an increase of 27 per cent, in which practically all branches of the industry shared. The last three months will be the worst of the whole year, whereas the corresponding three months of 1919 were the best, but, notwithstanding this, 1920 will show a good increase over 1919.

Despite a severe decline in the price of silver, the production of the Cobalt mines was maintained, and for the nine months amounted to 7,831,143 oz., valued at \$8,435,088, an increase of 8 per cent as compared with 1919. Owing to the low silver prices and to power shortage, the results for the last three months will be proportionately less. Total dividends paid by the Cobalt companies for 1920 were \$3,458,142, as compared with \$3,524,241 for the previous year.

No outstanding discoveries were made during 1920, and there were no particular changes in metallurgical practice. The Mining Corporation bought the Foster lease and the Buffalo property, and the Coniagas bought the Trethewey. Part of the Chambers-Ferland property was purchased by the Northern Customs Concentrator, Ltd., and the same company also operated the Silver Cliff, under lease. The long-drawn-out litigation of the Bailey resulted in its being amalgamated in a new company with the Northern Customs mill.

In Gowganda, the Miller Lake O'Brien maintained its production and a good discovery was made on the Castle property, which was taken over by the Trethewey. This caused considerable development in the district, but did not result in any new important discoveries. In South Lorrain, the Keeley resumed operations and built a mill.

In the gold camps of Porcupine and Kirkland Lake, production for the first nine months of 1920 was \$8,707,718, an increase of 15 per cent. The Hollinger, McIntyre, Dome, and Lake Shore paid dividends of \$2,994,042, as against \$2,186,028 for 1919. The only

dividend payer in Kirkland Lake was the Lake Shore, with a production of about \$500,000, made from an average recovery of over \$26 per ton. There was an increased amount of development throughout the district. The Wright-Hargraves continued construction of a mill, which will be in operation early in 1921. The Ontario-Kirkland completed excavation in the fall of 1920 for a mill to be built in 1921.

In Porcupine, the Hollinger maintained its leading position, and, in view of production, reserves, and possibilities, is probably the second greatest gold mine in the world. The Porcupine Crown amalgamated with the Thompson Krist, and was reopened. The Vipond was refinanced, and arrangements were made to resume operations. The McIntyre discovered the extension of one of the main Hollinger vein systems below the 1,000-ft. level, and was able to do sufficient work to be assured that the discovery was one of primary importance. The Dome, in addition to resuming dividends, exercised its option on the Dome Extension.

In the nickel field at Sudbury a peculiar situation existed. The British America blew in its furnaces at the beginning of the year, and worked on a limited production. The Mond, which refines and markets its products in England, in 1920, on account of the European market for nickel being almost non-existent, operated only a small part of its capacity, and piled up millions of dollars' worth of matte for future export. The International Nickel, on the other hand, gradually increased its output to 4,000 tons of matte per month, which was greater than its pre-war output. Owing, however, to the industrial depression in the United States, the output was cut to 3,000 tons in November and 2,000 tons a month in December. The production of nickel for the nine months, practically all of which was from Sudbury ores, was valued at \$12,310,075, an increase of 51 per cent. Copper, also almost entirely from Sudbury, was valued at \$3,459,920, an increase of 30 per cent.

In the Madoc district there are talc and fluorspar mines. The latter reflected the falling off in demand for fluorspar, but the talc companies did well. Ontario talc has very generally held its market against the best of the French and Italian grades.

British Columbia

BY ROBERT DUNN

Secretary to Minister of Mines, British Columbia

A SURVEY of 1920 in all of British Columbia leads to the conclusion that, in development and in output, the record of the year will not be found far behind that of 1919. Labor conditions are improving, and as soon as metal prices increase the mining industry of British Columbia, now depressed, will revive with a bound. Development everywhere is making rapid strides, and prospecting activity is increasing.

There will be a decline in output of gold for 1920, in comparison with the previous year. Whether this will be true for placer mining is doubtful, because there has been considerable activity in the Cariboo and in sections further north and northeast. Much of the work, however, has been preliminary, so that the results may not accrue until next season. In 1919, British Columbia produced 14,325 oz. of placer gold. Lode mining will not equal the previous year in output, as the Rosland mines, Consolidated Mining & Smelting Co. of Canada, Ltd., are not on the working scale of a few years ago, and the Nickel Plate mine of the Hedley Gold Mining Co. had been restricting operations prior to the final closing of the plant over three months ago.

Copper is expected to attain last year's production, 42,459,339 lb. During the first nine months of 1920, the larger companies maintained their output at a high level, but there was a slump in the last three months of the year. The Britannia Mining & Smelting Co., Ltd., milled in nine months as many tons of ore as it did throughout 1919. Production was cut down when copper reached 14c. in New York. The Granby Consolidated Mining, Smelting & Power Co., at Anyox and Hidden Creek, passed through a similar cycle. The returns of this company will not show a decline in production for any but the closing months of 1920. As at the Britannia, there has been a reduction in the force employed at the smelter and the mines. The Consolidated Mining & Smelting Co. of Canada, Ltd., is not a large producer of copper, although it is entering to a greater extent into that industry, its copper refinery capacity having been increased not long ago. The company is, however, not likely to show much increase in its copper output for 1920.

The construction of concentrating plants at the "Old Sport" group of claims, Quatsino Sound, Vancouver Island, and at the "Sunloch" copper mines, Jordan River, Vancouver Island, had been planned by the company for 1920, but costs of labor, supplies, and machinery were too high as compared with the average price of the metal, and the projects were permitted to stand. A start on these plants may be looked for during 1921. Development has, however, continued, the tonnage of available ore exposed having been materially increased.

The Tidewater Copper Co., operating the "Indian Chief" group of crown-granted mineral claims, Sidney Inlet, west coast of Vancouver Island, blocked out in 1919 and 1920 sufficient tonnage to furnish 300 tons of ore daily for two years. The output will be handled by a reconstructed mill. "Peterson" flotation cells and an electrical plant have been installed at the mill, which has been in operation since September. The Kamloops district, by reason of the closing down of the "Iron Mask" mine, will show a pronounced decline in copper

output for 1920. Since April, work has been concentrated upon the installation of a water system and in improvements to the mine and plant.

A distinct falling off in silver output in 1920 is to be expected. The coast and Boundary districts should produce about the same as in 1919. There has been much development in the coast district, but comparatively little actual shipping. The Dolly Varden mine, at Alice Arm, is one of the most important of the producers. Probably it will be found to have done better than in 1919. The Premier mine, on Salmon River, Portland Canal, did some shipping, but only of ore that was transported over the snow during the winter of 1919-20, and which can be so handled this winter. The work so far done consists for the most part of development. The 1920 output of silver from the Boundary district is likely to be somewhat better than that of the previous year. There have been important developments of a portion of the Summit Camp silver-lead ores near the head of Tulameen River, and many new high-grade silver veins have been discovered on Wallace Mountain, Beaverdell, Greenwood Mining Division.

During 1919, the northern coast, which includes the Dolly Varden and Premier, as well as many small mines and prospects, produced 920,413 oz. of silver, the Boundary-Yale districts 231,599 oz., East Kootenay 274,134 oz., and West Kootenay 1,799,229 oz. The total for the province was 3,403,119 oz.

The lead production for 1920 will probably be equal to that of 1919. Much depends upon the output of the Sullivan mine, Kimberley, B. C., Consolidated Mining & Smelting Co. of Canada, Ltd. The mine has been extensively developed and its yield has increased. The 1919 production shows that of a total output of 29,475,968 lb., 29,218,254 lb. came from East and West Kootenays.

A substantial increase will be shown in the amount of zinc produced in 1920. The Sullivan mine produces the greater part of the zinc. In 1919, East Kootenay produced 46,460,705 lb. of the total, 56,737,651 lb. The Slocan and contiguous territory contributed something over 10,000,000 lb., which almost accounts for the entire amount. A reduction is likely in the Slocan production, but heavy shipments from the Sullivan will more than overcome this expected decline.

Manitoba

BY R. C. WALLACE

Commissioner of Northern Manitoba, The Pas, Man.

DURING 1920 the demand for structural materials in Manitoba did not perceptibly stimulate the building stone, gypsum, portland cement, and brick industries in the province, but indications now are that before another year elapses a considerable activity in those industries will take place.

An option for one year was taken on the Flin Flon property, in Northern Manitoba, in March, 1920, by the Thompson interests, of New York, and the Mining Corporation of Canada. Shafts were sunk 500 ft. apart, and the orebody has been crosscut at the 100

and 200-ft. levels, and will probably be cut at the 300-ft. level before the work done under the option is completed. The underground work has checked up closely the figures obtained by diamond drilling, and the holders of the option feel satisfied that the orebody contains at least 16,000,000 tons of ore. Assurance has been practically given that the option will be taken up. The preliminary survey for the railway from The Pas to the property has begun. At the next session the Legislature of Manitoba will decide on financing the railway and leasing it to the Canadian National Ry. for operation. Mining in northern districts will be stimulated by these developments.

The final shipments of ore from the Mandy mine to Trail were made in the summer of 1920 and there now remain approximately 200,000 tons of lower-grade ore

in the mine. The smelter returns show that ore to the value of over \$2,000,000 has been mined from this property.

There has been considerable activity in gold mining in the Rice Lake and Herb Lake districts. In the former area, there is an average of 200 ft. of underground workings on eleven properties and many shallower workings. The district will probably reach the producing stage in 1921. In the Herb Lake district the Rex mine is operating steadily, and further production of gold and of silver from silver-galena discoveries may be expected in 1921.

An interesting and probably very important discovery in the Bear Lake district has disclosed a norite of the Sudbury type associated with copper and nickel sulphides.

Ontario

BY G. C. BATEMAN

General Manager, La Rose Mines, Ltd., Cobalt, Ont.

MINING in Ontario during 1920 can be divided into two periods. During the first period, which lasted from January to September, there was an acute shortage of labor. During the latter part of the year there was a shortage of power in Cobalt, Kirkland Lake, and Porcupine, which resulted in a curtailment of operations and a surplus of labor.

Production for the first nine months of 1920 was \$35,920,418, an increase of 27 per cent, in which practically all branches of the industry shared. The last three months will be the worst of the whole year, whereas the corresponding three months of 1919 were the best, but, notwithstanding this, 1920 will show a good increase over 1919.

Despite a severe decline in the price of silver, the production of the Cobalt mines was maintained, and for the nine months amounted to 7,831,143 oz., valued at \$8,435,088, an increase of 8 per cent as compared with 1919. Owing to the low silver prices and to power shortage, the results for the last three months will be proportionately less. Total dividends paid by the Cobalt companies for 1920 were \$3,458,142, as compared with \$3,524,241 for the previous year.

No outstanding discoveries were made during 1920, and there were no particular changes in metallurgical practice. The Mining Corporation bought the Foster lease and the Buffalo property, and the Coniagas bought the Trethewey. Part of the Chambers-Ferland property was purchased by the Northern Customs Concentrator, Ltd., and the same company also operated the Silver Cliff, under lease. The long-drawn-out litigation of the Bailey resulted in its being amalgamated in a new company with the Northern Customs mill.

In Gowganda, the Miller Lake O'Brien maintained its production and a good discovery was made on the Castle property, which was taken over by the Trethewey. This caused considerable development in the district, but did not result in any new important discoveries. In South Lorrain, the Keeley resumed operations and built a mill.

In the gold camps of Porcupine and Kirkland Lake, production for the first nine months of 1920 was \$8,707,718, an increase of 15 per cent. The Hollinger, McIntyre, Dome, and Lake Shore paid dividends of \$2,994,042, as against \$2,186,028 for 1919. The only

dividend payer in Kirkland Lake was the Lake Shore, with a production of about \$500,000, made from an average recovery of over \$26 per ton. There was an increased amount of development throughout the district. The Wright-Hargraves continued construction of a mill, which will be in operation early in 1921. The Ontario-Kirkland completed excavation in the fall of 1920 for a mill to be built in 1921.

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In the Madoc district there are talc and fluorspar mines. The latter reflected the falling off in demand for fluorspar, but the talc companies did well. Ontario talc has very generally held its market against the best of the French and Italian grades.

In northern Ontario, during the first nine months of 1920 there was a severe labor shortage, which curtailed production and, particularly, development. A survey was made by the superintendent of the government employment agencies, who admitted a shortage of at least 2,000 men, which the government bureau was unable to fill. This shortage no longer exists, and 1921 should be a particularly favorable year for the gold mines. Lack of fall rains produced a power shortage resulting in a curtailment of operations, particularly in Cobalt and Kirkland Lake, and, to a less extent, in Porcupine. Early in 1920 the Ontario Mining Association was organized, with headquarters in Toronto.

Quebec

BY W. J. WOOLSEY

Thetford Mines West, Quebec, Canada

THE asbestos production of Quebec for 1920 will show an increase of about 20 per cent, due principally to the larger production in the Coleraine and Broughton districts. The crude production is not greater, but would show a shrinkage, owing to substitution of mechanical separation of crudes for hand separation and cobbing. An attempt at unity of purpose among the operators augurs for ultimate success, and labor has adopted sound principles. The success attending the efforts of the manufacturers in their publicity campaign is acknowledged. The trend of developments has been: Extensive diamond drilling with a view to locating new orebodies, increasing development in underground methods of mining in contrast to original quarrying methods, and the establishment of the Coleraine mining district as an important fiber producer. No distinctive advance took place during 1920 in the mechanical treatment of crude asbestos rock.

Chrome operations during the year were confined to two companies: the Mutual Chemical Co., of New York, and the J. V. Belanger interests (U. S. Alloys), with the Black Lake Asbestos & Chrome Co. operating a short time on dump material. All operations were confined to the Caribou Lake district. The present status of the chrome industry shows an improvement.

Nova Scotia

BY G. F. MURPHY

Professor of Metallurgy, Nova Scotia Technical College, Halifax, Nova Scotia

THE production of gold in Nova Scotia in 1920 amounted to 745 oz., from 850 tons of ore crushed, an average of 0.86 oz. per ton. This shows a decrease of 20 per cent from the production of 1919, and only one-tenth of the gold produced in 1862, when gold mining was first established in this province. Since 1898, when the maximum production of 31,104 oz. was made, there has been a continuous decrease.

Only one company, the Montague Goldfields, Ltd., at Montague, Halifax County, made any attempt at continuous operation in 1920. The work was development, as the company intends putting in a new plant and opening the mine on a larger scale. The ore averages approximately two ounces per ton.

The provincial government has undertaken the production of hydro-electric power, to be distributed throughout the province. It is planned to supply the gold districts with cheap power. This should help to stimulate the industry, and, with labor again becoming plentiful, there should be increased activity in gold mining within the next few years.

The Consolidated Manganese Co., at New Ross, has a new concentrating mill about ready for operation. Approximately 100 tons of ore was shipped during the year. No further developments have occurred respecting the salt deposit containing potash recently discovered at Malagash. This deposit has been proved to be at least 600 ft. thick, and promises to become of great importance. The Canadian Geological Survey has recently published a report on the deposit by Dr. Hayes. Gypsum still continues in importance only second to coal. About 200,000 tons in the raw state was shipped in 1920, mostly to the United States, for manufacturing purposes. Several inquiries were made during 1920 for arsenic, which occurs so plentifully in some of the gold-bearing veins. About 500 tons of concentrates was shipped to the United States in 1920, to be treated for the arsenic content.

Mexico

EDITORIAL CORRESPONDENCE

AT THE END of 1920, mining in Mexico was depressed, although the petroleum industry was prosperous. Owing to the continued drop in the price of silver, the second week in December, 1920, saw many of the principal mines and camps closed and over 60,000 men out of employment. Efforts of the government to help by withdrawing taxation can hardly have more than temporary effect. The measures proposed may enable some of the high-grade properties to keep going a few weeks longer, but cannot materially prevent the depression that will fall upon the silver industry if the price of silver falls below 60c.

The beginning of 1920 was favorable and promised a largely increased output over 1919. With the sudden slump in silver most of the mining properties in Mexico were immediately affected. Although operation and even exploration and development were maintained under adverse circumstances over a period of several

months, the breaking point was reached early in December. The copper camp at Cananea announced that it would close on Dec. 15, but later postponed this until after the first of the year. Teziutlan (copper), in the State of Puebla, followed, and then all the smaller copper properties in the republic. The second week in December saw the closing of several of the more important silver-producing properties in the Pachuca camp, and of others in the states of Mexico, Jalisco, Guanajuato, and Zacatecas, with a large number of men out of work.

Aside from the panicky condition due to the drop in price of silver and other metals, the general mining outlook has been considered good. On Dec. 1, 1920, there were 3,138 properties actively working. Many millions of foreign capital were put into mill construction and development during the year in anticipation that Mexico's civil troubles were over and that peace

and prosperity had set in. Some of this capital comes from Europe, principally from English and French sources, but, most of it is American. Despite the setback, Mexico's silver output for the year will hardly fall below 80,000,000 oz.

Mining interests generally throughout the country are somewhat dazed at the immediate outlook, and fearful of the consequences of a prolonged decline of metal prices, but it cannot be said that they are either disheartened or by any means ready to shut down. Local conditions have not been so promising since the revolution of 1910. The present government has taken an intelligent interest in reforming tariffs and taxes, and whatever headway Bolshevism seemed to have been making six months ago has disappeared. Many of the properties have recently made a reduction in wages without any attempt on the part of labor organizations to resist. This is due probably to the fact that prices on almost all staple articles have been considerably reduced and are still dropping rapidly.

Statistics of mineral production for the first half of 1920 are given in the table. These statistics were compiled by the Department of Mines of Mexico and published in *Commerce Reports* late in December, 1920.

MINERAL PRODUCTION OF MEXICO

Mineral:	First Six Months of 1919		First Six Months of 1920	
	Kilos	Total Value	Kilos	Total Value
Antimony.....	4,148	\$3,434	577,723	\$381,875
Arsenic.....	1,358,860	898,206	770,797	309,860
Commercial copper.....	21,405,829	17,424,345	23,914,011	19,466,005
Tin.....	1,588	4,535		
Amorphous graphite.....	3,686,563	405,522	2,441,240	390,598
Manganese.....	1,437,495	343,561	31,509	7,531
Mercury.....	52,094	262,970	42,505	220,218
Molybdenum.....	1,563	14,891	648	6,173
Gold.....	10,343	13,790,663	11,775	15,699,996
Silver.....	954,333	69,666,309	1,029,940	75,824,183
Commercial lead.....	30,918,282	10,821,399	44,898,902	17,465,673
Tungsten.....	1,389	11,633	4,471	37,445
Commercial zinc.....	4,485,115	1,323,109	8,543,132	3,434,339

The conditions which affect silver mining have been paralleled in all other kinds of mining. Lead has suffered heavily, as well as zinc and copper. The output of these metals, however, will be in excess of that of 1919, excepting graphite.

The oil problem in Mexico remains unchanged. The Government of Mexico and independent companies adhere to Article 27, which declares that oil, until it has been brought to the surface, belongs to the government. The so-called "Allied" companies maintain that the constitution infringes upon rights legally acquired previous to its promulgation. The "Allied" concerns include most of the important producers and most of the pioneers in oil development in Mexico. The Aguila company (British), next to the so-called Doheny interests the largest in the Mexican oil fields, and one of the earliest explorers, recently withdrew from the association, and is now understood to be in sympathy with the Mexican government's contention. What the next move will be, or who will make it, is unknown.

In the meantime, oil is the principal source of support of the government. A high official of the Department of Commerce and Industry states that the potential possibilities of wells now open are over 1,000,000,000 bbl. a year, and that, beginning with January, 1921, the government's income from export taxes alone will amount to 15,000,000 pesos (\$7,500,000) monthly. This tax will be paid by fewer than thirty producing companies. The same authority estimates there are 160,000,000 acres of known oil-bearing land in Mexico, of which fewer than 400,000 have been "tromped" over.

There are now twelve refineries in operation and others under construction, and concessions have been

granted for numerous pipe lines, including one to the City of Mexico and one from the Atlantic to the Pacific ocean across the Isthmus of Tehuantepec. According to government statistics, the value of the oil industry in Mexico (including physical assets) amounts to \$660,000,000, whereas that of the mining industry totals only \$400,000,000. Exports to the United States exceeded 100,000,000 bbl. in 1920, as compared to 51,000,000 bbl. in 1919.

Owing, possibly, to the fact that many wells in the older districts in Tamaulipas and northern Vera Cruz have run into salt water, there has been a tendency to increase exploration further south. During the last three months of 1920, a great deal of land changed ownership in the states of Tabasco and Chiapas and southern Vera Cruz. Despite the government's insistence on its ownership of oil, leases for oil rights are constantly being entered into between land owners and representatives of important companies now on the ground. The value of these leases must depend in a large measure on the government receding from its present position. There has been great activity also in oil concessions granted by the government, almost exclusively to newcomers in the field, as the older companies largely refuse to handle concessions, protesting that they are illegal and in contravention of established rights and interests.

Under these concessions, some of which involve millions of acres, considerable development work has recently been started in the states of Sonora, Lower California, Sinaloa, Guerrero, Puebla, and Oaxaca. British capitalists recently began borings at Port Angel, on the Pacific coast, where seepages and other external evidences of oil are abundant, although the territory has been repeatedly rejected by geologists. Considerable activity has also been shown in the tier of Mexican states bordering on Texas and Arizona, though no wells have been actually brought in.

The oil situation in Mexico for 1921 appears particularly bright, but the industry is so involved with political difficulties that, until the snarl is unraveled and the final attitude of the two governments (American and Mexican) is known, Mexican oil will not reach its full possibilities. No one doubts the tremendous potential possibilities of petroleum in Mexico, but the industry has been greatly handicapped by the uncertainty surrounding its legal status. The present government has repeatedly expressed itself as favoring a broad and liberal interpretation of the law and has denied any intention of making the law retroactive, at the same time insisting on its rights of eminent domain and showing no disposition to abrogate Article 27 of the new constitution, which article is the principal bone of contention.

Cuba

BY C. M. WELD

Mining Engineer, New York

HIGH ocean freights, combined with intense activity in sugar, which drove wages to a high level and practically monopolized railway transportation, were largely responsible for keeping mineral production in Cuba during 1920 at a low ebb.

It is reported that new production of manganese ore was represented by 3,000 tons of dioxide and 1,000 tons of furnace ore, all from the Bueycito district, Oriente Providence. In addition, about 2,000 tons of furnace ore was shipped from stockpiles in Santiago and Bo-

queron (Guantanamo Harbor). Exact figures are not at hand. The Ponupo manganese mines were idle during all of 1920.

Copper-mining activity was limited to the Matahambre property, in Pinar del Rio. Operations at the well-known El Cobre mine, near Santiago, were discontinued in January, 1919. Matahambre will show a production for 1920 of approximately 14,000 tons of hand-sorted ore, containing 18.5 per cent copper and 1.6 oz. silver per ton, and 23,000 tons of concentrates containing 24.5 per cent copper and 1.85 oz. silver per ton; a total of nearly 16,500,000 lb. of copper and 65,000 oz. of silver.

All producing iron mines are operated by the Bethlehem Cuban Iron Mines Co. During the first ten months of 1920, Daiquiri (near Santiago) produced 251,384 tons and shipped 471,071 tons. The total figures for the year will be roughly 300,000 tons produced and 550,000 tons shipped, a considerable amount of ore still being left in stock. At Mayari, near Nipe Bay, the mines have been idle, the date of reopening depending on the iron industry. Shipments for the year, amounting to 280,000 tons of nodules and 20,000 tons of raw ore, about cleaned up the stockpiles.

Exploration for oil continues. Pyrites and chrome will probably be exported at some time in the near future. The export tax on iron and copper ores was repealed and a new law was passed imposing a tax of 6 per cent on net profits, and an annual tax of 20c. per hectare on all mineral lands held under denouncement, whether working or idle.

The foregoing information has been gathered from a number of sources. I am especially indebted to William Pitt, of Santiago, and J. C. Porter, of Havana.

Central America

BY M. B. HUSTON

General Manager, Eden Mining Co., Bluefields, Nicaragua

GUATEMALA.—Not much interest in mining was shown in Guatemala during 1920, and no new developments have been reported. This condition is probably due to the Cabrera revolution, which kept the country in an unsettled condition the greater part of the year.

Salvador.—The Butters Salvador Mines, Ltd., discontinued operations. The San Sebastian property of this company is reported to be worked out. The Divisadero mine of the same company has been sold to the El Salvador Silver Mines Co., which is continuing the production and development of the property.

Honduras.—No new developments of interest were reported. The mining interest in Honduras continues to center around the Rosario mine of the New York & Honduras Rosario Mining Co. This famous old silver mine, which has been in steady production since 1882 and which has produced a gross value of over \$28,000,000, continues to be the largest and most profitable mining operation in Central America. During 1919, the tonnage milled was 133,900, giving a production of \$2,115,158, and a net operating profit of \$779,603. Operation was continued on the same scale during 1920, and it is expected that the results will be about the same as for 1919. The principal value is silver and the mine has benefited during the last two years by the prevailing high price of that metal. A. R. Gordon continues as general manager.

Nicaragua.—Two new interesting projects are under

way in Nicaragua. In 1918, D. J. Pullinger and William Wallace Mein acquired, near the town of Santo Domingo, in the Department of Chontales, properties known as the Javali, Cedro, and Pabon, and are developing them under the name of the Chontales Mining Co. J. F. Thorn, formerly general manager of the San Sebastian and before that general manager of the Goldfield Consolidated, is in charge of the operation as consulting engineer and general manager. The company gives Mr. Thorn full credit for having discovered the possibilities of the property and for his recommendation to purchase it. The property covers about 12,000 ft. of vein, of which 3,300 ft. have been opened up, showing average widths of from 12 to 14 ft. A deeper crosscut tunnel is now being driven, which will intersect the vein at about the center of the property and give average backs of approximately 300 ft. A power plant and mill have been installed. Ore is being treated at present at an average rate of 210 tons per day. To date about 50,000 tons have been milled, giving a gross production of \$1,000,000 with an extraction of 90 per cent. Eighty per cent of the recovery is gold and the remainder silver. At present a hydro-electric plant of over 1,000 hp. is being erected. With this completed, it is planned to enlarge the treatment plant and increase operation to a capacity of 600 tons per day.

In the Pis Pis district, Barry Searle and associates have taken over the old Bonanza, Lonestar, and Concordia properties and have started operations under the name of the Nicaragua Mining Co. Some work has been done on the Lonestar and Concordia, but to date their principal activities have been centered in the development and equipment of the Neptune vein, on the Bonanza property. A considerable amount of development work has been done. An amalgamation mill has been erected, operation having been started in the latter part of October.

The property of the Eden Mining Co. in the Pis Pis district was in continuous production throughout 1920. During 1919, 36,159 tons of ore (99.1 tons per day) was treated, giving a gross production of \$443,399, with an extraction of 94.5 per cent. During the latter part of 1919 and early in 1920 the capacity of the mill was increased, since which time a production rate of 125 tons per day has been maintained. Owing to this increased capacity, the production for the year will be somewhat higher than for 1919. An extensive development campaign is being carried out in the effort to establish additional ore reserves. The company owns its own transportation system from the port of Prinzipolka to the mine and its own hydro-electric power plant of 1,200 hp. capacity. As with all gold mines, the operations have been considerably impeded by the prevailing high prices of supplies.

Work was carried on throughout 1920 at the Constancia Consolidated mine, in the Pis Pis district. The 80-ton cyanide plant was kept in operation during the first half of the year. Trouble was then encountered in the treatment process, due to the oxidized copper content of the ores from the secondarily enriched section of the vein. Tests are now being made to overcome this difficulty, and at the same time development work is being continued.

Costa Rica.—The Abangarez mine was in continuous operation throughout 1920. Considerable attention was given to petroleum during the year, and especially to the concessions granted by the government during a previous administration.

Panama.—So far as known, there was no mineral production in the Republic of Panama during 1920. Near Ocu, in the Province of Herrera, and near the headquarters of the Boqueron River, in the Province of Colon, where manganese deposits are found, considerable exploration work was done. At the latter place a railroad is projected for the transportation of the ore to the coast. The petroleum possibilities of the republic are still problematical, although numerous reports give encouragement.

Colombia

BY LUIS G. JOHNSON

Civil and Mining Engineer, Medellin, Colombia

PLACER mining for gold was conducted in Colombia in 1920 by American and native companies, principally on the rivers Porce and Nechí and also in Riogrande. On the Nechí, near Zaragoza, the Pato and Nechí mines were worked by two dredges with good results. On the Porce and Riogrande rivers two American companies successfully worked the rich placers about forty miles from Medellin, near a station on the Antioquia R.R. Of these two, McGuire Brothers worked the rich alluvial deposits in La Clara with hydraulic elevators and giants (made by the New York Engineering Co.) and the Segovia Mining Co. did the same on the Riogrande River. Below La Clara and for twenty-five miles on the Porce several native companies carried on mining operations, by the same methods, at the Guayabal, Pinal, La Isla, and Brazil mines. Good results were generally obtained by all these operators in 1920, and better returns are expected this year.

Rich alluvial deposits on several other rivers, including the Nechí, Nare, Nus, and Anorí, are awaiting American capital. One American company has already secured good results on the Nus and two others are preparing to begin at Totumo, on the Nus, and at Playarica, on the Nare. On the Nechí above the famous Pato mines, and on the Anorí the deposits awaiting investigation by engineers and capital for development include some that are very extensive, embracing both bars and high alluvials.

Quartzes are not so extensively exploited as placers. Nevertheless, the Frontino & Bolivia successfully worked their deep veins last year in Remedios and Segovia; likewise the Zancudo, a native company near Titiribi. Several other native companies milled ores in small plants in various parts of Antioquia and Caldos.

Near Barbosa, twenty-five miles from Medellin, an American-Colombian syndicate has done extensive development at the Guamal mines and has a large tonnage of \$12 ore blocked out by several tunnels and crosscuts. All this region is rich in quartz veins and has good facilities in the way of water, head, timber, climate, labor, and freight.

Platinum in the Chocó region and on the Condoto and San Juan rivers paid those well in 1920 that had invested there.

As stated above, mining conditions are expected to improve steadily, especially if American capital will undertake to develop the natural resources of the country after experienced engineers have examined and reported on them.

During 1920, there were no new discoveries of importance reported in petroleum and no production was made, although roads were built and additional drilling equipment brought in.

Venezuela

EDITORIAL CORRESPONDENCE

ON JUNE 26, 1920, a new mining law repealing the law of June 27, 1918, and all decrees and resolutions relating thereto was put into effect in Venezuela. On June 30, 1920, another law concerning hydrocarbons and other mineral fuels was enacted. Revival of interest in a placer gold district in southeastern Venezuela on the British Guiana border was reported.

There was no further progress of importance in gold mining in Venezuelan Guiana. The Callao Co. started crushing after being stopped since 1914, but again suspended, owing to lack of development. The Goldfields of Venezuela continued to produce on a small scale only, most of their attention being centered on development. The output of alluvial gold fell off.

Oil development work was in progress by a number of companies. The Caribbean Petroleum Co. had eight wells producing in the Mene Grande field, in the State of Zulia, and was drilling in the La Sierrita field, in the State of Zulia. The British Controlled Oilfields, Ltd., had three standard drill rigs in the western part of the Buchivacoa concession, in the State of Falcon, in August, 1920. One well was producing oil in small quantities at 1,800 ft., another had reached a depth of about 1,000 ft., at that date, and the third was about ready to start operation. This company had also three standard rigs under construction in the eastern part of its concession. The Colon Development Co. continued drilling operations in the District of Colon, Zulia.

The government is seeking to annul the concessions of several oil companies, and has brought suit in the federal courts to annul the concession held by the Colon Development Co., which covers the entire district of Colon. Asphalt was mined from the Bermudez lake by the New York & Bermudez Co. during 1920. The oil refinery at San Lorenzo was in operation, producing petroleum products for domestic consumption. The Venezuelan Oilfields, Ltd., acquired five concessions in the State of Falcon.

The Guianas

EDITORIAL CORRESPONDENCE

THE most important mining work in the Guianas in 1920 was bauxite production, the Aluminum Company of America being the largest operator. In British Guiana this company owns about 30,000 acres of bauxite land on the Demerara River, about sixty-five miles from Georgetown, and 90 per cent of the known bauxite bearing land of the country. This is held under three or more names. All except about 1 per cent of the known deposits in Dutch Guiana also belong to the company, the acreage being comparable with that held in British Guiana. No commercial deposits have been found in French Guiana. Large piers are being built at the property on the Demerara River, and a fifteen-mile railroad reaching the furthest part of the property is under construction.

During the latter part of 1920 the Guiana Development Co. sent out a party from New York to install gold-dredging equipment on the Maroni River between French and Dutch Guiana. The company is equipped to meet all difficulties of transportation by water or overland. George A. Laird is in charge.

Brazil

By F. LYNWOOD GARRISON

Mining and Civil Engineer, Philadelphia, Pa.

OUTSIDE the State of Minas Geraes and a few collieries in the lean coal deposits of the State of Rio Grande do Sul, Brazil possesses no mines whatever, if primitive diamond gravel washings, now being productively operated and only a few of which have ever been profitably worked, be excepted. At present, manganese is the most important mineral. In 1913, manganese mining reached its lowest ebb, but with the beginning of the European war it jumped to unprecedented proportions by reason of the enormously increased demand for the ore and the closing of the Dardanelles, which completely cut off the supply of the better Caucasian ore. During the last two years the Brazilian production of this mineral has greatly decreased. It has had to meet not only a slackening market, but competition with the Indian supply, which was greatly stimulated and developed by the war. The importance the strategic relation this source of manganese supply bears to the American steel industry cannot be overestimated, when considered in conjunction with the immense iron-ore reserves in Minas Geraes, as yet wholly unworked. These iron-ore deposits have been fairly well surveyed, sampled and explored. In quality the ore equals the best Lake Superior and in quantity it seems difficult to estimate within reasonable limitations.

With the exception of a few collieries in the Permian rocks of the states of Rio Grande do Sul and Santa Catharina, Brazil possesses no productive coal deposits, nor does it seem probable that any will ever be found except lignite and other inferior non-coking material of a similar character. There are, however, great areas of Eocene-Tertiary rocks extending along the coast for hundreds of miles, which contain thick beds of oil shale, some said to yield as much as 100 gal. of oil per ton of rock and averaging about 40 gal., with a proportionate yield of sulphate of ammonia. No notable discoveries of petroleum have yet been made in Brazil; but the country is so large, undeveloped, and unexplored in a mineral sense, and to some extent even geographically, that it would be rash to assume that this important natural product may not ultimately be found.

Monazite sand continues to be, as it has for a number of years, an important element of the mineral production in the State of Bahia. During the recent war chrome ore was mined for the first time in Brazil in considerable amounts at Santa Luzia, a small station on the railway connecting the city of Bahia with Joazeiro, an important shipping point on the Sao Francisco River. This ore carries from 43 to 47 per cent Cr_2O_3 and occurs in masses in serpentine near enough to the surface to be quarried. I discovered the deposits in 1916 in the thick catinga jungle about a mile west of the railway. The chrome mines are not being operated at present, but are likely to be in the near future if the price of such ore remains as high as it is now, and ocean transportation improves.

The gold production of Brazil has diminished greatly. The cream has long since been skimmed. The country's total gold output is now comparatively negligible. The Morro Velho, belonging to the St. John del Rey company, is apparently far from exhausted, although the

workings have now reached nearly if not quite 6,500 ft. in vertical depth. The St. John del Rey is an English company, the management of which has always been very efficient. In recent years it has acquired large holdings of rich iron-ore properties in neighboring districts. As far as I am informed, no ore has been mined and shipped from any of these holdings.

Peru

By JOSEPH T. SINGEWALD, JR.

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COPPER, long the leading mineral product of Peru, reflected declining prices in 1919 by a 12 per cent decrease in production, and an even more marked decline of 25 per cent is estimated for 1920. The great decrease in copper production caused a decrease in the silver output, for most of the silver production comes from the silver content of the copper ores. Petroleum showed an increased output, so that final 1920 figures will doubtless give it first place in value among Peru's mineral products. The vanadium production was also in excess of that of previous years.

An unusual amount of development and construction work was projected and carried out during 1920. The Cerro de Pasco Mining Co. started the construction of its new \$9,000,000 smelter at Oroya, which is to have a daily capacity of 2,500 tons. At the present smelter the company erected a 250-ton coal-pulverizing plant and prepared to equip its blast furnaces, reverberatories, and sintering plant for the use of pulverized coal, to reduce the consumption of coke and fuel oil. This change is largely experimental, the purpose being to apply the results to the installations in the Oroya smelter.

The Peruvian Copper & Smelting Co., which has acquired extensive copper deposits at Yauricocha and Felicidad and coal deposits in the Jatunhuasi district, proceeded with the development of its properties. It has under construction a road from Pachacayo station to the mines, blast furnaces, reverberatory furnaces, hydro-electric plant, and, at Jatunhuasi, coke ovens. At Yauricocha it has developed a considerable body of ore averaging 12 per cent copper and containing a high percentage of silver.

The Vanadium Corporation of America constructed six miles of narrow-gauge railroad from its Minasragna mine to Jumasha, on Lake Pun Run, and an automobile road sixteen miles long from Casa Laguna, on the opposite side of the lake, to Ricran, on the Cerro de Pasco railroad. A contract was also let to replace this auto road by a railroad. The construction of a 20,000-kw. hydro-electric plant on Jumasha River was started, and plans were made for a new treatment plant at Jumasha. This is to produce 80 to 90 per cent V_2O_5 concentrates in place of the 35 to 40 per cent V_2O_5 roasted ore that is now shipped.

A sixteen-mile branch of the Chimbote railroad, northward from Kilometer 75 to the coal field of Ancos, called the Chuquicara railway, was expected to be completed before the end of 1920. The line will be extended eventually to Huamachuco and Cajabamba, and thus open up a richly mineralized region of Peru.

A live interest was manifested in the petroleum possibilities of the country in 1920, and Lima was a Mecca for representatives of oil companies seeking concessions. The most desirable territories were withdrawn by the

government some years ago, and the policy to be adopted in the disposition of these reserved lands was one of the most agitated political problems of the year. Considerable exploratory work was done by some of the interests seeking concessions while awaiting the promulgation of a new petroleum law.

Bolivia

BY JOSEPH T. SINGEWALD, JR.

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DESPITE the falling prices of metals, the year 1920 was a notable one in the development of the mineral industry of Bolivia. The preliminary investigations of the Guggenheim Brothers in 1919 led to the acquisition of important tin properties on the east side of the Quimsa Cruz Range, and early in 1920 steps toward their development were initiated. Work was concentrated on a sixty-six-mile automobile road from Eucalyptus, on the Antofagasta and Bolivia railway, to the mines to replace the old pack trail. It was built at a cost of about \$400,000. Water-power sites were purchased to develop power for the new operations, and a ranch was established at a favorable altitude below the mines to supply provisions. The ores are of high grade, running 10 to 15 per cent tin, but are not argentiferous. Some of the veins carry more tungsten than tin. Until the advent of the Guggenheim Brothers, the International Mining Co. was the only American corporation active in the development of Bolivian tin mines. When the extensive plans of the new enterprise have been carried out, not only will the Quimsa Cruz region rival the Uncia-Llallagua district as a tin producer, but American capital will be playing a leading rôle in Bolivian tin mining.

The International Mining Co.'s Carmen mine, in the Yungas district, east of La Paz, which was a tungsten-tin producer, was idle in 1920, as were practically all the tungsten mines of the country. The company centered its attention on the development of its Tanapaca tin mines, in the Araca district, on the northwest side of the Quimsa Cruz range. At Machacamarca, the Cia. Minera de Oruro installed a new type of roasting furnace which was developed for chloridizing its Oruro ores. British and American interests considered the possibility of treating the enormous dumps of the Cia. Huanchaca de Bolivia at Pulacayo, which are estimated to contain 22 oz. of silver per ton.

Another region of considerable activity in development work in 1920 was the south of Bolivia. In May the Bolivian government contracted with an Argentine firm for the construction of the last link of 128 miles needed to complete the connection between the Bolivian and the Argentine railroads, that is, from Atocha to La Quiaca. When finished the road will provide greatly improved transportation facilities for this region and undoubtedly result in greater mining activity. Present mining operations are conducted by Aramayo Francke & Co. and the Cia. Minera y Agricola de Oploco. Both of these companies have installed new facilities for handling their increasing production, especially at Chocaya. The former company is building a new reduction works for silver ores at that place, and the latter is introducing the new type of roasting furnace devised at Machacamarca. The operations of the Oploco company were also expanded at Choroma.

The petroliferous regions of eastern Bolivia in the

departments of Santa Cruz, Chuquisaca, and Tarija attracted much attention in 1920. A number of geologic expeditions were sent in during the year, and preparations were made for drilling. American, Bolivian, and Chilean syndicates were most active in the work. Early in the year the Bolivia-Argentine Exploration Syndicate, headed by William Braden, announced the acquisition of a concession of nearly 5,000,000 acres.

Argentine Republic

EDITORIAL CORRESPONDENCE

THE installation of a 200-ton copper smelter by the newly organized Famatina Mining Co., operating at Santa Florentina, in the Chilecito region, was the principal event in mining in Argentina during 1920. This smelter, which is equipped with reverberatories fired with pulverized charcoal, was erected to treat a 5 to 6 per cent copper ore carrying gold and silver. Efforts were also made to organize a company with Chilean capital to exploit a wolfram mine in the Chilecito region. Benito Villeneuve, vice-president of the republic, endeavored to establish a company with Dutch capital to work the mines of Paramillo de Uspallata near Mendoza. Permits were sought by Argentinians, Chileans, and North Americans to explore 2,500,000 acres south of Mendoza for rafaelite, vanadium ore and petroleum.

Chile

BY GEORGE W. TOWER, JR.

Mining Engineer, New York

EXCEPT for the continuation of the construction programs of the Chile Exploration Co. at Chuquicamata and the Braden Copper Co. at Braden, the mining industry in Chile in 1920 seems to have continued on much the same scale as in 1919. Copper was the principal metallic product, major operations having been confined to six or seven companies, against twenty-four in 1913. The tonnage mined, however, in 1920 was about 7,000,000, yielding about 106,000 to 110,000 tons of copper, as against 1,050,000 tons of ore and 33,500 tons of copper in 1913.

Braden mined 2,275,000 tons of ore, which it is estimated will yield about 33,000 tons of copper. The grade of ore was a little poorer than in 1919, but operating costs were somewhat lower, or about 2c. per lb. copper, owing to improved labor or operating conditions. The construction program was continued during the year, and at the present rate will bring the plant to a 10,000-ton capacity in the fall of 1921.

The Chile Exploration Co. mined 4,000,000 tons of ore in 1920, estimated to yield 108,000,000 lb. of copper. The construction program progressed satisfactorily. Production was held down. About 15,000 tons of ore can now be mined and treated daily. The mine program has been so arranged as to permit an output of 30,000 tons per day by adding shovels, ore cars, and engines.

Anaconda's subsidiary, the Andes Copper Mining Co., continued development, but is not yet equipped to produce. A process of ore treatment is said to have been developed at Anaconda. A 60-mile railroad and a power plant on the coast have been built, and a water supply has been provided. Another subsidiary, the Santiago Mining Co., is said to be planning to erect a 750-ton concentrator, which seems to indicate a substantial tonnage of developed ore.

Other copper companies include the Catemou, at Aconcagua; the Central Chile, at Ovalle; the Naltagua, at El Monte; and the Poderosa, at Collahuasi. The Bethléhem Chile Iron Mines Co. is preparing to produce iron ore at the rate of 1,000,000 tons per annum from the Tofo deposit near Coquimbo, and has built five

steamships and is planning five more for bringing the ore to this country.

The figures of production of other metals are not readily available. These include gold, silver, lead, manganese, mercury, molybdenum, nickel and cobalt. Aside from the precious metals, such production was small.

South Africa

BY H. F. MARRIOTT

Consulting Mining Engineer, Leeds, England

GOLD MINING in South Africa entered an eventful period in its history during 1920. The fluctuating price of gold in the London market continued, and its influence on the profits of the industry enabled some of the lower-grade mines to operate. For the first ten months of 1920 the gold production of the Transvaal was 6,887,673 oz., of a value at the standard price of gold of £28,928,227, as against 7,001,940 oz., of the standard value of £29,762,304, for the corresponding period in 1919. The additional revenue due to the increased price obtained from January to October, 1920, is estimated at approximately £8,315,196, 28.9 per cent of the standard total. Another aspect of the gold premium is its effect on the ore reserves, as it enables many of the shorter-lived mines to include within the profit limit many blocks of reef standing in the mines which had previously been classed as unpayable.

The number of producing mines on the Rand at the end of September was 41, as against 46 in September, 1919. The mines which ceased operations meanwhile were the Jupiter, Simmer Deep, Princess Estate, and New Heriot, and the City and Suburban was absorbed by the City Deep. At the end of September the 400-stamp mill at the Knights' Deep burned down, and as the mine was getting toward the end of its life, it was decided to cease operations. At the Village Main Reef mine the remaining reserves were nearly exhausted, when a serious fall of rock in October necessitated immediate and permanent closing down. On the Roodepoort United, shaft sinking and development ceased in June, and the standing ore reserves are to be mined so long as they show a profit. The New Kleinfontein company suspended development in the Apex section, which it acquired in 1914. The native labor freed by these reductions was quickly absorbed by neighboring mines.

The Low Grade Mines Commission appointed last year by the Union Government to investigate the position of the lower-grade mines published its final report in May, 1920. Its recommendations were:

(1) That no state subsidies should be given; (2) that a full inquiry be made by the government before any mine closes down; (3) that the piece-work system should be extended; (4) that inducements should be offered to the natives to remain at the mines for longer periods; (5) that the system of joint councils of employers and employees to settle points at issue should be developed; (6) that about 5,000 natives be recruited from north of Lat. 22 deg. south to test the contention of the medical authorities that the previous prevalent diseases among tropical natives can be minimized; (7) that the color bar should be removed. This last recommendation was not unanimous.

No action has yet been taken by the government.

In February the white miners, influenced by the increase in the gold premium, demanded an increase in wages, and obtained an advance adding to the cost of

the industry by £2,250,000 per annum. Some natives fomented a strike in March, and the readjustment of wages to meet differences added an annual charge of £800,000. The question of the shortage of native labor tends to become more acute. Competition has increased considerably, owing to industries which can offer higher rates of pay and better conditions. Another important point is that 50,000 natives will be required to replace Indian labor being repatriated from Natal.

The increased profit obtained by selling gold in a free market is reflected to some extent in the increased dividends paid. In June, 1920, the total amount of dividends declared by gold-mining companies in the Transvaal was £3,268,196, as against £2,561,977 for the corresponding period of 1919. The forecast for the December dividend indicates a further increase. Detailed notes follow:

The Anglo-American Corporation absorbed the Rand Selection Corporation during 1920, giving eleven shares for five, and increasing capital from £2,000,000 to £4,000,000 for this purpose. The City & Suburban company found it impossible to continue working at a profit through its 7,000-ft. incline shaft, owing to the cost of upkeep, and in May it was absorbed by the City Deep for 45,000 fully paid-up shares in that company. On the Western Rand, the south vertical shaft of the Randfontein Central cut the reef in June at a depth of 4,130 ft. The sampled value given was 12.1 dwt. over 48 in. Later in the year this company acquired the Randfontein Deep's assets for 250,459 £1 shares. High-grade ore has been found in the deeper levels of the central portion of the Consolidated Main Reef property, and the prospects of the mine are much brighter. Sub-vertical shafts are being sunk to open up the reef in the southern section of the Crown Mines property. The development for the year is good, and the outlook for this mine is satisfactory. The south circular shaft at the City Deep mine was 2,577 ft. deep at the end of September. This shaft is in two stages, and will be, when finished, the deepest shaft in the world. The question of dealing with the water from the outcrop mines as they become worked out is occupying the attention of the mines below them. The installation of a central pumping station is being considered.

The resources of the Rand are being upheld by the Far Eastern Rand, where eight mines, viz., Brakpan, Geduld, Government Gold Mining Areas, New Modderfontein, Modderfontein East, Modderfontein B, Modderfontein Deep, and Springs, contain reserves actually developed amounting to 35,177,515 tons, of a gross value, at the standard rate, of £77,000,000. The reserves of the New Modderfontein and Government Areas alone total nearly 20,000,000 tons of high-grade ore. For the year ending June 30, 1920, the total profit of the New Modderfontein was £1,493,845. Of this £464,657 was due to the gold premium. A circular shaft is being sunk on Modderfontein B to facilitate the extraction of the high-grade ore in the western section of the mine. It is estimated that the total depth will be 1,700 ft., and 750 ft. had been sunk at the end of September. The southeast circular shaft has cut the reef, but good values are not as yet disclosed.

The Modderfontein East began milling on April 23, at the Apex plant of the New Kleinfontein company, seven miles distant, which has a capacity of 27,000 tons per month. The ore reserves on June 30 were 1,755,400 tons, of a value of 32.5/- at standard rate. It is stated that this company is acquiring the Jupiter-Simmer Deep 300-stamp reduction plant, capable of treating 50,000 tons per month. At the Geduld Proprietary, 2,820 ft. on the seventh level near the new shaft has shown 64 per cent payable, averaging 17.5 dwt. over 66 in. The south shaft of the New State Areas intersected the reef in October at 3,676 ft., the assay being 89.8 dwt. over 18.9 in. The reef is nearly flat, the dip being 8 deg. By the terms of the lease under which this property is held the government will get the major proportion of the profits. No. 3 shaft at Springs Mines cut the reef at 3,676 ft. Development throughout the mine showed 58 per cent payability for the year, at 21.7 dwt. over 26.5 in.

Early in the year the Union Government found it necessary to issue an official warning in regard to speculation on the Far Eastern Rand. It condemned the misuse of reef nomenclature, and confirmed the continuity of the Van Ryn Reef, which is the only payable gold carrier known in the district. The burdensome Miners' Phthisis Act of 1919 was reported on during 1920 by a select committee. Its findings do not foreshadow relief. A further commission is now sitting. A movement is on foot to begin the manufacture of wire ropes in South Africa. Prominence has been given to the question of establishing an iron and steel industry on a large scale in South Africa.

The coal industry in South Africa, especially in Natal, is expanding, the gross output increasing from 7,665,753 tons for the first nine months of 1919 to 8,436,832 tons for the corresponding period in 1920.

Oil shales have been the object of considerable attention. In the Wakkerstroom district the deposit has been estimated at 3,000,000 tons of shale per square mile. Samples have given 23 to 25 gal. of oil per ton from the upper shale, and 14 to 18 gal. per ton from the lower shale. The shale formation extends north and south over a distance of 200 miles. The African Oil Corporation has been formed to exploit the Wakkerstroom area. A test shipment to Scotland gave a production of 31 gal. a ton. The Union Petroleum Co. has been formed, with a nominal capital of £150,000, to investigate properties in the same district.

TABLE I. TRANSVAAL GOLD PRODUCTION
Witwatersrand District

Year	Tons Milled	Value	Value per Ton Milled, Shillings	Outside Mines Value	Total Value for Transvaal
1918	24,922,763	£34,823,017	27.9	£945,671	£35,768,688
1919	24,043,638	34,454,478	28.7	929,496	35,383,974
1920(a)	24,836,609	33,979,075	....	885,112	34,864,187

(a) Estimated. All values given are at standard price of gold.

The African Platinum Mines, Ltd., with a capital of £150,000, of which £100,000 is working capital, has been formed to work a deposit being opened up in the Cape province. Nickel has been discovered in the Barberton district. A sample taken over a width of 2 ft. 3 in. gave 17.2 per cent nickel. In the Messina district a new strike of copper is reported. The Messina (Transvaal) Development Co., Ltd., is erecting a new plant with largely increased capacity. A deposit of vanadium ore has been developed at Doornhoek, near Zeerust, and the African Vanadium & Lead Mines, Ltd., was formed, with a capital of £160,000, to work the mine. About 10,000 tons averaging 4 per cent V₂O₅ has been developed.

Interest has been revived in the silver deposits in the Transvaal, on which operations had been suspended for many years. The Transvaal Silver & Base Metals,

Ltd., with a capital of £70,000, was formed to work the old mines of the Transvaal Silver Mines, Ltd., on Dwarsfontein. The Pretoria Silver & Lead Co., Ltd., with a capital of £80,000, has acquired the mineral rights of another portion of the same farm. Shipments of ore have been made from both properties.

The post-war boom in diamonds, in which record prices were obtained, came to an end in March, but the industry remained active during the year. De Beers Consolidated Mines, Ltd., paid a record dividend.

Tables I and II show respectively the yield and the labor position in 1920, as compared with 1918 and 1919.

TABLE II. LABOR EMPLOYED IN TRANSVAAL GOLD MINES

	Whites	Natives	Native Death Rate per 1,000
1918.....	22,953	161,095	23.72
1919.....	23,574	173,168	16.43
1920, January.....	23,581	179,502	15.69(a)
April.....	23,883	199,700	
July.....	22,366	186,021	
September.....	21,914	174,616	

(a) For twelve months ended Sept. 30.

Belgian Congo

BY SIDNEY H. BALL

Mining Geologist, New York

IN THE Belgian Congo the year 1920 was remarkable more for the amount of development and construction work done than from the point of view of production. Indeed, on account of the lower metal prices, the 1920 production was exceeded by that of 1919.

The Union Minière du Haut Katanga produced in the Katanga copper belt approximately 19,500 long tons of copper, the production being unsatisfactorily affected in March, April, and May by strikes on the Rhodesian railroads and in September and early October by a strike at the company's mines and smelter. The white strikers demanded an excessive wage increase, but returned to work upon the deportation from the colony of E. J. Brown, an Australian agitator. The gross profit of the company for 1919 amounted to almost 30,000,000 fr.; the net profit being about 13,500,000 fr., of which 12,500,000 fr. was paid as dividends at the rate of 50 fr. per share. On Nov. 4, 1920, the capital of the company was increased to 15,000,000 fr. in common stock, there being, in addition, 150,000 dividend shares of no specified value. A debenture loan of 40,000,000 fr. was also authorized.

In 1920 the development in the Kasai diamond fields was pushed, but no attempt was made to increase the diamond production. The Forminière produced about 215,000 carats of diamonds and notably increased its reserves of diamondiferous gravel. The delimitation of the 4,000 miles of diamond-bearing land owned by the company is being pushed. In addition, this company directed the development work of five associated companies operating in the Belgian Congo, and the production, although not consequential in 1920, should in 1921 be important. A sister company, operating in Angola or Portuguese West Africa, known as Diamang, in 1920 had a production of approximately 100,000 carats.

The gold-placer mines operated normally in 1920, and the production presumably approximated \$2,000,000. The tin production by the Geomines continued to be important, and the Union Minière has recently created a new company to work its tin mines. Although progress in 1920 was not as great as in certain former years, the year is associated with fewer depressing factors than are to be noted in many other mining districts.

Australia

EDITORIAL CORRESPONDENCE

MUCH of the following information has been supplied by Mr. Arthur Moline, general manager of Bendigo Amalgamated Goldfields, now in this country:

During 1920, the long-drawn-out Broken Hill strike, which lasted from May, 1919, until November, 1920, was settled. After many abortive conferences, the federal prime minister and the premier of New South Wales succeeded in settling the controversy.

As during the last five or six years, there was a marked shortage of skilled labor in 1920, though the sharp decline in metal prices at the end of the year will probably reduce the demand. Owing to conditions common throughout the world since 1914, gold mining was seriously handicapped. The saving feature of the situation was the premium obtained by the sale of gold abroad, chiefly in the Far East and also in the United States. This premium is approaching a total of £2,000,000, which has been of material help to the industry. Wages in various districts have been increased from time to time to meet the increased cost of living, usually by means of conferences between the respective parties in interest. Cost of living continued to rise until the third quarter, but is now falling, and wages may be expected to follow.

The various mining industries of the country maintained their relative positions: Mount Lyell, Wallaroo & Moonta, and the Cloncurry district retained their places as producers of copper, and Western Australia was first in the production of gold and Victoria second. For the first time in several years Victoria's gold production showed an increase, but this came from the output of a limited number of mines, and the future is somewhat uncertain. Hopes for increased yield of copper in the Cloncurry field were not realized, Mount Elliott remaining down and Mount Cuthbert running but a short time, although Hampden Cloncurry, and several small properties were in full swing. The total mineral production was seriously reduced by the cessation of work at Broken Hill.

Few new discoveries of mineral of any importance were reported. The early promise of Hampton Plains was not fulfilled up to the end of the year. Numerous small disconnected deposits of high-grade ore were found here, but so far that is all that can be asserted. A number of discoveries in various other sections of Western Australia were made as a result of those at Hampton Plains, but the same remark applies to them as to the latter.

Nothing new was published in the way of metallurgical developments during 1920. The idleness of Broken Hill owing to industrial trouble affected the position. Considerable work has been done by Mount Lyell on the Minerals Separation concentration of low-grade copper ores, with probably far-reaching results.

The production of electrolytic zinc at Risdon, Tasmania, reached commercial dimensions in 1920, and it can be accepted that the future of this project is assured. As a result, the Electrolytic Zinc Co., is proceeding with equipment costing another million sterling. During the year this company took over the mines and other assets of the Mount Read & Roseberry Mines, Ltd., thereby adding materially to its reserves.

A project of national importance undertaken during 1920 was the further extension of the Broken Hill Proprietary Steel Works, at Newcastle. Within a few years Australia should be in position to supply all the structural steel it requires. State mining ventures in Queensland suffered checks in 1920, though the Chillagoe State Smelters showed a profit for the first six months, despite the fact that operations were hampered from lack of ore. In Tasmania there was a tendency in industrial matters to break away from federal control and return to state jurisdiction. The Queensland government announced its intention of acquiring the important iron deposits on Yampi Sound, Western Australia, on which it holds an option. In New South Wales, steps were taken to realize the assets of Great Cobar, Ltd., after many attempts had been made to carry on operations. A profit-sharing scheme for its employees was proposed by the Wallaroo & Moonta, and the co-operative plans started in 1919 by Bendigo Amalgamated Goldfields operated satisfactorily.

Mining in Europe

BY W. A. DOMAN

London Correspondent of the *Engineering and Mining Journal*

THE metal-mining industry in Europe during 1920 is, in general, a long series of disappointments.

Dealing first with England, tin winning is the principal metal mining industry, and it is rather surprising to relate that of the producing companies only one had paid a dividend up to the beginning of December. South Crofty disbursed only £20,000, and presumably the profit was obtained as much from wolfram as from tin.

It is scarcely necessary to state that such a poverty-stricken result, from the investor's standpoint, is the direct outcome of the weakness of the metal market. Tin started 1920 around £347 per ton. In March it exceeded £411 for cash, and forward metal was quoted as high as £416. Prices like these held out hopes of a flourishing industry, but a few thousand tons of tin unexpectedly arrived from the East and upset all calcu-

lations. At the time of writing the quotation is about £215, a drop of £130 from the beginning of the year and of £200 from the peak.

Only four companies made substantial outputs in 1920; namely, East Pool, with 666; Geevor, 198½; Grenville, 225½; and South Crofty, 448½ tons of concentrates. The return of South Crofty is for both tin and wolfram. Grenville occupies a respectable place, or did until July, for lack of funds has brought trouble upon the company. Early in 1920 money was obtained, but the amount proved inadequate, owing to the coal strike and labor troubles, for Cornish miners, like others, demanded higher wages. The Cornishmen are not overpaid, though this is due rather to the industry being down on its luck than to differences with employers.

Attempts to fix a minimum price for tin are so far without avail. The industry applied to the government

for a loan of £100,000. The government proved both stony and stony hearted. J. L. Collins has invented a chlorine process which is to be tried on tin ore to improve recovery. The original waste at Cornish mines is large. Streamers, however, make a pretty good living in treating it.

Apart from tin, the metal-mining activities of Great Britain were not extensive in 1920. Prices have not ruled at a level sufficiently high to attract capital. Representatives of the lead and zinc mines endeavored to get a subsidy from the government, but the authorities regard such matters as pertaining to private capital. Taxation is onerous, and though there are numerous deposits they are not of an extent to warrant the formation of large companies. Various lead mines are being reopened in Yorkshire. A "labor" lead mine is being worked in Derbyshire, and a zinc-lead property in Carnarvon. The outputs of these mines are not announced, but they are only small. The Great Laxey, a fine old lead mine, is being closed down on account of reduced yield and the demands of labor. The Swansea Vale and English Crown Spelter Works have ceased operations, as under present conditions they cannot continue profitably. The capital raised in England for mining companies in 1920 was approximately £4,200,000, of which more than half was for properties in the British Empire.

So far as can be gathered, metal mining on the Continent of Europe was not developed to any great extent in 1920. There the trouble seems to be identical with that in England—lack of capital to open up the mines. The Rio Tinto property has not been worked for many months, owing to a strike of workmen for higher wages.

In Portugal a tin-mining company called the Ervedosa Tin Mines has been formed to acquire the property of a French company, on the river Ruella, near Mirandella. Josiah Paull, of Cornish fame, reported upon the mine, and stated that the orebodies, though low grade, are large, the average content being 0.7 per cent to 1 per cent of tin, of which 70 per cent can be recovered. The method of working is by quarry. Although the capital was offered in England, the prospectus did not appear particularly attractive. Base-metal propositions have not the "pull" that formerly belonged to them.

A large amount of British capital is invested in Russian mines, these, by the way, being in Siberia. They form some of the finest gold, lead, zinc, and copper deposits in the world. Having been nationalized by the Bolshevik government, they are at a standstill, and are not likely to be reopened until satisfactory conditions can be restored. The Russo-Asiatic Corporation, which controls four of the largest mineral areas, embracing many thousands of square miles, is meantime turning its attention to oil and a silver-lead property in the Pyrenees. Some capital assays have been obtained from the latter. The principal attraction in the proposition, however, is the fact that the old workings can be traced for several miles, and consequently there is the possibility of the present company being converted into a parent undertaking. So far nothing in the way of production has been reported, according to information available at the present time.

The only satisfactory mining company about which occasional reports are heard is the Pennarroya, and this had to make a debenture issue. The methods of working practiced by French engineers differ materially from those of their British confrères, the latter always wanting to develop far ahead of requirements. A company called the Dome Mining Corporation has acquired a gold-mining concession in Spain. This covers a very large area, and in parts high assays are shown. The property was extensively worked by the Romans, and the remains of their engineering operations are still visible. Although the area was reported upon many months ago, operations do not appear to have yet begun. This may be due to the fact that conditions in Spain have altered, the workmen in nearly all industries demanding higher wages. Spain drew in large quantities of gold during the war, but her financial condition has taken a retrograde step.

Greece and parts of Turkey are highly mineralized. In the former country, attempts are being made to raise capital for working copper, lead, nickel, and zinc deposits, and the government has called for tenders to work argentiferous barytes concessions in Melos. According to estimates, there is 10,000,000 tons of the ore which contains on an average 164 gm. of silver per ton.

Mining in the Near East

BY LEON DOMINIAN
Washington, D. C.

THE condition of the mining industry for 1920 in the Near East may be defined as one of gradual recovery in the European section of the region. In the Asiatic area, however, the situation was at a standstill, and except perhaps in the case of the Heraklea coal field, there were few signs of progress toward the moderate activity of pre-war years. An outstanding fact deserves to be recorded, however, and that is that the Near East, taken as a whole, should be considered by American manufacturers as a good market and a virgin field for mining machinery of all kinds.

Of all the Near Eastern states, perhaps Yugoslavia and Rumania gave most evidence during the year of a partial recovery to pre-war conditions. The former nation, which now comprises the Kingdom of Serbia and Montenegro, as well as Dalmatia, Slovenia, and Croatia, is beginning to realize that its mineral re-

sources constitute an asset of no mean importance in the appraisal of its national wealth.

According to surveys of the mineral situation made in the course of 1920, it was found that the lack of modern machinery and appliances hindered the metal-producing industry, which, like all industries in this region, still depends on foreign capital for its development. Local financial resources are still greatly depreciated.

Though complete statistics are not available, it is estimated that through improved transportation the coal production of 1920 will exceed that of 1919, which was as follows for the several provinces:

	Metric Tons
Bosnia-Herzegovina	675,000
Serbia	104,000
Croatia and Slavonia	251,000
Slovenia	1,150,000
Baranga	311,000

About 215,000 tons of oil was produced in the Rumanian oil field during the first half of 1920, or about 50,000 tons less than in the corresponding period for 1919. The Pratrova district appears to have been the main producer, leading with 166,000 tons. Damboritzza produced 27,000 tons, Buzen 10,500, and Bacan 10,600. Strikes interfered with production. A five years' concession was granted by the Ministry of Industry and Commerce in June to a private Rumanian company, the Industria Rumana de Petrol, for the distribution of oil products.

From estimates and forecasts made before the end of 1920 it is expected that the average production of oil during the year will amount to 2,200 tons per day. This is still far from the pre-war production, as the average yield in 1913 was 5,237 tons per day, or about 500 wagons, as compared to the present output of 275 wagons. The year's production was in fact less than that of either 1918 or 1919, and the quantity of oil and its byproducts available for export was low.

In general, however, the Rumanian mining industry has been fairly active. The demand for concessions was heavy during the year, and grants were given mainly for the exploitation of petroleum, ozokerite, and asphalt in new localities. The liquidation of mineral lands owned before the war by German and Hungarian companies was in progress, along with their conversion into Rumanian concerns. During the year mica deposits were explored in the district of Mehedintz, and about fifteen carloads shipped in the summer. Work on the copper deposits of the Oltenic region, where mining dates back to the Roman period, was suspended, and production confined to the extraction of pyrites for the manufacture of sulphuric acid.

In Bulgaria operations were confined chiefly to coal. The country does not produce sufficient coal for home needs, nor is the coal high grade. Coal mining is still in a backward stage. Practically no oil was produced, as most of the oil companies operating in the country are awaiting confirmation by the Hellenic government of their titles to oil lands in Thrace.

In Turkey, by which Asia Minor is henceforth implied, mining operations have been confined almost exclusively to coal. In view of the urgent need of fuel during the war, attempts made to increase production succeeded, but since the armistice many of the mines which were worked during the period of hostilities have been abandoned.

Apart from coal, very few ores were mined. Production in the important chrome ore deposits of the Smyrna region, which formerly reached 10,000 tons, has fallen off considerably. The mines of the Borax Consolidated, a British company, were returned to their owners by the Turkish government, and work was resumed, although production is low when compared with pre-war records, the deficiency being ascribed mainly to labor shortage.

In the course of 1920 Italian engineers undertook extensive mining operations in the Georgian Republic, and it was announced in October that the coal of the Iquarceli Basin, stated to contain over 200,000,000 tons, was to be worked by an Italian company to supply the Italian market. In the Armenian region, although no production was obtained during 1920, interesting surveys of the mineral situation were made, which show that the region is rich in minerals and the industry awaits the re-establishment of order as well as the in-

roduction of capital and transportation facilities. Copper was extracted on a small scale at the Lori mines, in the district of Bortchalo, and sent to the near-by refineries of Allaverdi, Schamluk, Schagale, Scar, and Manes. Before the war these refineries yielded about 4,200 tons of red and electrolytic copper per year. In the Langhezur and Goward region it is estimated that about 722,000 tons of copper ore was ready for shipment to the smelters at Siounik at the end of 1920. In the Olti district the coal reserves are estimated at 226,000,000 tons and those of rock salt near Nakhitchevan at 47,000,000 tons.

The oil situation in the Near East is one that deserves close attention on the part of American oil interests. In general, it may be stated that the opening up of fresh supplies has fallen far below the ever-growing demands of the many great industries which depend on oil. The changing situation due to the constantly increasing use of oil was observable in Egypt during 1920. At Port Said and Suez the number of ships in transit fitted with combustion engines is rapidly growing, together with a corresponding decrease of those using bunker coal. The question of fuel shortage was an important one during 1920 in Egypt, and caused the Anglo-Egyptian Oilfields Co. to carry on exploration work at various sites. Production was kept up at the oil wells at Gensah and Hasgada, on the Egyptian coast of the Red Sea.

In Mesopotamia, the Anglo-Persian Oil Corporation of London, which is refining oil at Mohammerat, in Persia, had obtained certain rights from the Turks which have been recognized by the present British authorities. Little work appears to have been done in Mesopotamia. An oil refinery is in construction on the Tigris, ten miles north of Bagdad, and it is reported that crude oil will be brought there from the Persian fields to be refined for the Bagdad market.

Gold Mines of India

BY W. A. DOMAN

London Correspondent *Engineering and Mining Journal*

OLD AGE is beginning to tell upon the Kolar mines. As they become deepened, and additional capital is needed, results are less favorable. For years past, gold production has been on a declining scale, and in the eleven months of 1920 for which figures are available the output is only 409,413 oz. In 1919, the yield was 461,171 oz., and there seems little probability now of the difference being made up. The producing mines are the Mysore, Ooregum, Nundydroog, Champion Reef, Balaghat, and North Anantapur. Mysore is the premier producer, but even here a decrease is noticeable.

Twelve months ago Mysore recovered over 15,000 oz.; in November, 1919, the total was only 12,249 oz. In December, 1919, these mines received an addition to their output by the closer clean-up that is practiced. The total production in January, 1920, was 39,073 oz. It was 4,751 oz. less in November. The general decline can best be shown by pointing out that, in 1916, the output of gold was 541,077 oz.; in 1917, 520,362 oz.; and in 1918, 485,236 oz.

The companies were severely handicapped by the method of selling, for the premium which was available for the mines of the Rand did not operate to the advantage of those of India. During 1920 the Indian government made a new arrangement, and now has the option

of purchasing gold at the London market price calculated at the current rate of exchange. Any portion not so taken may be disposed of by the producers as they may choose.

With the declining fortunes of the Kolar field, though it will continue to produce for some years, three of the leading companies have formed the Indian Mines Development Syndicate to prospect mineral concessions elsewhere in India and in Burma. At the end of 1919, the Mysore doubled its capital of £305,000 for the deeper development of the mine, and the program is now being carried out, though only Ribblesdale's section is showing well. The Ooregum also had to spend money for extra development, about £40,000 for deepening the vertical shaft and £30,000 for equipment. These funds were on hand.

The Nundydroog was less fortunate, and was under the necessity of reconstructing to provide a sum of £170,000. The liability of the new 10s. shares was the heavy one of 6s. As the Balaghat, to the north, and the Ooregum, to the south, have shown better, there is the hope that Nundydroog will continue to yield profitable ore. The Anantapur field has proved a disappointment, and neither the Anantapur nor the North Anantapur has given encouragement.

On the Jibutil, where developments were suspended some months ago, prospecting is to be resumed. The Hutti Gold Mines is wound up. The dividend list is poor this year. The Champion Reef has disappeared, and the others have paid as follows: Mysore, 1s. 9d. per share; Nundydroog, 1s. 6d.; Ooregum, 2s. 3d.; Balaghat Preference, 10 per cent. The total is under £220,000.

At Rakha Hills, the only place where copper is produced in India, the Cape Copper and the Cordoba Copper companies are working. The latter had over £70,000 available, and the former has made a public debenture issue of £120,000.

China and Japan

BY THOMAS T. READ

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THE mining industry of Japan suffered from the financial crisis which so severely affected the whole country, beginning with the second quarter of 1920. The iron and steel industry, which had been expanded by the war more than any other, naturally was most severely influenced, but the situation of nearly all metallurgical enterprises was serious. The government works at Wakamatsu revised its program so that its output for 1920 will probably not exceed 300,000 tons, instead of 400,000 tons, as first projected.

The plans for building a steel plant at An-shan-chang, in Manchuria, have apparently been cancelled, and the relatively small blast furnaces already constructed are operating only at reduced capacity. The Toyo Seitetsu Kaisha (Oriental Steel Co.), which was reported by the British commercial attaché as having taken about 300,000 tons of iron ore from near Wuhu, on the Yangtze, in 1919, has greatly curtailed its operations. The Mitsubishi Iron Mining Co., near Chinnapo, in Korea, and the Pen-hsi-hu Iron Co., at the place of the same name in Manchuria, continue to operate, but no figures are available as to the present rate of output. It was proposed by the four principal Japanese steamship companies to advance freight rates on iron and steel

products 20 to 50 per cent, in order to help protect the domestic enterprises from the effects of foreign competition, but the competition for cargoes on the Pacific rendered this impracticable. The new blast furnaces at Tayeh of the Hun-Yeh-Ping Coal & Iron Co. (a Japanese-controlled Chinese company) are nearing completion, and it is hoped to have them in operation early in 1921. Meanwhile, the old plant at Hanyang continues in operation. The Yangtze Engineering Works blew in its 100-ton blast furnace on June 26, 1920. This is a purely Chinese company, which has grown rapidly and seems to have been managed with much greater skill than has characterized other Oriental iron and steel enterprises. Reports that the Lung-Yen Mining Co., which controls the Lungkan and Yentungshan iron deposits, near Hsuanhuafu, is constructing a blast furnace near Peking are premature, the project not having advanced beyond the planning stage. It has been definitely stated and as definitely denied that this enterprise is also Japanese controlled.

The demand for coal in the Far East continues to grow. Operating costs have greatly increased, and as production in Japan, which has chiefly supplied the coast markets, does not increase with equal rapidity, prices have sharply advanced of recent years. The Kailan Mining Administration has greatly increased its output, and even sent one cargo of coal to Europe. The coal trade in the interior of North China has been hampered by a shortage of equipment to move coal. The Kailan Mining Administration is considering a plan to build a blast-furnace plant near its mine, as its coal steamers returning from Shanghai will bring back iron ore from deposits along the lower Yangtze as return cargo.

The event of 1920 in metal mining in China was the announcement of the formation of the Yunnan Ming Hsing Mining Co., which is a joint company formed by the New York Orient Mines Co. and the government of Yunnan. According to a statement by H. K. Tong, in the Chinese press, the company is to have a capital of \$1,000,000, gold, at the beginning, but this amount may be increased without limit. Of the five directors of the company, three are to be Americans, and there will be one director-general, who will check all expenditures. The Chinese partners will not bear any expense for preliminary investigation. This company is now engaged in reopening an old lead-zinc-silver mine near Tengyueh, which offers a good deal of promise. At the request of the government of Yunnan, H. Foster Bain made a study of the tin and copper resources of Yunnan and reported on them to the government.

The Shuikousham lead-zinc-silver mine has been examined by W. H. Wiley and Jules Labarthe for another American firm, and the possibility of constructing a zinc smelter is being considered. Much interest has been displayed in Chinese mineral deposits by various American firms, but none of the other investigators has proceeded as yet to the point at which public announcement in regard to them has been made. J. Morgan Clements carried on investigations of the mineral deposits of China for the Bureau of Foreign and Domestic Commerce throughout 1920, and furnished to the Bureau a number of reports that have been made available to firms that are likely to be interested. A significant feature is the interest shown in the non-metallic mineral deposits of China, both asbestos and magnesite having attracted considerable attention in the year under review.

Metallurgy of Copper

BY E. P. MATHEWSON

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ALTHOUGH nothing startling was discovered in copper metallurgy in 1920, many interesting improvements were made. The most important was the development of the application of pulverized coal to both blast and reverberatory furnaces. Several different plants have equipped blast furnaces to operate with pulverized coal. It is generally conceded that about 30 per cent of the coke on the charge can be replaced by an equal weight of pulverized coal. The blast furnaces of the new Cerro de Pasco smelter now under construction at Oroya, Peru, are designed to burn pulverized coal, the first large blast-furnace plant to be so equipped.

One plant in the Southwest has put in a large installation for the use of pulverized coal for reverberatory copper smelting, omitting the complicated drying and separating apparatus. After the coal is pulverized it is drawn directly to a fan under suction and thence to the furnace under fan pressure. The furnace has been operating about two months, and reports are very favorable. Most metallurgists would rather not attempt to put in a large installation of this character, owing to the great variation of moisture in the coal in most localities, hence an irregular supply of fuel to the furnace. The coal used at the installation referred to is remarkably free from moisture. Of course, many small furnaces are equipped in this way; in fact, the first application of pulverized coal to reverberatory copper furnaces was made in this manner. This was at the Highland Boy plant, at Murray, Utah.

At the Copper Queen reduction works a nine-hearth roaster, of the McDougall type, has been developed, and is said to be a success.

At Chrome, N. J., where nodulizing has been practiced for some years, an improvement has been made in passing the nodulized product between rolls which flatten out the nodules, making a product which is well suited for blast-furnace charge.

Hydro-metallurgy of copper has received a great deal of attention, and many modifications of old processes have been studied. One of the most important of these is the process to be adopted by the Andes Copper Co., of using liquid sulphur dioxide as the precipitant of the copper from the leach solution. This process is being developed in the Anaconda research laboratory under the direction of Fred Laist, general manager. This is the process that was called to the attention of the metallurgical world by Dr. George D. Van Arsdale. At Ajo, Ariz., some improvements have been made in the handling of cement copper from rejected electrolyte. The cement copper is dissolved in agitation tanks in a portion of the electrolyte containing approximately 0.5 per cent ferric sulphate. This reduces the ferric sulphate to the ferrous state. The solution is added to the purified electrolyte from the sulphur-dioxide towers, and then the combined solutions are returned to the electrolytic tanks.

W. E. Greenawalt has taken out a number of patents for his electrolytic process for the deposition of copper. In this, the chief features are that the ferric sulphate is never allowed to exceed one-quarter of 1

per cent in the electrolyte, and when the electrolyte is to be rejected, owing to excess of impurities, the copper is precipitated out by hydrogen sulphide. This semi-fluid precipitate is pumped to those tanks which are most acid and there re-dissolved, at the same time reducing the ferric sulphate in the electrolyte to the ferrous state.

The enormous installation of Cottrell apparatus at Anaconda was put in good working order during 1920, and results are said to be gratifying. Many other installations of Cottrell apparatus have been noted recently. Some interesting discoveries have been made regarding the theory of electrical precipitation.

In the concentration of copper ore, flotation held the center of the stage. The litigation instigated by Minerals Separation against the so-called infringers has gone merrily on; and Minerals Separation has itself been the subject of investigation through the efforts of the Federal Trade Commission and the American Mining Congress. A great many new flotation machines have been put on the market, but it cannot be said that much was added to the knowledge of flotation during the year, and the true physical explanation of the phenomena is still rather obscure. So many investigators are working on the problem that it would not be surprising to have many discoveries recorded in the near future. The Minerals Separation people have allowed one of their chief engineers in London, Mr. Sulman, to publish a long paper on flotation. This paper has met with a great deal of criticism, both favorable and unfavorable. However, the gold medal and premium of forty guineas founded by the Consolidated Rand Goldfields of South Africa, Ltd., has been awarded to the author.

Flotation reagents other than oils are being investigated thoroughly. Not only is the attempt being made to obtain a substitute for flotation oil, but efforts are being made to accomplish selective flotation by means of various reagents, with results that look promising. The discovery of selective flotation reagents that will finally solve the complex sulphide ore problem may be hopefully expected.

Considerable experimentation has been undertaken in this country, Canada, and Mexico in the sintering of flotation concentrate to prepare the material for subsequent blast-furnace treatment. This development is being closely watched by metallurgists, particularly those interested in semi-pyritic smelting. It has been found that the sulphur can be retained in the sintered product or can be driven out at will. It has also been found that the sintered product is well suited for the blast-furnace charge. In the early experiments, the concentrate was put through a fine screen before sintering. The fine screening was a mistake; the most approved screen now is of one-inch mesh.

Copper smelting, like many other industries, has developed to the point where the byproducts produced often show more profit than the principal product. Much of this development was caused by the fact that the agitation regarding smelter smoke has forced the smelting companies to take means to abate the nuisance.

Baghouses and the Cottrell electrical precipitation apparatus have been introduced, resulting in the accumulation, in the form of flue dust in the various smelters, of enormous quantities of rare metals and metallic compounds for which a use must be found. Formerly anything that did not produce silver, gold or copper was allowed to go out of the stack in the form of fumes. Now, this material is largely retained, and at some of the plants it has been a nuisance, as there was no bleeder provided to get rid of the surplus of the various subsidiary metals and compounds.

Some smelters are so situated as to be able to dispose of even their sulphur gases. For example, the Tennessee Copper Co. turns practically all of its sulphur into sulphuric acid, and this is used in the fertilizer industry. Some plants have gone extensively into the manufacture of liquid sulphur dioxide, for which there is an excellent market with the pulp mills and for the manufacture of concentrated sulphuric acid by the contact process. Among the byproducts now being recovered and placed on sale by the prominent smelting companies may be mentioned sulphuric acid, liquid sulphur dioxide, gold, silver, lead, zinc, zinc oxide, zinc dust, test lead, blue vitriol, litharge, cadmium, bismuth, thallium, selenium and its compounds, tellurium, arsenic, fungicides, insecticides, phosphate fertilizers, aluminum and aluminum compounds, antimony, lithopone, platinum, palladium, iridium, nickel

and nickel sulphate, fire brick and common brick.

It would thus appear that the copper-smelting industry is passing through a stage of development that compares with the development of the packing industry. Soon everything in the ore will be saved and put to some valuable use. Slag from the smelters has been utilized for many years in certain localities for ballast for railroads, for the building of highways in concrete mixing, particularly; for foundation work, and in other useful applications. Waste heat is now recovered from all reverberatory furnace installations, and in a few instances is recovered from slag in the form of low-pressure steam. An ingenious recovery of heat from slag is noted at the Tacoma Smelting Co.'s plant, where the slag pots are used for heating certain buildings, it being only necessary to change the slag pots at intervals of many hours. This particular installation should be copied in other plants to cut down the consumption of coal.

In the matter of apparatus for the concentration of ores, vibratory screens seem to have come to the front in a remarkable way. This apparatus seems to be in a fair way to displace the trommel and other less efficient screening devices.

Labor conditions make it imperative that increasing attention be given to the use of mechanical appliances calling for the services of skilled labor in substitution for common labor.

Lead Smelting

BY JULES LABARTHE

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ADVANCEMENT in the process of lead smelting and refining during 1920 was confined principally to the introduction of labor-saving devices for the purpose of mechanically handling the ores, fluxes, and byproducts. Improved crushing and sampling facilities have also been installed at most plants to reduce manual labor.

The use of pulverized coal on the lead blast furnace is one notable achievement in smelting to be recorded, and although only partly successful so far, there is every indication of its ultimate success and great economic value. Conditions incidental to lead blast-furnace smelting have not permitted the use of coal to so large an extent as in copper work, but its use has been successful to a point of replacing approximately one-third of the fuel needed for smelting. This development, in itself, would result in great economy at points where coke is high in price and bituminous coal available at a reasonable cost. The use of coal has resulted in a falling off in the tonnage smelted, but this may be compensated for by the relative cost of the cheaper fuel in replacing coke. The metallurgists of the United States Smelting & Refining Co., Midvale, Utah, deserve great credit for their work in this connection.

Pulverized coal has now been successfully used in the following departments of lead smelting and refining: Steam boilers, drying furnaces, roasting furnaces, blast furnaces, drossing kettles, softening furnaces, desilverizing kettles, refining furnaces, merchant kettles and furnaces, retorts, cupels, silver-melting furnaces, and

assay furnaces. At two Western plants, pulverized coal has replaced oil as fuel for ignition of the charge on Dwight & Lloyd sintering apparatus. This development has resulted in a saving in the cost of fuel and also more perfect ignition of the charge. The coal requirements are approximately six pounds per ton of charge.

A number of improvements in the Dwight & Lloyd grate bars have been made. At the Bunker Hill smelter, a more substantial design of the Trail grate has been developed. This grate is so designed that the air spaces are maintained at a uniform width of opening at all times. This is accompanied by spacing devices which hold the stationary grate rigid and at the same time allow movement in the central member of the grate to keep the openings clean and free from slagged charge. This improvement prevents the sifting of an undue amount of fines into the wind box and at the same time allows a maximum oxidization of the charge and a more equal distribution of air.

At Midvale, another change has been made in the Trail grate, wherein the central member of the grate is made convex on top. This feature tends to deflect the coarse particles of the charge to the sides and over the openings, thus allowing a better circulation of air through the charge and also preventing fine particles from reaching the grate openings and filtering through into the wind box.

The use of the Cottrell fume-precipitating apparatus has become quite general in Western lead smelters. At

some plants, the installation is used for collecting dust and fume contained in roaster gases only, whereas at other plants, blast-furnace gases as well as roaster gases are passed through the treater. In some installations where mixed gases are treated, their basic character has caused difficulty in obtaining good clearance or results approaching perfect precipitation. This has been largely overcome by humidifying the gases by means of water sprays introduced in the flue at a point before the gases enter the treater. The precipitated fume, in most operations, can be ignited in the treater in the same manner as baghouse fume, and this sintered material is then in good condition for smelting in the blast furnace.

An interesting installation of the vacuum system of handling flue dust and baghouse fume has been developed at the Selby smelter, in San Francisco. With this

equipment it is possible to clean the baghouse compartments much more quickly and thoroughly and at the same time prevent a dusty and unhealthy atmosphere, which was a bad feature of this work when performed by the old method with shovel and wheelbarrow. This apparatus consists of flexible suction pipe, which can reach various parts of the baghouse basement. The fume is collected in a cyclone collector by means of a connection to a high vacuum exhaustor. The fume from the collector is mixed in a pug mill into a thick mud and smelted direct in the blast furnace.

At the Bunker Hill smelter, a circular merchant furnace has been installed. This furnace replaces four fifty-ton merchant kettles. The furnace is fired by pulverized coal, and is much more economical, requiring less fuel, and it produces less dross than the kettles. The temperature of the lead can also be kept more constant.

Metallurgy of Gold and Silver

BY P. A. ROBBINS AND HENRY HANSON

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NO REVIEW of the progress in gold and silver metallurgy in 1920 would be complete without paying tribute to the work of John Stewart MacArthur, who died on March 16, 1920. The immediate and spectacular expansion of the electrical industry following the invention of the rotating magnetic field has scarcely been more wonderful than has been the result of MacArthur's invention of the cyanide process.

Looking back over thirty years of progress in the art of extracting precious metals from their ores, two phases of metallurgical endeavor are discernible. The first phase shows a somewhat stubborn avoidance of the use of the cyanide process coupled with attempts to improve upon MacArthur's invention. The second phase is marked by a world-wide acceptance of the process as originated by the inventor, the efforts of metallurgists being now directed toward the application of preliminary treatments which will make their ores more amenable to cyanidation, rather than endeavoring to devise processes which avoid cyanidation.

The psychological reason for this change in attitude would seem to be due in some measure to the coming of a younger generation of metallurgists, who, without experience or beliefs in other processes, could accept, without questioning, the cyanide process as being generally the most efficient system of extraction yet developed. Any reluctance upon the part of an older generation to abandon processes to which they had become wedded was a very natural and commendable attitude of caution. MacArthur's carefully designed process has remained unchanged, and only in improved mechanical details and in an ever-widening application of the process to refractory gold and silver ores has progress been made.

A discussion before the London Institution of Mining and Metallurgy, concerning the possible use of haloid cyanides, revealed no innovations. The only haloid compound which has been put to commercial use is bromo-cyanogen, which, however, is not a solvent for gold unless in the presence of an alkaline cyanide. The consensus of opinion is that the bromide merely acts as an oxidizing agent, a conclusion which seems to receive

strong support from the fact that roasting and aëration have in most cases supplanted the use of bromo-cyanogen.

Although the process is still used in West Australia, it is to be noted that one of the largest mines in Kalgoorlie, which had previously used bromo-cyanogen, was compelled during the war to resort to ordinary alkaline cyanide treatment, no supplies of bromine salts being obtainable. This company will not return to the use of bromine, owing to the success of the present treatment.

Cyanide containing 36 per cent equivalent of the free cyanogen in standard sodium cyanide has been used in some American and Canadian mills as a means of reducing costs. The Tonopah Extension reports satisfactory results after seven months' exclusive use of the low-grade product. No fouling of solution is noted, and an advantage is claimed in that the low-grade salt possesses a high alkalinity, which assists in neutralizing the acidity of the ore, thus saving lime. Acetylene gas and sometimes ammonia are liberated when dissolving the low-grade cyanide, and hence it is advisable that good ventilation be maintained over the dissolving tank.

The impetus given to the production of low-grade cyanide at Niagara Falls has led to marked improvements in methods of manufacture and increases in the free cyanogen content of the product. The manufacturers of standard sodium and potassium cyanide are no doubt able to meet the competition of lower-grade substitutes, but competition in not only the precious-metal mills but also in the art of steel hardening and in the killing of scale on plants and trees may be expected to lead to an adjustment in prices of benefit to all consumers.

The low-grade cyanide is now manufactured from cyanamid, which latter has its principal use in the fertilizer industry, being one of the cheapest sources of combined nitrogen known, and thus offering an admirable material for transformation into cyanide.

At the Connemara mine (gold) in Rhodesia, it is claimed that heating the ore previous to cyaniding has raised the extraction from 68 to 86 per cent. The heating is referred to as "baking," as distinguished

from roasting, the heating not being carried to a point where a roast is obtained. The process is stated to drive off water of crystallization from hydrated oxides of iron, thus making the ore more amenable to cyanidation.

The application of flotation to the recovery of slime concentrates at the Belmont Shawmut mill (California) is to be noted. The company was operating a gravity concentration plant producing a \$60 concentrate, which was shipped to a smelter for treatment at a net cost of \$16 per ton of concentrate. The plant was remodeled to treat the concentrate locally at a gross cost of \$4 per ton, of which \$1 is operating cost, and \$3 is in discarded tailings. Four hundred tons of ore are treated per day, producing eighteen tons of sand concentrate from shaking tables and about thirteen tons of slime concentrate from flotation. The tailings from gravity concentration are classified, the coarse material being re-ground and the whole fed to an oil flotation plant consisting of two series of four cells each, followed by one cleaner cell. Froth from the last three pairs of cells goes to a cleaning cell, which discharges its tailings back into the head of the slime treatment circuit, while its froth joins the froth from the first pair of cells, the mixture flowing to a gravity concentrating table which makes three products; namely, two tons of \$60 granular product, which goes to the roasting plant; two tons of \$2.50 talcose middlings, which go to waste, and nine tons of \$25 slimes, which go to cyanide treatment. The granular product from the slime treatment joins the concentrates from the main sand concentrating mill, and the mixture is roasted. The charge contains 30 per cent sulphur, whereas the calcine contains 4.3 per cent. The roasted sand concentrate is cooled and mixed with the raw, wet slime concentrate, the mixture being dewatered and cyanided. Sodium sulphide is vital to the success of the flotation, and is added at the cleaner cell to flocculate the sulphide particles and deflocculate the gangue. It is stated that cyaniding the raw concentrate gives an extraction of only 60 per cent, whereas roasting the granular concentrate, mixing with raw slime concentrate, and then cyaniding gives an extraction of from 91 to 94 per cent.

Satisfactory results are reported at the Shattuck Arizona mill (Bisbee, Ariz.) from the application of flotation to the concentration of silver-lead carbonate ores. The mill has a capacity of 400 to 500 tons per day. After coarse concentration on tables the ore is ground fine in ball and tube mills, then classified in cones, the overflow from the cones (containing 90 per cent minus 200) going to flotation, while the spigot discharge from the cones goes to tables. The slime overflow (all through 100 mesh) is thickened and sulphidized by a weak solu-

tion of sodium sulphide, after which it is agitated and then treated in eight oil flotation machines arranged in four series of two cells each. The froth from the first cell in each series is collected in a thickener, from which the thickened product passes to a filter, which discharges into storage bins ready for shipment to local smelters. The froth from the second cells is returned to the agitator which feeds the flotation system, and the tailings from the second series of cells go to waste.

The McIntyre-Porcupine mines (Ontario) are reported to have decided upon a flotation method for eliminating graphitic material which occurs in certain orebodies, causing losses of gold by reprecipitation.

Few new plants have been constructed during the year, although several enlargements of existing plants have been reported.

Although no marked improvements in milling apparatus have been noted, there is an increasing use of electrically vibrated screens, and a number of innovations in flotation apparatus have made their appearance.

Much earnest research work has been done during the year in the roasting and volatilization of refractory precious-metal ores, but experimenters have yet to report satisfactory commercial results.

In the Cobalt district of Ontario flotation continues to aid in the recovery of silver. Progress is exemplified by a comparison of the process at the Coniagas mill in 1914 with that in 1920. In 1914 the practice was straight concentration; 60 stamps, crushing to 14 mesh, treated 180 tons of 20-oz. ore daily, the product being classified and treated on sand, slime, and canvas tables, from all of which the tailings went to waste with an average silver content of from 5 to 6 oz. In 1920 60 stamps crushing to 3 mesh treat 300 tons of 10-oz. ore daily, the product being treated on tables and then re-ground in tube mills to 100 mesh, after which it is treated in flotation machines, the tailings from which carry one ounce per ton. Flotation concentrates are, by means of a cleaner cell, raised from 150 oz. per ton to 450.

It is rumored that Alaska Juneau has made good progress in improving the company's milling practice by rejecting a considerable portion of the low-grade rock sent to the mill.

There has been some discussion upon, and some experimental work has been carried on with, the electrical precipitation of cyanide solutions, but no improvements of commercial value seem to have developed. From Canada and Mexico reports have come of the continued success and economy of the Crowe vacuum zinc-dust precipitation process, and a number of new installations have been made.

Recent Trends in Ore Dressing

BY ALFRED JAMES*

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WHEN the cyanide process for treating refractory ores was introduced, the Grusonwerk mill was found to be the best ball mill. It was unapproachable as a dry granulator—not slimer—and it has surprised me that in America millmen should have been

content to run a shortened tube mill, with various modifications in the way of baffles and discharge, instead of first adopting, as normal standard for comparison, the Grusonwerk mill, with its peripheral screening and the cascading of balls by successive drops.

In western Australia, Messrs. Bewick Moreing, who contributed so materially to the success of Kalgoorlie practice, introduced at Oroya Brownhill—or at least I

*A part of Mr. James' "Annual Christmas Letter." Most of the remainder of the letter was published in *Engineering and Mining Journal* for Jan. 15, 1921.

first noted the practice at that mine—a system of screening, on shaking-sieve feeders, all the rock fed to the ball mills used for dry crushing. This screening materially increased the output by preventing the choking of the mill with material already sufficiently fine.

At the outset two tons per hp.-day of hard West Australian ore was crushed, with these mills, from breaker size, 2½-in. cubes, to 46 per cent through 200 holes per square inch (14 mesh). At Hannan's Star (where the tube mill was first introduced into gold mining) this output was increased, possibly by preliminary screening, to 2½ tons per hp.-day using 30- and 40-mesh screens. By the adoption of preliminary screening to divert from the feed all the ore already sufficiently fine, the South Kalgurli definitely increased its output to 100 tons per day from each of the No. 5 mills taking 36 hp. or nearly three tons per hp.-day.

Wear of balls in these Grusonwerk mills amounted to 0.5 lb. per ton crushed; liners lasted eight months. In the test described by C. T. Van Winkle (*Trans. A. I. M. E.*, Vol. LIX, p. 231) the consumption of balls by the Marcy mill is given at 1.7 lb. per ton crushed. Hines (*idem.* p. 261) shows a consumption of 1.5 lb. for chrome steel and 2.8 lb. for cast composition balls per ton of ore crushed through 48 mesh. The discrepancy is not so great as at first appears. The Grusonwerk ball mill was found to be unequaled as a *dry* granulator on ores not too tough, but the abrasion of iron was so great when wet crushing that millmen, the world over, preferred to use gravity stamps for this purpose. With these, abraded iron amounted to only 0.57 lb. per ton crushed (0.4 lb. for shoe and 0.17 lb. for die).

It is customary for some to refer to stamps as out of date. Their position has been obscured by the remarkable friability of some of the huge copper deposits, whence come reports of high outputs from ball and rod mills. It seems to have been left to private enterprise and energy to restore sanity by the publication of a series of tests on the varying hardness of ores (see Lennox, p. 1,262, *Bull.* 140, A. I. M. E.). Up to the outbreak of war, for ore of the hardness of that found on the Witwatersrand, the Nissen stamp was considered to be the most effective appliance known, for crushing from 2-in. cubes down to, say, 3 or 4 mesh perior to tube milling. On this work it was proved to have an efficiency about 15 per cent greater than that of the ordinary Californian stamp. That so little is heard of the Nissen stamp nowadays is perhaps owing to the absence of "paternal care," either with regard to advertisement in the press or in the fostering care of the inventor.

Weigall and Mitchell-Roberts, in their valuable article on their work at Suan (*Min. & Sci. Press*, Dec. 13, 1917, p. 847) show a crushing capacity with their stamps which I work out to be at the rate of 2½ tons per hp.-day crushed for tube milling.

Professor Truscott suggests the duty of stamps on 2-in. cubes of average (South African) hardness to be

100 lb. per hp.-hour to 30 to 40 mesh
200 lb. per hp.-hour to 12 to 16 mesh
400 lb. per hp.-hour to 3 to 4 mesh

with a consumption of 1 lb. of steel (used or thrown out) per ton of ore crushed fine, and a less consumption for coarser crushing.

It will be seen that Professor Truscott's figures on stamps (wet crushing) approximate for power closely to

those given by me for Grusonwerk mills (dry crushing).

In comparisons of ball mills and stamps on the same tough ore, wet-crushed, it is not infrequently found that stamps require less power per ton output and that they have a less abrasion of iron or steel. Doubtless ball-mill specialists will develop a ball of greater endurance, but some of the consumptions, over 2 lb. of metal in balls alone per ton milled, have caused me regret.

The effect of fresh, finely abraded iron on cyanide work has been more than once mentioned. I have viewed with concern the apparent apathy of millmen as to the vitiation of their ore charges by this material. On the other hand, the adoption of special wear-resisting metal should materially lessen the vitiation of ore charges in this way.

SLIMING

The adoption of peripheral discharge in the Marcy ball mills is a reversion to the original tube-mill practice. Davidsen, the inventor of tube mills, invariably equipped his mills with peripheral discharge, either by direct outlet or by scoop, until the Africans made the mistake—I am afraid for patent rather than for technical reasons—of insisting on trunnion-level discharge. With the expiry of the Davidsen patents, more enlightened views prevailed, and peripheral discharge once more came into its own.

The tube mill remains the accepted standard appliance for wet or dry comminution. I note with regret the tendency to an increased cost of tube milling. Cannot some means be devised of effecting a material reduction? A cost of over 35c. (or 2/-) per ton tube milled is not an encouraging introduction to the beneficiation of huge dumps of low-grade tailings such as those existing in India. I have lessened costs by the adoption of roller bearings, but my experience is that the heaviest operating costs occur when the outlet screen is of large dimensions (peripheral discharge) and mine rock of large diameter displaces pebbles or balls. Whether the increased cost is more than counterbalanced by the profit resulting from the additional mine rock thus crushed is of course a question to be determined by the user, but the cost certainly is somewhat alarming. Lowest costs are associated with the use of rounded pebbles, or balls and light liners.

Pans, as fine slimers, seem to have definitely fallen out of the running. Formerly there was the pans vs. tube mills controversy from western Australia, and after tube mills had definitely proved their superiority the matter was regarded as settled until Mr. Söhnlein's articles in the *Engineering and Mining Journal*, Sept. 27, 1913, once more raised the question by showing the remarkably high duty from the pans in his mill, resulting from a series of experiments to improve efficiency and output. I have this year taken up the matter direct with Mr. Söhnlein and asked him how time had dealt with his remarkable results. His reply is instructive:

"I fear that grinding pans are not so satisfactory on an unroasted charge of ore as they were formerly on roasted material at Machacamarca. Also, with the high price of iron I fear that they cannot compete with tube mills; therefore I fear that the grinding pan is not longer a machine to be reckoned with. Further, I found that it needs rather a good class of labor to keep the pans running right; unskilled people are very apt not to let the dies low enough on the shoes, and the result is an enormous amount of oversize from the classifier, which will finally choke the pan. For all

these reasons I am not as much in favor of the pan as I used to be, and have always used tube or ball mills during the last years in installations which were erected or operated under my charge."

Thus ends a skillful effort, and millmen should be as indebted to Mr. Söhnlein for his frankness as they were for his initiative and public spirit.

At the moment an enterprising attempt is being made by Hugh Rose at Fresnillo to slime ore from 1½ in. maximum down to 75 per cent minus 200 mesh in one operation in Marcy rod mills working in closed circuit with a Dorr classifier. The nature of the ore at Fresnillo may assist the experiment, but previous experience with rod mills has not been of an encouraging nature.

Agitation is not swirling; it is the perfect descent of each solid particle separately through, and not with, the liquid. Grothe showed mathematically, as well as by ocular demonstration in a glass model, how the heaviest and coarsest material obtained most agitation—it descended vertically through the column of solution at a greater rate than the lighter and finer matter even in a 1:1 thickened pulp ready for filtration without decantation. What more perfect agitation could be devised than this continuous settlement of particles—ever separating with reference to each other and yet without classification—through the solvent column! What finer record than that of E. H. Johnson's four agitators at the East Rand, continuously agitating year after year, for twelve horsepower, no less than 1,800 solid tons a day, with a 97 per cent extraction!

I have recently had, or seen in the public press, reports from three different parts of the world of agitators failing through the ore settling hard on the bottom of the tank and caking there. The Pachuca tank still stands supreme, and attention has of late been forcibly directed, in the absence of these agitators, to

the necessity for thorough aëration of solutions prior to, or during, solvent action.

The increased price of silver has resulted in the profitable treatment of accumulations of old "fills," dumps, and tailings. These usually require the employment of oxidizers. First principles cannot be overlooked in a devotion to mechanical efficiencies. Hamilton, in his recently published handbook, refers to the advantages gained from a simple testing of sump solutions and the resulting addition of alkali. Crowe's work emphasizes the benefit of aëration to prevent precipitation—in the solution vats. The fragments and logs of wood recovered from the "fills" makes the warning all the more serious. In early work on some ores rich in silver the amount of silver absorbed in, and recovered by burning from, the surface of wooden vat staves was astonishing. The condition of the fragments of wood now clogging up mill screens or plates makes them much more absorbent of silver than are vat staves. This wood must be avoided. A washing apparatus can be so designed that all the wood shall be floated off before the ore enters the mill; and this should be done. A report by a well-known metallurgist on the treatment of the ores of a Mexican silver mine states that reprecipitation on these old "fills" is so serious as to make impossible their treatment with the ordinary ore. Washing as above, plus an oxidizer, should overcome this difficulty.

It is not out of place here to refer to Embury's method of handling pulp in transit from agitators to filters. Simply and smoothly working, it is extremely attractive. The automatic regulation is superior to the many attempts I have noted to obtain similar flexibility with diaphragm pumps. The industry is surely entitled, by reason of its need, to a paper from Mr. Embury on this subject.

Ferro-Alloys

BY ROBERT J. ANDERSON

THE unsettled conditions that prevailed in the ferro-alloy and metallurgical ore industries in 1919 continued in general through 1920, although it must be admitted that these industries are better off than they were a year ago. The steel industry was upset at several times during the year by labor troubles and transportation difficulties, and any factors that govern steel output are immediately reflected in the ferro-alloy industry. Owing to the inability of British ferromanganese makers to obtain supplies of Indian ore, there was a threatened shortage of ferromanganese in the United States, and several electric-furnace makers here found it profitable to re-enter the field. The export demand for Continental Europe was fair, but the unsettled political and financial conditions abroad acted as a deterrent to much business. This refers especially to ferromanganese and spiegeleisen. At the same time, heavy offerings of foreign ferrochromium and ferrotungsten were made here at stiff price concessions.

One of the most important metallurgical developments of 1920 was the introduction of the Söderberg self-baking electrode at the plant of the Southern Manganese Corporation, Anniston, Ala. The possibility of the use of oxygen-enriched air in the blast-furnace production

of some of the ferro-alloys also received further attention in 1920. The carbon reduction of ferrovandium is a metallurgical development that has been brought to commercial success.

Ferromanganese and Spiegeleisen—Owing to the scarcity of foreign ores and the inability of English makers to supply ferromanganese, the domestic mining of metallurgical manganese ore was stimulated in 1920.

The domestic ferromanganese industry was considerably revived in 1920, and the inability of the British makers to supply the American market was the most important contributing factor in this situation. The domestic output of ferromanganese in 1920 was about 280,000 tons, as compared with 179,029 tons in 1919. The spiegeleisen production was about 116,000 tons in 1920, as against 65,391 tons in 1919. Prices for 78@82 per cent ferromanganese fluctuated widely during the year, the range being from \$130 per ton in January to \$225 per ton in July. Prices declined in the second half. In England the situation as to ferromanganese supplies was quite desperate at times, but the threatened shortage in the United States had disappeared by September. The reappearance of the electric-furnace alloy

is noteworthy; five plants were operating in June, as against none in January. Prices for spiegeleisen increased from \$38@40 per ton for 18@22 per cent alloy in January to \$75@85 in August, where they remained during the remainder of the year. The export demand for spiegeleisen was active.

Ferrosilicon—Owing to shutdowns at the plants of blast-furnace ferrosilicon makers, because of coke scarcity, there was a shortage of bessemer ferrosilicons throughout 1920, and high prices were obtained for these alloys. Large quantities of the 12@15 per cent electric-furnace product were offered, however, at prices lower than those for bessemer ferrosilicons. Domestic electric-furnace ferrosilicon, 12@15 per cent grade, sold at \$65, furnace; the 50 per cent grade was overproduced, but the prices were held at \$80@90. The 75 per cent alloy sold at \$150@200 per ton. Bessemer ferrosilicons, 9, 10, 11, and 12 per cent grades, brought \$56.50, \$59.50, \$62.50, and \$66.10 per ton, f.o.b. New Straitsville, Ohio, until July, when a series of increases set in to \$66, \$69.50, \$72.80, and \$76.10, respectively. Imports of all grades of ferrosilicon in 1920 were about 16,000 tons, as against 10,445 tons in 1919. Foreign competition for the domestic market in 1920 was strong, but the demand was better than in 1919. Owing to the shortage of pig iron in some districts, some foundries made iron in the cupola by smelting a mixture of scrap steel and ferrosilicon with coke.

Ferrochromium.—Ferrochromium was steady but low throughout 1920; and consumption and demand were low. There were heavy offerings of foreign alloys at price concessions, particularly by French makers. Ferrochromium, 6@8 per cent C grade, sold at 19@22c. per lb. of contained Cr, whereas the 4@6 per cent C grade brought 20@24c. The cancellation of alloy-steel orders, owing to the collapse in the automotive industry, was a contributing factor in the dull ferrochromium markets. Stainless steel, the iron alloy containing about 14 per cent chromium, has continued to attract much attention. This steel was prominent in the British cutlery trade prior to the war, but it is now being employed for many construction purposes where an anti-corrosive alloy is needed. Low-carbon ferrochromium is desired for the manufacture of stainless steel.

Ferrotungsten—The production of both metallic tungsten and ferrotungsten was small. Prices for metallic tungsten and ferrotungsten were lower in 1920 than in 1919, owing to the decline in demand and the dumping of foreign ferrotungsten. The demand for high-speed steel was light. British ferrotungsten was offered as low as 50c. per lb. of contained W, and although the domestic 70@80 per cent alloy brought \$1.25@\$1.40 during the opening months of 1920, it did not get below 75@90c. There is small possibility of tungsten losing its pre-eminence in the manufacture of high-speed steel through the use of molybdenum as a substitute, despite the many rumors circulated recently.

Ferrovanadium—The heavy demand for ferrovanadium continued through 1920, and supplies were scarce. Numerous improvements were effected by the Vanadium Corporation of America at its Peruvian properties, and the operations there were considerably enlarged. Owing to the discovery of additional large ore deposits, it is estimated that this company can now supply ore almost indefinitely at the present rate of consumption.

The ferrovanadium situation in England was acute during 1920, owing to the heavy decline in exports from the United States, but many domestic tool-steel makers

were pinched for supplies also. Ferrovanadium sold for \$5.50@\$8.50 per lb. of contained V, depending upon the percentage of silicon present; spot resale alloy in brokers' hands brought up to \$14.

In the metallurgy of ferrovanadium, the successful solution of the carbon-reduction process in the electric furnace is especially noteworthy. This process, which has been in the formative stages for some years, has been put into commercial operation. Evidently, the bulk of the future output of the alloy will be made by this method, and it should result in lower production costs. The possibility that vanadium, in the form of cuprovanadium or alumino-vanadium, will find considerable application in non-ferrous metallurgy in the next few years is not to be overlooked.

Ferromolybdenum—Ferromolybdenum sold at \$3@\$3.50 per lb. of contained Mo in the early months of 1920, but the price later declined to \$2@2.50. A gradual and wider use of molybdenum steels is looked for, and many of the motor companies are experimenting with these steels. A so-called all-molybdenum-steel motor car is announced.

Ferrotitanium, Ferro-Uranium, and Ferrozirconium—Further experiments have been made by some steel companies with a view to using titanium as an alloying element in steels, and it is reported that noteworthy results have been obtained with titanium steels for use as armor plate and in ordnance. Details are lacking. Ilmenite sold at 1½@2c. per lb. for 52 per cent TiO₂ in 1920, and rutile brought 10@25c. per lb. for 95 per cent material. Ferrocobalt-titanium sold at \$200@\$250 per ton, and the aluminothermic alloy was higher in price. Metallurgical developments of note in ferro-uranium and ferrozirconium were at a standstill in 1920.

Uranium oxide sold in 1920 at \$2.75@\$3 per lb. for 96 per cent material, whereas carnotite ore, minimum 2 per cent U₃O₈, brought \$2.75@\$3 per lb. of contained U₃O₈. Ferro-uranium, 35@50 per cent U, sold at \$7 per lb.

The use of ferrozirconium in the metallurgy of cast iron has been investigated recently by Moldenke. He states that the alloy is useful as a deoxidizer in cast iron and that an addition of 0.10 per cent results in increased strength and deflection. Some complex alloys high in zirconium for use as high-speed cutting tools have been developed recently by Cooper. A 20 per cent ferrozirconium has been employed in England, in steel metallurgy, as a substitute for ferrotitanium.

Minor and Complex Ferro-Alloys.—Nothing of striking importance occurred in the minor and complex ferro-alloys in 1920, although considerable experimental work is going on. Ferro-aluminum is receiving some attention again, and the 10@20 per cent alloy has been used in Germany for the deoxidation of steel in the last few years. Little is heard of boron steels and ferrobore. Further work on the use of cerium in steel is in progress, and the possibility of using the native mineral fluorcerite as a means for introducing cerium into steel, rather than employing ferrocerium or misch metal, is suggested by the recent experiments of Cammen. Metallic cobalt is still employed in some of the good grades of high-speed tool steels, and considerable cobalt now goes into the manufacture of the stellite alloys. A new complex deoxidizer, viz., a uranium-magnesium-aluminum alloy, has been employed commercially for the deoxidation of chromium steels. Both silicomanganese and calcium silicide were employed considerably in 1920, especially abroad, owing to the shortage of ferromanganese.

Mining Stocks in 1920

Stock	Exch	High	Low	Last	Sales
COPPER					
Adventure C.	Boston	1 1/2 Feb. 27	*40 Aug. 10	*60	4,640
Ahmeek	Boston	77 Jan. 3	40 1/2 Dec. 29	45	11,372
Alaska-B. C.	N. Y. Curb	2 1/2 Apr. 7	15 Dec. 23	18	1,486,000
Allouez	Boston	42 Jan. 7	30 Dec. 21	33 1/2	6,944
Anacosta	N. Y.	6 1/2 Apr. 6	30 Dec. 21	33 1/2	1,381,300
Ariz. Com'l.	Boston	15 1/2 Jan. 5	5 1/2 Dec. 2	6 1/2	55,437
Big Ledge	N. Y. Curb	1 1/2 June	1 1/2 Nov.	1 1/2	1,195,900
Bingham Mines	Boston	10 1/2 Apr. 27	6 1/2 Mar. 18	9 1/2	26,265
Calumet & Ariz	Boston	69 Jan.	39 1/2 Dec.	41	56,421
Calumet & Hecla	Boston	409 Jan. 3	200 Dec. 11	250	8,397
Canada Copper	N. Y. Curb	1 1/2 Mar.	*11 Dec.	*13	233,700
Centennial	Boston	16 1/2 Jan. 5	6 1/2 Dec. 21	6 1/2	2,403
Cerro de Pasco	N. Y.	61 Jan. 3	24 Dec. 29	26 1/2	72,130
Chief Consol.	Boston Crb	5 Jan.	1 Aug.	2	89,889
Chile Copper	N. Y.	21 Jan. 3	7 Nov. 30	9 1/2	89,889
Chino	N. Y.	1 1/2 Jan. 3	7 Dec. 21	1 1/2	488,580
Columbus Rexall	Salt Lake	*40 1/2 July	*31 Dec.	*32 1/2	165,850
Con. Ariz.	N. Y. Curb	1 1/2 Feb.	*1 Dec.	*1	106,725
Con. Copper M.	N. Y. Curb	4 1/2 Jan.	5 Dec. 21	26 1/2	63,913
Copper Range	Boston	48 1/2 Jan. 5	25 Dec. 21	26 1/2	63,913
Crystal Cop. (N)	Boston Crb	*74 Feb.	*21 Jan.	*36	131,668
Davis-Daly	Boston	14 1/2 Jan. 5	4 1/2 Dec. 22	5 1/2	72,936
East Butte	Boston	16 Jan. 3	7 1/2 Dec. 30	8	29,537
First Nat'l	Boston Crb	1 1/2 Jan.	*50 Dec.	*65	39,250
Franklin	Boston	5 1/2 Apr. 7	*50 Aug. 11	2 1/2	36,056
Gadsden Copper	N. Y. Curb	3 Jan.	*20 Dec.	*25	71,663
Granby Consol.	N. Y.	55 1/2 Jan. 5	15 Dec. 21	17 1/2	2
Greene-Cananea	N. Y.	38 1/2 Jan. 3	15 Dec. 22	19	6,137
Hancock Consol.	Boston	6 1/2 Mar. 31	2 Dec. 29	2	35
Houghton	Boston Crb	*80 Apr.	*30 Dec.	*25	48,650
Howe Sound	N. Y. Curb	4 1/2 Feb.	2 1/2 Dec.	2 1/2	685,465
Inspiration Con.	N. Y.	61 1/2 Apr. 8	28 Dec. 21	31 1/2	27,553
Iron Cap	N. Y.	*14 Jan.	*6 Nov.	*6 1/2	839,200
Isle Royale	Boston	38 Jan. 3	15 Dec. 29	16 1/2	9,975
Kennecott	N. Y.	33 1/2 Apr. 7	14 1/2 Dec. 22	17 1/2	12,676
Keeweenaw	Boston	2 1/2 Jan.	1 1/2 Dec.	1 1/2	10,055
Lake Copper	Boston	4 1/2 Apr.	1 1/2 Dec.	1 1/2	192,000
La Salle	Boston	3 1/2 Jan.	1 1/2 Dec.	1 1/2	35,260
Magma Chief	N. Y. Curb	39 1/2 Jan.	*17 Sept.	*15 1/2	8
Magma Copper	N. Y. Curb	39 1/2 Apr.	*15 Dec.	*15 1/2	9,466
Majestic	Boston Crb	*22 Jan.	*7 Oct.	*8	13,551
Mason Valley	Boston	3 Jan. 21	*90 Dec. 21	*90	46,813
Mass Consol.	Boston	5 1/2 Jan. 3	1 1/2 Dec. 20	3 1/2	163,735
Mayflower-O.C.	Boston	11 1/2 Jan. 2	3 Dec. 23	3 1/2	17,377
Miami	N. Y.	26 Jan. 5	14 Dec. 22	15 1/2	18,900
Michigan	Boston	7 1/2 Jan. 2	1 Dec. 15	4 1/2	138,250
Mohawk	Boston	72 Mar. 27	40 Dec. 30	43 1/2	211,500
Mother Lode (N)	N. Y. Curb	6 1/2 May	4 Mar.	5 1/2	11,569
Nevada Con.	N. Y.	17 1/2 Jan. 5	8 Nov. 18	9 1/2	46,389
New Arcadian	Boston	5 1/2 Jan. 2	3 Feb.	2 1/2	196,422
New Baltic	Boston Crb	4 Jan.	3 Jan.	3	3,205
New Cornelia	Boston	24 Jan. 5	12 Nov. 20	13 1/2	5,478
Nixon Nev.	N. Y. Curb	*23 Jan.	*5 Aug.	*5	22,821
North Butte	Boston	21 1/2 Apr. 20	8 Dec. 30	8 1/2	9,111
North Lake	Boston	*80 Jan. 27	*25 Oct. 14	*40	349,695
Ohio Copper	N. Y. Curb	1 1/2 Mar.	1 Sept.	1 1/2	13,860
Ojibway	Boston	2 1/2 Jan. 26	1 Dec. 17	1 1/2	59,212
Old Dominion	Boston	37 1/2 Jan. 5	15 Dec. 22	15 1/2	27,105
Oseola	Boston	58 Jan. 3	20 Dec. 29	22 1/2	54,000
Phelps-Dodge	Open Mar.	†230 Apr.	†150 Ncv.	.....	4,919
Quincy	Boston	65 Jan. 3	34 Dec. 21	35	26,289
Ray Con.	N. Y.	22 1/2 Jan. 5	10 Nov. 18	11 1/2	9,369
Ray Hercules	Boston Crb	22 1/2 Jan.	*50 Oct. 2	*50	96,624
St. Mary's M.L.	Boston	58 Jan. 5	25 Dec. 21	28	354,275
Seneca Copper	Boston	23 Nov. 11	12 May 24	16 1/2	77,792
Shannon	Boston	2 Jan. 7	*50 Dec. 28	*75	23
Shattuck, Ariz.	N. Y.	13 Jan. 17	4 Dec. 30	4 1/2	44,558
South Lake	Boston	2 1/2 Jan.	1 Dec.	1	552,800
South Utah	Boston	*25 Jan.	1 Dec.	*4	143,994
Superior Copper	Boston	6 Jan. 7	2 Dec. 30	3 1/2	7,175
Superior & Bost.	Boston	6 1/2 Jan. 29	1 Dec. 21	1 1/2	24,278
Tenn. C. & C.	N. Y.	13 1/2 Mar. 31	6 Dec. 28	6 1/2	9
Tuolumne	Boston	1 1/2 Jan. 10	*33 Dec. 2	*35	2,984
United Verde Ex	Boston Crb	*43 Jan.	*18 Nov.	23	.....
Utah Consol.	Boston	9 1/2 Feb. 20	2 Dec. 29	3	.....
Utah Copper	N. Y.	80 1/2 Jan. 3	44 Dec. 21	50 1/2	.....
Utah M. & T.	Boston	3 1/2 Jan. 5	*42 Nov. 18	*90	.....
Victoria	Boston	3 1/2 Jan. 8	1 Dec. 3	1 1/2	.....
Winona	Boston	2 Jan. 7	*25 Sept. 9	*45	.....
Wolverine	Boston	23 Jan. 10	8 Dec. 28	9	.....
LEAD					
Hecla Mining	N. Y. Curb	5 1/2 Jan.	2 Jan.	3 1/2	.....
St. Joseph Lead	N. Y.	17 1/2 Apr. 12	10 Dec. 20	12	94,620
Stewart	Boston Crb	*20 Feb.	*6 Dec. 18	*6	.....
Utah Apex	Boston	4 Oct. 21	1 1/2 Aug. 7	3	74,534
ZINC					
Am. Z. L. & S.	N. Y.	21 1/2 Jan. 10	5 Dec. 21	7 1/2	167,500
Am. Z.L.&S.pf.	N. Y.	59 1/2 Jan. 9	25 Dec. 9	30	20,400
Butte C. & Z.	N. Y.	11 1/2 Jan. 9	3 Dec. 28	4 1/2	225,500
Butte & Superior	N. Y.	29 1/2 Jan. 12	8 Dec. 10	10	221,525
Con. Interst. Cal.	N. Y.	20 1/2 Jan. 3	4 Dec. 23	4 1/2	22,906
New Jersey Z.	N. Y. Curb	300 Apr.	127 Dec.	130	36,443
Success	N. Y. Curb	*7 Jan.	*1 Dec.	*3	492,395
Yellow Pine	Los Angeles	1.25 Apr.	0.35 Dec.	0.40	.....

* Cents per share. † Bid or asked.

Stock	Exch.	High	Low	Last	Sales
GOLD					
Alaska Gold	N. Y.	2 1/2 Mar. 24	1 Dec. 22	1	181,500
Alaska Juneau	N. Y.	3 Mar. 31	1 Dec. 21	1	241,300
Carson Hill	N. Y. Curb	*40 Jan.	*19 Feb.	*22 1/2	64,215
Cresson Con. G.	N. Y. Curb	2 1/2 Jan.	1 Sept.	1 1/2	102,900
Dome Ex.	Toronto	*50 Oct.	*18 May	*41	.....
Dome Mines	N. Y.	13 Jan. 3	9 1/2 May. 19	10 1/2	89,200
Golden Cycle	Colo. Sprgs	*186 May	*65 June	*73	.....
Goldfield Con.	N. Y. Curb	*15 Jan.	*4 Dec.	*5	1,065,625
Hollinger Con.	Toronto	7.00 Feb.	5.15 May	.....	.....
Homestake	N. Y.	71 Jan.	45 Oct. 21	50	9,154
Kirkland Lake	Toronto	*81 Jan.	*36 Dec.	*39	.....
Lake Shore	Toronto	1.25 July	1.00 Dec.	1.05	.....
McIntyre-Poreu	Toronto	2.15 Mar.	1.76 Dec.	1.79	.....
Poreupine Crown	Toronto	*31 Apr.	*15 Dec.	*17	.....
Portland	Colo. Sprgs.	*66 May	*55 June	*60	.....
Reorgan. Booth	N. Y. Curb	*7 Jan.	*2 Dec.	*3	796,310
Silver Pick	N. Y. Curb	*30 Mar.	*2 Jan.	*4	710,610
Teck Hughes	Toronto	*19 Jan.	*5 Dec.	*10	.....
Tom Reed	Los Angeles	2.00 Mar.	0.90 July	1.22	.....
United Eastern	N. Y. Curb	4 1/2 Jan.	2 Dec.	2 1/2	357,290
Vindicator Con.	Colo. Sprgs.	*20 May	*17 June	*18	.....
West Dome Con.	Toronto	*10 1/2 Mar.	*4 Dec.	*8	.....
White Caps Min.	N. Y. Curb	*20 Apr.	*3 Dec.	*4 1/2	6,741,950
Yukon Gold	N. Y. Curb	1 1/2 Feb.	*50 Dec.	*50	.....
SILVER					
Arizona Silver	Boston Crb	8 1/2 Jan.	*10 Aug.	*18	.....
Beaver Con.	Toronto	*67 Jan.	*25 Dec.	*25 1/2	.....
Coniagas	Toronto	3.25 Mar.	2.00 Dec.	2.00	.....
Crown Reserve	Toronto	*43 Feb.	*15 Dec.	*16	.....
Kerr Lake	Boston	5 Mar. 24	2 Dec. 31	2 1/2	20,572
La Rose	Toronto	*48 Apr.	*22 Dec.	*22	.....
McKinley-Dar.	Toronto	*65 Jan.	*20 Dec.	*24	.....
Mining Corp.	Toronto	2.00 Apr.	0.85 Dec.	1.00	.....
Nipissing	N. Y. Curb	12 1/2 Jan.	7 Dec.	7 1/2	162,200
Ontario Silver	N. Y.	9 1/2 Apr. 6	3 Nov. 19	4 1/2	103,120
Ophir Silver	N. Y. Curb	1 1/2 Feb.	1 May	1 1/2	134,250
Peterson Lake	Toronto	*22 Jan.	*9 Dec.	*9	.....
Temiskaming	Toronto	*47 Apr.	*24 Dec.	*25	.....
Trethewey	Toronto	*48 Feb.	*13 Dec.	*15 1/2	.....
GOLD AND SILVER					
Atlanta	N. Y. Curb	*5 1/2 Mar.	*3 Dec.	*1 1/2	921,400
Boz. & Mont.	Boston	*94 Apr.	*23 Sept.	*44	.....
Cashboy	N. Y. Curb	*12 Mar.	*3 Dec.	*3 1/2	1,079,470
El Salvador	N. Y. Curb	3 1/2 Mar.	1 Dec.	1 1/2	459,000
Jim Butler	N. Y. Curb	*27 Jan.	*10 Aug.	*17	750,590
Jumb. & Exten.	N. Y. Curb	*13 Sept.	*4 July	*4 1/2	506,280
Louisiana Con.	N. Y. Curb	1 1/2 Jan.	1 Dec.	1 1/2	506,280
MacNamara M.	N. Y. Curb	*97 Jan.	*7 May	*7 1/2	1,980,600
N. Y. Hond. Ros.	Open Mar.	†15 1/2 Apr.	*9 Dec.	*10	.....
Tonopah-Bel'n't	N. Y. Curb	3 1/2 Jan.	1 1/2 Aug.	1 1/2	203,834
Tonopah-Divide	N. Y. Curb	4 1/2 Jan.	1 1/2 Aug.	1 1/2	1,252,280
Tonopah Ex.	N. Y. Curb	2 1/2 Jan.	1 1/2 June	1 1/2	214,564
Tonopah Mining	N. Y. Curb	3 1/2 Jan.	1 July	1 1/2	309,540
West End Con.	N. Y. Curb	2 1/2 Jan.	1 Dec.	1	524,345
SILVER-LEAD					
Caledonia Min.	N. Y. Curb	*42 Jan.	*15 Oct.	*16	849,170
Consol. M. & S.	Montreal	32 1/2 Jan.	15 Nov.	18	.....
Daly Mining	Salt Lake	4.25 Mar.	2.00 Dec.	2.00	.....
Daly-West.	Boston	4 1/2 Mar. 3	3 Dec. 21	3 1/2	34,233
Eagle & Bl. Bell	Boston Crb	2 1/2 Apr.	2 May	2 1/2	.....
Electric Point	Spokane	*45 Apr.	*4 Dec.	*5	.....
Fed. M. & S.	N. Y.	16 1/2 Mar. 30	5 Dec. 17	7 1/2	14,557
Fed. M. & S. pf.	N. Y.	44 1/2 May 14	21 Dec. 21	22	51,872
Florence Silver	Spokane	*50 May	*10 Dec.	*14	.....
Grand Central	Salt Lake	*47	*37 Aug.	*37 1/2	.....
Iron Blossom	N. Y. Curb	5 1/2 Feb.	*16 Dec.	*16	84,315
Judge M. & S.	Salt Lake	5.50 Jan.	2.92 Dec.	2.92	.....
Marsh Mines	N. Y. Curb	*32 Jan.	*6 Dec.	*8	762,267
Prince Consol.	N. Y. Curb	*19 Jan.	*5 Nov.	*7 1/2	50,050
Rambler-Cariboo	Spokane	*19 May	*3 Dec.	*4	671,700
Rex Con.	Salt Lake	*12 Jan.	*6 Dec.	*6 1/2	.....
South Hecla	Salt Lake	1.30 Mar.	*60 Dec.	*65	.....
Stand. S. L.	N. Y. Curb	1 Jan.	1 Nov.	1	156,620
Tamarack-Custer	Spokane	2.75 May	1.25 Dec.	1.80	.....
Tintio Standard	Salt Lake	7.15 Mar.	2.52 Sept.	3.32	.....
Wilbert Mining	N. Y. Curb	*12 Mar.	* 1/2 Dec.	* 2	803,545
NICKEL-COPPER					
Internat'l Nickel	N. Y.	26 1/2 Jan. 7	11 Dec. 21	13 1/2	913,068
Internat'l. N. pf	N. Y.	88 Feb. 5	75 Dec. 30	78 1/2	7,350
QUICKSILVER					
New Idria	Boston	7 1/2 Jan. 8	*35 Dec. 27	*35	22,565
TUNGSTEN					
Mojave Tungsten	Boston Crb	*20 Jan.	*5 Feb.	*5	.....
VANADIUM					
Vanadium Corp.	N. Y.	97 Apr. 16	28 Dec. 21	33	3,635,895
ASBESTOS					

Mining Dividends

DIVIDENDS OF MINING AND METALLURGICAL COMPANIES IN THE UNITED STATES, 1919 AND 1920

Company Name	Situation	Shares Issued	Par Value	Dividends Paid				Total to Date	Latest Date	Amount
				1919	1920	Per Share	Total			
Ahmeek, c.	Mich.	200,000	\$25	\$3.00	\$600,000	\$1.50	\$300,000	\$12,150,000	Sept. '20	\$0.50
Allouez, c.	Mich.	100,000	25	1.00	100,000			2,850,000	Mar. '19	1.00
Am. Sm. & Ref.	U. S.-Mex.	609,980	100	4.00	2,439,920	4.00	2,439,920	45,855,598	Dec. '20	1.00
Am. Sm. & Ref., pfd.	U. S.-Mex.	500,000	100	7.00	3,500,000	7.00	3,500,000	72,296,386	Dec. '20	1.75
Am. Smelters, pf. A.	U. S.	97,381	100	6.00	584,288	6.00	584,288	14,134,238	Oct. '20	1.50
Am. Smelters, pf. B.	U. S.	31,884	100	5.00	165,334	5.00	165,334	18,018,981	Oct. '20	1.25
Am. Zinc, Lead & Sm., pfd.	U. S.	80,540	25	6.00	483,240	6.00	483,240	2,188,401	Nov. '20	1.50
Anaconda, c. s. z.	Mont.	2,331,250	50	4.50	10,490,625	4.00	10,490,625	175,938,750	Nov. '20	1.00
Argonaut Consol., g.	Cal.	200,000		.10	40,000	.10	10,000	1,940,000	Mar. '20	.10
Arizona Binghamton, c.	Ariz.	2,000,000	1	.20	200,000			2,000,000	Jan. '19	.05
Arizona Copper, pf. (c)	Ariz.				119,221			2,605,949	Nov. '19	.15
Arizona Copper	Ariz.	1,519,896	5 sh.	2/6	£170,998	9 d.	£56,996 2/0	£4,637,894	May '20	9 d.
Arizona Silver Mines	Nev.	450,000	\$7	\$0.03	\$13,500	\$0.12	\$54,000	\$67,500	Apr. '20	\$0.03
Barnes-King Dev., g.	Mont.	400,000	5	.30	120,000	.15	60,000	440,000	Aug. '20	.05
Bingham Mines, c.	Utah	150,000	10	.75	112,500			675,000	Sept. '19	.25
Bunker Hill & Sullivan, l. s.	Ida.	327,000	10	3.50	1,144,500	\$6.00	1,962,000	25,275,000	Dec. '20	.50
Caledonia Mining, l. s.	Ida.	2,605,000	1	.12	312,600	.07	182,350	4,256,206	Oct. '20	.01
Calumet & Arizona, c.	Ariz.	642,521	10	3.00	1,927,560	4.00	2,570,080	45,630,263	Dec. '20	1.00
Calumet & Hecla, c.	Mich.	100,000	25	10.00	1,000,000	5.00	500,000	152,250,000	July '20	5.00
Camp Bird, pfd., g. s.	Col.	649,625	£1	7%	£45,473.75	7%	£45,473.75		July '20	8 d.
Cardiff, l. g.	Utah	500,000	\$1	£0.15	\$75,000	.15	\$75,000	875,000	Dec. '20	.15
Central Eureka, g.	Cal.	392,616	\$1	.03	11,778	.10	39,261.60	977,363.38	Feb. '20	.05
Champion, c.	Mich.	100,000	25	12.80	1,280,000			25,250,261	Dec. '19	6.40
Chief Consolidated, c. g. l.	Utah	884,232	1	.32	283,954	.40	353,689.20	1,869,514.20	Nov. '20	.10
Chino Copper	N. M.	869,980	5	3.00	2,609,940	1.12 1/2	978,728	29,991,709.50	Sept. '20	.37 1/2
Columbus Rexall, l. s.	Utah	586,342	1	.02 1/2	14,659			14,659	Jan. '19	.02 1/2
Con. Interstate Callahan, z.	Ida.	323,303	10			2.00	755,606	7,721,688.25	Dec. '20	.50
Copper Range, c.	Mich.	395,000	25	2.50	986,015.50	1.50	592,500	26,999,219.50	Sept. '20	.50
Cresson Consol., g.	Col.	1,220,000	1	1.20	1,464,000	.20	244,000	8,979,162	June '20	.10
Daly, s. l. g.	Utah	150,000	20	.65	97,500	.30	30,000	3,142,500	July '20	.10
Daly West, s. l.	Utah	250,000	20			.90	225,000	6,868,000	Dec. '20	.25
Davis Daly, c. s.	Mont.	600,000	10	.50	300,000	.25	150,000	900,000	Mar. '20	.25
Dragon Con., s. c. l. g. i.	Utah	1,875,000	1			.02	37,500	206,250	Apr. '20	.01
Eagle & Blue Bell, l. s.	Utah	893,146	1	\$0.16	89,316	.35(b)	312,606	1,663,012	Dec. '20	(b) .25
East Butte, c.	Mont.	421,849	10	.50	210,366			1,687,396	Dec. '19	.50
Eastern Tale	Vt.	69,696	10		27,837			55,646.40	Nov. '20	.04
Electric Point, l.	Wash.	793,750	1	.06	47,625	.21	166,687.50	468,312.50	Oct. '20	.15
Elko Prince, g. s.	Nev.	1,108,566	1	.07 1/2	83,142			360,284	Sept. '19	.03 1/2
Fairview Round Mountain, g.	Nev.	963,471	1	.14	134,666			153,715	Nov. '19	.02
Federal M. & Sm., pfd.	Ida.	120,000	100	3.75	449,479	6.00	720,000	15,933,837	Dec. '20	1.75
First Natl. Copper	Cal.	600,000	5	.15	90,000			660,000	Feb. '19	.15
Gemini, g. s.	Utah	5,000	100			6.00	30,000	2,490,000	Aug. '20	6.00
Golden Cycle, g.	Col.	1,500,000	1	.36	540,000	.12	180,000	9,438,500	Dec. '20	.02
Goldfield Consol., g.	Nev.	3,559,148	10	.05	117,958			29,177,790	Dec. '19	.05
Grand Central, g.	Utah	500,000	1	.06	30,000	.03	15,000	1,825,250	June '20	.03
Hecla Mining, l. s.	Ida.	1,000,000	0.25	.60	600,000	.65	650,000	8,655,000	Dec. '20	.15
Homestake, g.	S. D.	251,160	100	4.50	1,130,220				Sept. '19	.50
Inspiration Consol., c.	Ariz.	1,181,967	20	6.50	7,682,787	5.00	5,909,836	38,983,704	Oct. '20	1.00
Internat. Nickel	U. S.-Can.	1,673,384	25	.50	836,692			53,113,676.20	Mar. '19	.50
Internat. Nickel, pfd.	U. S.-Can.	89,126	100	6.00	534,756	6.00	534,756	8,021,225.99	Nov. '20	1.50
Iowa, g. s. l.	Col.	1,666,667	1	.00 1/2	8,333			378,499	Oct. '19	.00 1/2
Iron Blossom, s. l. g.	Utah	1,000,000	0.10	.07 1/2	75,000	.05	50,000	3,300,000	Apr. '20	.02 1/2
Iron Cap Copper	Ariz.	142,106	10	.50	72,942	.25	35,526	996,090	Sept. '20	.25
Isle Royale Copper	Mich.	150,000	25	1.00	150,000			2,025,000	Sept. '19	.50
Judge Min. & Sm. s. l.	Utah	480,000	1	1.2 1/2	60,000	.37 1/2	180,000	2,550,000	Sept. '20	1.12 1/2
Kennebec Copper	Alaska	2,787,057		2.00	5,574,120	2.00	5,574,120	53,502,344	Dec. '20	.50
Liberty Bell, g.	Col.	133,560	5	.05	66,778			2,660,959	Sept. '19	.02
Magma Copper	Ariz.	240,000	5	.50	120,000			1,704,000	Jan. '19	.50
Miami Copper	Ariz.	747,114	5	2.50	1,867,785	2.00	1,494,228	21,957,057	Nov. '20	.50
Mohawk, c.	Mich.	100,000	25	5.00	500,000	5.50	550,000	9,675,000	Nov. '20	1.00
Nevada Consol. Copper	Nev.	1,999,457	5	1.50	2,999,188	.75	1,499,592.75	46,768,626.50	Sept. '20	.25
Nevada Packard, g.	Nev.	1,164,492	1	.02	23,290			110,627	Apr. '19	.02
Nevada Wonder, g. s.	Nev.	1,408,240	1	.05	70,423			1,549,005	May '19	.05
New Cornelia Copper	Ariz.	1,800,000	5			.50	900,000	1,350,000	Aug. '20	.25
New Idria, g.	Cal.	100,000	5	.25	25,000			2,705,000	Jan. '19	.25
New Jersey Zinc	U. S.	420,000	100	20.00	7,000,000	12.00	4,760,000	(Not reported)	Nov. '20	4.00
North Star, g.	Cal.	250,000	10	.40	100,000			5,537,040	June '19	.40
Ontario Silver	Utah	150,000		.50	75,000			15,187,500	Jan. '19	.50
Oroville Dredging, g.	Cal.	686,538	£1	2 sh.	329,540	1/6	£51,490.135	£429,036	Sept. '20	9 d.
Oseola Consol., c.	Mich.	96,150	\$25	\$3.00	288,450	\$1.00	\$96,150	\$1,856,375	June '20	\$0.50
Phelps Dodge Corp.	U. S.	450,000	100	15.50	6,975,000	10.00	4,500,000	96,071,000	Oct. '20	2.50
Plymouth Consol., g.	Cal.	240,000	£1	117,040				700,240	July '19	1 sh.
Portland Gold	Col.	3,000,000	\$1	\$0.08	240,000	.06 1/2	195,000	11,692,080	Oct. '20	\$0.01 1/2
Quincy Mining	Mich.	110,000	25	4.00	440,000	1.00	110,000	27,002,500	Mar. '20	1.00
Ray Consol., c.	Ariz.	1,577,179	10	2.00	3,154,356	1.00	1,577,179	30,412,619	Dec. '20	.25
Reorg. Booth, g.	Nev.	1,000,000	1	.05	50,000			400,000	May '19	.05
St. Joseph Lead	Mo.	1,409,466	10	1.05	1,550,414	2.00	2,818,932	25,912,962	Dec. '20	.50
Shattuck Arizona, c.	Ariz.	350,000	10	1.25	437,500	.25	87,500	7,612,500	Jan. '20	.25
South Hecla	Ida.	263,000	1	.15	39,450			78,888	Sept. '19	.15
Tamarack & Custer, l. s.	Ida.	1,776,288	1	.03	53,288			515,118	Dec. '19	.03
Tintic Standard, l. s.	Utah	1,174,700	1	.47	552,109	.50	587,350	1,538,338	Dec. '20	.20
Tom Reed, g.	Ariz.	909,555	1	.24	218,923			2,755,952	Dec. '19	.02
Tonopah-Belmont, s. g.	Nev.	1,500,000	1	.25	375,000	.10	150,000	10,193,063	Oct. '20	.05
Tonopah Extension, g. s.	Nev.	1,282,801	1	.30	384,840	.15	192,420	2,553,820	Oct. '20	.05
Tonopah Mining, g. s.	Nev.	1,000,000	1	.30	300,000	.05	50,000	14,925,000	Oct. '20	.05
United Eastern, g.	Ariz.	1,363,000	\$1	\$0.66	\$899,580	\$0.72	\$981,370	\$3,134,910	Oct. '20	\$0.15
U. S. Sm., Ref. & Min.	U. S.-Mex.	351,115	50	5.25	1,843,354	6.00	2,106,693	15,140,222	Oct. '20	1.50
U. S. Sm., Ref. Min., pfd.	U. S.-Mex.	486,350	50	3.50	1,702,225	3.50	1,702,225	24,851,267	Oct. '20	1.87 1/2
United Verde, c.	Ariz.	300,000		9.00	2,700,000	6.00	1,800,000		Dec. '20	1.50
United Verde Ext., c.	Ariz.	1,050,000	0.50	2.25	2,362,500	2.00	2,120,000	11,150,000	Nov. '20	.50
Utah Apex, c.	Utah	528,200	5			.25	132,050	1,254,475	Nov. '20	.25
Utah Copper	Utah	1,624,490	10	6.00	9,746,940	6.00	9,746,940	111,509,663	Dec. '20	6.00

a Two classes. b Include returned capital.

DIVIDENDS OF MINING AND METALLURGICAL COMPANIES IN THE UNITED STATES, 1919 AND 1920

Company Name	Situation	Shares Issued	Par Value	Dividends Paid		Total	Total to Date	Latest Date	Amount
				1919 Per Share	1920 Per Share				
Vanadium Corp.	Col. and Peru	373,334	1	.04	60,000	4.50	1,680,003	Oct. '20	1.50
Vindicator-Consol., g.	Col.	1,500,000	1			.01	15,000	Jan. '20	.01
Wellington, g.	Col.	1,000,000	1	.10	100,000			Jan. '19	.10
West End Consol., s.	Nev.	1,788,486	1	.10	178,850			Dec. '19	.05
Wolverine, c.	Mich.	60,000	25	2.50	150,000	.50	30,000	Jan. '20	.50
Yellow Pine, z. l.s.	Nev.	1,000,000	1	.15	150,000	.06	60,000	June '20	.03

CANADIAN, MEXICAN, SOUTH AND CENTRAL AMERICAN MINING COMPANIES

Company Name	Situation	Shares Issued	Par Value	1919		1920		Total to Date	Latest Date	Amount
				Per Share	Total	Per Share	Total			
Alvarado, g. s.	Mex.	350,000	\$20			\$1.50	\$52,500	\$52,500	Oct. '20	\$0.50
Amparo, g. s.	Mex.	2,000,000	1	\$0.18	\$360,000	.20	400,000	3,712,176	Nov. '20	.05
Asbestos Corporation.	Que.	30,000	100	3.75	112,500	11.25	337,500	450,000	Oct. '20	1.50
Asbestos Corp'n, pfd.	Que.	40,000	100	4.50	180,000	13.00	520,000	1,000,000	Oct. '20	1.75
Beaver Cons., s.	Ont.	2,000,000	1			.03	60,000	710,000	May '20	.03
Belmont Surf Inlet, g.	B. C.	2,500,000	1	.10	250,000	.20	500,000	750,000	Oct. '20	.05
Cerro de Pasco, c.	Peru	898,229		4.00	3,592,909	4.00	3,592,916	18,255,312	Dec. '20	1.00
Coniagas, s.	Ont.	800,000	5	.50	400,000	.62	500,000	10,140,000	Nov. '20	.12
Consol. M. & S. Canada	B. C.	419,098	25	2.50	1,047,744	2.50	1,053,370	7,093,896	Oct. '20	.62
Dome Mines, s.	Ont.	400,000	10			1.00	400,000	1,900,000	Oct. '20	.25
El Oro M. & R.R., g. s.	Mex.	1,147,500	£1	1 sh.	£57,375	1 sh.	£57,375	£2,013,125	Nov. '20	1 sh.
Florence Silver.	B. C.	1,100,000	\$1	\$0.03	\$35,300			\$35,300	Apr. '19	\$0.01
Frontin & Bolivia, g.	Colombia	140,000	£1			2 sh.	£14,000		July '20	1 sh.
Frontin & Bolivia, pfd.	Colombia	23,390	£8			5%	£10,000		July '20	5%
Cranby Consol., s. l. c.	B. C.	150,000	\$100	3.75	562,500	\$1.25	\$187,500	10,526,885	May '20	\$1.25
Green Cananea, c.	Mex.	500,000	100	1.50	750,000	1.00	500,000	17,097,165	Nov. '20	.50
Hedley Gold.	B. C.	240,000	10	.20	48,000			2,459,520	June '19	.10
Hollinger Consol., g.	Ont.	4,920,000	5	.35	1,722,000	.40	1,968,000	13,114,000	Dec. '20	.05
Howe Sound, c.	B. C.	1,984,150	1	.20	396,832	.20	396,832	1,081,288	Oct. '20	.05
Kerr Lake.	Ont.	600,000	4	1.50	900,000	.12	75,000	8,985,000	Oct. '20	.12
Lake Shore, g.	Ont.	2,000,000	1	.05	100,000	.04	80,000	280,000	Oct. '20	.02
Lucky Tiger-Comb., g.	Mex.	715,337	10	1.62	1,158,346	1.85	1,323,373	7,469,573	Dec. '20	.15
McIntyre Porcupine, s.	Ont.	3,640,283	1	.10	364,028	.15	546,042	1,994,654	Sept. '20	.05
McK.-Dar.-Sav., s.	Ont.	2,247,692	1	.12	269,724	.12	269,724	5,955,395	Oct. '20	.03
Mexico Mines of El Oro, g. s.	Mex.	180,000	£1	18 sh.	£162,000	4 sh.	£36,000		June '20	4 sh.
Min. Corp. of Can., s.	Ont.	1,600,050	\$5	\$0.37	\$622,518	\$0.37	\$622,518	5,499,275	Sept. '20	\$0.12
N. Y. & Hond. Ros., s. g.	C. A.	200,000	10	2.00	400,000	2.00	400,000	5,790,000	Oct. '20	.50
Nipissing Mines, s.	Ont.	1,200,000	5	1.50	1,800,000	1.50	1,800,000	22,140,000	Oct. '20	.50
Ouro Pret. Gold, pfd.	Brazil	27,161	£1			1 sh.	£1,358		Aug. '20	1 sh.
Pato Mines, g.	Colombia	100,000	£1	10 sh.	£50,000	14 sh.	£70,000	£120,000	Oct. '20	4/6
Rambler-Cariboo, c.	B. C.	1,750,000	\$1	\$0.01	\$17,500			\$440,000	Feb. '19	\$0.01
St. John del Rey, g.	Brazil	600,000	£1			1/12	£8,500		Dec. '20	9d.
St. John del Rey, pfd.	Brazil	100,000	£1			2 sh.	£10,000		Dec. '20	1 sh.
Santa Gertrudi, g. s.	Mex.	1,500,000	£1	2 sh.	£150,000	2 sh.	£150,000	£1,011,450	July '20	1 sh.
Temiskaming, s.	Ont.	2,500,000	\$1	\$0.05	\$50,000	\$0.04	\$100,000	\$2,159,156	Jan. '20	\$0.04
Trethewey, s.	Ont.	1,000,000	1					1,211,998	Jan. '19	.05

HOLDING COMPANIES

California Exploration.		231,617	\$2.40	\$0.24	\$56,278			\$196,973	Oct. '19	\$0.12
Exploration Co.	Mex.	750,000	10 sh.	9d.	£28,125			\$1,845,000	Mar. '19	9d.
General Development.	U. S.	120,000	\$25			1.00	120,000	4,973,917	Aug. '20	\$0.50
St. Mary's Min. Land.	Mich.	160,000	25	\$4.00	\$640,000	2.00	320,000	12,320,000	June '20	2.00
White Knob C. & D., pfd.	Cal.	200,000	10	.20	40,000	.05	10,000	360,000	Feb. '20	.05
Yukon-Alaska Trust.		203,433		4.00	813,732	1.00	203,433	3,254,928	Sept. '20	1.00

Bonds on New York Stock Exchange

	1919			1920			Sales in Thousands of Dollars
	High	Low	High	Low	High	Low	
Alaska Gold M., 6% conv., 25, Series A.	35	13	21	Nov. 12, 11	May 21, 14	197	
Alaska Gold M., 6% conv., 26, Series B.	34	12	20	Nov. 12, 10	July 28, 13	112	
Am. Sm. & Ref. 1st 30-yr. 5's Series A, 1947.	93	84	86	Jan. 5, 70	Dec. 23, 74	6,482	
Beth. Steel, 1st ext. 5's, 1926	98	95	97	Jan. 21, 85	Aug. 10, 85	310	
Beth. Steel, 1st and ref. 5's, 1942.	92	84	89	Jan. 2, 75	Nov. 23, 77	2,021	
Beth. Steel, pur. money and invest. 5's, 1936.	89	80	86	Jan. 3, 74	Dec. 3, 76	1,236	
Braden Copper, coll. tr. 6's, 1931.	97	89	93	Mar. 4, 79	Dec. 29, 80	541	
Chile Copper, conv. 7's, 1923	128	101	108	Jan. 5, 87	Dec. 23, 90	3,450	
Chile Copper, conv. 6's, 1932	95	82	86	Jan. 2, 62	Dec. 23, 66	7,590.5	
Col. Fuel & Iron, gen. s.f.g. 5's, 1948.	92	83	85	Jan. 19, 76	Oct. 27, 76	104	
Granby Consol. conv. 6's, '28	98	96	95	May 4, 90	Jan. 26, 92	23	
Granby Consol., conv. 6's, '28, stamped.	98	95	95	Apr. 26, 94	Apr. 20, 95	7	
Illinois Steel, deb. 4 1/2's, 1940	86	82	84	Jan. 2, 72	May 24, 75	915	
Indiana Steel, 1st mtg., 5's, 1952.	98	91	93	Jan. 7, 83	June 4, 85	933	
Lacka. Steel, 1st conv. 5's, 1923.	98	94	97	Feb. 6, 89	Sept. 17, 93	620	
Lacka. Steel, 1st conv. mtg. 5's, Series A, 1950.	107	86	99	Jan. 5, 71	Dec. 28, 72	1,041	
Nat. Tube, 1st mtg. 5's, 1952	99	92	93	Jan. 7, 83	June 15, 86	397	
Republic I. & S. 10-30-yr. s.f. 5's, 1940.	96	92	92				
Tenn. C. I. & R.R. 1st 5's, 1951	93	87	93	Jan. 3, 83	May 25, 87	191	
Tenn. Copper, 1st conv. 6's, 1925.	96	91	96	Feb. 25, 90	May 17, 94	125	
U. S. Sm., Ref. & M., conv., 6's, 1926.	107	97	105	Jan. 10, 87	Dec. 29, 88	537	
U. S. Steel, 10-60 yr., s.f. 5's, 1963.	101	94	99	Jan. 12, 88	Dec. 22, 93	15,582	
U. S. Steel, 10-60 yr., s.f. 5's, 1963, registered.	101	97	99	Jan. 8, 88	June 16, 90	144	
Va. Iron C. & C., 1st g. 5's, 1949.	87	81	87	Oct. 23, 80	Aug. 12, 83	74	

THE MARKET REPORT

Daily Prices of Metals

Jan.	Copper, N. Y. net refinery*		Tin		Lead		Zinc
	Electrolytic		99 Per Cent	Straits	N. Y.	St. L.	St. L.
13	12.75		33.50	38.00@38.25	4.75@5.10	4.80	5.50@5.55
14	12.75		32.00	37.00@37.25	4.75@5.10	4.80@5.00	5.50@5.55
15	12.75		32.00	37.00@37.25	4.75@5.10	4.80@5.00	5.50
17	12.75		31.00	35.75@36.00	4.75@5.10	4.80@5.00	5.50
18	12.75		30.00	34.75@35.00	4.75@5.00	4.70@5.00	5.45@5.50
19	12.75		30.00	34.75@35.00	4.75@5.00	4.80	5.45

*These prices correspond to the following quotations for copper, "delivered": 13c. for the week.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Jan.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3 M	Spot	3 M	Spot	3 M
	Spot	3 M							
13	73 $\frac{7}{8}$	73 $\frac{3}{4}$	81 $\frac{1}{2}$	205	211	23 $\frac{1}{2}$	23 $\frac{3}{4}$	26	26 $\frac{3}{4}$
14	73	72 $\frac{3}{4}$	81	200	204 $\frac{1}{2}$	23 $\frac{1}{2}$	24	24 $\frac{3}{8}$	26
15									
17	72	71 $\frac{3}{4}$	80	191	196	23 $\frac{1}{2}$	23 $\frac{1}{4}$	24 $\frac{1}{2}$	25 $\frac{3}{4}$
18	70 $\frac{3}{4}$	70 $\frac{3}{4}$	79	180 $\frac{1}{2}$	185 $\frac{1}{2}$	22 $\frac{7}{8}$	23 $\frac{1}{4}$	24	25 $\frac{1}{4}$
19	70 $\frac{1}{4}$	70	79	181 $\frac{1}{2}$	187	22 $\frac{3}{8}$	23 $\frac{1}{4}$	24 $\frac{1}{4}$	25 $\frac{1}{4}$

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Jan.	Sterling Exchange	Silver			Jan.	Sterling Exchange	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
13	372	99 $\frac{1}{2}$	65 $\frac{7}{8}$	39 $\frac{7}{8}$	17	373 $\frac{1}{2}$	99 $\frac{1}{2}$	66 $\frac{1}{4}$	39 $\frac{7}{8}$
14	373 $\frac{1}{2}$	99 $\frac{1}{2}$	66 $\frac{3}{8}$	40	18	375 $\frac{1}{2}$	99 $\frac{1}{2}$	66 $\frac{3}{8}$	39 $\frac{3}{4}$
15	372	99 $\frac{1}{2}$	67 $\frac{1}{4}$	40 $\frac{1}{4}$	19	374	99 $\frac{1}{2}$	65 $\frac{1}{2}$	39 $\frac{1}{2}$

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

Metal Markets

New York, Jan. 19, 1921

The metal situation shows no change of importance over last week, although a lull in buying seems to have set in since Monday. Consumer demand is, in general, confined to deliveries within two months, although inquiries for later deliveries are beginning to come in somewhat greater volume. Sellers, however, are indifferent and prefer to take chances on an improvement in prices in the future.

Import costs, it must be remembered, should not necessarily be figured on London prices plus freight to this country, for direct importation from the Continent in many cases represents a considerable saving both in asked price

and freight. Freight rates from this country to France, Holland and Germany are now from \$4 to \$5 per ton and from Baltimore to Havre even lower rates have been quoted. To Spain, Italy and Denmark the rate is \$13@ \$15 and to England the conference rate of \$13 still applies, though it has been raised to \$15 on ingot bars. From Europe to this country freights are in many cases lower. Transpacific rates are about \$11.25 per ton.

Copper

Sales continue in satisfactory volume considering prevailing general business conditions; at least they did up to Saturday. Since then business has been scanty. Export demand has decreased over that of two or three weeks ago, but is still in fair volume. Prices have

held steady with all interests asking about the same figure, which is the same as we mentioned last week, viz, 13c. delivered for January, and 1c. additional for each month beyond. The wire mills have been the chief buyers.

Lead

The A. S. & R. official price continues at 4.75c. New York and St. Louis. Lead has continued active, although orders for large tonnages have not been in evidence. Demand for spot metal has almost entirely disappeared, but it has apparently been obtainable from one of the principal producers at all times for 4.75c. New York. Most of the business has been done for February and March delivery on a basis of 4.95@5.10c. New York, and much of this was done on Thursday, Friday and Saturday. In the last three days demand has fallen away somewhat, which has caused a slight lowering of prices. April and May lead continues at a premium of about 1/4c., but producers in general are not interested in these sales. It would seem probable that lead will continue at present prices for some weeks, as the relation of supply and demand does not indicate a decline; on the other hand comparatively large stocks in Spain and Italy, and also supplies in Belgium, Germany and England, would probably be thrown on this market if the price were only slightly higher. There would also be a possibility of Australian lead coming to this country.

Zinc

The market continues very restricted at prices below cost of production. Curtailments are still going on and it is likely that the Bartlesville smelters will shut down entirely on the first of February. Many consumers in Ohio and Pennsylvania will soon be using imported zinc, contracts for which have already been made. With European lead reaching this country, the price in New York is no higher than in St. Louis for future delivery. The market for high-grade is almost non-existent, but it can be obtained for 7@7 1/4c.

Tin

Demand is still poor, the price decline, originating in London, serving to scare off buyers rather than interesting them. The price range is so irregular that consumers do not care to provide for future needs, even though they know the price is low. A little electrolytic has been sold at prices which represent slight concessions over Straits. It is rumored that the Straits government has reduced the fixed price to an equivalent of £230, but we have been unable to confirm this.

Straits tin for future delivery: Jan. 13th, 38.50@38.75c.; 14th, 37.50@

37.75c.; 15th, 37.50@37.75c.; 17th, 36.50@36.75.; 18th, 35.75@36.25c.; 19th, 35.-75@36.25c.

Arrivals of tin, in long tons: Jan. 11th, Australia, 100; 12th, Straits, 350; 14th, Straits, 25; China, 10; 17th, Singapore, 175.

Silver

The Indian bazaars have been buyers again during the last week, and it would appear that the chief inquiry in the market now is from this source rather than from China. The market has been dull of late, probably owing to the absence of speculative operations which had until recently been in evidence.

Mexican Dollars—Jan. 13th, 50; 14th, 50½; 15th, 51½; 17th, 50¾; 18th, 50¾; 19th, 50.

Gold

Gold in London: Jan. 13th, 110s. 6d.; 14th, 109s. 8d.; 17th, 109s. 9d.; 18th, 108s. 9d.; 19th, 109s. 5d.

General stock of money in the United States, Jan. 1: Gold coin (including bullion in Treasury), \$2,784,834,427; standard silver dollars, \$269,746,326; subsidiary silver, \$270,536,268; United States notes, \$346,681,016; Federal Reserve notes, \$3,735,719,345; Federal Reserve Bank notes, \$242,164,400; National Bank notes, \$723,277,222; total, \$8,372,959,004. The gold coin has increased about \$23,000,000 but the Federal Reserve notes are about \$72,000,000 over the preceding month.

Foreign Exchange

Foreign money in general has been steady during the last week, with sterling in rather better demand. On Tuesday, Jan. 18th, francs were 6.21c.; lire, 3.50c.; and marks, 1.54c. New York funds in Montreal, 14½ per cent premium.

Other Metals

Aluminum—List prices of 28.3@28.5c. are purely nominal.

Antimony—Chinese and Japanese brands, 5@5½c.; market quiet. W.C.C. brand, 6½@6¾c. per lb. Cookson's "C" grade, shipment from England, 9¾c. Chinese needle antimony, lump, nominal at 4½c. per lb. Standard powdered needle antimony (200 mesh), 7@7½c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb₂O₃, wholesale lots, 7c.

Bismuth—\$2.40 per lb., 500-lb. lots, and \$2.42 per lb., 100-lb. lots.

Cadmium—Nominal, \$1.40 per lb., in 1,000-lb. lots.

Cobalt—Metal, \$5 per lb.; black oxide, \$3.40 per lb. in bbls.; sulphate, \$1.35 per lb. in bbls.

Iridium—Nominal, \$325 per oz.

Magnesium—Crude, 99 per cent, \$1.35 per lb. f.o.b. Philadelphia.

Molybdenum Metal in rod or wire form, 99.9 per cent pure, \$32@40 per lb., according to gage.

Nickel—Ingot, 43c.; shot, 43c.; electrolytic, 45c., f.o.b. Bayonne, N. J.

Monel Metal—Shot, 35c.; blocks, 35c., and ingots, 38c. per lb., f.o.b. Bayonne.

Osmium—Open market, \$70@80 per troy oz.

Palladium—\$70@75 per oz.

Platinum—Firm at \$70@75 per oz.

Quicksilver—Nominally \$50 per 75-lb. flask. San Francisco wires \$50.

Rhodium—\$200@225 per troy oz.

Ruthenium—\$175@200 per troy oz.

Selenium—Black powdered, amorphous, 99.5 per cent pure, \$2@2.25 per lb.

Thallium Metal—Ingot, 99 per cent pure, \$20 per lb.

Tungsten Metal—Wire, \$35@60 per kilogram, according to purity and gage.

Metallic Ores

Chrome Ore—Guaranteed 50 per cent Cr₂O₃ foreign ore with a maximum of 6 per cent silica, 55@60c. per unit, New York. Practically no change on California chrome ore since August; 40@50 per cent can be bought at 50@60c. per unit, f.o.b. cars, California. One party has offered 800 tons of 40@45 per cent at 55c., and has been able to dispose of only 150 tons.

Manganese Ore—38@40c. per unit, seaport; chemical ore (MnO₂) \$60 per gross ton, lump; \$75@80 per net ton, powdered.

Molybdenum Ore—85 per cent MoS₂, 55@60c. per lb. of contained sulphide, New York.

Tantalum Ore—Guaranteed minimum 60 per cent tantalic acid, 40c. per lb. in ton lots.

Titanium Ores—Ilmenite, 52 per cent TiO₂, 1½@2c. per lb. for ore. Rutile, 95 per cent TiO₂, 12c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore—Scheelite or wolframite, 60 per cent WO₃ and over, per unit of WO₃, \$3.25@3.50, New York.

Uranium Ore (Carnotite)—Ore containing 1½ per cent U₃O₈ and 5 per cent V₂O₅ sells for \$1.50 per lb. of U₃O₈ and 75c. per lb. of V₂O₅; ore containing 2 per cent U₃O₈ and 5 per cent V₂O₅ sells for \$2.25 and 75c. per lb., respectively; higher U₃O₈ and V₂O₅ content commands proportionately higher prices.

Vanadium Ore—\$1.50 per lb. of V₂O₅ (guaranteed minimum of 18 per cent V₂O₅), New York.

Zircon—Washed, iron free, 3c. per lb.

Zirkite—According to conditions, \$70@90 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at \$1.15 per lb. in ton lots.

Zinc and Lead Ore Markets

Joplin, Mo., Jan. 15.—Zinc blende, per ton, high \$34.55; basis 60 per cent zinc, premium, \$29; Prime Western, \$27.50; fines and slimes, \$25@22.50; calamine, no sales. Average settling price, all grades of blende, \$32.12.

¹Furnished by Foote Mineral Co., Philadelphia, Pa.

Lead, high, \$52.50; basis 80 per cent lead, \$50. Average settling price, all grades of lead, \$47.90 per ton.

Shipments for the week: Blende, 7,371; lead, 891 tons. Value, all ores the week, \$279,460.

Production and purchases of zinc are now near balancing, with the demand around 7,000 to 8,000 tons per week. Some of the mines operating are devoting attention to lead production and are producing very little blende. The lead market improved this week, advancing to \$50 basis. Ten inches of snow Thursday handicapped hauling, yet the shipment was 1,100 over the preceding week.

Platteville, Wis., Jan. 15.—Blende, basis 60 per cent zinc, a base price of \$32 was offered for high-grade blende, but producers refused to sell at this price. Shipments for the week: Zinc ore, 255; lead, 250 tons. Shipments for the year: Zinc ore, 651; lead, 360. Shipped during the week to separating plants, 878 tons blende.

Non-Metallic Minerals

Asbestos—Crude, No. 1 \$2,000@3,500; No. 2, \$1,400@2,000; spinning fibres, \$400@1,000; magnesia and compressed sheet fibres, \$325@500; shingle stock, \$110@150; paper stock, \$60@75; cement stock, \$17.50@30; floats, \$8.50@15, all per short ton, f.o.b. Thetford, Broughton, and Black Lake mines, Quebec, Canada; 5 per cent to be added as export sales tax.

Barytes—Crude, 88 to 94 per cent barium content, \$10@12 per net ton; ground (white) \$24@30 in bags, carload lots; (off-color) \$22@26 in bags, carload lots; all f.o.b. Kings Creek, S. C. Crude, 88 to 94 per cent, \$23; ground (white), \$45; ground (off color) \$30@32 per net ton, less than carload lots, f.o.b. New York. Crude, first grade, \$10 per ton, f.o.b. cars, Missouri; floated, \$28 per ton in bbls.; \$26.50 per ton in 100-lb. bags; extra charge for bags, f.o.b. St. Louis.

Chalk—English, extra light, 5@5½c.; light, 5@6c.; dense, 4½@5c. per lb., all f.o.b. New York.

China Clay (Kaolin)—Crude, \$8@12; washed, \$12@15; powdered, \$18@22; bags extra, per net ton, f.o.b. mines, Georgia; crude, \$8@12; ground, \$15@40, f.o.b. Virginia points. Domestic lump, \$10@20; powdered, \$25@30; imported lump, \$25@35; powdered, \$30@35, f.o.b. New York.

Feldspar—Crude, \$8@14 per gross ton, f.o.b. Maryland and North Carolina points; \$7.50@10, f.o.b. Maine; ground, \$27@30, car lots, f.o.b. Baltimore; ground, \$17@21, f.o.b. North Carolina points; \$17@21 per ton, No. 1 ground, f.o.b. New York State; \$21@23 per ton, ground, f.o.b. Maine.

Fluorspar—Gravel, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, \$25 per ton, f.o.b. Illinois mines, and \$25.50, f.o.b. Kentucky; ground, suitable for acid, chem-

ical or enameling purposes, \$60; lump, \$15, f.o.b. Tonuco, N. M. In Canada 85 per cent calcium fluoride sells for \$20 per ton, f.o.b. Madoc; output limited. Canadian price generally \$18 (Canadian currency) per ton, f.o.b. mines.

Fuller's Earth—\$16 per ton, carload lots, f.o.b. New York.

Graphite—The 90 per cent crucible grade is held in Alabama for 9c. per lb. and 85 per cent grade, 7@9c. Lubricating grade commanding the best price is a fine flake, passing a 100@120 mesh, and running higher than 96 per cent carbon. Linotype machines use a flake passing 90 mesh and standing on a 120 screen, with 90 per cent carbon, retailing at 75c. to \$1 per lb. and selling to jobbers at 11@40c.

Gypsum—Plaster of paris in carload lots sells for \$4.25 per 250-lb. bbl., alongside dock, New York. Raw crushed rock, \$3.50@4.50; calcined stucco, \$9; f.o.b. works, Illinois.

Kaolin—See China Clay.

Limestone—Dolomite, 1@2 man size, \$1.60@1.65; 2@8 in., \$1.55@1.65 per net ton, f.o.b. Plymouth Meeting, Pa.; fluxing, \$1.65@1.75 per net ton, f.o.b. Howellville, Pa.

Magnesite, Calcined—High-grade caustic calcined, lump form, \$35@40 per ton, carload lots, f.o.b. California points. In Chicago district, \$57.70; Atlantic seaboard, \$61@63.

Dead-Burned—\$38 per net ton, Chewelah, Wash.; \$58@64, Chester, Pa. Austrian grade, \$55@60 per ton, f.o.b. Baltimore. (Magnesite brick—See Refractories.)

Mica—India block mica, slightly stained, per lb.: No. 6, 50c.; No. 5, \$1.20; No. 4, \$2@3; No. 3, \$3.25@3.50; No. 2, \$5.50@7; No. 1, \$8. Clear block: No. 6, 55c.; No. 5, \$1.75; No. 4, \$3.25; No. 3, \$5; No. 2, \$6.50; No. 1, \$8; A1, \$10; extra large, \$25; all f.o.b. New York; ground, \$60 per ton, in car lots, Philadelphia. Domestic, uncut, f.o.b. Franklin, N. C., as follows: Scrap, \$45@50 per ton; punch, 10c. per lb.; circle, 15@25c.; 1½ x 2 in., 75c.; 2 x 2 in., \$1.15; 2 x 3 in., \$1.65; 3 x 3 in., \$2.10; 3 x 4 in., \$2.50; 3 x 5 in., \$2.75; 3 x 6 in., \$3.75; ground 165 mesh, \$150 @170 per ton; ground roofing mica, \$60; mica washers, 75c.@2 per lb.; 1½-in. disks, No. 1, \$1.40 per lb.; No. 2, \$1.25. Lower prices are obtainable on certain sizes of domestic. Cut No. 1 stove, clear and slightly stained, 1½ x 2, \$2; 4 x 5, \$10; 8 x 10, \$30.

Monazite—Minimum of 6 per cent thorium oxide, quoted \$30 per unit, duty paid.

Phosphate Rock—Per long ton, Florida ports: 77 per cent tricalcium phosphate, \$13; 75 per cent, \$11.50; 75@74 per cent, \$11; 70 per cent, \$8.35; 68 per cent, \$7.85; 68@66 per cent, \$7.60. Finely ground Tennessee rock sells for \$8.50 per net ton for 13 per cent phosphorus content, agricultural application; for acid-making, 14 per cent, \$9; both prices f.o.b. Centerville, Tenn.

Pumice Stone—Imported, lump, 4@

50c. per lb.; domestic lump, 6c.; ground, 4@7c., all f.o.b. New York.

Pyrites—Spanish fines, per unit, 12c., c.i.f. Atlantic seaport; furnace size, 16½c.; Spanish lump, 14@16c.; domestic fines, f.o.b. mines, Georgia, 12@14c.

Quartz—(Acid tower) fist to head, \$10; 1½ to 2 in., \$14; rice, \$17; all net ton, f.o.b. Baltimore; lump, carload lots, \$5@7.50 net ton, f.o.b. North Carolina mines.

Sand (Glass)—Dry glass sand, \$4 per net ton, f.o.b. cars Mapleton, Pa. Sand, f.o.b. Ottawa, Ill., is \$3 per ton; \$2.50 on annual contracts. Sand at Klondike, Gray Summit and Pacific, all in Missouri, is \$2.50 on contract; some outside sales have been made at \$4. St. Louis, open market, at \$3.50; contract price on large quantities, \$2.50; on small quantities, \$3.

Sulphur—\$18 per ton for domestic; \$18@20 for export, f.o.b. Texas and Louisiana mines. Market quiet.

Talc—Paper making, \$12@22 per ton; roofing grades, \$9.50@15; rubber grades, \$12@18; all f.o.b. Vermont. California talc, \$20@45, talcum powder grade. Southern talc, powdered, carload lots, \$12@15 per ton; less than carload, \$25, f.o.b. cars; freight to New York \$5.25 per ton, carload lots; less than carload lots, \$9.25. Imported, \$40 @50; Canadian, \$20@40 per ton.

Mineral Products

Arsenic—White arsenic, 10½@11c. per lb.; sulphide, powdered, 15@15½c. per lb. in carload lots.

Sodium Nitrate—\$2.85@3 per cwt. ex vessel, Atlantic ports. Market quiet.

Sodium Sulphate—For 95 per cent material, \$22 per ton, f.o.b. mines, Idaho and Arizona, spot and six months' contract.

Potassium Sulphate—Domestic, \$220 @230 per net ton, basis 90 per cent, f.o.b. New York.

Ferro Alloys

Ferrocobalt—For 15 to 18 per cent material, \$200@225 per ton, f.o.b. Niagara Falls, N. Y.

Ferrocobalt—Per lb., \$12@15.

Ferrocobalt—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 16@17c. per lb. of chromium contained; 4 to 6 per cent carbon, 17@18c., f.o.b. works.

Ferromanganese—Domestic 76 to 80 per cent, \$105@110, f.o.b. seaboard bases; resale, \$115; English, \$110, c.i.f. Atlantic seaports. Spiegeleisen, 18@20 per cent, \$50.50, f.o.b. furnace.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, \$2 per lb. of contained metal, f.o.b. works.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, \$55@60; 50 per cent, \$78@80; 75 per cent, \$140@145.

Ferrotungsten—Domestic, 70 to 80 per cent W, 55@60c. per lb. of con-

tained tungsten, f.o.b. works. Foreign, 60c.

Ferro-uranium—35 to 50 per cent U, \$7 per lb. of U contained, f.o.b. works.

Ferrovanadium—Basis 30 to 40 per cent, \$5.75@6.75 per lb. of V contained, according to silicon content, f.o.b. works.

Metal Products

Copper Sheets—Current New York list price, 21½c. per lb.; wire, 15½.

Lead Sheets—Full lead sheets, 8½c.; cut lead sheets, 8½c. in quantity, mill lots.

Nickel Silver—33½c. per lb. for 18 per cent nickel.

Yellow Metal—Dimension sheets, 19½c.; sheathing, 19½c.; rods, 5 to 3 in., 16½c.

Zinc Sheets—\$11.50 per 100 lb., less 8 per cent on carload lots, f.o.b. smelter; zinc plates, 10c. per lb.

Refractories

Bauxite Brick—56 per cent alumina, \$160 per 1,000, f.o.b. Pittsburgh.

Chrome Cement—40@45 per cent Cr₂O₃, \$50@55 per net ton, and \$60 in sacks, carload lots, f.o.b. eastern shipping points.

Chrome Brick—Straights, \$80 per net ton, shipping point; arches, keys, wedges, \$85; splits, soaps, \$100.

Fire Brick—First quality, 9-in. shapes, \$55@60 per 1,000, Pennsylvania, Ohio and Kentucky. Second quality, \$45@50.

Magnesite Brick—9-in. straights, \$100 per net ton; 9-in. arches, wedges and keys, \$105; soaps and splits, \$120.

Silica Brick—9-in., per 1,000: Chicago district, \$65@70; Birmingham, Ala., \$56@61; Mount Union, Pa., \$50 @60.

Iron Trade Review

Pittsburgh, Jan. 18, 1921

The steel market continues stagnant, as to open market transactions. There is a moderate amount of buying from the Steel Corporation, by regular customers, but even such business is at a slower pace than in December. The independents are booking some business, but not much.

Pig Iron—A half dozen sales or more of foundry iron in lots of a few hundred tons each have been made at \$31.50, Valley basis, or \$1.50 under the previous nominal quotation. The Standard Sanitary Manufacturing Co. took at least 1,000 tons, for January-February shipment. Bessemer and basic have been altogether inactive. The market is now \$31.50 for foundry, bessemer and malleable remaining at \$32, and basic at \$30, all f.o.b. Valley furnaces.

Semi-finished Steel—Prices are practically nominal at mill quotations of \$43.50 for billets and \$47 for sheet bars.

Charcoal and Coke

Charcoal—Willow, 7c. per lb. in bbls., hardwood, 5½c. per lb., in 250-lb. bbls. Barrel charge is 35c. additional.

Connellsville—Furnace, \$6.25@7; foundry, \$5@5.50.

¹Furnished by Foote Mineral Co., Philadelphia, Pa.

