

# The Engineering and Mining Journal

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## Introduction

This annual statistical number of the JOURNAL is laid out on the same general plan as its predecessors, but as has always been the case it comprises numerous new features that are important. Besides a comprehensive treatment of many of the minor minerals and metals, there is presented again a valuable series of metallurgical articles, reviewing the progress of 1913 in the various departments of metallurgy. Also there are numerous articles upon mining developments by leaders of the industry, many of those that are unsigned being fully as responsible as those that are. No one can turn over the following pages without a recognition of the impressive list of contributors and the authoritativeness of their summaries. To all of

great mass of material in this huge number in a few days leaves no time for leisurely comparison and revision to effect a careful coordination of all the data. We feel sure that no one, in the light of this explanation, will be misled by any discrepancies that may be discovered.

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We commend to our readers a careful reading of the remarkable series of reviews of technical progress that appears in this issue. Mr. Knopf writes of advances in the science of economic geology, Mr. Huntoon of stamp milling, Professor Hofman of the metallurgy of lead, Mr. Addicks of the metallurgy of copper, Mr. Stoughton of the metallurgy of iron and steel, Mr. Ingalls of the metallurgy of zinc, Mr. Megraw of cyanidation and Mr. Cranston of gold dredging. All of these contributors are of national reputation as experts in their specialties; several of them are of international reputation. Such contributions as they offer in this issue are real enrichments of technical literature and are especially valuable to the general practitioner as expert summaries of what has been done in technical metallurgy.

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American mining companies that publicly announce their dividends paid \$76,215,014 in 1913, compared to \$68,776,540 in 1912. Canadian and Mexican companies paid \$21,501,930 in 1913 and \$21,212,929 in 1912.

United States metallurgical and holding companies connected with the mining industry, paid \$99,529,253 in 1913, as compared with \$91,948,280 in 1912.

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The unsold stock of spelter in the hands of American smelters at the end of 1913 was about 40,000 short tons, which is the largest on record.

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The world's production of copper in 1913 was 1,000,000 metric tons, compared with 1,020,000 tons in 1912.

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The world's production of gold in 1913 was \$463,312,673, compared to \$474,333,268 in 1912.

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The production of copper in the United States in 1913 decreased, but the productions of iron, lead and zinc increased.

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The world's production of spelter in 1913 was about 1,001,000 metric tons compared with 978,000 metric tons in 1912.

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The world's production of tin in 1913 was 120,356 long tons, compared with 114,196 in 1912.

### PRODUCTION OF METALS IN THE UNITED STATES

Metal	Unit	1911	1912	1913
Aluminum.....	pounds	(g) 40,000,000	(g) 40,000,000	(h) 50,000,000
Copper (a).....	pounds	1,083,856,371	1,241,762,508	1,228,811,581
Ferromanganese.	long tons	184,717	227,725	353,100
Gold (b).....	dollars	96,890,000	93,451,500	88,301,023
Iron.....	long tons	23,464,627	29,525,412	30,808,300
Lead (c).....	short tons	400,958	410,006	433,476
Nickel (e).....	pounds	29,545,967	42,168,769	(e) 38,614,745
Quicksilver.....	flasks	21,500	(f) 25,147	(h) 21,000
Silver (b).....	troy ounces	60,399,400	63,766,800	67,601,111
Zinc (d).....	short tons	295,836	348,638	356,146

(a) Production from ore originating in the United States. (b) The statistics for 1911 and 1912 are the final and those for 1913 are the preliminary statistics reported jointly by the director of the Mint and the U. S. Geological Survey. (c) Production of refined lead from ore and scrap originating in the United States; antimonial lead is included. (d) Total production of smelters, except those treating dross and junk exclusively; includes spelter derived from imported ore. (e) Imports; for 1913, first 10 months only. This nickel is refined in the United States for the production of metal, oxide and salts. (f) As reported by U. S. Geological Survey. (g) As reported by the Metallgesellschaft, Frankfurt am Main. (h) Estimated.

### PRODUCTION OF MINERAL AND CHEMICAL SUBSTANCES

Substance	Unit	1911	1912	1913
Arsenic.....	pounds	6,162,000	5,852,000	4,624,140
Coal, anth. (b).....	short tons	90,526,556	84,478,527	90,099,903
Coal, bitu. (b).....	short tons	402,121,307	449,962,723	471,969,903
Coke (b).....	short tons	34,972,534	42,528,653	45,328,890
Copper sulphate.	pounds	33,454,000	39,480,741	54,330,000
Iron ore.....	long tons	41,878,190	59,196,798	61,770,478

(b) The coal and coke statistics are the estimates of Coal Age.

these contributors, who have collaborated in this number, we tender our thanks, and also to the many persons who have assisted in the collection of statistical information. Our thanks are due also to the producers of copper, lead, spelter and other substances, who have communicated to us the amount of their output in 1913 and have thereby enabled a close approximation to the actual production in 1913 to be made by Jan. 7, 1914, our date of going to press.

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The production of the more important minerals and metals is summarized in the table on this page. The details appear in subsequent pages. It will be found that in some cases our contributors give figures that do not agree with our own. The explanation of such differences will generally be that the articles of outside contributors were necessarily written and put into type before our own statistics were available. The necessity of handling the

## METAL MARKETS

NEW YORK—Jan. 7

The metal markets have not been especially active in the first week of the year. Copper prices have declined slightly, but other metals have been steady.

### Copper, Tin, Lead and Zinc

**Copper**—The activity which occurred last week turned out to be of short duration. Domestic manufacturers, having filled their immediate wants, withdrew entirely from the market. A similar condition of things prevails in Europe. Consequently the business last week fell to small proportions. There were but few domestic sales, and only a small volume for export. A wide range of prices asked have been named, but these mean nothing except being a starting point from which to talk business. At the end of the week copper was freely offered at 14½@14¾c., delivered, usual terms. Stocks are accumulating in first hands and there is evident willingness to meet the market, which would probably have expressed itself in prices more than was actually the case if the volume of business had warranted it. The small orders that were taken in Europe were at reduced prices.

The situation in Lake copper remains unchanged and the quotations are nominal at the figures of the principal producer. Some arsenical Lake is reported sold at low prices. In casting copper there is a strange inability to make sales and a pronounced weakness. The average price of electrolytic copper for the week was 14.41 cents.

The standard market has been reactionary and is now following closely the market for refined sorts. The close is cabled as steady at £63 17s. 6d. for spot and £64 5s. for three months.

On Jan. 1 base price of copper sheets was advanced ¼c. and is now 20¼c. per lb. for hot rolled and 21¼c. for cold rolled. The usual extras and discounts are charged and higher prices for small quantities.

**Visible Stocks of Copper** in Europe on Dec. 31 are reported as follows: Great Britain, 11,510; France, 3190; Rotterdam, 3750; Hamburg, 3590; Bremen, 1180; other European ports, 850; total, 24,070 long tons, or 53,916,800 lb. This is an increase of 1870 tons over Nov. 15. In addition to the stocks above 2300 tons are reported afloat from Chile and 4000 from Australia, making a total of 30,370 tons.

**Tin**—The decline in London during the latter part of last week tended to dampen the enthusiasm displayed early in the week by domestic consumers. Buying ceased entirely and the concession in price below the London parity which was made by local dealers was of no avail. The low price established on Monday of this week attracted consumers and some future orders were placed. The London market improved in consequence, but did not retain its entire advance. The close is dull at £167 10s. for spot and £169 5s. for three months, and about 36¾c. for January tin here.

**Visible Stocks of Tin** on Dec. 31 are reported as follows, including tin afloat: London, 8464; Holland, 1115; United States, excluding Pacific ports, 4314; total, 13,893 long tons, a decrease of 577 tons in December.

**Lead**—There has been very little business during the week, and prices are nominal and unchanged at 4.15c. New York and 4.07½c. St. Louis.

The continued absence of shipments from Mexico is again beginning to affect the foreign markets, which is reflected in an advance in the London quotation to £19 for Spanish lead and 12s. 6d. higher for English.

**Spelter**—The market has been rather dull and there has been a little more pressure to sell, evidently because of the unfavorable statistics, but so far buyers have not shown any inclination to take hold. In the early part of the week a moderate tonnage was sold at 5.10c., St. Louis, but in the latter part liberal offers at 5.10c. failed to develop business. The London quotation is cabled at £21 11s. 3d. for good ordinaries and 7s. 6d. higher for specials.

Base price of sheet zinc was advanced ¼c. per lb. on Jan. 1, and is now \$7.50 per 100 lb., in carload lots, f.o.b. Peru. Ill., less 8% discount.

### Other Metals

**Aluminum**—The market remains quiet and prices are unchanged at 18½@19c. for No. 1 ingots, New York.

**Antimony**—The market is slow and prices are unchanged. Cookson's is 7.40@7.60c. per lb.; Hallett's, 7½@7¾c.; while 6@6¼c. per lb. is paid for Chinese, Hungarian and other outside brands.

**Quicksilver**—Business has been quiet but the market is firm. New York quotation is \$39@40 per flask of 75 lb. for large lots. The jobbing price for small lots is 54@56c. per lb. San Francisco, \$39 per flask for domestic orders, with special price for export. London price is £7 10s., with £7 2s. 6d. quoted from second hands.

### Gold, Silver and Platinum

**Gold**—Gold on the open market in London remained at the Bank price, 77s. 9d. per oz. for bars.

**Platinum**—The market is quiet, and there is little doing. Prices are easy, and metal can be had at \$42.75@43.75 per oz., New York. Hard metal is quoted \$46@49 per oz., according to grade.

Our Russian correspondent reports a strong, but not active, market. Work at the mines has been almost stopped by the cold. At Ekaterinburg quotations for crude metal, 83% platinum, are 9.65 rubles per zolotnik; at St. Petersburg, 37,200 rubles per pood—equal to \$36.28 and \$36.45 per oz., respectively.

**Silver**—The market has continued dull and inactive around 26½d. in London, but closes higher today at 26¾d. for spot delivery, while forward delivery remains unchanged at 26⅞d. Tendency uncertain, but price is likely to remain around present level.

### DAILY PRICES OF METALS

#### NEW YORK

January	Sterling Exchange	Silver	Copper		Tin Cts. per lb.	Lead		Zinc	
			Lake, Cts. per lb.	Electrolytic, Cts. per lb.		New York, Cts. per lb.	St. Louis, Cts. per lb.	New York, Cts. per lb.	St. Louis, Cts. per lb.
1	.....	.....	.....	.....	.....	.....	.....	.....	.....
2	4.8550	57½	@15½	@14.50	36½	4.15	4.07½	@5.22½	@5.07½
3	4.8560	57½	@15½	@14.50	36½	4.15	4.07½	@5.27½	@5.12½
4	4.8575	57½	@15½	@14.40	36½	4.15	4.07½	@5.20	@5.05
5	4.8575	57½	@15½	@14.40	36½	4.15	4.07½	@5.25	@5.10
6	4.8590	57½	@15½	@14.40	36½	4.15	4.07½	@5.25	@5.10
7	4.8620	58	@15½	@14.40	36½	4.15	4.07½	@5.25	@5.10

\*Nominal.

The quotations herein given are our appraisal of the markets for copper, lead, spelter and tin based on wholesale contracts; and represent, to the best of our judgment, the prevailing values of the metals specified as indicated by sales by producers and agencies, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.15c. apart. The quotations for electrolytic copper are for cakes, ingots and wirebars. The price of electrolytic cathodes is usually 0.05 to 0.10c. below that of electrolytic; of casting copper 0.15 to 0.25c. below. The quotations for lead represent wholesale transactions in the open market for good ordinary brands, the specially refined corroding lead commands a premium. The quotations on spelter are for ordinary Western brands; special brands command a premium. Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals; per 100 lb., are: St. Louis-New York, 15½c.; St. Louis-Chicago, 6c.; St. Louis-Pittsburgh, 12½c.; New York-Bremen or Rotterdam, 15c.; New York-Havre, 16@17½c.; New York-London, 16c.; New York-Hamburg, 18c.; New York-Trieste, 22c.

#### LONDON

January	Silver	Copper				Tin		Lead		Zinc	
		Spot		3 Mos.	Best Sel'd	Spot	3 Mos.	£ per Ton	Cts. per lb.	£ per Ton	Cts. per lb.
		£ per Ton	Cts. per lb.								
1	26 7/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	
2	26 7/16	64½	13.93	64½	70½	168	169½	18½	3.97	21½	4.67
3	26 7/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	
5	26 7/16	63½	13.81	64½	69	166½	168½	18½	4.02	21½	4.67
6	26½	64 1/16	13.95	64½	70	168½	170	18½	4.02	21½	4.64
7	26½	63½	13.87	64½	69½	167½	169½	19	4.13	21 1/16	4.68

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17½c.; £15 = 3.26c. = £25 = 5.44c.; £70 = 15.22c. Variations, £1 = 0.21½c.



# Gold and Silver Production in 1913

BY FREDERICK HOBART

The gold output of the world in 1913, as far as it can be approximated at the present time, showed a decrease from that of 1912 of about \$11,000,000, or 2.3%. For the first time in 10 years, the Transvaal, which has been the principal contributor and has, year by year, shown the largest gain, had an actual decrease from the previous year. The United States, which is the second producer, also reports a less production, and Mexico had a considerable loss. That the decrease was not greater was due to the gains made by Canada, Russia, and a number of the smaller producers.

### GOLD PRODUCTION OF THE WORLD

	1911 (a)	1912 (a)	1913
Transvaal.....	\$170,059,273	\$188,599,260	\$182,351,000
Rhodesia.....	12,986,000	13,166,230	14,179,600
West Africa.....	5,197,488	7,386,028	8,288,600
Madagascar, etc.....	2,706,639	2,925,000	3,015,000
<b>Total Africa.....</b>	<b>\$190,949,400</b>	<b>\$212,076,518</b>	<b>\$207,834,200</b>
United States.....	\$96,890,000	\$93,451,500	\$88,301,023
Mexico.....	24,880,100	22,500,000	17,500,000
Canada.....	9,762,100	12,559,288	15,300,000
Central America, etc.....	3,399,000	3,632,500	3,945,000
<b>Total North America.....</b>	<b>\$134,931,200</b>	<b>\$132,143,288</b>	<b>\$125,046,023</b>
Russia, inc. Siberia.....	\$32,151,600	\$27,635,500	\$30,000,000
France.....	1,707,100	1,847,000	1,890,000
Other Europe.....	2,584,900	3,615,000	3,650,000
<b>Total Europe.....</b>	<b>\$36,443,600</b>	<b>\$33,097,500</b>	<b>\$35,540,000</b>
British India.....	\$11,054,100	\$12,115,162	\$12,150,000
British and Dutch East Indies..	4,726,500	4,925,000	4,850,000
Japan and Chosen.....	6,896,900	7,165,000	7,350,000
China and others.....	3,769,600	3,750,000	3,650,000
<b>Total Asia, not inc. Siberia...</b>	<b>\$26,447,100</b>	<b>\$27,955,162</b>	<b>\$28,000,000</b>
South America.....	\$10,421,800	\$12,425,000	12,975,000
Australasia.....	60,184,200	56,635,800	53,917,450
<b>Total.....</b>	<b>\$459,377,300</b>	<b>\$474,333,268</b>	<b>\$463,312,673</b>

(a) Official returns of the respective countries and reports of the Director of the U. S. Mint.

The details of the production will be found in the accompanying table. In this, the figures for the principal producers have been received for 11 months of 1913, and it has been necessary to estimate only one month's output. The figures for the United States, both of gold and silver, are furnished by the preliminary statement compiled jointly by the Director of the Mint and the U. S. Geological Survey. In other cases, where it has been necessary to estimate the production to some extent, it has been done on a conservative basis, so that it is quite possible the final figures may show a slight gain.

The silver production of the United States increased nearly 6% over 1912. As in previous years, the winning of silver is almost entirely in connection with that of other metals, principally copper, lead and gold, and the rate of its production depends largely upon the causes which influence the demand for those metals.

While there was an increase of silver in the United States, there was a decrease in some other countries, notably in Mexico, and the Director of the Mint estimates the total silver production of the world in 1913 at 212,000,000 oz., against 224,000,000 oz. in 1912.

### COMMERCIAL MOVEMENT OF GOLD AND SILVER

The decrease in the production of gold occurred at a time when there was an acute demand for it in almost all commercial countries. In Europe, England, France and Germany, were alike active bidders for gold during a large part of 1913, France being the most urgent. Gold shipments from South Africa and Australia were quickly absorbed in the London market. The premiums offered

were sufficient to draw more gold from the United States than it received, although there was a large trade balance in favor of this country all through the year. In part, this demand was due to the activity of trade, but in part also to the disturbed political conditions in eastern

### GOLD PRODUCTION OF THE WORLD FOR 20 YEARS

1894.....	\$182,509,283	1904.....	\$349,088,293
1895.....	198,995,741	1905.....	378,411,054
1896.....	211,242,081	1906.....	405,551,022
1897.....	237,833,984	1907.....	411,294,458
1898.....	287,327,833	1908.....	443,434,527
1899.....	311,505,947	1909.....	459,927,482
1900.....	258,829,703	1910.....	454,213,649
1901.....	260,877,429	1911.....	459,377,300
1902.....	298,812,493	1912.....	474,333,268
1903.....	329,475,401	1913.....	463,312,673

Europe and the absorption and destruction of capital by the Balkan war. The demand for gold from India was a little less than in 1912, when it showed such a remarkable increase. The accompanying tables show the gold movement in some of the leading countries for 11 months of 1913.

### GOLD PRODUCTION IN THE UNITED STATES (a)

	(Value) 1912	1913	Changes
Alabama.....	\$16,400	\$8,062	D. 8,338
Alaska.....	17,198,600	14,783,512	D. 2,415,088
Arizona.....	3,785,400	3,803,039	I. 17,639
California.....	20,008,000	20,105,447	I. 97,447
Colorado.....	18,741,200	18,420,031	D. 321,169
Georgia.....	10,900	9,881	D. 1,019
Idaho.....	1,401,700	1,366,605	D. 35,095
Maryland.....	1,200		D. 1,200
Montana.....	3,707,900	3,078,202	D. 629,698
Nevada.....	13,575,700	12,279,131	D. 1,296,569
New Mexico.....	734,600	844,086	I. 89,486
North Carolina.....	156,000	111,442	D. 44,558
Oregon.....	759,700	1,370,987	I. 611,287
South Carolina.....	15,400	1,985	D. 13,415
South Dakota.....	7,823,700	7,197,498	D. 626,202
Tennessee.....	11,500	7,711	D. 3,789
Texas.....	2,200	120	D. 2,080
Utah.....	4,312,600	3,400,103	D. 912,497
Virginia.....	300	3,514	I. 3,214
Washington.....	682,600	692,021	I. 9,421
Wyoming.....	24,300	30,491	I. 6,191
Continental U. S.....	\$92,989,900	\$87,512,868	D. \$5,477,032
Porto Rico.....	1,116		I. 1,116
Philippines.....	461,600	787,039	I. 325,439
<b>Total.....</b>	<b>\$93,451,500</b>	<b>\$88,301,023</b>	<b>D. \$5,150,477</b>

(a) As reported by the Director of the Mint and the U. S. Geological Survey.

The gold holdings of the great banks of Europe on Dec. 31, 1913, reached a total of \$2,779,540,000, which compares with \$2,513,807,000 at the close of 1912; the increase being \$265,733,000. The Bank of Russia was the largest holder, reporting about \$836,000,000, which includes the government balances. The Bank of France held the largest commercial balance, \$701,537,000. The Treasury department estimates the total gold in the United States at \$1,917,498,400 at the close of the year.

The fluctuations in silver prices in 1913 were not very great. For most of the year, prices were maintained to some extent by the heavy speculation carried on, by Indian capitalists chiefly, to which reference has frequently been made in our columns. The collapse of this speculation and the failure of the Indian banks, which were backing it, at one time threatened a disastrous break in prices, which was averted by a London syndicate, which took over the great stocks of silver which the Indian banks had been carrying.

The exports of silver to the East, which have a most important effect on prices, decreased considerably during 1913. In China the disturbed condition of politics and trade and the apparent hopelessness of any early reform in currency, cut down the demand, and in India the im-

ports of gold, coupled with buying from China and Australia, were the causes of the smaller buying in London.

Shipments of silver from London to the East, Jan. 1 to Dec. 18, as reported by Messrs. Pixley & Abell:

SILVER PRODUCTION OF THE UNITED STATES (a)

	(In Fine Ounces)		
	1912	1913	Changes
Alabama.....	200	84	D. 116
Alaska.....	539,790	379,575	D. 160,125
Arizona.....	3,445,500	3,390,846	D. 54,654
California.....	1,384,800	1,527,026	I. 142,226
Colorado.....	7,933,100	9,159,367	I. 1,226,267
Georgia.....	200	84	D. 116
Idaho.....	7,862,900	9,573,328	I. 1,720,428
Illinois.....	1,800	3,659	I. 1,859
Maryland.....	700	700	D. 0
Michigan.....	543,500	429,014	D. 114,486
Missouri.....	30,000	33,763	I. 3,763
Montana.....	12,524,000	13,035,841	I. 511,841
Nevada.....	13,851,400	15,092,190	I. 1,241,790
New Mexico.....	1,460,800	1,525,133	I. 64,333
North Carolina.....	2,300	2,268	D. 32
Oregon.....	54,000	158,594	I. 104,594
South Carolina.....	13	13	I. 0
South Dakota.....	205,800	168,231	D. 37,569
Tennessee.....	112,000	124,009	I. 12,009
Texas.....	379,800	428,490	I. 48,690
Utah.....	13,076,700	12,269,088	D. 807,612
Virginia.....	700	23,706	I. 23,006
Washington.....	350,800	263,090	D. 87,710
Wyoming.....	300	3,729	I. 3,429
Continental U. S.....	63,761,000	67,591,128	I. 3,830,128
Porto Rico.....	9	9	I. 0
Philippines.....	5,800	9,974	I. 4,174
Total.....	63,766,800	67,601,111	I. 3,834,311

(a) As reported by the Director of the Mint and the U. S. Geological Survey.

In the United States, there was a decrease in the quantity of silver obtained from Mexican bullion, which was balanced by a decrease in the exports. The sale of silver for use in the arts was fairly good, being about equal to that of 1912. The United States Mint bought in 1913 a total of 2,288,000 oz. of silver for subsidiary coinage. Foreign governments also made considerable purchases during the year, notably France, Russia, and Holland.

IV. MONTHLY AVERAGE PRICE OF SILVER

Month	New York			London		
	1911	1912	1913	1911	1912	1913
January.....	53.795	56.260	62.938	24.865	25.887	28.983
February.....	52.222	59.043	61.642	24.081	27.190	28.357
March.....	52.745	58.375	57.870	24.324	26.875	26.669
April.....	53.325	59.207	59.490	24.595	27.284	27.416
May.....	53.308	60.880	60.361	24.583	28.038	27.825
June.....	53.043	61.290	58.990	24.486	28.215	27.199
July.....	52.630	60.654	58.721	24.286	27.919	27.074
August.....	52.171	61.606	59.293	24.082	28.375	27.355
September.....	52.440	63.078	60.640	24.209	29.088	27.986
October.....	53.340	63.471	60.793	24.594	29.299	28.083
November.....	55.719	62.792	58.995	25.640	29.012	27.263
December.....	54.905	63.365	57.760	25.349	29.320	26.720
Year.....	53.304	60.835	59.791	24.592	28.842	27.576

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Gold and silver movement in the United States, 11 months ended Nov. 30:

	Gold		Silver	
	1912	1913	1912	1913
Exports.....	\$46,768,138	\$81,226,017	\$64,353,611	\$58,319,092
Imports.....	55,151,765	58,631,475	44,402,933	33,037,451
Excess.....	I. \$8,383,627	E. \$22,594,542	E. \$19,950,678	F. \$25,261,641

Merchandise exports for the 11 months were valued at \$2,250,929,715; imports, \$1,608,829,114; excess of exports, \$642,100,403. Adding the excesses of gold and silver, we have \$689,956,586 as the total export balance for the 11 months.

Gold and silver movement in Great Britain, 11 months ended Nov. 30:

	Imports		Exports		Excess	
Gold.....	£54,588,642	£44,044,028	I. £10,544,614			
Silver.....	13,695,206	14,938,564	E. 1,243,358			

Gold and silver movement in France, 10 months ended Oct. 31:

	Imports		Exports		Excess	
Gold.....	Fr. 559,351,000	Fr. 58,959,000	I. Fr. 500,392,000			
Silver.....	315,423,000	287,605,000	I. 27,818,000			

	1912		1913		Changes	
India.....	£11,924,500	£9,727,000	D. £2,197,500			
China.....	1,796,000	755,000	D. 1,041,000			
Total.....	£13,720,500	£10,482,000	D. £3,238,500			

Exports of silver from San Francisco, 11 months ended Nov. 30 were: Coin, \$48,200; bullion, \$11,952,344; total, \$12,000,544, being an increase of \$2,282,207 over 1912. The greater part of these exports went to China.

The Arkansas Diamond Field in 1913

By JOHN T. FULLER\*

The work done in 1913 in the Arkansas diamond field showed more progress toward the ultimate development of this field than any previous year since its discovery. Active operations have been carried on during the year by the Ozark Mining Co. and the Kimberlite Diamond Mining & Washing Co.

The Ozark company in the spring purchased and erected a first-class washing plant capable of handling about 100 loads in 10 hr. This plant was in operation about three months and washed approximately 5000 loads, principally from the pipe first discovered, a portion of which they acquired by purchase from M. M. Mooney. It also washed about 1000 loads from the so called Riley tract, located about a half mile from the large pipe. This Riley tract was apparently merely a dike, and it is doubtful whether any diamonds are contained in it. The returns from the washings on the main pipe were, taken as a whole, satisfactory. The pit excavated during the progress of mining demonstrated that the soft disintegrated kimberlite extends to a greater depth than was at first estimated. Between seven and eight hundred diamonds were recovered. No attempt has been made to dispose of these stones, and the work was simply done by the Ozark company as a means of testing out its property.

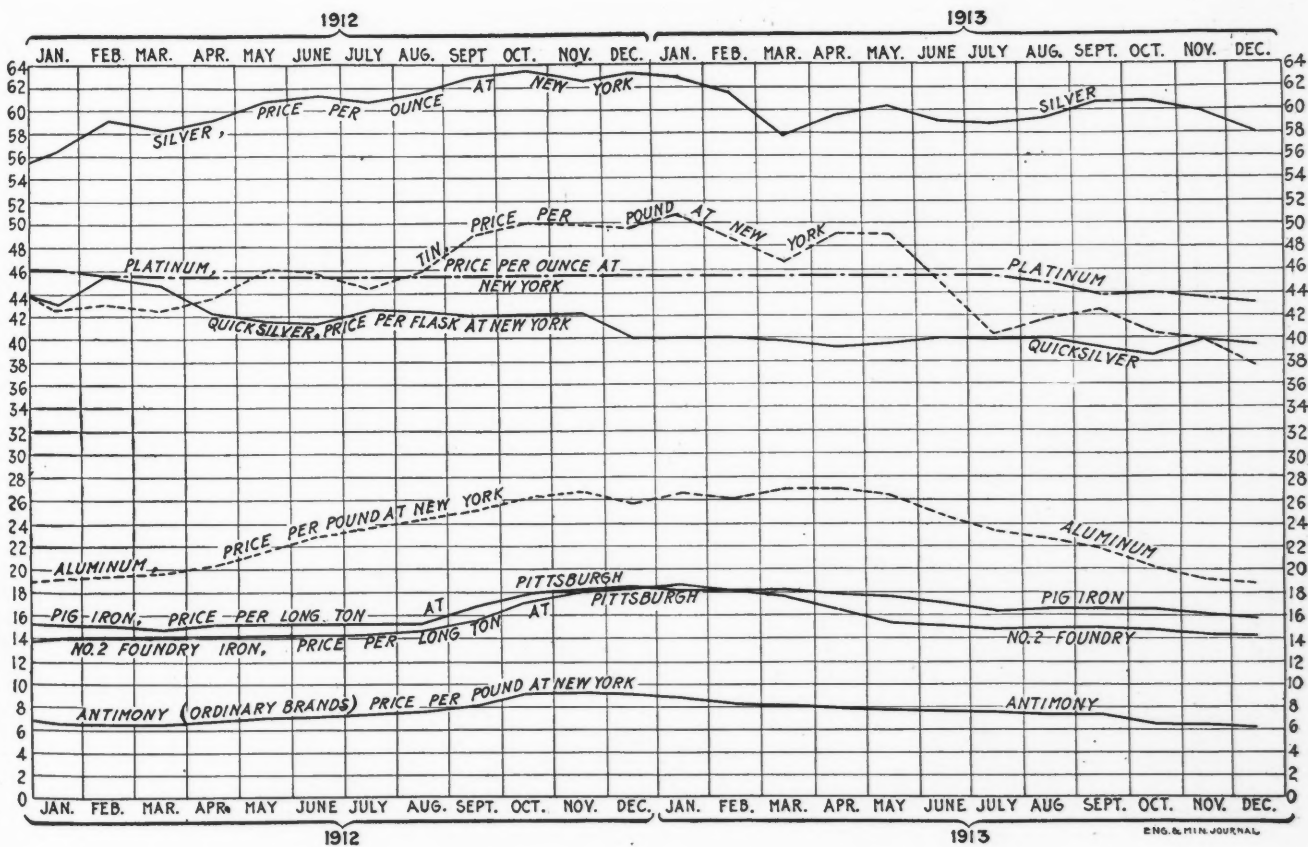
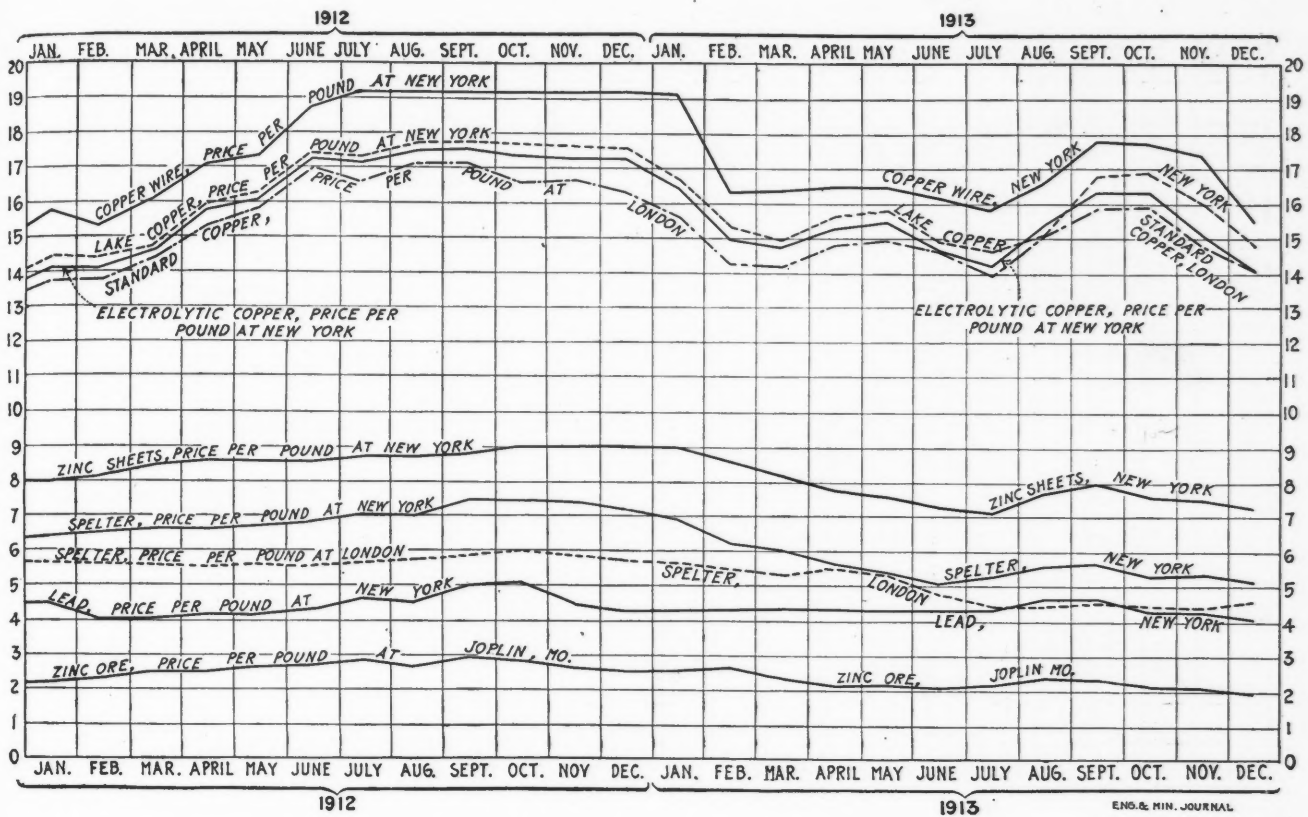
The Kimberlite Diamond Mining & Washing Co. erected a small plant on the banks of Prairie Creek and is working the remaining part of the Mooney tract acquired by it on a 50-year lease from M. M. Mooney. It has done considerable work in the way of development on the Mooney tract, built a mile of tram line from mine to mill and will probably be in active operation by January, 1914. Operations to date have been of a minor character, more in the way of testing machinery and the various kinds of ground encountered on the tract, than an attempt to produce on a commercial scale. The plant is now erected and will probably handle 50 to 100 loads of disintegrated kimberlite per day (10 hr.). It has made no returns as to the number of diamonds which it has recovered.

The Arkansas Diamond Co. did no work during the year, but a reorganization of this company is talked of for 1914, and it will probably make some determined effort to get to work during this year.

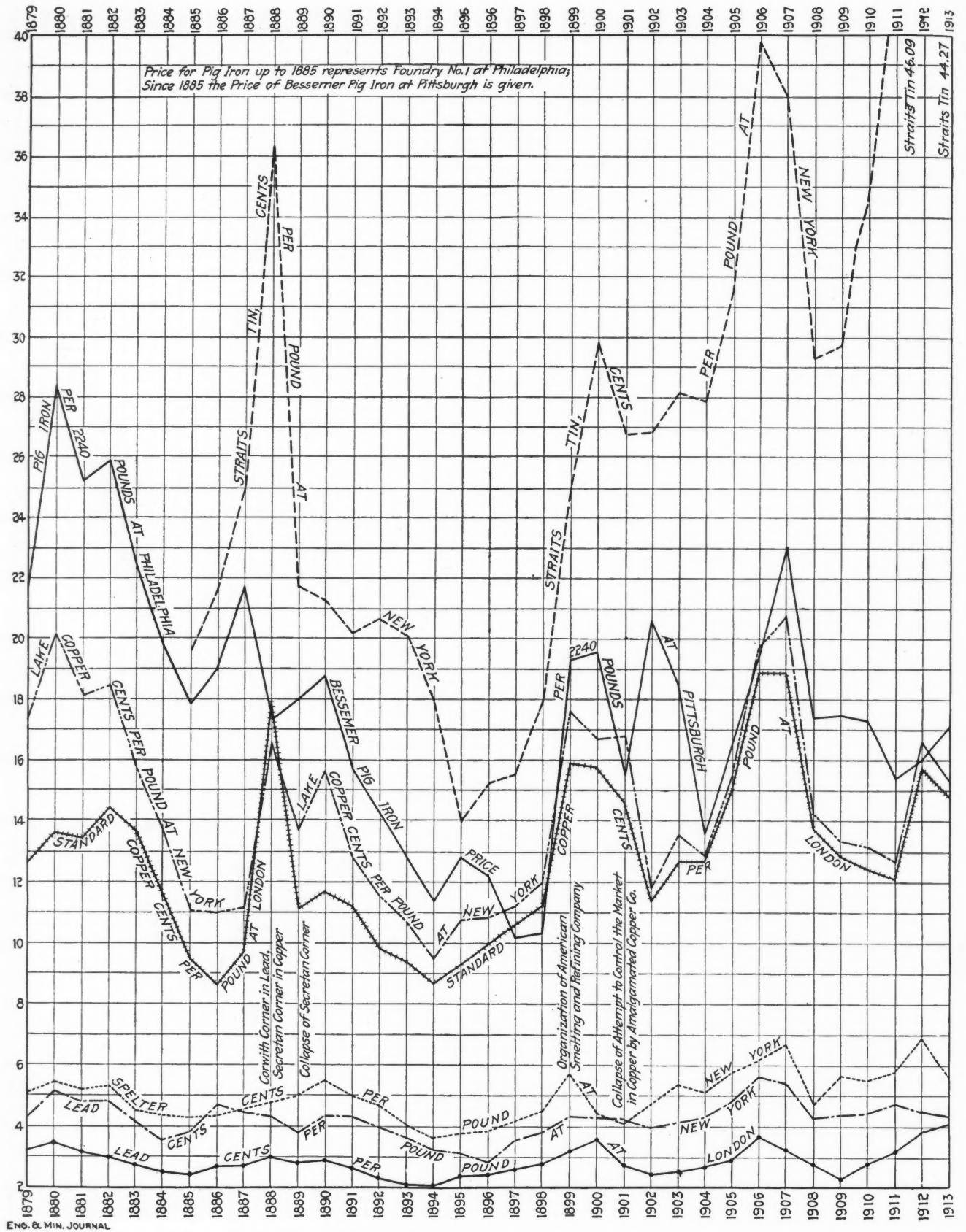
The American Diamond Mining Co. did no active work on their property, but reports the finding of one fine stone.

\*Consulting engineer to the Arkansas Bureau of Mines, Manufactures and Agriculture, Little Rock, Ark.





METAL PRICES IN 1912 AND 1913, MONTHLY AVERAGES



COURSE OF METAL PRICES SINCE 1879—ANNUAL AVERAGES



# The Copper Industry in 1913

The production of copper in the United States, Canada, Mexico and Cuba in 1913 and previous years, is given in the following table. Our figures are based uniformly upon reports received from the several producers and represent the smelters' output, which is a different thing either from the mine output or the refinery output. In the case of the Michigan production, however, the smelters are also refiners and their figures for smelting and refining productions are consequently the same.

SMELTERS' PRODUCTION OF COPPER IN THE UNITED STATES (In Pounds)

State	1910	1911	1912	1913
Alaska.....	5,008,171	19,412,000	32,602,000	23,360,000
Arizona.....	299,606,971	300,578,816	357,952,962	401,223,786
California.....	45,793,894	36,806,762	31,069,029	32,206,435
Colorado.....	10,127,012	8,474,848	7,502,000	7,320,000
Idaho.....	6,216,461	3,745,210	5,964,542	8,594,722
Michigan.....	221,400,864	216,412,867	231,628,486	161,000,000
Montana.....	286,242,403	271,963,769	309,247,735	284,210,911
Nevada.....	63,877,500	65,385,728	82,530,608	83,829,329
New Mexico.....	3,632,351	1,518,288	27,488,912	48,710,000
Utah.....	125,042,381	138,336,905	131,673,803	148,274,658
Washington.....			1,121,109	(a)
East and South.....	18,195,450	19,656,971	18,592,655	20,857,849
Other States.....	1,106,525	1,564,207	4,396,667	9,223,891

Totals..... 1,086,249,983 1,083,856,371 1,241,762,508 1,228,811,581  
(a) Included in "Other States."

SMELTERS' PRODUCTION OF COPPER IN NORTH AMERICA (In Pounds)

Country	1910	1911	1912	1913
United States.....	1,086,249,983	1,083,856,371	1,241,762,508	1,228,811,581
Canada.....	52,492,282	56,370,754	75,425,575	76,250,667
Mexico.....	137,797,217	136,430,331	162,295,545	116,435,566
Cuba.....	7,799,764	8,274,563	9,684,934	7,534,010
Totals.....	1,284,339,246	1,284,932,019	1,489,168,562	1,429,031,824

REFINERS' PRODUCTION (In Pounds)

Class	1910	1911	1912	1913 (b)
Electrolytic.....	1,151,624,597	1,156,627,311	1,288,333,298	1,390,000,000
Lake.....	221,400,864	216,412,867	231,628,486	161,000,000
Casting.....	32,193,196	22,977,534	24,777,266	25,000,000
Pig.....	46,903,463	35,920,626	37,181,237	39,000,000
Totals.....	1,452,122,120	1,431,938,338	1,581,920,287	1,615,000,000

(b) Estimated.

SMELTERS' PRODUCTION (In Pounds)

Source	1910	1911	1912	1913
North American ore.....	1,284,339,246	1,284,932,019	1,489,168,562	1,429,031,824
Foreign ore.....	41,976,733	34,392,091	53,701,307	59,234,779
Scrap.....	10,962,099	18,529,547	11,949,348	18,788,093
Totals.....	1,337,278,078	1,337,853,657	1,554,719,217	1,507,054,696

	1910	1911	1912	1913
To foreign refiners...	33,855,800	32,413,440	45,735,673	36,459,295
To American refiners	1,303,422,278	1,305,440,217	1,508,983,544	1,470,595,401
Crude copper imported.....	146,185,104	146,422,851	144,480,144	173,127,139
Total crude copper	1,449,607,382	1,451,863,068	1,653,463,688	1,643,722,540

CRUDE SUPPLY AND REFINED PRODUCTION COMPARED (c)

	1910	1911	1912	1913
Crude.....	1,449,607,382	1,451,863,068	1,653,463,688	1,643,722,540
Refined.....	1,452,122,120	1,431,938,338	1,581,920,287	1,615,000,000

(c) Owing to some uncertainty as to the counting of copper regained from scrap, and also to the fact that production for the last month of 1913 is partially estimated, it is unsafe to draw fine deductions from the comparison of figures in this last table.

Our system of collecting the statistics from the smelters of North America enables us to arrive at the totals not only for the United States, but also for Canada, Cuba, Chile, Peru and Mexico. The details of the production in Chile and Peru are given in an accompanying table. The production in Russia and Spain-Portugal has been reported to us by reliable correspondents abroad. The Australian production is closely represented by the shipments to Europe. Only in the cases of Bolivia, Japan, Germany and other countries do we have to guess at the output in 1913 and errors in those cases are not of great consequence, the aggregate of their production being but little more than 10% of the world's total.

The statistics show how the Michigan strike reduced the American total and how the Mexican production was adversely affected by the political troubles of that country and the Spanish production by the strikes at Rio Tinto. Chile and Peru just about held their own, the Braden and Chuquicamata enterprises not yet having gained headway. The production of Katanga increased. However, Siberia (Russia) was the only part of the world to show a great rate of increase in 1913.

As for the United States our statistics are presented in such great detail that no special comment upon them is necessary. However, it may be remarked that although the smelters reported a decreased production, the refiners showed an increase. In 1911 and 1912, there was a surplus on the part of the smelters. In 1913 it was the

WORLD'S PRODUCTION OF COPPER (a)

Country	(In Metric Tons)			
	1910	1911	1912	1913
United States.....	492,712	491,634	563,260	557,387
Mexico.....	62,504	61,884	73,617	52,815
Canada.....	23,810	25,570	34,213	34,587
Cuba.....	3,538	3,753	4,393	3,417
Australasia.....	(b) 40,962	(b) 42,510	(b) 47,772	(f) 45,300
Peru.....	(c) 27,375	28,500	26,483	25,715
Chile.....	38,346	33,088	39,204	40,195
Bolivia.....	3,212	2,950	4,681	(g) 5,000
Japan.....	(c) 50,703	(d) 52,303	(d) 62,486	(g) 65,000
Russia.....	(b) 22,700	(c) 25,747	(c) 33,550	(e) 44,000
Germany.....	(b) 25,100	(b) 22,363	(b) 24,303	(g) 25,000
Africa.....	(b) 15,400	(b) 17,252	(b) 16,632	(g) 20,000
Spain and Portugal.....	(b) 51,100	(b) 52,878	(b) 59,873	(e) 52,300
Other countries.....	(b) 24,888	(b) 26,423	(b) 29,555	(g) 30,000
Totals.....	882,351	886,855	1,020,022	1,000,716

(a) The statistics in this table are our own compilations, except where specially noted to the contrary. (b) As reported by Henry R. Merton & Co. (c) As officially reported. (d) Privately communicated to us from Japan. (e) As communicated by our correspondents. (f) Shipments to Europe. (g) Estimated.

other way. The explanation of this is that refiners carried over into 1912 an accumulation of crude copper and into 1913 a still larger one. During 1913 that accumulation must have been eaten into very largely. The supply of crude copper received by the refiners in 1913 was augmented by increased quantities of crude copper from Spain, and Chile, and by the importation of Standard

COPPER PRODUCTION OF CHILE AND PERU, 1912

	(In Pounds)			
	Chile—1912	Chile—1913	Peru—1912	Peru—1913
Blister copper to U. S....	8,627,421	18,000,000	43,891,439	41,000,000
Copper in ore to U. S....	27,445,679	25,958,880	11,373,009	12,131,098
Copper to England and France.....	50,136,800	44,304,960	2,900,000	3,310,000
Sundries, estimated.....	220,000	250,000	220,000	250,000
Total, lb.....	86,429,900	88,513,840	58,384,448	56,691,098
Totals, metric tons....	39,204	40,195	26,483	25,715

copper from Great Britain, diminishing the supply of foreign refiners by just so much. There are statistical complications that preclude the drawing of very fine deductions respecting the relative position of crude and refined copper in the absence of specific reports of stocks of crude copper, but it is safe to say that in 1913 not only was the American stock of refined copper largely reduced, but also was the stock of crude copper largely reduced, and the smelters' production now being materially diminished there will be no cause for surprise if we see some comparatively small refiners' productions in the forthcoming monthly reports.

## The Copper Market in 1913

The year 1913 opened with electrolytic copper at 17½c., cash, New York, but the market soon crumbled away. By the end of January electrolytic had declined

to 16c., and by the end of February it was down to 14½. In retrospect, the decline is easily understood, for while the statistical position of the metal was excellent, the abstention of buyers from the market threw the entire burden of carrying the stock back upon the producers, and this necessarily caused an increase in the visible supply to appear and led to the general belief that the statistical position of the metal was going to move from bad to worse. Speculative sentiment became bearish, and there being little business in electrolytic, there were sharp attacks on the London market, which moved during January from £77 to £68¾.

During February the market worked into a more normal condition. American and European buyers having depleted their stocks, and being attracted into the market by the comparatively low price which had been es-

somewhat, but the American consumer, seeing that the market was improving, took hold and bought liberally for early and distant shipment. The result was that producers were well booked up and advanced their price to 15¾c.

Early in May, when the political situation abroad became alarming, liquidation in the London Standard market ensued, which, in turn, scared off buyers of refined copper. Then, in the middle of the month, the political skies abroad were again brighter, large orders were placed, and as the American statistics for April showed a very heavy decrease in the visible supply, heavy purchases were made, and the prices advanced to 157/8c., delivered at buyers' works, usual terms.

During May and June the financial stringency in Europe, the aftermath of the Balkan war, affected sentiment

COPPER SMELTERS' REPORTS IN 1913

This table is compiled from reports received from the respective companies, except in the few cases noted (by asterisk) as estimated, together with the reports of the U. S. Dept. of Commerce as to imported material, and in the main represents the crude copper content of blister copper, in pounds. In those cases where the copper contents of ore and matte are reported, the copper yield then is reckoned at 97%. In computing the total American supply duplications are excluded.

	Jan.	Feb.	March	April	May	June	July	August	September	October
Alaska shipments.....	1,668,328	660,250	472,293	1,730,252	1,771,508	2,203,191	2,705,136	1,847,785	2,261,216	1,951,883
Anaconda.....	20,900,000	21,250,000	22,900,000	23,800,000	25,600,000	21,500,000	22,100,000	22,500,000	22,600,000	18,400,000
Arizona, Ltd.....	3,100,000	3,000,000	3,200,000	3,100,000	3,200,000	2,600,000	2,600,000	1,800,000	1,800,000	3,550,000
Copper Queen.....	7,554,966	6,810,706	7,558,709	8,210,166	8,301,605	7,477,936	8,369,607	8,252,404	8,434,803	8,292,929
Calumet & Ariz.....	4,750,000	4,050,000	4,250,000	4,500,000	4,300,000	3,200,000	3,800,000	4,500,000	4,000,000	4,500,000
Chino.....	3,298,266	3,898,225	4,464,723	3,925,409	3,945,461	3,760,237	4,746,525	5,788,572	4,196,296	4,767,466
Detroit.....	1,769,071	1,689,277	1,640,671	1,856,517	2,001,633	1,750,601	1,549,224	2,187,223	2,102,818	1,861,878
East Butte.....	1,469,000	1,325,000	1,400,000	1,400,000	1,268,595	1,055,646	1,060,257	1,162,007	1,233,018	1,040,997
Giroux.....	650,000	*600,000	*625,000	*600,000	839,317	598,240	584,546	524,953	198,178	156,084
Mammoth.....	1,957,804	1,661,150	1,641,091	1,450,000	1,700,000	1,750,000	1,800,000	1,750,000	1,750,000	1,700,000
Mason Valley.....	1,655,319	1,348,070	1,608,492	1,264,304	1,186,560	1,097,014	908,892	867,060	918,000	1,052,000
Miamif.....					1,943,900	2,612,000				
Nevada Con.....	4,169,705	4,798,531	5,555,320	5,650,608	5,933,275	6,344,863	5,403,919	5,989,973	4,441,671	5,898,046
Ohio.....	492,760	380,849	596,651	690,001	650,071	537,400	601,700	689,000	685,900	698,691
Old Dominion.....	2,727,000	2,381,000	2,853,000	3,040,000	2,749,000	2,511,000	2,526,000	2,524,000	2,679,000	2,037,000
Ray.....	3,610,000	3,610,000	4,287,400	4,379,128	4,384,400	4,392,612	4,097,000	4,269,519	4,336,434	4,275,419
Shannon.....	1,233,273	1,150,777	1,265,514	1,238,000	1,080,000	924,000	880,000	924,000	1,233,000	1,216,000
So. Utah.....	nil	nil	62,224	132,267	200,000	185,000	140,000	223,498	241,843	232,269
Tennessee.....	1,824,637	1,600,151	1,796,394	1,718,188	1,037,115	1,379,220	1,247,804	1,101,019	1,309,985	1,392,162
United Verde*.....	2,900,000	2,750,000	3,000,000	3,000,000	3,000,000	2,900,000	3,000,000	3,000,000	3,000,000	3,000,000
Utah Copper Co.....	7,333,495	7,585,303	8,248,880	9,539,847	10,003,227	11,637,949	9,849,043	10,302,251	11,463,905	9,929,478
Lake Superior*.....	17,500,000	19,000,000	19,000,000	17,000,000	18,750,000	16,500,000	17,500,000	9,700,000	6,950,000	5,500,000
Non-rep. mines*.....	5,675,363	5,399,849	6,203,606	6,000,000	6,200,000	6,000,000	6,200,000	6,200,000	6,000,000	6,200,000
Total prod.....	96,238,987	94,949,138	102,629,968	104,224,687	110,045,667	102,916,909	101,669,653	96,427,264	91,836,075	88,102,302
Imports, bars, etc.....	34,026,236	21,372,292	24,215,480	25,578,297	22,205,942	18,255,267	29,029,990	22,474,471	35,703,660	21,935,023
Total blister.....	130,265,223	116,321,430	126,845,448	129,802,984	132,251,609	121,172,176	130,699,643	118,901,735	127,539,735	110,037,323
Imp. ore and matte.....	7,563,758	9,459,432	11,911,041	7,177,363	10,528,562	7,497,002	8,527,046	9,171,351	10,800,162	5,062,015
Total Amer.....	137,828,981	125,780,862	138,756,489	136,980,347	142,780,171	128,669,778	139,226,689	128,073,086	138,339,897	115,099,340
Miamif.....	2,932,369	2,817,200	3,102,200	2,312,900			2,890,000	3,007,500	2,688,000	2,862,050
Shattuck-Arizona.....	1,381,422	1,136,480	1,234,450	1,158,326	1,026,170	1,059,625	1,019,388	1,001,634	1,163,237	993,224
Brit. Col. Cos.:										
British Col. Cop.....	720,260	688,312	844,735	794,000	618,076	634,238	618,379	647,905	621,120	688,581
Granby.....	1,792,245	1,740,000	1,967,962	1,857,452	1,782,570	1,789,000	1,664,102	1,847,344	1,824,659	1,718,258
Mexican Cos.:										
Boleof.....	2,658,880	2,535,680	2,204,720	2,811,200	2,424,800	1,984,640	2,240,720	2,264,640	2,369,920	2,424,800
Cananea.....	5,450,000	4,880,000	4,772,000	3,581,690	2,272,000	2,908,000	3,328,000	3,186,000	3,148,000	3,682,000
Moctezuma.....	2,913,294	2,730,914	3,062,159	2,753,240	2,695,881	3,438,793	2,693,006	3,542,047	3,024,121	3,178,136
Other Foreign:										
Braden, Chile.....	1,484,000	1,178,000	1,472,000	1,512,000	1,150,000	1,804,000	1,046,000	1,572,000	1,332,000	2,006,000
Cape Cop., S. Af.....	770,540	712,320	732,480	586,880	387,520	414,400			607,040	712,320
Kyshtim, Russia.....	1,644,160	1,352,960	1,478,400	2,544,640	1,490,000	1,000,000	2,500,000	1,585,000	1,187,000	
Spassky, Russia.....	974,400	1,003,520	974,000	974,400	721,280	835,520	660,800	1,048,320	1,025,920	983,360
Exports from:										
Chile.....	6,752,000	5,824,000	7,840,000	7,616,000	3,584,000	5,824,000	9,856,000	8,736,000	5,600,000	6,160,000
Australia.....	9,744,000	5,512,000	6,944,000	6,608,000	7,840,000	7,616,000	10,304,000	7,720,000	6,944,000	7,728,000
Arrivals—Europe††.....	17,689,280	8,509,760	15,585,920	10,545,920	13,661,760	5,277,440	11,728,640	14,624,960	9,661,120	18,040,960

\*Boleof copper does not come to American refiners. Miami copper goes to Cananea for treatment, and reappears in imports of blister. From May 1, Miami copper was refined in the U. S. and appears under American mines; from July 1, Miami ore went back to Cananea.  
 ††Does not include the arrivals from the United States, Australia or Chile.

established by that time, bought liberally and deliveries of copper assumed more normal proportions.

In March, a fair amount of business was booked at around 15c. In April, the clearing of the political horizon in Europe and the accompanying relaxation in the tension of the money market which had prevailed there for some time, brought about an improvement in general business conditions, which found a pronounced reflection in the copper market. European consumers bought on a large scale, and for the first time for some months not only covered their immediate requirements, but replenished their reserves and placed orders for delivery over the next three months. A large business was done at 15½c., delivered c.i.f. Europe, during the first half of the month. Then the European demand subsided

over there and kept buyers out of the market. A worldwide process of liquidation seemed to be going on and this had a very depressing influence. Consumers began to fear that a serious contraction in their business was impending. While the larger sellers of copper did not reduce their price, considerable copper was offered from other sources, and while the statistical position of the metal remained excellent, and it was evident that it would be further improved by the labor disturbances which broke out at one of the large refineries in New York, consumers nevertheless remained entirely indifferent, and the Standard market in London and the electrolytic market at New York declined steadily.

By July 1 Standard had gone down to about £64 and electrolytic had gone back to 14¼c., but even at these



prices the market remained dull and weakish. Buyers deferred their purchases as long as possible. The large selling agencies completely abandoned the asking price for which they had been holding and tried to create a market by making considerable concessions, but it was not until the middle of the month when the price of electrolytic had been cut to about 14c., delivered in Europe, that European buyers took hold and bought largely for August-September, as well as October shipment. The producers having at that time few orders on their books, met the demand freely, but when they found that it continued, they raised their prices. American consumers remained completely apathetic at 14c., but when they found that the European consumers were taking the copper freely at that level, they also came into the market and prices advanced sharply, with large transactions, moving up to 15c., delivered.

MONTHLY AVERAGE PRICE OF COPPER

Month	New York						London Standard		
	Electrolytic			Lake			1911	1912	1913
Jan.	12.295	14.094	16.488	12.680	14.337	16.767	55.600	62.760	71.741
Feb.	12.256	14.084	14.971	12.611	14.329	15.253	54.974	62.893	65.519
Mar.	12.139	14.698	14.713	12.447	14.868	14.930	54.708	65.884	65.329
Apr.	12.019	15.741	15.291	12.275	15.930	15.565	54.034	70.294	68.111
May	11.989	16.031	15.436	12.214	16.245	15.738	54.313	72.352	68.807
June	12.385	17.234	14.672	12.611	17.443	14.871	56.365	78.259	67.140
July	12.463	17.190	14.190	12.720	17.353	14.563	56.673	76.636	64.166
Aug.	12.405	17.498	15.400	12.634	17.644	15.904	56.266	78.670	69.200
Sept.	12.201	17.508	16.328	12.508	17.698	16.799	55.253	78.762	73.125
Oct.	12.189	17.314	16.337	12.370	17.661	16.913	55.170	76.389	73.383
Nov.	12.616	17.326	15.182	12.769	17.617	16.022	57.253	76.890	68.275
Dec.	13.552	17.376	14.224	13.768	17.600	14.904	62.068	75.516	65.223
Year.	12.376	16.341	15.269	12.634	16.560	15.686	55.973	72.942	68.335

New York, cents per pound, London, pounds sterling per long ton of standard copper.

As a result of the buying movement, the producers were now comfortably booked for August and September, and in view of the small stocks and the strike which had broken out at Lake Superior, the position of the metal was an exceedingly strong one, and in August a large business was done at higher prices. Considerable copper was still required for September shipment and the supplies for early delivery were scant. Prices moved up to 15 7/8c., delivered at buyers' works. The strike at Lake Superior continued; the visible supplies of copper had dwindled down to 100,000,000 lb., and the demand for early delivery had by no means been satisfied. From Sept. 3 to Sept. 8, there was an almost perpendicular rise, and transactions amounted to many millions of pounds. By Sept. 10, the market had reached 16 1/4c.

AVERAGE MONTHLY PRICES OF COPPER MANUFACTURES (In Cents per Pound)

	1911		1912		1913	
	Copper Wire	Sheet Copper	Copper Wire	Sheet Copper	Copper Wire	Sheet Copper
January	14.06	18.50	15.75	19.50	19.09	23.50
February	13.50	18.50	15.25	19.50	16.38	22.50
March	13.25	18.50	16.03	20.30	16.39	21.50
April	13.75	18.50	17.06	21.50	16.50	21.50
May	13.75	18.50	17.30	21.63	16.50	21.50
June	13.75	18.50	18.68	22.50	16.18	21.10
July	13.90	18.50	19.13	22.50	15.88	20.50
August	13.81	18.50	19.13	22.75	16.60	21.50
September	13.75	18.50	19.13	23.50	17.84	22.50
October	13.50	18.50	19.13	23.50	17.75	22.50
November	13.75	18.63	19.13	23.50	17.28	21.15
December	14.94	19.13	19.13	23.50	15.79	20.50
Year	13.81	18.56	17.96	22.02	16.85	21.69

During October the market relapsed into dullness. This was natural after the very heavy buying that had taken place during September. While the leading producers held for 16 7/8c., dealers, traders and other agencies having facilities for arbitrage transactions accepted considerably lower figures. Standard copper had gone down to about £70. By the middle of October electrolytic copper had receded to 16 1/4c. Toward the end of the month the copper in second hands and that in the hands of small

producers having been pretty well cleaned up, and consumers having exhausted their supplies, buyers had again to come to the larger producers, and considerable business was done at 16 7/8c. However, the movement did not last long for the reason that the contraction in business in the United States had begun to affect consumption, and the copper manufacturers were forced to reduce the time of their working hours. This produced a distinct weakening in the attitude of several sellers.

There was also a decided falling off in European consumption. This fact explained the apathy of buyers in the face of the continued improvement in the statistical position, the visible supply having dwindled down by the end of October to only 80,000,000 lb., or less than two weeks' supply. These conditions continued and the market remained quiet and weakish until about the middle of December, when prices again crumbled away. By the time 14 1/4c., delivered, was reached, European consumers had completely exhausted their supplies and were forced into the market, and there was also a decided improvement in business sentiment in the United States, due to the passing of the Currency Bill. American consumers had also been feeding on their previous purchases, and their stocks being entirely depleted, they too came into the market. In consequence, the second half of December witnessed large transactions, and during the last few days of the year a large business was done at 14 7/8c., delivered buyers' works, and the copper market closed active and strong at that figure.

### Statistics of Refined Copper

The accompanying table embraces the reports of the Copper Producers' Association and the stock of Standard copper, which is reported semimonthly from Europe.

Month	United States			Visible Stocks.		
	U.S. Refin'y Production	Deliveries Domestic	Deliveries for Export	United States	Europe	Total
Year 1912	1,581,920,287	819,665,948	746,396,452			
I. 1913.	143,479,625	65,210,030	60,383,845	105,312,582	78,491,840	183,904,422
II. ....	130,948,881	59,676,492	72,168,523	123,198,332	77,504,000	200,702,332
III. ....	136,251,849	76,585,471	77,699,306	122,302,890	81,244,800	203,547,690
IV. ....	135,353,402	78,158,837	85,894,727	104,269,270	87,180,800	191,450,070
V. ....	141,319,416	81,108,321	68,285,978	75,549,108	85,948,800	161,497,908
VI. ....	121,860,853	68,362,571	68,067,901	67,474,225	77,235,200	144,709,425
VII. ....	138,074,602	58,904,192	78,480,071	52,814,606	71,904,000	124,808,606
VIII. ....	131,632,362	73,649,801	73,263,469	53,594,945	66,420,480	120,015,385
IX. ....	131,401,229	66,836,897	73,085,275	38,314,037	63,716,800	102,030,837
X. ....	139,070,481	68,173,720	68,123,473	29,793,094	53,625,600	83,418,692
XI. ....	134,087,708	48,656,858	70,067,803	32,566,382	48,787,200	81,353,582
XII. ....				47,929,429	46,592,000	94,521,429
Yr. '13						
I. 1914.					53,910,800	

Note—From Jan. 1, 1913, visible supplies in Europe do not include copper afloat.

### The London Copper Market in 1913

January—The Standard market opened at £76 7/8 per ton for cash, and £77 5/8 for three months' delivery; and the trend of prices was downward throughout the month in spite of great activity in all consuming industries. This was due mainly to the disquieting aspect of international politics, followed by reductions in prices asked by the leading American producers, whose concessions only served to strengthen anticipations of further decline. Closing prices were £68 3/4 and £68 7/8 respectively.

February opened at £68 3/4 and £68 1/2, but the back-

wardation was only transitory. Prices, however, continued to droop until, on the 19th, £63¼ was touched for three months' delivery. A long expected reduction in the price of American electrolytic to 14¾c. brought it more into harmony with ruling prices. A large volume of business ensued, and Standard gradually improved, closing at £65 for cash and for three months'.

*March*—Standard opened at £66¼ cash, and £66¾ three months', and remained thereabout for some days and with considerable activity in trade. Thereafter the political horizon darkened and the stock markets developed weakness, reflected in copper which gradually declined until, on the 19th, quotations were £64⅞ and £64¾ respectively. Following the Easter holidays speculation revived, and consumers hastened to cover their early requirements, causing a rapid advance during the rest of the month; closing prices being £67⅝ for cash, and £67¾ for three months'.

*April*—The market was overshadowed by the shifting phases of international politics and consequent instability of the Stock Exchange; but this was offset by steady consumptive demand, and fluctuations were within narrow limits. American producers sold largely and advanced their price of electrolytic gradually from 15¼c. to 15¾c. per lb. Standard opened unchanged but advanced—with occasional relapses—until the 14th, when cash warrants changed hands at £69⅞, and three months' at £69⅝. Thereafter prices dipped to £67 and £67¼ on the 24th. The close was steady at £67⅞ and £67⅞ respectively.

was not fully maintained. American producers had meanwhile reduced their price for electrolytic to 15c., which was more in harmony with the general market but was too late to attract the volume of business which had been expected. Consuming industries were well employed, but manufacturers were reluctant to cover more than their immediate requirements. Closing prices were £64⅞ for cash and £64¾ for three months'.

*July* opened with a steady market, fluctuations being unimportant until the 8th, when a relapse set in, due to alarming aspect of affairs in the Balkans and general depression in the stock markets. This culminated on the 14th, when cash Standard fell to £62⅞, and three months' to £62¾. Meanwhile statistics, both European and American, disclosed a serious shrinkage in stocks; and consumption of the metal was everywhere active. The result was that recovery in values, once started, was very rapid; and it intensified toward the close, when news came to hand that all mines in the Lake Superior district were closed down in consequence of a strike. The highest was touched on the 28th, when £67½ was paid for both prompt and extended delivery. On the morrow a vigorous bear raid, prompted by a rumor that the strike had ended, caused a relapse of £1½; but the rumor proved false, and a rapid recovery ensued. Final values were £67¼ for sharp cash, and £67¾ for three months'.

*August*—The market opened at a fractional advance, prompted by favorable European statistics and the gravity of the labor trouble at Lake Superior. The tendency

## ELECTROLYTIC COPPER REFINERIES OF THE UNITED STATES

Works	Situation	1911 Capacity, Pounds	1912 Capacity, Pounds	1913 Capacity, Pounds††
Nichols Copper Co.	Laurel Hill, N. Y.	1330,000,000	*400,000,000	400,000,000
Raritan Copper Works.	Perth Amboy, N. J.	*320,000,000	†360,000,000	400,000,000
Baltimore Copper Smelting & Rolling Co.	Canton, Md.	†288,000,000	*312,000,000	348,000,000
American Smelting & Refining Co.	Perth Amboy, N. J.	†180,000,000	*192,000,000	216,000,000
U. S. Metals Refining Co.	Chrome, N. J.	*180,000,000	*180,000,000	200,000,000
Balbach Smelting & Refining Co.	Newark, N. J.	*48,000,000	*48,000,000	48,000,000
Anaconda Copper Mining Co.	Great Falls, Mont.	†65,000,000	*65,000,000	65,000,000
Tacoma Smelting Co.	Tacoma, Wash.	†28,000,000	*36,000,000	36,000,000
Calumet & Hecla Mining Co.	Buffalo, N. Y.	*55,000,000	*55,000,000	55,000,000
Total		1,494,000,000	1,648,000,000	1,768,000,000

\*Official figures furnished by the respective companies. † Estimated. †† All of the figures for 1913 were officially furnished.

*May* was a period of general depression in the stock markets, speculative enterprise being checked by various adverse factors, notably financial stringency and prolonged unsettlement in European politics. Copper started at a fractional advance, due to favorable European statistics, and values improved further when the American statistics for April disclosed a shrinkage of 12,821 tons. Highest values were registered on the 13th, when £70 was paid for early delivery, and £69⅞ for three months'. Thereafter the market was subject to persistent attack in the form of forced liquidations and bear sales, notwithstanding the general activity in consumption of the metal. The decline in values was gradual but persistent until the close, when cash Standard was quoted £67⅞, and three months' at £67⅝.

*June*—The acute depression in all financial centers had inflicted enormous losses upon investors and speculators, and the Copper Market shared in the general decline in values, notwithstanding very favorable statistics. It opened with a relapse of £1 per ton, and showed some signs of steadiness for a few days, but was not proof against the successive alarms produced by financial stringency and a renewed outbreak of hostilities in southeastern Europe. The decline was not arrested till the 23d, when cash Standard touched £61¾. This was followed by a recovery to £64¼ on the 25th, which, however,

was toward higher values throughout the month, consumers buying largely; but there were occasional relapses in the Standard market, due chiefly to fears inspired by international politics, notably in regard to Turkey and Mexico. Toward the end of the month the situation was too apparent for operators to doubt the genuine nature of the improvement, and some sharp advances occurred, culminating in highest prices at the end of the month, viz., £71⅞ for cash Standard, and £71 for three months'.

*September*—The upward movement continued, consumers buying freely, and speculative interest reviving. American statistics disclosed a decrease of 6822 tons during August, and prompted large purchases; but the resulting advance in values was checked by realization of profits. Thereafter the market firmed up again under the threatened depletion of available supply and the persistent trade demand. Labor trouble then arose in various parts of the country, and bears ventured to attack the market, but with only transitory success. On the 22nd values declined sharply on a newspaper report of threatened increase in the American production. The report proved to be groundless, and next day saw a sharp recovery from £72¾ to £74. Thereupon came reports of fresh political trouble in the Balkans, whereat stock markets were adversely disturbed and the metal suffered



in sympathy. Producers were firm throughout the month and at the close had little left for sale for earlier delivery than December. The American price for electrolytic advanced steadily from  $16\frac{1}{4}c.$  to  $17c.$  The London market for Standard opened at  $\text{£}71\frac{3}{8}$ ; the highest price was  $\text{£}75$  on the 16th; and the close was at  $\text{£}72\frac{1}{2}$  for cash, and  $\text{£}72\frac{3}{8}$  for three months'.

October opened with the statistical position looking very sound, but outside influences were against all markets, it becoming more apparent day by day that a very decided setback was occurring in all branches of industry throughout the world. Values opened weak and dropped to  $\text{£}70\frac{1}{2}$ , but owing to a bull flurry caused by unsatisfactory strike news from America and the Rio Tinto mines, prices improved steadily to  $\text{£}75$  cash and  $\text{£}74\frac{5}{8}$  three months'. This was brought about by the fact that agents for American producers were taking English Standard brands from warehouse and shipping them to America for conversion. The best prices for the month were, however, not maintained, and we closed at  $\text{£}73\frac{3}{8}$  for cash and  $\text{£}72\frac{1}{8}$  three months'.

November witnessed flat markets almost throughout, owing to the undecided methods adopted by the large producers who, all through, were indisposed to make concessions in price sufficiently drastic to tempt buyers to come in freely. This policy, at a time when the actual demand for manufactured metal had fallen almost to zero, and new ventures were practically suspended, gave the bears great confidence, and onslaughts were made on the Standard market in London which caused prices to recede almost without a break to  $\text{£}65\frac{1}{4}$  spot and  $\text{£}64\frac{1}{4}$  three months. Trade with consumers was throughout on a very poor scale, the only real business of importance being a few orders placed by railway companies and an unexpected demand from India for copper and yellow-metal squares. Bear covering at the end of the month resulted in a slight rally, so that prices closed at  $\text{£}66\frac{5}{8}$  for cash, and  $\text{£}65\frac{1}{4}$  for three months'.

December—A firmer and steadier tone characterized the copper market in December, brought about by a better sentiment in general markets. The American producers were able to market good lines of refined metal at the basis of  $14.25@14.50c.$  per lb., and being relieved of these quantities were not so aggressive in their selling policy, so that buyers who had been holding off and were faced with depleted stocks, entered the market and bought with more freedom than for some time past.



### The Miami Mine in 1913

By J. PARKE CHANNING\*

During 1913 the Miami Copper Co. treated approximately 1,050,000 tons of ore, producing about 32,675,000 lb. of copper, after allowing for smelting and refining losses. About 37,000 ft. of development work was done, a large part of which was in the Captain orebody. This orebody has an extreme height of 350 ft. above the 420-ft. haulage level, and it is planned to mine it in two lifts, probably using 15-ft. shrinkage stopes with 10-ft. pillars between. There is a possibility that an electrically driven belt conveyor, 100 ft. long, mounted on trucks, will be tried for the purpose of drawing off ore to the main transfer chutes leading to the 420-ft. level. The Captain, or No. 1, shaft has been sunk to the 420-ft. level to be

used as a supply shaft to the various sublevels of the Captain orebody. This, together with Nos. 3 and 4 shafts, gives three good entries from the surface to the mine, the No. 2 or original discovery shaft having caved in.

But little development work on the 570-ft. level has been carried on as the quantity of ore above the 420-ft. level will make it unnecessary to produce ore from the 570-ft. level for some years to come. The development work above the 420-ft. level has shown ore to exist 200 ft. east of the boundary as determined in this portion of the property by churn drilling. Diamond drilling from the 420-ft. and 570-ft. levels and churn drilling from the surface was stopped a little after the middle of 1913. The ore developed for the year will probably equal that extracted, after allowing for losses, thus putting the reserves of sulphide ore at approximately 20,800,000 tons of 2.48% ore, and in addition there has been developed 6,000,000 tons of 2% ore, of which half of the copper is present in the form of sulphide, the other half being oxide. No change is made in the 17,200,000 tons of low-grade material which was reported last year at 1.21% copper.

A large portion of the ore mined during 1913 consisted of slicing the main orebody east of the No. 2 shaft. This is nearly all sliced down to the 370-ft. level with an excellent mat of timber above it, and at the extreme east a new slice has been started midway between the 370- and 395-ft. levels. In the northwest section of the mine, work has consisted of opening up the pillars which were crushed at the time the capping caved down in April, and these are being blasted to prepare them for drawing. The ore in these pillars will be drawn until the tonnage remaining is approximately the same as that in the rooms. The work in this northwest orebody, in which 50-ft. rooms and 50-ft. pillars were used has demonstrated that both room and pillar are probably too wide, and that it will be necessary in the future to make them both smaller. The northwest orebody was selected to make this experiment as it was entirely disconnected from the main orebody, or from the Captain orebody.

In the concentrator the installation of the Hardinge mills was completed in January. Three Evans-Waddell Chilean mills are still running in section five. These mills have about the same capacity as the 8-ft. Hardinge mills and the maintenance is about the same. They require, however, considerably more power and water, and metallurgically this is a distinct disadvantage as it decreases the efficiency of the cone tanks on the slime floor, and consequently sends a large tonnage of untreated slime into the dirty-water-circulating system. Considerable experimental work on Hardinge-mill linings was done during 1913. A patented manganese-steel lining was given a thorough trial in three mills. It consists of flat plates with ribs or lifting bars running longitudinally. This proved unsatisfactory on account of the increase in power required, poor grinding and excessive wear on the plates. A flat cast-iron lining was also tried without success. It appeared that a rough lining is absolutely necessary for the best results. The lining now being used consists of two rows of ribbed cast iron in the cylindrical part and in the adjacent part of the discharge cone. The entire feed cone and the remainder of the discharge cone are lined with pebbles set closely in neat cement. One mill so lined has run four months and an examination of the lining indicates a life of about two months more. This

\*Vice-president, Miami Copper Co.

would be nearly double the life of the ordinary silex lining.

The preliminary grinding apparatus in the mill was completed during the year by the installation of six Traylor heavy-type 42x16-in. rolls. In the shaft crusher house the machinery was augmented by the addition of two Traylor heavy-type 42x16-in. rolls, two 24-in. elevators and two sets of tromeels. This was started the first of November and the product of the shaft crusher house is now approximately  $\frac{1}{2}$  in. instead of  $\frac{3}{4}$  in. The size is absolutely uniform as all the material must pass through the tromeels. The most noticeable benefit in this crushing is in the decreased pebble consumption in the Hardinge mills, which in November amounted to 1.44 lb. per ton of crude ore (material actually crushed probably 70% of this) as against 2.88 lb. for the previous 10 months. This alone means a saving of 1.84c. per ton. The re-grinding addition in section six continued to operate during the entire year, and about 25% of the total tailings from this section, containing the greater part of the included mineral, is reground and retreated. The finest slime from the upper cone-tank overflow is treated on four Deister 6-deck tilting slimers, and this section has produced 2 lb. better saving per ton than the rest of the mill with practically no increased operating expense, except for power.

The present capacity of the concentrator is about 3200 tons daily, though this figure has been exceeded at times. The coarse, intermediate and fine-grinding equipment is already ample for 4200 tons daily, and it is proposed to bring the remainder of the mill up to this capacity. This will be accomplished by the installation of either double-deck tables, or tables with an improved deck on the sand floor and by the regrinding of 1000 tons of tailings daily, similar to that done in section six, and its treatment on proper machines.

### ❖ Copper Metallurgy in Arizona in 1913

BY JAMES DOUGLAS\*

The erection of new smelting works by the Arizona Copper Co. and the United Verde Co. were the most important steps toward the development of the copper interests of Arizona during the past year. The Arizona Copper Co. abandoned its old smelter at the mouth of Chase Creek, and constructed larger works on the line of the railroad to the southwest of Clifton. The company replaced cupola furnaces with reverberatories because the percentage of first-class lump ore has declined to an insignificant percentage of the mineral suitable only for preliminary mechanical concentration. The three new reverberatories of the largest type, 120 ft. in length, should smelt 400 to 500 tons each per day. With converters of ample capacity, after the concentrator at Morenci has been enlarged to its full capacity, the company's production should be increased from say 38 million lb. per annum to at least 50 million. The smelting works were designed by Doctor Ricketts, and the power plant, from which electricity will be transmitted for all purposes, by John Langton.

The new smelter of the Calumet & Arizona Co. at Douglas has been erected adjacent to the site of the old one, but is designed for both cupola and reverberatory

work, and is larger than the old. At present the monthly production of the smelter is in excess of five million pounds of copper.

The Copper Queen company has just finished the erection of a third reverberatory which, however, will simply relieve the cupola furnaces of more fine ore, thereby enabling them to run with lower blast, slightly less fuel, and the production of less flue dust. During the year an experimental plant has been running on a small working scale, the operations being principally for devising the most economical method of extracting copper from extremely fine tailings from the slime tables of the company's mills. It is in these that the heaviest waste of concentration occurs. The experiments have aimed at working out an electric method which would deposit the copper from weak solutions electrolytically, at reduced electrical resistance, through the injection of sulphurous-acid gas into the electrolyte, thus regenerating, in part at least, the acid consumed in the leaching department.

The Miami, the Ray and the Chino mills are approaching their full capacity. Two new concentrators, the Inspiration at Globe, and the Burro Mountain, at Tyrone, will not be completed in time to add to the production of the Southwest in 1914. The Burro Mountain Co. will not at first add much over a million pounds per month to the sum total of production, but the Inspiration will be a notable factor.

The aim of the superintendents of all the older and larger mines has been to replace the square-set system of extraction and timbering, with slicing, caving, or other methods which will economize labor and lumber. This substitution has been found easier to effect in Clifton than in the Warren district, where the irregularities of most of the most oxidized orebodies, and the plasticity of the ledge matter which incloses them, render difficult any modification of the old method, if safety to life be the first consideration. But even on the property of the three active companies at Bisbee, especially on that of the Calumet & Arizona, there are orebodies in which square setting has been abandoned to great advantage. The modifications, however, cannot be made without exploring the full capacity of a new orebody, determining its total height and depth, and tracing its eccentric lateral shape as a preliminary to laying it out for extraction by either of the new systems. This necessarily involves an expenditure of time which temporarily embarrasses production, and at first is an unremunerative outlay compared with the old-fashioned method of attacking the orebody piecemeal wherever encountered. Thus everywhere decisive improvements are being made in mining methods which, coupled with the notable improvements in concentration and smelting, enable the companies to face the gradual shrinkage in the grade of the ore handled and the shorter hours and high price of labor and the heavier taxes under state government.

In the Clifton district, the Arizona Copper Co. has coupled up its large Coronado copper property with the Morenci claims by long tunnels, and thus is able to assemble all its ores requiring concentration at one large mill at Morenci. The mill is being completely reorganized by David Cole.

The Detroit Copper Co. has extended its ownership over the properties of the Standard Copper Co. and the New England & Clifton Co., but as yet has developed on

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neither acquisition any orebodies of significant value. The company recognizes that it must rely upon ores of a lower grade in the future and is making provisions to handle them economically.

At Globe, the Old Dominion and the United Globe mines are both confirming the indications of previous recent developments, which all point to the occurrence of oxidized and secondary orebodies of large extent in depth, as far as yet explored below the 1800-ft. level. Although the concentrator and crushing plant of the Old Dominion Co. is of comparatively recent date, improvements have followed one another so rapidly, that improvement in hoisting, in crushing, and in concentrating have necessitated a replacement of much old equipment by newer and better.

As the age of the original copper companies and that of their old employees has come to reach beyond the maturity of human life, the adoption of systems of annuities and pensions has come under serious consideration. The State of Arizona has by legislative action provided for relief against accidents and death in hazardous vocations, and has thus replaced the independent action previously taken by some of the mining companies. But state action has not deterred the companies from organizing active safety-first organizations with a view of imposing closer inspection over details by their own officers, and educating their workmen to exercise keener vigilance and closer observance of rules.

As might be expected, mining being the prominent industry of the new states of Arizona and New Mexico, it is inevitable that legislation should have been directed in large measure toward its regulation. Measures of doubtful utility may have been passed, and probably will be passed, but the large mining companies, believing in the good sense and intention of the electorate, feel that in the long run their men who largely control legislation and who best know the details and requirements of their own work, will come to recognize that their interests really harmonize with, instead of antagonize, the welfare of corporations with which they work, and the corporations will learn to appreciate the coöperations and suggestions of their men, when reasonably expressed.

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### Mining in Butte in 1913

BY B. B. THAYER\*

Notwithstanding the feeling of pessimism concerning business conditions in general that existed throughout the country during 1913, and the shrinkage in business of every character which occurred during that period, the conditions in the Butte district were normal. All of the operating companies carried on work continuously, and there was new work undertaken which made itself felt materially.

The properties of the North Butte, Anaconda, East Butte, Alex Scott, Tuohimne, Pilot-Butte and Davis-Daly companies were operated upon the same scale as that of previous years. The operations of the Butte-Ballaklava Mining Co. were somewhat restricted on account of litigation with the Anaconda Copper Mining Co., which controversy, however, was settled out of Court during the latter part of the year.

The greatest amount of new work was done in the extreme eastern section of the district. The Butte & Du-

luth Mining Co. and the Bullwhacker Mining Co. carried on operations continuously, and the officials of both companies have stated that the results obtained from their respective leaching plants were satisfactory.

The Rainbow Lode Development Co. was busy with development work for the entire period. The officials of the Butte & Superior Mining Co. expressed themselves as being well pleased with the results obtained in their concentrating department. The method of concentration, however, is at present involved in legal complications with the Minerals Separation Co.; but a regular output was maintained.

The copper ores extracted from the properties owned by W. A. Clark during 1913 were shipped for treatment at the Washoe smeltery, but his concentrator for the reduction of the zinc ores is rapidly nearing completion. It is thought that the complete output of zinc made by the Butte & Superior Mining Co. and the properties owned by W. A. Clark will be an important factor in the zinc production of this country.

The Anaconda Copper Mining Co. during the last few months of 1913 started some new work in the extreme western end of the Butte district, in a section known as the Burlington district, the ores of that section having been worked many years ago for silver.

A great deal of attention was given to experimentation with new processes by several of the companies, apparently with promising results. The processes, if worked out satisfactorily, will mean much to the Butte district in the future.

During 1913 an important piece of work was completed in the electrification of the Butte, Anaconda & Pacific R.R. between Butte and Anaconda, and it has been stated that the resulting economies have exceeded the greatest expectations of the officials of the railroad. This piece of work was the pioneer movement in electrification in the Rocky Mountain region, and it has been reported that one of the great transcontinental railroads will shortly begin work on the electrification of a division across the Rocky Mountains, and that after this has been completed the work of electrification will be carried on probably to the Pacific Coast.

The use of electric power has become general throughout the Butte district, the power being furnished by the Montana Power Co. and generated at several points on the Missouri, Madison and Big Hole Rivers.

The output of copper from the Butte district during 1913 was less than that during 1912, due largely to extensive repairs which one of the large companies found it necessary to make, and also to the fact that on account of conditions the railroads at times were unable to deliver a sufficient quantity of ore to the several reduction works. The new companies have thus far not advanced sufficiently in their operations to make their output appreciable in the total output from the district.

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### Lake Superior Copper District

BY CARL L. C. FICHEL

The year 1913 will long be remembered in the annals of the Lake Superior copper district. The first time in the history of the district, a period of nearly 50 years, a general strike was called by the Western Federation of

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Miners. This organization has looked with longing eyes upon the copper district of Michigan for a long time and its emissaries had been quietly working among the men for a number of years.

The agitation and discontent aroused by these paid organizers was felt for the past two years and resulted in a number of men leaving the district, causing a labor shortage. New men came in, materially aiding the Federation in its campaign for membership.

On July 14, demands were made by the several locals in the district upon the various mining companies for a conference with their representatives for the purpose of discussing the possibilities of shortening the working day, raising the wages and making some changes in the working conditions, limiting the time of the conference to July 28, and demanding a reply to the request to be not later than July 21. The request was ignored by the companies and as a result a general strike was called on July 23 with the following demands: Recognition of the Western Federation of Miners; abolishment of the one-man drill or the working of two men on each drill; a minimum wage of \$3 for trammers and \$3.50 for miners; and an eight-hour working day.

The calling of the strike was attended with violence, a number of men who had not left their posts were driven from their work and badly beaten. The deputy force of Houghton County was disorganized and the sheriff was unable to cope with the situation. An appeal was made to the governor for assistance and the entire state militia was dispatched to the strike zone. Crime was rampant, murder, dynamiting and violence of all kinds prevailed; trains were fired upon and railroad tracks demolished. A reign of terror covered the district, equaling anything that had been previously brought about by strikes fostered by the federation in other districts.

The Department of Labor sent investigators into the district and offered its services in an attempt to bring about a settlement by arbitration, as also did Governor Ferris. The mining companies absolutely refused to deal with the Federation in any way, but stood ready at any and all times to meet with their men as employees to hear and adjust any legitimate grievance that might exist; taking the stand that the Federation was a detriment to good government, the future welfare of the men and the district as a whole.

The companies held off several weeks before bringing in outside men to fill the places of the men on strike and allowed all former employees who had not taken part in any violence or who were not openly antagonistic to the company to return to their former places, not to be discriminated against.

At this writing, all of the producing mines with the exception of the Mohawk have resumed operation and in all probability before this is published shipments will be resumed from this property, as preparations are about completed for a large number of imported men, but no attempt has been made to resume work at the smaller properties.

The mining companies throughout the district put into effect, on Dec. 1, an 8-hr. working day for all underground employees and a 9-hr. day for surface work.

The Keweenaw Copper Co. carried on exploratory work on the Ashbed lode and succeeded in getting some fine drill cores. A shaft was started on the formation, and while only a limited depth has been reached, the show-

ing developed was such that there are great expectations of the ultimate success of the property.

The Ojibway property was closed down during the summer, all work was abandoned and the mine was allowed to fill with water.

A change of management was made at the Mohawk and Wolverine properties. Theodore Dengler, formerly superintendent at the Atlantic mine, succeeded Fred Smith as agent and William Hartmann succeeded Willard Smith as superintendent of the Mohawk. Nos. 3 and 4 shafts of the Ahmeek started regular production, but no attempt was made to resume work at that branch after the strike. At the stamp mill, work was started on the erection of an addition to the mill. Contracts for all the machinery were closed, including a 2000-kw. low-pressure steam turbine to utilize the exhaust steam of the heads for the generation of electrical energy. Mayflower and Old Colony did further diamond-drill work with results that correlated with the previous exploration.

The Calumet & Hecla took advantage of the temporary shutdown and the force at the mills was put on construction and repair work. At the No. 2 regrinding plant, all the buildings were completed and the installation of the machinery placed well under way. A 7500-kw. substation was completed and put into commission. At the electric power plant the 9000-kv.-a. mixed-pressure steam turbine, utilizing the exhaust steam from the mills, was put into commission. The building of the electrolytic plant was completed, the electrical machinery installed, and a large number of tanks built. As far as this property was concerned it was practically a strike of the trammers and as soon as the necessary protection was afforded the other employees returned to work. The underground forces were disorganized through the trouble and it was necessary to bring in men to do the tramming, but the number of men employed underground at this writing is equal to that employed before the strike and production has been brought up to a point where it is nearly equal to what it was before the trouble began.

The Tamarack Mining Co. permanently closed down shortly after the strike was called, with the exception that the pumps were kept operating. No. 2 shaft of LaSalle was developing good ground in the lower levels, but no work has been done, other than pumping and keeping up repairs since July 24. An electrically driven pump was installed at the 12th level of No. 2 shaft to handle all the mine water. Hancock began rock shipments to the Lake Milling, Smelting & Refining Co.'s plant, but has not attempted to resume operations. The Superior company shipped more rock to the mill for the past six weeks that it did during a like period before the strike.

The Copper Range company put in commission a low-pressure turbine at the Baltic mill, and installed several motor-driven Hardinge mills for regrinding purposes. The Lake company suspended all work and the property is entirely closed down and is being allowed to fill with water.

## El Cobre Mines in 1913

By B. B. LAWRENCE\*

El Cobre mines, Province of Santiago de Cuba, were at work during 1913 completing the task of unwatering the old workings to a depth of about 1100 ft. This

\*President, Cuba Copper Co.



task has been a difficult one, but it is anticipated that the mine will be finally unwatered during 1914.

The total production of ore during 1913 was 62,482 tons. The amount shipped to smelters in the United States was 7594 tons. The remainder was treated by concentration.

Under the direction of the Minerals Separation Co., Ltd., of London, a flotation plant has been erected at El Cobre with a capacity of 400 tons in 24 hours. A small unit was operated, showing substantial recoveries over ordinary wet methods of concentration, which decided the company to run its entire product by flotation. The complete plant has not been in operation long enough to give any definite figures as to recovery, but the 50-ton unit showed an average of 85% recovery upon an ore which is extremely complex. The ores of El Cobre are a mixture of sulphide and semi-oxidized ores, chalcopyrite and bornite predominating. The ore is crushed in Hardinge mills and then treated with oil in the usual way.

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### The Copper-Smelting Works of North America

The accompanying table gives the names of the companies engaged in copper smelting in the United States,

others on the basis of 350 days, or something else. Anyway, annual capacity is a rather variable figure. In modern practice a rather large quantity of ore is reduced directly to copper by charging it into the converter along with matte.

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### The Chuquicamata Mines

One of the world's great deposits of copper ore is situated at Chuquicamata, Chile, and is now being developed by the Chile Copper Co. When present plans are consummated a great production of copper will come from this source. We have obtained the following information from the management of the Chile Copper Co.:

The mine is at Chuquicamata, on a branch of the Antofagasta & Bolivia R.R., in the Province of Antofagasta, Chile, 155 miles by railroad from Antofagasta, and 82 miles in a straight line from the coast, and lies at an altitude of 9500 ft.

Prior to 1911 this copper deposit was owned by many companies and individuals, both native and foreign. It had been prospected through hundreds of opencuts, shallow holes and trenches and a few shafts, to a depth of over 300 ft. As only high-grade ore was sought or could be utilized by the old owners and prospectors, practically no

COPPER SMELTING WORKS OF NORTH AMERICA

Company	Situation of Works	No. of Blast Furnaces	Annual Capacity	No. of Reverberatory Furnaces	Annual Capacity	No. of Converters	Annual Capacity in Ore*
American Smelting & Refining Co.	Aguascalientes, Mex.	8	730,000	..	..	4	**
American Smelting & Refining Co.	Perth Amboy, N. J.	3	111,000	..	..	2	**
American Smelting & Refining Co.	Omaha, Nebr.	..	..	..	..	3	**
American Smelting & Refining Co.	El Paso, Texas	3	250,000	2	290,000	3	**
American Smelting & Refining Co.	Matehuala, Gto., Mex.	3	325,000	..	..	..	..
American Smelting & Refining Co.	Hayden, Ariz.	..	..	2	290,000	3	**
American Smelters Securities Co.	Garfield, Utah	4	800,000	6	875,000	6	**
American Smelters Securities Co.	Tacoma, Wash.	3	525,000	..	..	6	**
American Smelters Securities Co.	Velardeña, Dgo., Mex.	3	227,500	..	..	..	..
Anaconda Copper Mining Co.	Anaconda, Mont.	3	2,190,000	8	730,000	13	123,000
Anaconda Copper Mining Co.	Great Falls, Mont.	5	800,000	3	225,000	3	34,500
Arizona Copper Co.	Clifton, Ariz.	..	..	3	360,000	3	..
Balaklala Consolidated Copper Co.	Coram, Calif.	3	630,000	1	52,500	2	..
Compagnie du Boleo	Santa Rosalia, Mex.	8	650,000	..	..	..	..
British Columbia Copper Co.	Greenwood, B. C.	3	75,000	..	..	2	..
Calumet & Arizona Mining Co.	Douglas, Ariz.	2	657,000	4	365,000	6	55,000
Canadian Copper Co.	Coppercliff, Ont.	6	840,000	2	280,000	5	..
Cananea Consolidated Copper Co.	Cananea, Son.	8	868,000	2	153,000	5	35,000
Consolidated Arizona Smelting Co.	Humboldt, Ariz.	1	130,000	1	22,000	2	5,000
Consolidated Mining & Smelting Co.	Trail, B. C.	5	374,000	..	..	..	..
Copper Queen Consolidated Copper Co.	Douglas, Ariz.	10	1,217,620	3	275,000	8	36,000
Detroit Copper Mining Co.	Morenci, Ariz.	1	132,657	..	..	3	7,578
Ducktown Sulphur, Copper & Iron Co.	Isabella, Tenn.	2	214,971	..	..	..	..
East Butte Copper Mining Co.	Butte, Mont.	2	310,250	..	..	3	7,300
Granby Consolidated Mining, Smelting & Power Co.	Grand Forks, B.C.	8	1,440,000	..	..	3	7,000
Granby Consolidated Mining, Smelting & Power Co.	Anyox, B. C.†	3	700,000	..	..	3	..
International Smelting & Refining Co.	Tooele, Utah	..	..	5	456,250	5	25,450
International Smelting & Refining Co.	Miami, Ariz.†	..	..	3	262,500	5	..
Mammoth Copper Mining Co.	Kennett, Calif.	5	730,000	..	..	2	18,250
Mason Valley Mines Co.	Thompson, Nev.	2	800,000	..	..	2	22,000
Mazapil Copper Co.	Saltito, Coah., Mex.	4	350,000	1	52,500	4	..
Mond Nickel Co.	Coniston, Ont.	2	420,000	..	..	2	24,000
Mountain Copper Co.	Martinez, Calif.	1	..	3	125,000	2	..
Nevada Consolidated Copper Co.	McGill, Nev.	1	175,000	5	900,000	4	40,000
Nichols Copper Co.	Laurel Hill, N. Y.	2	94,500	..	..	2	..
Old Dominion Copper Mining & Smelting Co.	Globe, Ariz.	5	562,500	..	..	3	8,400
International Nickel Co.	Constable Hook, N. J.	2	94,500	..	..	3	..
Penn Mining Co.	Campo Seco, Calif.	1	51,939	1	54,750	..	..
Pioneer Smelting Co.	Corwin, Ariz.	1	60,000	..	..	..	..
Santa Fe Gold & Copper Co.	San Pedro, N. M.	1	52,500	..	..	..	..
Shannon Copper Co.	Clifton, Ariz.	3	500,000	..	..	..	..
Swansea Consolidated Gold & Copper Mining Co.	Bouse, Ariz.	1	190,000	..	..	2	8,000
Tennessee Copper Co.	Copperhill, Tenn.	7	1,000,000	..	..	4	15,700
Tezuitlan Copper Mining & Smelting Co.	Tezuitlan, Puebla, Mex.	2	350,000	..	..	3	..
Cia. Metalurgica de Torreon	Torreon, Coah., Mex.	2	175,000	..	..	2	..
Tyce Copper Co.	Ladysmith, B. C.	2	175,000	..	..	..	..
U. S. Smelting Co.	Midvale, Utah	6	670,000	2	73,000	4	..
Virginia Smelting Co.	West Norfolk, Va.	1	200,000	..	..	..	..
United Verde Copper Co.	Jerome, Ariz.	4	427,300	..	..	4	37,600
United Verde Copper Co.	Clarkdale, Ariz.†	4	840,000	3	315,000	4	..

\* Raw ore smelted as flux. \*\* Included in furnace tonnages. † Plants building.

Canada and Mexico, the situation of their works, the number of their smelting furnaces and the estimated annual capacity in terms of tons of charge, meaning ore and flux, but not including fuel. In most cases the data have been communicated to us by the operating companies. However, the figures should be taken as only approximately correct. Some companies may have figured their annual capacity on the basis of the year of 365 days, and

mining of any consequence was done. In 1910 and 1911 practically the whole deposit was taken under option by Albert C. Burrage, of Boston, Mass., and in January, 1912, he was joined by the Messrs. Guggenheim, of New York, who, with him, soon after formed the Chile Exploration Co. to take over the options. Vigorous development under the direction of Pope Yeatman was at once started, principally by churn drills, and by January, 1913, 75,-

000,000 tons of ore, averaging 2.70% copper, were assured—enough to warrant the building of a plant of 10,000 tons daily capacity—and by July, 1913, 146,000,000 tons of 2.31% copper, and by January, 1914, over 200,000,000 tons of over 2% copper were developed.

Although further drilling is a luxury and wholly unnecessary from a practical point of view, nevertheless, drills are still working at Chuquicamata, and it is expected by the management that within a short time there will be proved at this mine the largest known deposit of copper in the world.

The copper is found disseminated through an altered and highly fractured zone of grano-diorite, which is the country rock. The central part of the orebody is mineralized up to the surface so that no capping or stripping need be removed before mining this part of the property.

The property owned by the Chile Exploration Co., on account of its size and peculiarities, is really a district rather than a mine or group of mines. The orebody, as developed, is over 8000 ft. long and from at least 500 ft. to over 1200 ft. wide, but neither width nor depth has yet been accurately determined. Contrary to the conditions found in the usual disseminated porphyritic copper mine, the value of the ore does not decrease with depth, for in the center, i.e., the main portion where the greatest depth has been reached by the drills, the underlying sulphide ore is of higher grade than the upper oxidized ore, the entire average of the lower section being 3.17% copper, as shown by the drills, five of which have reached over 1000 ft. in depth, one reaching 1133 ft., and one 1285 ft. Enough ore has already been developed to supply for over 60 years the treatment plant now being built.

At present there are over 1500 men at work on the plant, which is expected to be finished during 1915. A railroad from the mine to the mill has been constructed and a leaching and electrolytic plant, power plant and transmission line are being erected. The plant railroad, about 12 miles in length, is of standard gage and of heavy rails. The crushing plant consists of gyratory and Symons crushers and Garfield rolls. The leaching plant consists of six acid-proof lined concrete tanks, of 10,000 tons capacity each, with lead-lined iron pipe for the solutions. The ore will be fed into the tanks by conveying machinery and discharged by clam-shell buckets and conveyors. The electrolytic tank house and equipment are similar to that of the usual refinery tank houses, except that the tanks are built of concrete with acid-proof asphalt lining.

The electrolytic plant will have a capacity of 335,000 lb. of copper per day or 120,000,000 lb. per year. The power house of 40,000 kw. capacity, situated at Tocopilla, on the Pacific Coast, is being built by Siemens-Schuckertwerke, of Germany. There are 16 Babcock & Wilcox water-tube boilers and four Zoelly steam turbines, directly connected with four Siemens turbo-generators of 10,000 kw. each. The plant has been designed so that either coal or oil may be used as fuel. This plant is sufficient to care for twice the tonnage of the initial mill plant, that is, to provide power for treating 20,000 tons per day.

The transmission line is 86 miles in length and has a capacity of 21,000 kw., delivered at the mine, with an efficiency at this capacity of 92½%. The copper wire, 000 in size, will be strung on steel towers of American design and make, spaced eight to the mile. The voltage will be 110,000. A second similar transmission line will

be erected later when the mining and treatment-plant capacity is increased from 10,000 to 20,000 tons per day.

The 12-in. steel-pipe water line, 40 miles in length, will take the water from the San Pedro branch of the Loa River to Chuquicamata by gravity. As this water is too salty for domestic purposes, another 4-in. pipe line for carrying pure drinking water will be run from the Salado, another branch of the Loa River, also about the same distance.

The town site for both mine and mill is situated between the two, which are about three miles apart. There are two separate villages, one for the foreigners, and one for the natives, with ample offices, stores, hospitals, halls, houses, etc.

The upper ore, i.e., for the first 300 or 400 ft., beneath the surface is mostly brochantite (a sub-sulphate of copper) with some chalcantite and a little atacamite, but the underlying ore is chalcocite with a little chalcopyrite and bornite. The upper ore is absolutely devoid of gold and silver and contains but little iron, of which only a very small amount is soluble, and is extremely easy to leach in a dilute solution of sulphuric acid.

The ore will be crushed to ¼-in. mesh and placed in the large concrete tanks. A solution of about 8% sulphuric acid and 1½% copper as sulphate will then be run on the ore and allowed to percolate through. After 48 hours of soaking, several wash solutions will be run on. The first enriched solution will then be freed from the chlorine taken up from the salt in the ore, by passing it over shot copper, and next will be run through the electrolytic tanks in which the copper will be deposited, thus regenerating the sulphuric acid for the next batch. The loss in sulphuric acid in the operation is more than made up from the copper sulphate contained in the ore itself, so that after once starting the operation, it is self-sustained so far as the acid is concerned.

The copper deposited will be of high grade and practically free from arsenic. Insoluble anodes of magnetite, made in Germany, give very satisfactory results, over 15 lb. of copper per horsepower-day being deposited on the cathodes. From the results in the trial mill a recovery of over 90% of the total copper in the ore is expected.

On account of being able to mine with steam shovels, ore of such grades, in such large quantities, and with no stripping for several years, it is expected that copper will be produced at an extremely low cost.

The Chile Exploration Co., the mine-owning and operating company, is entirely owned by the holding company, the Chile Copper Co., of Delaware, which has an authorized capital of \$110,000,000 divided into 4,400,000 shares of \$25 each. Of this, 3,800,000 shares, aggregating \$95,000,000, have been issued, the remaining \$15,000,000 of capital being deposited with the trustee for the conversion of the \$15,000,000 of 7% bonds convertible into stock at par, which have been authorized and of which \$10,106,000 have been sold, all of which is being used for the property and plant and for interest during construction. The board of directors comprises Daniel Guggenheim, president; Albert C. Burrage, vice-president; Pope Yeatman, consulting engineer; John N. Steele, counsel, and Isaac Guggenheim, Murry Guggenheim, S. R. Guggenheim, Simon Guggenheim, William Loeb, Jr., Albert C. Burrage, Jr., Russell Burrage and Clarence Myers. The management of the property in Chile is in the hands of Fred Hellmann.



# The Production of Lead in 1913

Our statistics of the production of lead in the United States from 1910 to 1913, are given in the accompanying tables, the first of which is based on reports received from all of the refiners, classified as in previous years, i.e., the lead reported as "desilverized" and "antimonial" is the product of the refiners treating Western and foreign

PRODUCTION OF LEAD (REFINERY STATISTICS)  
(In tons of 2000 lb.)

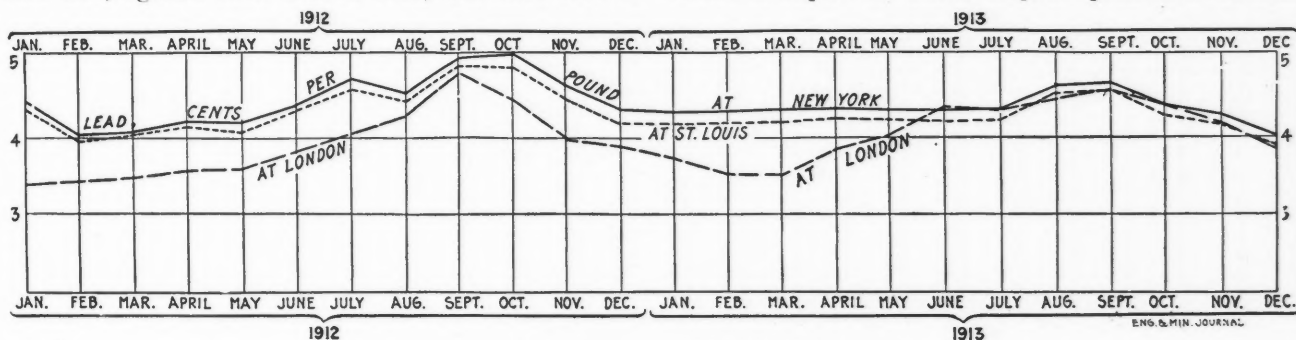
Domestic: Class	1910	1911	1912	1913
Desilverized.....	217,490	211,041	236,207	261,616
Antimonial.....	9,098	8,916	9,239	16,345
S. E. Missouri.....	145,387	155,008	145,366	133,203
S. W. Missouri.....	20,729	25,993	19,224	22,312
Totals.....	392,704	400,958	410,036	433,476
Foreign:				
Desilverized.....	90,473	89,487	82,715	54,774
Antimonial.....	4,892	4,929	5,003	2,300
Totals.....	95,365	94,416	87,718	57,074
Grand totals.....	488,069	495,374	497,754	490,550

bullion, while the production of the Missouri and Illinois refiners is entered according to the main sources of their ore supply. Some of the Missouri lead is desilverized, but this is not enumerated separately. Many of the refiners treat lead scrap and dross. The amount of refined lead derived from such old material in 1913 was 4624 tons, against 6589 tons in 1912, and 3916 tons in

broken down, and the reduction in the duty of approximately 70% to 25% *ad valorem* will mean that the American lead market will be sensitive and influenced by the occurrences in the lead markets of the rest of the world. By reason of the continuous political disturbances in Mexico, a considerable percentage of its lead production has been withheld from the European market, thereby creating a scarcity of lead abroad and forcing prices to a level considerably above the average for the last 10 years. This affected the American market, insofar as it prevented the importation of European refined lead into this country even at the reduced rate of the new tariff.

The year 1913 opened with lead selling at around 4.15c. at St. Louis and about 4.30c. at New York. Business at these prices, which were considered low in comparison with those ruling during the summer of 1912, was active and buying by consumers on a good scale. The market remained at around this level until the latter part of April, when buying became so insistent that the largest interest was forced to advance its price to 4.50c., New York.

Advantage was taken of the higher prices by outside sellers to dispose of their anticipated production at some-



LEAD PRICES IN 1912 AND 1913

1911. These figures are included in the totals of the accompanying tables.

## WORLD'S PRODUCTION OF LEAD

(As reported by Metallgesellschaft, Frankfurt a. M., in Metric Tons).

	1910	1911	1912
Spain.....	191,900	175,100	186,700
Germany.....	159,900	161,300	165,000
France.....	20,200	23,600	33,000
Great Britain.....	29,600	26,000	29,000
Belgium.....	40,700	44,300	57,100
Italy.....	14,500	16,700	20,500
Austria-Hungary.....	17,500	19,600	21,400
Greece.....	16,800	14,300	14,500
Sweden and Norway.....	400	1,100	1,300
Russia.....	1,200	1,000	1,000
Servia.....			
Turkey.....	12,700	12,400	12,500
Europe.....	505,400	495,400	542,000
United States.....	369,400	377,900	386,700
Mexico.....	120,700	124,600	120,000
Canada.....	15,000	10,700	16,300
North America.....	505,100	513,200	523,000
Japan.....	3,500	4,200	4,500
Australia.....	98,800	99,600	107,400
Others.....	15,700	20,500	12,200
World's production.....	1,128,500	1,132,900	1,189,100

## The Lead Market in 1913

With the passing of the new tariff law, the intrenchment which made the American lead market practically independent of that of the rest of the world, was partially

what below the fixed schedule of the American Smelting & Refining Co., with the result that the latter again reduced its price about the beginning of May to 4.35c., New York. Competition for business continued keen and prices remained practically unchanged until the end of July.

### MONTHLY AVERAGE PRICE OF LEAD

Month	New York			St. Louis			London		
	1911	1912	1913	1911	1912	1913	1911	1912	1913
Jan.....	4.483	4.435	4.321	4.334	4.327	4.171	13.009	15.597	17.114
Feb.....	4.440	4.026	4.325	4.266	3.946	4.175	13.043	15.738	16.550
Mar.....	4.394	4.073	4.327	4.238	4.046	4.177	13.122	15.997	15.977
Apr.....	4.412	4.200	4.351	4.262	4.118	4.242	12.889	16.331	17.597
May.....	4.373	4.194	4.342	4.223	4.072	4.226	12.984	16.509	18.923
June.....	4.435	4.392	4.325	4.292	4.321	4.190	13.260	17.588	20.226
July.....	4.499	4.720	4.353	4.397	4.603	4.223	13.530	18.544	20.038
Aug.....	4.500	4.569	4.624	4.406	4.452	4.550	14.260	19.655	20.406
Sept.....	4.485	5.048	4.698	4.356	4.924	4.579	14.744	22.292	20.648
Oct.....	4.265	5.071	4.402	4.139	4.894	4.253	15.332	20.630	20.302
Nov.....	4.298	4.615	4.293	4.181	4.463	4.146	15.821	18.193	19.334
Dec.....	4.450	4.303	4.047	4.332	4.152	3.929	15.648	18.069	17.798
Year.....	4.420	4.471	4.370	4.286	4.360	4.238	13.970	17.929	18.743

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

At that time, the first rumors of a strike in southeast Missouri became current, and in anticipation of this threatened event sellers became reluctant and the market developed a very strong tone. Quotations were advanced to a 4 1/2c., New York, basis, and when the strike was actually declared on Aug. 15, the market was further advanced to 4.75c.

A curious situation developed, insofar as the curtailed deliveries of southeastern Missouri established prices in St. Louis at the New York level, and in some instances even somewhat higher. The strike was settled at the beginning of September, with the result that outside sellers again became aggressive and readily took business at below the established quotations of the American Smelting & Refining Co. The latter reduced its price in rapid succession on Oct. 1 to 4.60c., on Oct. 8 to 4.50c., and on Oct. 16 to 4.35c.

These continual reductions necessarily made consumers cautious in covering their requirements. Buying was done on a hand-to-mouth scale and lead was obtainable at considerable concessions from the quoted prices of the largest seller. A reduction was made by it on Nov. 26 to 4.25c., which was quickly followed by further reductions on Dec. 2 to 4.10c. and on Dec. 9 to 4c.

Considering the present state of the European market, the level thus reached must be considered a low one, the more so as it is approaching dangerously close to the point when it becomes unprofitable for some of the largest mines in this country to produce. As is usual at this season of the year, consumption was not very brisk, but speculation took hold and considerable purchases for this account were made.

The producers outside of the largest interest withdrew entirely from the market, in consequence of which almost the entire business was turned over to the American Smelting & Refining Co. The quantities which were ordered from it became so large that it was forced to advance its price, which was established at 4.10c. on Dec. 24, and at 4.15c. on Dec. 29. The year closed with the market firm at the latter figure for New York delivery, and about 4.05 to 4.10c. for St. Louis.

### A. S. & R. Co's Prices

The prices for lead at New York named by the A. S. & R. Co. during 1913 were as follows:

	Lb.		Lb.
Opened.....	4.35c.	Oct. 16.....	4.35c.
April 22.....	4.50	Nov. 26.....	4.25
May 5.....	4.35	Dec. 2.....	4.10
July 29.....	4.50	Dec. 9.....	4.00
Aug. 15.....	4.75	Dec. 24.....	4.10
Oct. 1.....	4.60	Dec. 29.....	4.15
Oct. 8.....	4.50		

In the latter part of the year especially the open market was below the Smelting company's quotations most of the time.

### The London Lead Market in 1913

SPECIAL CORRESPONDENCE

*January*—The market throughout was sensitive to political influences, and the speculative element tended to depress values. Opening at a fractional decline, soft foreign was quoted £18 per ton, and drifted downward till the 17th, when £16½ was accepted. A recovery to £17¼ was of short duration, though trade was normally good. The month closed with £16½ again ruling.

*February*—An early recovery up to £17 was followed by a gradual relapse, which continued with little intermission till the end of the month. Consumers bought cautiously, and full prices were paid only for prompt delivery. The close was quiet at £16⅛@£16¼.

*March*—The market remained unchanged for a few days and then developed sudden weakness, due to large arrivals in London, whereby prices were depressed to £15⅜ for foreign brands. This attracted some demand, particularly from the continent, and values improved gradually, closing quotations being £16⅜@16⅞.

*April* was a period of unwonted excitement in this market. Disturbances at the producing centers, and particularly in Australia, tended to restrict supplies at a time when trade requirements were large and numerous short sales had to be covered. Opening prices were unchanged, but a gradual and persistent advance began on the following day and culminated on the 15th, when £18¼ was paid for April delivery, £18 being accepted for August. Thereafter the tension was relieved by better news from the producing centers and by the approach of incoming supplies. Prices eased with occasional fluctuation and closed at £17¾ for early delivery, and £17¼ for forward delivery.

*May* saw a general shrinkage of values in most commodities, due to financial stringency and the disturbed aspect of international politics; but lead was a remarkable exception. Notwithstanding plentiful incoming supplies, the trade demand from all quarters was such that the premium for prompt delivery was maintained throughout. Values were unaltered at the opening, but advanced persistently until the close, when £19⅞ was quoted for early delivery and down to £19¼ for deliveries extending into August.

*June*—Some extraordinary features developed as the month advanced. In other markets the depression of values was very marked, and speculative enterprise was severely curtailed; but lead was in active demand throughout. The dominating feature was the scarcity of available supply, whereby a wide divergency was produced between the prices ruling for early and later delivery. This culminated on the 23rd, when £20½ was paid for prompt delivery, while September delivery commanded only £18¼. The ultimate trend of prices was downward, but not to the same extent as in the other commercial metals. For prompt delivery the highest paid was £21½, and the lowest £19¼; for later delivery the highest was £19½, and the lowest £18, closing values being £19½ and £18¼, respectively.

*July*—The prevailing feature was the continued scarcity of available supplies and the disturbed state of Mexico, with consequent impossibility of relief from that quarter. The premium for prompt delivery varied from £1 to £1½. The market was active throughout, speculators participating freely. The lowest values ruled on the 7th, when markets generally were depressed by outside influences; £19¼ being accepted for early delivery, and £18¼ for forward. Thereafter the trend was upward, the highest being reached on the 29th, viz., £21¼ and £19¾, respectively, closing at £20¾ and £19¼, respectively.

*August*—Scarcity of available supply was again the dominating feature of the month, spot parcels at one time commanding a premium of £2 per ton. The relative cheapness of forward delivery attracted buyers as the month advanced, and the difference in value narrowed accordingly, occasionally to 15s. Trade for home and export was continuously brisk. Opening prices were £20⅝ for early delivery, down to £19½ for forward. The lowest was recorded on the 12th, being £20½ and £18½.



respectively. The close was at £20¼ and £19, respectively.

September opened with a sharp rally in values to £20¾ for early delivery and £19½ for later. Fluctuations were numerous and irregular throughout the month, but the underlying conditions remained unaltered with available supplies very meager, the premium for the latter varying between 20 and 30s.

October saw a steadier market, owing principally to the grave news received from Mexico, together with a better export demand. These factors were enough to keep values firm almost throughout, and lead closed at £20⅝ for near metal with forward at about 25s. discount.

November saw a dull and declining market brought about by sales by speculators who took a bear view of the position based on the poor trade reports from all sources. The chief factors in favor of the article were the continued demand from Russia and labor troubles at the mines in Spain, but these did not prevent values from falling to £18 for near stuff and £17⅜ for forward.

December again saw lower prices despite a slight revival in demand from the electrical users, "bear" covering and further purchases for Russian account. The closing price was £18¼ for spot lead.

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### White Lead and Oxides in 1913

Until the last quarter of 1913, sales of white lead and oxides showed a gain over 1912. October saw a general falling off in paint sales, however, and although there was a good recovery during the following months, sales for the year will be only slightly above those of last year. It was feared that the reduced duties might lead to serious competition from abroad, but the difference in the price of pig lead here and in Europe has been so narrow that thus far the quotations from abroad have not been low enough to tempt American buyers to any extent.

Changes in the price of white lead during the year have coincided both in point of time and the extent of the fluctuations with those of 1912, and have been due entirely to fluctuations in pig-lead prices. While there have been 11 published changes in the smelters' quotations, however, only three have occurred in the card prices of white lead or oxides.

Dry white lead has been sold mainly at the contract price of 5¼c., which was established in November, 1912, although corrodors advanced their quotations to 5¾c. and 6c. late in August to meet the higher cost of pig lead and the prospective further rise likely to result from strikes in the Missouri mines. With the settlement of these difficulties and the resumption of mining, however, prices on pig lead had so far receded as to bring about a decline in dry white lead in November, to 5¼c., and at the close that quotation is the basis for current sales and for such contracts as are being made. As noted in our last review, the unbusinesslike custom of entering up contracts for a year, which guaranteed the buyer against advance or decline, is being gradually eliminated, and dry lead is coming to be sold under the same conditions as most other merchandise, the corrodor committing himself only for such a period as he can in turn cover by contracts for his own crude materials.

White lead in oil opened at 6¾c. and 7c., the price established in November, 1912, and was without change

until Aug. 14, when there was an advance of ¼c., followed on the 21st by another rise of ¼c. These changes were due to the strong position and advancing prices of pig lead, but the decline in the latter, as noted above, was followed by a reduction of ½c. in the card price of white lead on Nov. 21, bringing the quotation back to the opening figures of the year.

Oxides have fluctuated to about the same extent as white lead, the extreme changes being covered by ½c. The business in red lead has been chiefly within a range of 6¼c. to 6¾c. Litharge to the largest consumers has ranged from 5½c. to 6c., but there is a tendency at the close of the year toward slightly lower prices, if pig lead remains on its present low basis.

Linseed oil, although an important factor in the paint trade, has not influenced any of the price changes this year, as it has fluctuated but little either above or below 50c. per gal. Nor has the competition of other pigments affected the sales or prices of lead products to any appreciable extent, the latter apparently retaining their preëminent position as paint pigments and for other industrial uses.

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### The Silver-Lead Smelting Works of North America

The accompanying list gives the several silver-lead smelting works of the United States, Mexico and Canada, together with the number of their furnaces (in all cases, blast furnaces), and their estimated annual capacity in tons of charge. By "tons of charge" we mean ore and flux, but exclude coke. The ton of charge is manifestly the correct unit. In the case of a self-fluxing ore, the ton of ore smelted and the ton of charge smelted is the same thing. In other cases, fuel and labor have to be used in smelting the flux as well as in smelting the ore, and the economy of smelting depends largely upon the percentage of ore in the charge. The management of this question is about the highest exercise of the metallurgist's skill.

#### SILVER-LEAD SMELTING WORKS

Company	Place	Furnaces	Annual Capacity(a)
American Smelting & Refining Co.....	Denver.....	7	511,000
American Smelting & Refining Co.....	Pueblo.....	7	380,000
American Smelting & Refining Co.....	Durango.....	4	146,000
American Smelting & Refining Co.....	Leadville.....	10	509,000
American Smelting & Refining Co.....	Murray.....	8	657,000
American Smelting & Refining Co.....	East Helena.....	4	306,600
American Smelting & Refining Co.....	Omaha (c).....	2	82,000
American Smelting & Refining Co.....	Chicago (c).....	2	60,000
American Smelting & Refining Co.....	Perth Amboy (c).....	3	140,000
American Smelting & Refining Co.....	El Paso.....	7	380,000
American Smelters Securities Co.....	Selby.....	3	210,000
Ohio & Colorado Smelting Co.....	Salida.....	4	345,000
U. S. Smelting Co.....	Midvale, Utah.....	6	547,500
Needles Smelting Co.....	Needles, Calif.....	2	70,000
Pennsylvania Smelting Co.....	Pittsburgh, Pa.....	2	60,000
International Smg. & Ref. Co.....	Tooele, Utah.....	5	500,000
Totals, United States.....		76	4,904,100
American Smelting & Refining Co.....	Monterey.....	10	475,000
American Smelting & Refining Co.....	Aguascalientes.....	2	100,000
American Smelting & Refining Co.....	Chihuahua.....	5	274,000
American Smelters Securities Co.....	Velardeña.....	3	140,000
Compañía Metalurgica Mexicana.....	San Luis Potosi.....	11	385,000
Compañía Metalurgica de Torreon.....	Torreon.....	8	360,000
Compañía Minera de Peñoles.....	Mapimi.....	6	325,000
Totals, Mexico (b).....		45	2,050,000
Consolidated Mining & Smelting Co.....	Trail, B.C.....	3	210,000

a Tons of charge. b The Compañía Fundidora y Afinadora of Monterey is missing from this list. c Smelt chiefly refinery between products.

The figures in the above table are from official communications of the respective companies and other reliable data. Estimated capacity is, however, always a matter of more or less uncertainty, and for this reason, if for no

other, the figures that we give ought to be accepted only as approximations. There is some doubt, also, whether in every case the smelters have discriminated between their lead furnaces and their copper-matte furnaces, almost every lead-smelting works having both.

It appears that the total capacity of the Mexican works is a little over 2,000,000 tons per annum; of the American works, a little over 4,800,000 tons. With respect to the American works, at least, such capacity has never been in use at one time. More or less of it represents capacity that has become idle because of changes in the conditions of ore supply. We doubt if there has ever been so much as 3,500,000 tons of silver-lead ore smelted in the plants of the United States in a single year. It must be recognized that the works of the country could never be operated at 100% capacity for long and a nominal surplus is necessary.

### The Coeur d'Alenes During 1913

BY STANLY A. EASTON\*

For 1913 the Coeur d'Alenes show a yield in lead, silver and zinc greater than any preceding year; there was a falling off in copper alone. But more important than this record production is the successful exploration work done in large measure in the old mines and in the new properties. There are more producing mines in the Coeur d'Alenes now than ever before, as follows:

Federal Mining & Smelting Co.  
Hercules Mining Co.  
Bunker Hill & Sullivan Mining & Concentrating Co.  
Hecla Mining Co.  
Green Hill Cleveland Mining Co.  
Stewart Mining Co.  
Snowstorm Mining Co.  
Interstate-Callahan Consolidated Mining Co.  
Success Mining Co.  
Tamarack & Custer Consolidated Mining Co.  
Caledonia Mining Co.  
Gold Hunter Mining Co.  
Ontario Mining Co.  
Sierra Nevada Consolidated Mining Co.  
Marsh Mining Co.  
Idora Hill Mining Co.  
Hypothek Mining Co.

The Yankee Boy, Alice, and mines of the Coeur d'Alene Development Co. are operated under lease, and there are mills on the Black Horse, Monarch, Bear Top and Surprise mines which have made periodic production. The National Mining Co. is making good progress in the erection of a most modern concentrator for the treatment of its well developed large body of silver-bearing disseminated copper ore, and the Federal Mining & Smelting Co. is preparing machinery to treat the zinc-lead-silver ore from the old Frisco mine, so the year closes with the greatest well directed activity all over the district.

Better organized and more diligent metallurgical work is being done by the larger mining companies than heretofore. The special problems in addition to the general all-around better extraction always sought, are: Recovery of zinc and its separation from lead and iron minerals, recovery of slimed galena from vanner and other fine tailings, raising average grade of shipping product with lowered tailings, and at the copper mines the making of low tailing and clean concentrate from the fine mineral scattered thoroughly through the hard quartzite vein rock. The unequalled advantages of abundant water, accessibility, climate and cheap power, are now supplemented by metallurgists from the foremost colleges and best known plants who are applying to these local conditions the

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various devices and processes proven elsewhere, and modifying them and developing others to meet the problems here.

Mining litigation because of apex rights was confined to the Wardner or Yreka District, the pending case, Bunker Hill & Sullivan vs. Caledonia Mining Co., having just been dismissed, the former company granting concessions to the latter and receiving a portion of its stock, on a basis advantageous to both. Stewart Mining Co. vs. Ontario Mining Co. was tried before District Judge Woods during January. Many of the best known geologists and engineers appeared for either side. The plaintiff claimed apex rights based upon an edge of the vein against a fault of unknown but admitted great throw. Defendant asserted the edge was not an upper terminal edge constituting a legal apex to the vein, but was a side, or even undercut, edge, and thus no apex. Judge Woods held for defendant and was sustained by the Supreme Court, an appeal has been taken to the Supreme Court of the United States.

The particularly satisfactory feature of the present state of the industry is the good low-level development in the old mines, notably in the Green Hill Cleveland on the famous Standard-Mammoth oreshoot; the Hercules has a fine orebody on its lowest level, as have also the Hecla and Bunker Hill & Sullivan.

No new promotion of magnitude was made during the year, nor was outside capital in any large amount brought to the district, the mining companies have done their own financing from their outset and the new enterprises have had their principal and almost entire support from local mine-made money. So then, the opening of a new year finds this sound industry looking to another period of legitimate activity and, with a fair metal market, confidently expecting and planning a betterment of the well earned and substantial results of 1913.

### The Southeastern Missouri Lead District

BY H. A. WHEELER\*

The southeastern, or disseminated lead district of Missouri, produced about 137,000 tons of pig lead in 1913, which had an approximate value of \$11,700,000. This is about 10,000 tons, or 7% less than in 1912, due to a strike of the miners' union last summer that shut down the entire district for nearly a month. But for this occurrence, the output would have exceeded that of the previous year, 146,913 tons. Even with this shrinkage the district maintains its position as the largest lead producer of the world, derived from a simple ore with no silver or other byproducts to assist in lowering costs, as have the mines in the West, Spain, Germany, Mexico, Australia and the other large lead producers.

Strikes have been rare and hitherto only individual mines have been affected as, with one exception, they were not complicated with union affiliations. The union began proselyting in this district 12 years ago, but at first with poor success. To advertise their power and attract a large following, the union called a strike at the Central mine in December, 1903, on a trivial pretext, in which it was defeated. The plant was promptly closed down, and after three months the employees were willing

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to return on any conditions. It was a heavy burden for the Central company to bear, as the unwatering of their large, wet mine was costly, but it crushed the union for several years. For the past three years the union has again been building up its membership and decided to test its strength last summer. It demanded recognition of the Western Federation and an increase of about 20% in wages. When the operators refused to recognize the union and only conceded an advance of 5%, it called a strike on Aug. 16 and refused to allow the running of the mine pumps. Although the mines are wet, their size permitted several conferences with the State Labor Commissioners before the pumps were submerged. When an advance of 25c. daily, or about 10%, was conceded after 11 days, the strike was called off without the union recognition. About a month was lost before the mines were unwatered and normal conditions were restored. There was no trouble during the strike, nor were any strike breakers imported. The majority of the miners are local Americans and the foreigners, mostly trammers, are Hungarians.

The unsettled labor situation and the low price of lead discouraged prospecting, beyond the drilling necessary to extend and develop the present orebodies, and the partially developed Manhattan, Penicaut and Bogy lands remained inactive.

The adjoining counties of Washington, Jefferson and Franklin that have thus far only produced lead from the shallow diggings and small veins, were quiet during the last year and the shipments were small. This is due to the low price of lead, rather than exhaustion of deposits.

The important question of the presence of disseminated-lead deposits in Washington County is receiving attention from a St. Louis company which began drilling last fall near Potosi. Only one hole has been finished, but the results are encouraging, as 3 ft. of disseminated ore is said to have been cut at 827 ft. depth, and 4 ft. at 930 ft. depth. While I have not examined the cores from this important hole, excellent authorities state that the ore is good grade. If this is correct, it is likely to lead to the rapid development of Washington County, where the shallow "diggings" are much richer than in St. Francois County, and which several experts predict will surpass St. Francois County, the present record-holder. Thus far there have been only a few holes bottomed to the underlying sandstone, about 1000 ft., in Washington County, compared with several thousand holes in St. Francois, and of the latter but a small percentage have found pay ore. That St. Francois County operators are so astoundingly slow in prospecting in Washington County is not surprising, as they are accustomed to 200- to 600-ft. drilling at a cost of 30 to 70c. per ft. Hence, 1000 ft. of drilling at \$1.50 to \$2 a foot has frightened them off, especially as the lead market has not been strong since 1907. Washington County probably will be opened up by outsiders, who have been educated to the \$2 to \$5 rates that prevail in other camps and who have not been spoiled by the unusual conditions for cheap diamond drilling in St. Francois County.

The fiscal year of the St. Joseph company showed net earnings of \$637,910, out of which \$597,300 was distributed in dividends. This was on a lead market that averaged 4.3c., while in 1907, when the market averaged 5.7c., the net earnings rose to \$2,038,820.

Internal dissensions made 1913 a stormy year that

demoralized the local *esprit-du-corps*. A St. Louis stockholder made a bitter attack on the administration, especially in the New York office, that was carried on through circulars, in the press and finally in the courts. A stockholders' committee finally harmonized the conflicting interests, after making some changes in the directorate and introducing some reforms, and an efficiency engineer has been engaged to effect economies. The stock of these two companies is in the same hands and a consolidation is purposed, under which they will be operated by a single administration.

The St. Joseph company has distributed about \$9,000,000 in dividends on an original capital of \$1,000,000 that was issued for land, while \$30,000 for plant and working capital was realized by the sale of bonds. Today there is \$10,000,000 stock outstanding that represents stock dividends based on solid assets. A large share of the earnings has been reinvested, providing increased acreage, towns, mines, mills, smelting plant and an extensive railroad system.

The Doe Run company, which is much younger, has distributed over \$3,000,000 in dividends, and while more cash was put into the company, most of the \$6,578,500 stock outstanding today represents stock dividends based on reinvested earnings. There is \$10,000,000 of unissued stock in the St. Joe treasury, about half of which will be used in absorbing the Doe Run company. The smelting plant of the St. Joseph company, at Herculeum, on the Mississippi River, where the concentrates of the St. Joseph and Doe Run companies are treated, has been further improved. The large baghouse is about completed. A 7-hearth Wedge mechanical roaster has been added for roasting matte, in addition to a 36-ft. Holthoff roaster. The ore is roasted by six Dwight-Lloyd sintering furnaces, and the Savalsberg pot-roasting plant has been dismantled. The 350x20-ft. stack is effectively defusing the smoke and no complaints are heard from the farmers. This smelter produces about 14% of the pig-lead output of the United States.

The Desloge Lead Co. had an active year and suffered only slight loss in its output through the shut-down caused by the strike. Since then it has not operated the No. 4 shaft on Big River, and is concentrating the work at the old No. 3 shaft at the mill and the new No. 6 shaft that is close to the Washington County line.

The St. Louis Smelting & Refining Co., under which the National Lead Co. operates its mining department, expanded its operations in 1913 by taking over the extensive Mine La Motte property under a 10% lease, with the privilege of purchase at \$800,000. The property is in Madison County and has been worked for over 150 years in the shallow "diggings," and for the past 40 years in the deeper disseminated deposits. There are several disseminated orebodies that occur along a well defined fault and in marked contrast to the ideas promulgated in the recent report of the Missouri Geological Survey dealing with the disseminated-lead belt. While this report has added much valuable information and contributed a fine set of maps and sections of this district, it has also presented theoretical ideas and the results of incomplete studies that are proving decidedly harmful in discouraging prospecting in some very promising areas.

The Federal Lead Co., one of the operating departments of the Guggenheim Exploration Co., had a very active year and continued operating under lease the former

Catherine property at Fredericktown, Madison County, in addition to its large holdings and 4000-ton mill at Flat River. The No. 7 and No. 11 mines, on the former Central property, were connected last year, and No. 11 shaft was remodeled to take care of the output from both mines. Balanced 5-ton skips, operated by a double-drum electric hoist, were installed.

This property is on Big River, between the Gumbo and Hunt mines of the St. Joseph company, and has 357 acres. A shaft, 430 ft. deep, was sunk to the orebody in 1912 after it had been repeatedly condemned by most of the local operators during the past 15 years. A spur from the Hoffman branch of the M. R. & B. T. R.R. was built to it in 1913, since which active shipments

have been made to the National Lead Co., under a contract by which they both mill and smelt the ore. The shipments assay from 9 to 11% lead, which is exceptionally rich, as the average assay of ores of the district usually ranges from 4 to 6% lead by wet method.

The property of the former North American Lead Co. at Fredericktown is still idle and is said to have passed under control of the nickel trust. The mine is kept pumped out, but otherwise there is no sign of immediate resumption. As it was producing about five tons of ingot copper a day, besides nickel, cobalt and lead, it would seem as though it could have been profitably operated during the past year, with copper averaging above 15 cents.

## Zinc Production in 1913

The production of zinc in the United States in 1913 was about 356,146 tons, an increase over 1912. The production in Europe was about 673,000 metric tons, a decrease from 1912. Unsold stocks, which in the United States were about 4000 tons at the beginning of the year, increased steadily, and at the end of the year about 40,000 tons were on hand. The stock of spelter in Europe also increased, amounting to nearly 75,000 metric tons at mid-summer. Thenceforward it decreased, and at the end of the year was but little more than 40,000 tons. The reduction in the European stock was promoted by the curtailment of production which went into effect on Sept. 1.

### PRODUCTION OF ZINC

(In Tons of 2000 Lb.)

By Ore Smelters Only (a)

States	1910	1911	1912	1913
Colorado.....	6,564	7,477	8,860	8,521
Illinois.....	79,570	88,681	94,902	111,632
Missouri and Kansas.....	112,182	106,173	111,761	83,159
Oklahoma.....	34,760	46,333	76,837	83,062
East.....	43,989	47,172	56,278	69,772
Totals.....	277,065	295,836	348,638	356,146

(a) Includes some works that smelt dross and scrap as well as ore, but does not include works that smelt dross and scrap only. Discrepancies among statistical reports of the spelter production of the United States arise largely on account of the difference in the dividing line that is drawn in this respect.

As a matter of interest we have accounted for the spelter production in 1913 by quarters. Our figures are not precise, two concerns having failed to make the division in that way, and it having been necessary to assume a division of their totals, which cannot, however, affect the results by more than a few hundred tons for any quarter.

### SPELTER PRODUCTION IN 1913 BY QUARTERS

(In Tons of 2000 Lb.)

District	I	II	III	IV
Illinois.....	27,924	28,523	26,118	29,067
Kansas-Missouri.....	22,006	23,820	19,204	18,129
Oklahoma.....	21,430	21,840	18,502	21,290
Others (a).....	20,722	20,153	19,238	18,180
Totals.....	92,082	94,336	83,062	86,666

(a) With the exception of one plant in Colorado these are all Eastern works

It was known soon after midsummer that the production had increased during the first half of 1913, but it was commonly believed that there was a large curtailment in the second half. There was indeed a curtailment, but it was not so large as supposed, and it occurred especially in the third quarter rather than the fourth. Only three smelters reported an output in the fourth quarter much smaller than in the third. Apparently the works in

Kansas suffered most from the adverse conditions of the latter part of 1913. The works in Colorado, West Virginia and Pennsylvania were operated pretty uniformly throughout the year.

The European zinc convention was renewed on Dec. 18, 1913, for a period running to Apr. 1, 1916. The new terms are about the same as the old ones, but restriction of production is made a little more prompt. Under the old terms curtailment began after the price had ruled below £22 for four consecutive months, the unsold stocks being in excess of 50,000 tons. The new terms require that the price run below £22 for only two months.

Neither in Europe nor America do the statistics reflect the actual situation. The European smelters have an immense stock of accumulated ore, especially in Australia, upon which to draw. In America, the smelters had only a trifling quantity of spelter on hand at the beginning of 1913, but the galvanizers and brass makers, who had previously over-bought, had large stocks in their yards. The visible stock was small, but the invisible was large. At the end of 1913 the opposite conditions were supposed to prevail.

There was some increase in smelting capacity in the United States in 1913, but the adverse conditions delayed a good deal of what was planned. The new Granby works at East St. Louis, with 3240 retorts, was practically completed, but no operation was attempted. Construction work was carried on by the American Zinc & Chemical Co., at Langeloth, Penn., and, at the end of 1913, the grading and foundations were about completed. The Prime Western Spelter Co. began construction of roasting furnaces and sulphuric-acid chambers at Tiltonville, Ohio (near Wheeling, W. Va.). The Tulsa Spelter Co. began the erection of a five-block plant near Tulsa, Oklahoma.

Three new works were put into operation in Europe in 1913, one large plant in Belgium, which is in the convention, and two small works in the coal field of Bohemia. The latter two did not get into operation until late in the year and their production was negligible. A small tonnage of electrically smelted spelter was produced in Sweden and Norway. Two works in Australia made a small production, and some zinc ore was smelted in Japan. It looks as if we should in the not distant future see some further expansion of zinc smelting in the Far East.



WORLD'S PRODUCTION OF SPELTER

(As Reported by Metallgesellschaft, Frankfurt am Main, in Metric Tons, except the Figures for 1913, which we have estimated.)

	1910	1911	1912	1913
Rheinland-Westphalia (a)	78,765	81,458	86,619	} 285,000
Silesia (a)	140,249	156,174	169,088	
Germany, other districts	8,733	12,761	15,357	
Belgium	172,578	195,092	200,198	
Holland	20,975	22,783	23,932	
Great Britain	63,078	66,956	57,231	
France and Spain	59,141	64,221	72,161	
Austria and Italy	13,305	16,876	19,604	
Russia	8,631	9,936	8,763	
Norway (b)	.....	6,680	8,128	
Europe	565,455	632,887	661,081	673,000
United States	250,627	267,472	314,512	323,100
Australia	508	1,727	2,296	5,000
Total	816,000	902,100	977,900	1,001,100

(a) Germany. (b) Presumably Sweden's output is also included.

The stock of spelter, on hand at American smelters' works at the end of 1913 was 40,115 tons, against 4264 tons at the end of 1912; 9323 tons at the end of 1911 and 23,000 tons at the end of 1910. The stock at the end of 1913 was the largest of which we have record. Deliveries may be computed by difference between stocks plus production plus imports, and exports plus stocks, but the experiences of 1912-13 show how futile it is to attempt to compute consumption in that way, and how important a part is played by the stocks in the yards of galvanizers and brass makers, the invisible supply. At the end of 1912 that invisible supply was large, no doubt; at the end of 1913 it is believed to be small. Included in the stock reported at the end of 1913 was 615 tons of bonded spelter.

ZINC SMELTING CAPACITY OF THE UNITED STATES

(Number of Retorts at End of Years)

Name	Location	1912	1913
Altoona Zinc Smelting Co.	Altoona, Kan.	3,300	3,300
American Zinc Co. of Ill.	Hillsboro, Ill.	1,600	3,200
American Zinc, Lead & Smg. Co.	Dearing, Kan.	3,840	3,840
American Zinc, Lead & Smg. Co.	Caney, Kan.	3,648	3,648
Bartlesville Zinc Co.	Bartlesville, Okla.	5,184	5,184
Bartlesville Zinc Co.	Collinsville, Okla.	8,064	8,064
Chanute Zinc Co.	Chanute, Kan.	1,280	(b) 1,280
Collinsville Zinc Smg. Co.	Collinsville, Ill.	1,536	(b) 1,536
Edgar Zinc Co.	St. Louis, Mo.	2,000	2,000
Edgar Zinc Co.	Cherryvale, Kan.	4,800	4,800
Granby Mining & Smg. Co.	Neodesha, Kan.	3,840	3,760
Granby Mining & Smg. Co.	E. St. Louis, Ill.	.....	3,240
Grasselli Chemical Co.	Clarksburg, W. Va.	} 12,672	12,672
Grasselli Chemical Co.	Meadowbrook, W. Va.		
Hegeler Bros.	Danville, Ill.	1,800	1,800
Illinois Zinc Co.	Peru, Ill.	4,640	4,640
La Harpe Spelter Co.	La Harpe, Kan.	640	1,856
Robert Lanyon Zinc & Acid Co.	Hillsboro, Ill.	.....	1,600
Lanyon-Starr Sm. Co.	Bartlesville, Okla.	3,456	3,456
Matthiessen & Hegeler Zinc Co.	La Salle, Ill.	5,256	5,256
Mineral Point Zinc Co.	Deque, Ill.	4,520	6,800
National Zinc Co.	Bartlesville, Okla.	4,256	4,480
National Zinc Co.	Springfield, Ill.	3,200	3,200
Nevada Zinc Co.	Nevada, Mo.	(b) 648	(a) 648
New Jersey Zinc Co.	Palmerston, Penn.	5,772	5,760
Pittsburg Zinc Co.	Pittsburg, Kan.	910	(b) 910
Prime Western Spelter Co.	Gas City, Kan.	4,834	4,768
Sandoval Zinc Co.	Sandoval, Ill.	896	896
Tulsa Fuel & Manufacturing Co.	Collinsville, Okla.	6,232	6,232
United States Zinc Co.	Pueblo, Colo.	1,920	1,920
Totals	.....	100,744	110,746

(a) Inactive. (b) Inactive during latter part of year.

There was a production of 380 tons of zinc dust in 1913, against 492 in 1912 and 254 in 1911.

The smelters had a bad year. The extravagant margins between zinc in ore and in spelter that prevailed in 1912 disappeared, and save for the ore that was contracted by sliding scale there were in 1913 very small margins, or none at all. The cutting off of Mexican ore and the competition among the smelters made conditions favorable to the domestic producers of ore, although the latter suffered, of course, from the low scale of prices. The increased production of spelter with these circumstances, reflecting, of course, an increased production of ore, must cause us to reconsider our generally held ideas respecting a shortage of zinc ore. However, the increased production of ore resulted in part, no doubt, from the stimulus of the high prices of 1912 and early 1913.

In fact, there was a large increase in the zinc-ore pro-

duction of Butte, of Magdalena, N. M., and in Idaho and Tennessee, important new resources having been developed in the last state, while milling difficulties have been solved in Butte and Magdalena. Joplin and Leadville about held their own. Wisconsin's output suffered seriously.

The Spelter Market in 1913

At the opening of 1913, the edge had been taken off the unprecedented advance which marked the closing months of 1912. Consumers had bought far beyond their requirements in order to be protected against a sudden falling-off in the output of spelter, which was apprehended on account of the failure of the gas supply in Oklahoma and Kansas. The demand had been so urgent and, as later on developed, far beyond current requirements that large contracts for the importation of spelter were placed in Europe. When it became known that the most important smelters had been able to secure gas from hitherto undeveloped districts which would supply continuous operations for some time to come, a sudden restriction in pur-

AVERAGE PRICE OF ZINC SHEETS

(In Cents per Lb.)

January	9.00	May	7.63	September	8.00
February	8.63	June	7.25	October	7.63
March	8.20	July	7.13	November	7.50
April	7.88	August	7.90	December	7.25

Average for the year—7.833 cents.

Note:—There are base prices for ordinary size sheets, in carload lots, f.o.b. LaSalle-Peru, Ill., less 8% discount.

chases took place, and as a result a good portion of the foreign spelter was left in the hands of the importers.

Smelters were fairly well sold out for nearby shipment. However, they realized the new factors which had made their appearance in the market, and were, therefore, anxious to dispose of their product as far ahead as possible. The pressure to make sales for future delivery was accentuated by the liberal consignments of zinc ore, the production of which had been unduly stimulated by the high spelter prices, so that the accumulation of ore stocks in the hands of smelters were far beyond normal proportions. In the meantime, consumers were disposed to work up their stocks, and a situation was thus created by the cumulative causes above outlined which made the position of the market untenable and explains, in a great measure, the perpendicular decline which started with the beginning of 1913.

MONTHLY AVERAGE PRICE OF SPELTER

Month	New York			St. Louis			London		
	1911	1912	1913	1911	1912	1913	1911	1912	1913
Jan.	5.452	6.442	6.931	5.302	6.292	6.854	23.887	26.642	26.114
Feb.	5.518	6.499	6.239	5.368	6.349	6.089	23.276	26.661	25.338
Mar.	5.563	6.626	6.078	5.413	6.476	5.926	23.016	26.048	24.605
Apr.	5.399	6.633	5.641	5.249	6.483	5.491	23.743	25.644	25.313
May	5.348	6.679	5.406	5.198	6.529	5.256	24.375	25.790	24.583
June	5.520	6.877	5.124	5.370	6.727	4.974	24.612	25.763	22.143
July	5.695	7.116	5.278	5.545	6.966	5.128	25.056	26.174	20.592
Aug.	5.953	7.028	5.658	5.803	6.878	5.508	26.801	26.443	20.706
Sept.	5.869	7.454	5.694	5.719	7.313	5.544	27.790	27.048	21.148
Oct.	6.102	7.426	5.340	5.951	7.276	5.188	27.256	27.543	20.614
Nov.	6.380	7.371	5.229	6.223	7.221	5.083	26.975	26.804	20.581
Dec.	6.301	7.162	5.154	6.151	7.081	5.004	26.849	26.494	21.214

Year.. 5.758 6.943 5.648 5.608 6.799 5.504 25.281 26.421 22.746  
New York and St. Louis, cents per pound. London, pounds sterling per long ton.

The market then stood at 7.05@7.10c., St. Louis, and the downward course was practically uninterrupted until the low point of 4.85@4.95c., St. Louis, had been reached about the middle of June. The recession was accelerated by the disorganization of the business of the galvanizers during the memorable floods which inundated the manufacturing centers in the Middle West States during the spring months.

A further impetus was given the decline by reason of the sudden drop in the London spelter quotations at a time when a reduction in the duty on the metal was under discussion. The previous rates of 1c. per lb. on spelter in ore and  $1\frac{3}{8}$ c. per lb. on the metal were cut down in the House bill to 10% *ad valorem* on both. The Senate subsequently raised the rate on spelter to 15%. This was the first favorable news the market had received in many months and was promptly reflected in speculative buying. These purchases, combined with the short-lived revival in business during the late summer, carried prices up to  $5.60@5.70$ c., St. Louis, where they stood at the middle of September. The advance, however, could not be held.

The foreign market had declined close to £20, and with the passage of the Underwood Tariff Bill early in October, the smelters were put to the necessity of reducing prices sharply in order to prevent the importation of foreign spelter. The contraction in the business of all spelter-consuming industries which began to make itself felt at that time contributed toward increasing the selling pressure, which brought about a decline to a fraction below 5c., at which level the market rested during the greater part of December.

Even though large stocks of spelter have gradually accumulated at the smelting works, which, in size, were not equaled even in the closing days of the panic year of 1907, there is great reluctance to part with the metal at present prices. Ore supplies have fallen off sharply, because the long drawn out decline has caused miners in most producing sections to suspend or curtail operations, as a great many properties are not favored with ores of a sufficiently high grade to make mining profitable when spelter prices rule around 5c., St. Louis. Moreover, the margin between ore and spelter in many instances leaves no profit and frequently an actual loss to the smelters whose operating costs have steadily advanced during the past year. The spelter on hand has cost the smelters a great deal more to produce than can at the present time be realized for it. It is, therefore, not surprising that it should be withheld from the market in the hope that the time is not far distant when an improvement in the consumption of spelter will help the smelting industry out of its present dilemma.

As 1913 drew to a close, a more hopeful view was taken of the general situation, and speculators began to discount the better times which they believed to be ahead of us. Under the stimulus of a modern speculation, prices advanced somewhat, and the market was quoted at  $5.10@5.15$ , St. Louis, at the end of 1913.

## The London Spelter Market in 1913

### LONDON CORRESPONDENCE

*January*—The market opened at  $£26@26\frac{1}{4}$  per ton for ordinary brands, and so remained to the 27th, consuming industries being well employed but with requirements sufficiently covered. Some speculative sales for delivery several months ahead tended to depress values by a few shillings toward the close, and final figures were  $£25\frac{3}{4}@26$ .

*February*—The drooping tendency continued until, on the 11th, the Producers' Syndicate reduced its price to  $£25\frac{3}{8}$ , so as to conform to current values; and thereupon consumers bought largely after their recent long absten-

tion, but without covering their requirements far ahead. Thereafter the market remained dull and easily governed by casual sellers, the closing quotation being £25.

*March*—There was no alteration in the market until the 7th, when the prolonged stagnation of business induced a relapse to  $£24\frac{1}{2}$ , which quotation remained in force for the rest of the month. Consumption was active, but requirements were mostly covered, and consumers had no inducements to buy for extended delivery.

*April* was uneventful until the 8th, when the quotation was depressed to  $£24\frac{1}{4}$  on the report of large purchases from America for the London market. This, however, did not relieve the scarcity of metal for early delivery, nor did it induce the associated producers to reduce their prices as had been long and confidently expected. Prospective buyers remained passive until the 15th, when they were forced to enter the market and pay syndicate prices. The London quotation advanced in consequence to  $£25\frac{1}{4}$  for early delivery, and  $£25\frac{1}{2}$  was paid a week later; but the volume of business was relatively small. Closing prices ranged from  $£24\frac{3}{4}$  to  $£25\frac{1}{2}$ , according to time of delivery.

*May*—Values remained unaltered for about 10 days; but business in all commodities was restricted by financial stringency and disturbed international politics, and spelter soon felt the prevailing depression. Consumers bought nothing beyond their small immediate requirements until, on the 26th, the Producers' Syndicate made a drastic cut to £23 per ton in London. On this basis consumers bought freely, and large quantities changed hands, the market closing steady thereat.

*June* opened with the metal quoted at a fractional reduction, but with little actual business, demand having been mostly satisfied. Moreover the metal markets in general were depressed by the persistent weakness of the Stock Exchange and consequent curtailment of speculative enterprise. Toward the middle of the month dealers made bold to underquote widely the prices quoted by the Producers' Convention. The latter, it was thought, would be obliged sooner or later to bring their prices more into harmony with market quotations; and buyers were content to await the event. Thus prices declined throughout the month, and with meager business. The highest quotations for ordinary brands were, at the outset  $£22\frac{3}{4}$  to £23; and the lowest were, at the close,  $£20\frac{1}{2}$  to £21.

*July*—The market was fairly steady throughout, trade demand being satisfactory and fluctuations unimportant. The opening price was about  $£20\frac{5}{8}$ ; the highest was  $£20\frac{3}{4}$ , followed by a relapse at the close to  $£20\frac{1}{2}$ .

*August* opened at a fractional advance, but fluctuations were unimportant for the first fortnight or so, when speculation intervened in sympathy with other metals, and up to  $£21\frac{1}{2}$  was paid for forward delivery; but this movement was promptly checked by liberal offerings of the metal in first hands, and the price relapsed to  $£20\frac{1}{2}$ . Thereafter consumers bought considerable quantities and, with a revival of speculative demand, the price rose gradually and close at the highest,  $£21\frac{1}{8}$ .

*September*—The market opened at an advance to  $£21\frac{1}{2}$  with fair demand chiefly for early delivery, but otherwise remained uneventful until the 18th, when values were depressed by heavy arrivals of the metal. Thereafter transactions on the London market were on a small scale, though reports from consuming districts were distinctly good. The closing official price was  $£20\frac{3}{4}@21$ .



October saw no improvement in price and the general feeling among consumers was apathetic. The Convention meeting renewed prices, but buyers appeared uninterested and drew their supplies chiefly from second hands. On the Continent the syndicate modified its prices which helped it to market a fair quantity of metal.

November opened with rather more demand from consumers, steel rollers and galvanizers buying rather freely, but prices showed practically no variation.

December was looked forward to with interest as rumors had been rife that there might be hitches among the members of the Convention, but when it was seen that its continuance was assured, more confidence was shown by buyers, and the market hardened.

### Platinum

The platinum market during 1913 was inclined toward lower prices, owing largely to a less demand by the electric and jewelry trades. It is said that the manufacturing jewelers find the metal too expensive for general use in jewelry and rumors within the past few months intimate that the electrical manufacturers have found a substitute which answers their purpose very well. Experiments in the latter direction have been progressing for some years and they seem to have been crowned with more or less success. The automobile industry is still using platinum and iridio-platinum sparking points, which creates a demand that a few years ago was not in evidence. This is a considerable consumption. Every magneto has a pair of platinum points, or buttons, which completely wear away in two to four years of use.

AVERAGE PRICES OF PLATINUM  
In Dollars per Ounce Troy

	New York Refined Platinum	Russia, Crude Metal 83% Platinum St. Peters- burg	Ekaterin- burg
January.....	45.50	36.93	36.45
February.....	45.50	36.95	36.46
March.....	45.50	36.95	36.47
April.....	45.50	36.98	36.47
May.....	45.50	37.01	36.50
June.....	45.50	37.01	36.66
July.....	45.50	36.97	36.66
August.....	44.90	36.50	36.30
September.....	43.96	35.72	35.67
October.....	44.00	35.72	35.67
November.....	43.70	35.72	35.74
December.....	43.45	36.02	35.90
Year.....	\$44.88	\$36.54	\$36.25
Average for 1912.....	45.55	37.08	37.05
Average for 1911.....	43.12	35.21	35.09
Average for 1910.....	32.70	26.96	26.37

So far as the dental trade is concerned, the introduction of base-metal-piu teeth a few years ago has had a marked tendency to cut the demand materially, and the present high cost of the metal has caused much activity in the experimental line, but with not very marked success. Some coated wire is being used, and if it proves successful, will greatly reduce the use of platinum in the dental trade.

At the beginning of 1913 quotations for the metal in good-sized lots were \$44.25@45 per oz., New York. About June 1 there was a decline of about \$1 per oz, which has ruled since. This refers to the conditions of the big trade, in which purchases of 500- to 1000-oz. lots are common and 100 oz. is only an ordinary transaction. In the retail trade, 5-oz. lots, etc., there are more fluctuations in price.

For lots of ordinary size—100 oz. or under—the ruling price for three-quarters of the year was \$45@46 per oz. Late in the year prices declined \$1 or more and about

\$43.50 was the ruling quotation. Scrap seems now to be weaker than new metal, and a number of choice lots have been, and are still offered at \$41@42 per oz. This is mostly from the chemical manufacturing establishments, particularly the producers of acids, and consists of old stills and apparatus of various sorts.

Palladium is ruling about the same as platinum, although it should not do so, being of less value. On account of the light demand, some lots have sold as low as \$40, but the prevailing quotations are closed to platinum rates.

Iridium is firm at \$74@75 per oz. in lots of 100 oz., with a decided tendency to decline on account of little demand, it being used only in small quantities as an alloy. For several months the supply was short and for a time prices went up to \$81 and even \$85 per oz. This caused an advance in hard metal—platinum-iridium alloy—from \$3 to \$6 per oz. over the price of refined platinum being charged.

The supply of platinum continued to come chiefly from Russia. The exports from Colombia, as usual, were irregular and the trade relied upon the Urals for its chief supply. A few hundred ounces are obtained in the United States from gold refined and parted by the Mint, chiefly from northern California. The Balbach Smelting & Refining Co. saves some platinum from complex ores treated. The Anglo-Colombian Co. is reported to have discovered a large deposit of platinum-bearing gravel, which is to be worked by dredges.

Imports of platinum into the United States for the 10 months ended Oct. 31 were: Unmanufactured, 41,669 oz.; bars, plates and other manufactured forms, 59,021; total, 100,690 oz., which is an increase of 16,334 oz. over the previous year.

A reported discovery of platinum-bearing placers in Germany may be of some importance to users and dealers in that metal. An account is given of this discovery in a recent consular report, from which it seems that the find was accidental, in drilling conducted for other purposes. The supposed platinum deposits are near Wenden in Westphalia, and the metal was found in analyzing the borings.

### Copper in Katanga

At stockholders' meeting of the Union Minière, du Haut Katanga, at Brussels, Dec. 1, 1913, the president of the company gave the accompanying figures:

	1911	1912	(11 months) 1913
Days at work—first furnace.....	88	171	298
Days at work—second furnace.....	..	..	90
Tons, metric, of ore treated.....	10,300	20,900	48,500
Average metal content.....	12-13%	13-15%	15-16%
Average daily production..	11.3	14	33.4*
Output of blister copper, tons.....	986	2,404	6,420
Percentage of copper.....	90%	95%	96%
Output of matte, tons.....	..	..	130

\*Two furnaces.  
During 1913 Wankie coke was used, 3.40 tons being used per ton of copper produced. Subsequently using coke made from washed coal, consumption was reduced to 2.90 tons per ton of copper. No. 2 furnace was blown in on July 4, and ran to Nov. 13. No. 1 furnace, which had been blown out because of shortage of coke, was to be started again in December.

The Imports of Tin Ore into the United Kingdom from Nigeria in the first 11 months of 1913 amounted to 3507 long tons, compared with 2246 tons in the corresponding period of 1912.

# The Joplin District in 1913

BY JESSE A. ZOOK

In the production of galena, 1913 heads the list of all productive years in the Joplin district. In the production of blende it is behind 1912, but ahead of all preceding years. In calamine production it is ahead of 1912 and 1911, but is less than 1910, the greatest calamine year of the district. In the total value of all ores 1913 is exceeded only by 1912, a year of exceptional strength in ore prices and market steadiness. With many market uncertainties and lowering prices 1913 has yet made a record of credit.

## CHANGES IN PRODUCING AREAS

Numerous changes were made in mine location during 1913; the poorer of the sheet-ground mines were deserted for areas where ore can be produced at a less milling expense. This gave an impetus to the Thoms Station group near Joplin, the only point of increased blende production in Jasper County. Duenweg increased its calamine production over 100%, while other localities decreased. Newton County has a decrease of blende at all points, with an increase of calamine at Granby alone. Greene County dropped almost out of the race in both blende and calamine. Lawrence County was short on

### JOPLIN DISTRICT ORE SHIPMENTS, IN POUNDS

Missouri	Blende	Calamine	Lead	Values
Jasper County.....	408,645,030	3,673,460	63,439,800	\$10,952,815
Newton County.....	21,938,510	31,095,380	5,028,060	966,881
Greene County.....	696,650	63,400	18,370	18,370
Lawrence County.....	679,550	4,823,310	272,030	85,930
Total.....	431,959,740	39,655,550	68,739,890	\$12,023,960
Oklahoma				
Ottawa County.....	42,929,330		13,560,870	1,138,259
Kansas				
Cherokee County.....	37,756,020	151,020	5,750,660	1,002,370
Total eleven months.....	512,645,090	39,806,570	88,051,420	\$14,164,625
Estimate of December....	40,550,000	3,101,000	6,500,000	1,000,000
Total 1913.....	553,195,090	42,907,570	94,551,420	\$15,164,625
Total 1912.....	575,483,170	36,679,430	93,589,040	18,703,015
Increase from 1912.....		6,228,140	962,380	
Decrease from 1912.....	22,288,080			\$3,558,390

blende, but Aurora made an 100% increase in calamine. Cherokee County, Kansas, held up with last year's production in blende, calamine and galena. But the crowning gain in production is Oklahoma, the Miami output having increased over 200% in both blende and galena, all the old mines and many new ones contributing toward this remarkable record. Miami has come to be known as the area where ore can be produced at the lowest cost per ton of concentrates. Without the enormous increase of Ottawa County, Oklahoma, the district's galena production would be short and it would have made a poor showing in blende.

## THE YEAR'S PRICE RANGE

The year opened with high prices for all ores of this district, as it closed in 1912, but the decline of spelter from 7½c. in the beginning to 5.50c. in March brought blende from a \$56 base per ton of 60% zinc, and calamine from a base of \$32 per ton of 40% zinc, during the first week of the year, to a \$40 base for blende and a \$23 base for calamine at the end of March. Prices of blende ranged \$40 to \$45 base until September, when it reached a \$48 base one week, declining to \$40 in October, to \$38.50 in November, but advancing to \$40 again in December. Calamine made little change after April, ranging from \$20 to \$23 base the balance of the year.

Lead ore began the year at \$54, advancing to \$55.50 in March and April, then down to \$53.50 in June, up to \$54.50 in July, \$58 in August and September, reaching the climax at \$59.50 in October, from which it dropped to \$56 in November and \$52 at the year-end.

## THE EFFECT OF LOW PRICES

On Dec. 9 a number of producers held a called meeting to talk over the situation. A few were producing at a loss, others breaking even, and others yet making a profit. Unlike meetings of a few years ago there was no bombast and no talk of forcing the smelter to pay higher prices. Conditions are vastly different, and this is realized. The meeting was to discuss the subject from a business point of view, and also from a charitable point of view. The question of quitting and leaving the miners without employment in the midst of winter, with nothing to look forward to, was discussed quite as much as the losses sustained. It was found necessary to make a cut in wages and it was partially agreed that rather than cease operations entirely they would be continued on a limited

### ORE PRICES IN JOPLIN DISTRICT

Year	(13 Years)		Lead Ore	
	High	Aver.	High	Aver.
1901.....	\$34.00	\$24.21	\$47.50	\$45.99
1902.....	42.00	30.33	50.00	46.10
1903.....	42.00	33.72	60.50	54.12
1904.....	53.00	35.92	62.00	54.80
1905.....	60.00	44.88	80.00	62.12
1906.....	54.00	43.30	87.00	77.78
1907.....	53.50	43.68	88.50	68.90
1908.....	47.00	34.36	66.00	54.66
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	52.15	68.00	56.60
1913.....	53.16	42.62	57.78	52.82

scale, provided the miners were willing to accept a reduction in wage scale that would make it possible to produce ore without a serious loss, holding on and hoping for an early improvement of conditions.

## THE METAL BASE

The plan of contracting blende on any schedule has met with so little favor that it is no longer a feature of serious consideration. Last year's procedure of buying ore on contract and reselling for a margin of profit on the open market brought this plan into disrepute.

During the summer there was introduced a method of buying blende, carrying over 6% of iron, on what is termed a "metal base." In substance there is no penalty on the iron content, differing from the "assay base" which recognizes a reduction of \$1 per ton of concentrates for each 1% of iron in excess of 1%. Observing the metal base places settlements on the exact zinc content indicated by assayed samples. The assay base permits a deduction for the iron content and lowers the price of the zinc content for each unit of iron content.

## ZINC PRODUCTION AND TARIFF

In the manufacture of political capital it is asserted that the existing metal and ore market is the direct result of tariff legislation, no explanation being offered for the preceding European weakness. The Joplin ore market has maintained a plane of prices relatively high, so high that smelters selling spelter have lost money on



numerous purchases of ore. There has been no time since the tariff law became effective when it had any bearing on the situation in this district, for the simple reason that Mexican importations have been severely restricted by revolution. Further, there was never a time under the preceding tariff when this district received a permanent benefit, because what restriction was placed on the importation of Mexican ore was more than offset by increased production in the Rocky Mountain region—now producing comparatively a low tonnage. Honesty would place all discrepancies in their proper sphere—demand and supply—but not so with politicians.

### Monthly Lead and Ore Prices

The accompanying table gives the average prices of lead and zinc ore as determined from actual transactions

AVERAGE MONTHLY ORE PRICES

	Zinc Ore				Lead Ore					
	Joplin base 1912	Joplin all ores 1913	Platteville 1912	Platteville 1913	Joplin 1912	Joplin 1913	Platteville 1912	Platteville 1913		
	\$	\$	\$	\$	\$	\$	\$	\$		
Jan.....	44.90	53.30	43.54	52.22	45.30	53.10	58.92	52.55	56.50	51.00
Feb.....	45.75	46.88	43.31	44.34	46.44	46.63	52.39	52.66	48.50	52.38
Mar.....	51.56	46.50	49.25	44.62	51.63	46.38	54.64	53.22	50.63	52.50
Apr.....	52.00	42.50	50.36	40.92	52.56	42.20	54.18	52.71	53.13	52.70
May.....	55.30	43.69	53.27	41.76	54.25	42.25	52.45	51.84	52.72	52.63
June.....	55.88	41.75	54.38	40.30	55.75	42.19	55.01	52.22	53.63	52.50
July.....	58.85	43.55	56.59	40.88	57.74	43.35	58.83	52.39	58.10	52.50
Aug.....	55.13	47.06	53.27	44.54	55.63	46.13	57.04	55.79	57.43	55.25
Sept.....	59.75	46.13	57.07	44.30	59.13	46.75	61.28	56.59	63.00	58.00
Oct.....	57.00	42.10	55.97	40.07	56.80	42.20	63.22	52.94	63.75	54.60
Nov.....	55.69	41.81	53.98	39.99	55.19	41.50	56.55	51.49	56.00	52.75
Dec.....	54.63	39.19	52.39	37.50	56.00	38.50	52.42	49.46	51.00	48.00
Year.....	53.87	44.54	51.95	42.62	53.87	44.26	56.41	52.82	55.37	52.90

Joplin base and Platteville zinc prices are on standard ores, 60% zinc. See-ond Joplin price is average for all zinc ores sold.

in the field, and reported by the JOURNAL'S correspondents.

### Zinc Mining in Wisconsin in 1913

BY J. E. KENNEDY\*

The net tonnage of zinc ore shipped to smelteries from the Wisconsin district in the first 11 months of 1913 was 136,355,310 lb., a decrease of 48,026,880 lb. from the figures given for the corresponding period of last year. The gross tonnage of zinc ore produced and shipped by mining companies to smelteries and to custom roasters was 192,354,230 lb., a decrease of 31,261,080 lb. The tonnage of lead ore shipped was 5,123,080 lb., a decrease of 2,368,080 lb., while the shipment of sulphur ore, 53,034,910 lb. showed an increase of 17,200,460 pounds.

#### ORE PRICES

The first three months of the year saw the highest level of prices. The base price of 60% zinc started 1913 at \$56 per ton, but a decline soon began until it reached the low mark of \$40 during April and May. In the third quarter the market improved and \$49 base was paid. During the last quarter the base price again declined and went below \$40 in December. The highest base price of the year was \$56, the best premium price being \$57.50; the average base price for the first 11 months was \$45 per ton.

#### FIELD ACTIVITY

Considerable prospect and development work was carried on by the larger operating companies, particularly at

\*Platteville, Wis.

Benton, New Diggings, and Hazel Green. At Highland the Mineral Point Zinc Co. increased its holdings by the purchase of the lands and mining rights of the Richard Kennedy Estate, comprising 550 acres of mineral lands, also the Kreuhl and Minter farms, and the mining rights of the Franklin Mining Co. Extensive improvements in machinery and equipment since made will increase the tonnage of zinc carbonate from these properties, which were idle a year pending settlement and transfer. The big Black Jack Mine, four miles south of Galena, including the fee to 160 acres was also bought by the Mineral Point Zinc Co. Valuable new discoveries were made on the Champion land at New Diggings, also on the Martin, Cottingham and Grotkin farms at Benton, the Brown land at Galena, the Stephens land at Platteville, the Ross land at Crow Branch and the Biddick land at Mifflin. A

#### WISCONSIN ZINC-LEAD PRODUCTION

(First 11 Months)

	Gross from Mines		Net to Smelteries	
	1912 lb.	1913 lb.	1912 lb.	1913 lb.
Highland.....	7,755,500	2,613,020	7,570,900	2,613,020
Linden.....	14,262,130	17,207,210	2,075,000	4,701,520
Harker.....	12,045,490	5,807,170	7,892,540	2,565,230
Mineral Point.....	1,214,530	2,223,650	36,609,700	31,268,750
Dodgeville.....	1,390,930	407,100	1,390,930	227,100
Montfort.....	2,104,160	2,301,980	1,299,160	1,272,000
Livingston.....	17,414,850	22,730,460	665,000	.....
Rewey.....	2,357,000	1,445,740	2,166,000	1,374,740
Platteville.....	27,722,130	23,319,110	23,897,790	23,075,270
Cuba City.....	6,561,150	6,331,830	9,358,100	12,762,280
Benton.....	44,255,870	41,451,090	29,921,120	24,538,590
Hazel Green.....	32,488,900	29,186,440	16,266,500	14,202,000
Shallsburg.....	24,030,800	17,025,810	21,346,900	14,086,410
Galena.....	30,011,870	20,059,820	23,922,550	3,424,400
Potosi.....	.....	244,000	.....	244,000
Totals.....	223,615,310	192,354,230	184,382,190	136,355,310

total of 65 mills were in operation at various times during the year. Five new properties were equipped with concentrators, viz., the Masbruch, at Cuba City, the Martin and Grotkin at Benton, the Lawrence at Hazel Green and the Great Western at Galena.

### Zinc and Lead in Oklahoma During 1913

BY R. R. HEAP\*

The developments in zinc and lead mining in Oklahoma during 1913 were confined to Ottawa County in the north-east corner of the state, and within this area the only large development was in the Miami camp, where the activity was so great as to place it as one of the foremost lead- and zinc-producing areas in the entire Missouri-Kansas-Oklahoma field. The production of the district will give it second place in lead and third place in lead and zinc combined; a jump from sixth to third place in one year.

All other operations in Ottawa County are in the two older camps, Quapaw-Lincolnvillle and Peoria, where little

#### PRODUCTION OF MIAMI CAMP, OKLAHOMA

		Lb.	Value
Zinc	Jan. 1—Dec. 1.....	42,520,980	\$678,710.40
Zinc	Dec. 1—Dec. 31..... (Est.)	4,252,100	67,870.00
	1913—Total zinc.....	46,773,080	746,580.40
Lead	Jan. 1—Dec. 1.....	13,462,980	348,876.31
Lead	Dec. 1—Dec. 31..... (Est.)	1,346,290	34,887.63
	1913—Total lead.....	14,809,270	383,763.94
	Total concentrates 1913.....	61,582,350	\$1,130,344.34

activity was displayed. The operations in the Quapaw-Lincolnvillle comprised a total of six mills and one hand-jig plant of which only two mills and the hand-jig plant

\*Superintendent, Lennan Zinc & Lead Co., Miami, Okla.

have remained active. There have been no new developments or explorations. Mining in Peoria camp was confined almost entirely to the silicates and carbonates of zinc on a small scale. No new developments of any importance have been reported. No activity has been reported from the Arbuckle Mountains region in the south central part of the state.

The production of zinc and lead concentrates and their values for the three camps for 1913, from available figures and estimates will be as follows:

PRODUCTION, QUAPAW-LINCOLNVILLE			
		Lb.	Value
Zinc	Jan. 1—Sept. 1.....	994,180	\$21,870.00
Zinc	Sept. 1—Dec. 31.....(Est.)	330,000	6,600.00
	1913—Total zinc.....	1,324,180	28,470.00
Lead	Jan. 1—Sept. 1.....	121,290	3,153.54
Lead	Sept. 1—Dec. 31.....(Est.)	30,000	780.00
	1913—Total lead.....	151,290	3,933.54
	Total concentrates 1913.....	1,475,470	\$32,403.54

#### PEORIA

Total concentrates Zn and Pb (Est.) 400,000 lb., value \$7500.

In January, 1913, there were in active operation in Miami 11 mines with mills and two tailing mills; in December, 1913, 20 mines with mills and the two same tailing mills, with also two additional mills under construction. There are, besides the active mining properties, 18 properties under development, of which number nine are developed sufficiently to warrant the subsequent erections of concentrating plants. Thirty-one prospect churn-drill rigs are at active work at the close of the year, and of these 10 have entered the field within the past four months.

Of most importance as shown by the development and exploration work done this year is the proven trend of the ore runs for a long distance toward the northeast and the southwest, the greater stride in development having been toward the northeast, where one mill is now operating on a very promising run of ore, in the Grand Falls Chert,  $3\frac{1}{2}$  miles northeast of the nearest operation.

The area covered by the mineralized belt as now proven by actual mining and exploration operations covers 22 square miles, with a length in a general northeasterly and southwesterly direction of over 11 miles.

Unusual interest has been displayed in the advent of the Picher Lead Co., the largest lead-smelting concern of its kind, into the Miami district. Negotiations were closed this fall by which it assumed control of over 2000 acres of land along the trend of the northeast extension and started its exploration work with five drill rigs.

The largest mineral acreage is controlled by the Commerce Mining & Royalty Co., formerly the Miami Royalty Co., which is adopting more and more the policy of operating rather than of leasing at an increased royalty.

The extension toward the southwest has been proven for over three miles along a general southwesterly course but the development has not been so thorough as that of the northeast extension.

The most important feature in mining operations has been the sinking by Lennan Zinc & Lead Co. of its south shaft through the lower Boone Chert ore run to the 317-ft. level, making it the deepest operating shaft in the entire district. A large pump seat has been cut at the 306-ft. level in which a duplicate condensing pumping plant has been installed of 2000 gal. capacity per minute. The importance of this shaft to the district is the assured drainage of the present operating mines to their lowest known occurrence of ore in the Boone Chert.

## Butte @ Superior

According to the *Boston News Bureau*, Butte & Superior production in 1913 was approximately 103,000 tons of concentrates, the total up to Dec. 1 being 92,000 tons. The property did not get into full swing until July, so that next year's production will probably be larger. Since August the mill has secured an average extraction of about 90%, concentrates running about 50% Zn. The monthly production of metal (in concentrates) is given in the accompanying table.

	Silver, Oz.	Gold, Oz.	Lead, Lb.	Zinc, Lb.
January.....	118,344	269	301,061	5,380,907
February.....	129,383	266	271,788	4,944,997
March.....	183,994	351	417,656	6,693,737
April.....	132,610	276	304,517	5,415,084
May.....	214,743	426	420,488	7,993,986
June.....	186,714	389	408,670	6,946,981
July.....	239,659	490	488,901	8,989,704
August.....	285,642	591	672,607	11,299,053
September.....	286,996	561	612,161	11,601,697
October.....	272,737	582	755,326	11,896,365
November.....	252,058	567	708,121	11,205,649
December*.....	263,745	592	730,341	11,944,200
Totals.....	2,548,486	5360	6,091,637	104,312,360

\*Estimated.

## Bismuth in 1913

Bismuth was produced in the United States in 1913 by the United States Smelting, Refining & Mining Co., at Grasselli, Ind., and by the American Smelting & Refining Co., at Omaha, Neb. Each of these companies obtains it as a byproduct from the refining of lead bullion. Market conditions now decree that corroding lead must be practically free from bismuth, wherefore the refiners are compelled to separate that element, anyway; at least for the manufacture of the highest grade of corroding lead.

At Grasselli, Ind., all of the base lead is refined by the electrolytic process, the bismuth accumulating in the anode slime, from which it is subsequently separated. At Omaha, Neb., a modern development of the old steam-pattinson process has been made. The bismuth content of the base lead is finally concentrated in a small portion of the lead, which is then passed on to electrolytic refining. At Grasselli all of the lead is refined electrolytically; at Omaha, only a part of it. So far as can be learned, the extraction of bismuth from copper slimes is not yet a commercial affair.

The price of bismuth continues to be established by the European convention. During 1913 it remained uniformly at 7s. 6d., at London, and at about the equivalent thereof in the United States.

The chief source of bismuth supply is Bolivia. According to a British consular report, the production of crude bismuth in that country in 1909 was 139 metric tons; in 1910, 134; in 1911, 242; and in 1912, 263.

## Cadmium

Cadmium was produced in the United States in 1913 by the Grasselli Chemical Co., at Cleveland, Ohio, and by the American Smelting & Refining Co., at its Globe plant, Denver, Colo. The total production was about 25,000 lb. In both cases it is a byproduct. The Grasselli Chemical Co. recovers it from its cadmium-bearing blue powder and from its first draw of spelter; the American Smelting & Refining Co. gets it from a certain part of its baghouse fume.



# The Tin Industry in 1913

There is no record of any primary tin production in the United States in 1913. There is a secondary production of tin recovered from scrap, old cans and tin-plates, etc., which amounts to about 5000 tons. This is largely used in making tin salts and for chemical purposes.

Figures for the tin production of the world are necessarily based upon the market reports of shipments and receipts. The chief part of the production is recorded in what are generally known in the trade as "The Statistics," which cover from 70 to 75% of the total, and which are closely kept, both as to shipments and deliveries. The considerable production outside of statistics is generally accepted as going directly into consumption. In the accompanying table the production and deliveries are given for the 12 months ended Nov. 30, 1913, in long tons:

## PRODUCTION AND DELIVERIES OF TIN IN 1913 (In long tons)

Exports from the Straits and Malay Peninsula.....	62,242
Exports from Australia.....	3,253
Banka and Billiton sales.....	17,142
Chinese exports and production*.....	8,200
Bolivian exports*.....	22,719
South African production*.....	1,900
Cornwall production*.....	4,900
<b>Total.....</b>	<b>120,356</b>
United States, imports and consumption.....	45,900
Great Britain, imports and consumption.....	28,736
Holland, imports.....	16,573
Other European Countries, imports.....	21,250
Australian consumption.....	1,000
China and India consumption.....	6,500
<b>Total.....</b>	<b>119,959</b>

\*Not in "Statistics."

The total production as reported and estimated in the table exceeded that for 1912 by 6160 tons. The deliveries also increased, but in slightly less ratio, the increase last year being 2528 tons. In other words, in 1912, deliveries exceeded production by 3235 tons, while in 1913, there was a small margin the other way, though the excess of production as shown was only 377 tons. The comparatively limited output and the very small margin of production over consumption, explains the ease with which the floating supplies of tin can be cornered and the reason why tin is a favorite metal for speculation in the markets.

## STRAITS SHIPMENTS OF TIN (In Tons of 2240 Lb. as Reported by Edward Boustead & Co.)

	1909 Tons	1910 Tons	1911 Tons	1912 Tons	1913 Tons
January.....	5,732	5,872	4,315	3,997	5,949
February.....	4,133	4,174	4,290	5,256	4,666
March.....	3,380	2,858	4,491	5,142	4,814
April.....	4,904	4,025	3,115	4,235	4,301
May.....	5,185	4,977	4,311	5,753	6,176
June.....	4,618	4,117	5,057	4,302	4,824
July.....	5,644	5,047	4,553	4,381	4,793
August.....	4,727	5,705	4,675	5,366	6,011
September.....	5,081	4,218	5,163	5,475	5,152
October.....	3,801	4,476	4,371	4,422	5,015
November.....	5,497	4,856	4,841	5,642	5,662
December.....	5,838	4,296	5,994	4,996	5,400(a)
*Sundries.....	2,032	1,494	1,873	2,790	2,000(a)
<b>Totals.....</b>	<b>60,592</b>	<b>56,115</b>	<b>57,049</b>	<b>61,757</b>	<b>64,763</b>

\* To India and China. (a) Estimated.

The visible stocks of tin on Dec. 31, are reported as follows, including tin afloat: London, 8464; Holland, 1115; United States, excluding Pacific ports, 4314; total, 13,893 long tons, this total comparing with 10,977 tons at the close of 1912, and 16,514 tons at the close of 1911. The past year, therefore, shows an increase in visible stocks of 2916 tons. From the nature of the buying throughout the year, and from the known consumption in manufacturing, it is not believed that there was in

either year any considerable quantity of invisible stocks, that is in tin, held by consumers for their own use.

The Straits Settlements, which include the Malay Peninsula, showed a good increase in production and exports during the year, which was a favorable one for mining, being free from droughts, floods and other causes tending to limit production. Mining was also stimulated by the high prices which prevailed in the first part of the year.

## MALAYA'S TIN OUTPUT As Reported by the London Mining Journal

	1909 Pikuls	1910 Pikuls	1911 Pikuls	1912 Pikuls	1913 Pikuls
January.....	73,612	66,277	64,333	67,566	69,232
February.....	46,352	64,199	53,147	72,545	64,219
March.....	61,100	46,850	50,132	53,098	59,842
April.....	65,126	60,020	54,568	67,270	68,305
May.....	63,131	61,935	62,868	71,849	72,563
June.....	75,890	62,180	64,202	59,465	67,078
July.....	68,627	65,350	63,799	71,175	71,313
August.....	73,560	70,639	68,592	74,831	77,613
September.....	68,827	56,324	62,862	69,133	73,574
October.....	68,316	60,444	68,764	65,605	67,552(b)
November.....	73,190	61,771	66,334	69,087	60,783(b)
December.....	81,156	60,909	62,091	71,248	65,000(c)
<b>Totals.....</b>	<b>818,887(a)</b>	<b>736,898(a)</b>	<b>741,698(a)</b>	<b>813,472(a)</b>	<b>817,079</b>

Note.—These figures show the monthly exports of tin and tin ore (the latter being stated at its assumed metal content upon which duty is paid to the F.M.S. Government. (a) Finally revised figures. (b) Exclusive of Pahang, etc. (c) Estimated. 1 ton (2240 lb.) = 16.8 pikuls.

The real consumption of tin is confined to certain well known uses in which no substitute has been found for the metal, though many attempts have been made with generally limited success. In these uses there is not a great variation from year to year, beyond the normal increase in demand and production of manufactured goods. This increase may be put at about 5% in ordinary years, but not so much gain in production is to be expected unless some new sources of the metal are to be found.

It is not clear at the present time where any new supplies of importance are to come from. The expected production from Alaska has not yet materialized. The Transvaal tin mines and those in Nigeria have been rather disappointing in results. It is believed that some expansion in China is possible, but under the methods of administration in that country, it will take some time. Australian tin production remains about the same, although considerable work has been done in exploiting new deposits, but this has not done more than to make up for the exhaustion of older ones.

## The Tin Market in 1913

As the market for this metal is entirely dominated by the activities of speculators, the law of supply and demand is of secondary importance only, in the development of prices, and the market either advances when the bulls hold the whip-hand or declines when the bears are in power. The new contract for standard tin introduced in 1912 on the London Metal Exchange, which does not confine the seller to one brand, and thereby makes squeezes of the shorts more difficult, has to a large extent done away with the violent fluctuations in quotations that were previously witnessed on the London Metal Exchange.

Prices for the greater part of 1913 were on a high level, and only when it became apparent during the latter part of the year that consumption was not keeping up at the extraordinarily large rate of 1912 did the bulls in the European market become disturbed and ready to unload some of their burden at the expense of prices.

The year 1913 opened with prices at the high-water mark, almost 51c. being paid for spot and nearby material. It remained at this level up to the beginning of February, the unstableness of the market, however, being evidenced by a considerable discount for future tin. The market declined at the beginning of February to about 48¾c., which, in comparison to former figures, was considered as low and attracted buyers, so that a good-sized business was placed in London from this side, with the result that prices advanced again about 1c. per pound.

The bears on the London Metal Exchange became active the latter part of February, attacking the market by selling considerable quantities of future tin and thereby creating a backwardation for this position of about £7 against spot, while this market varied from 48 to 48½c.

The market developed further weakness in both spot and future positions during March, when the precarious

Month	New York			London		
	1911	1912	1913	1911	1912	1913
January	41.255	42.529	50.298	186.896	191.510	238.273
February	41.614	42.962	48.766	189.642	195.036	220.140
March	40.157	42.577	46.832	182.617	192.619	213.615
April	42.185	43.923	49.115	193.042	200.513	224.159
May	43.115	46.053	49.038	197.767	208.830	224.143
June	44.605	45.815	44.820	207.388	205.863	207.208
July	42.406	44.519	40.260	193.100	202.446	183.511
August	43.319	45.857	41.582	190.479	208.351	188.731
September	39.755	49.135	42.410	180.846	223.762	193.074
October	41.185	50.077	40.462	187.138	228.353	184.837
November	43.125	49.891	39.810	194.967	227.619	180.869
December	44.655	49.815	37.635	203.358	226.875	171.786
Av. year	42.281	46.096	44.252	192.353	209.322	206.279

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

financial conditions on the Continent led to liquidation. London prices declined about the middle of March to £210 for spot and £206½ for three months', and metal in this market was offered at ¼ to ⅓c. per lb. under the parity of these prices, namely, 46 cents.

When statistics for March disclosed heavy American deliveries, buying both here and in London became active and prices advanced quickly about £9 in London and 2c. here. It retained this strong tone all during April. The rise culminated at the end of that month, when London quoted £230 for spot and £220¼ for three months', while domestic sales were made at around 50 cents.

Again the April statistics proved to be favorable, as shipments from the Far East had fallen off considerably and a scarcity of spot tin developed, which advanced this position £12 over three months' in London. American consumers were more fortunate, in that an accumulation of tin existed on this side and offers therefrom were freely made at almost 1c. per lb. below the London parity. At that time, prices stood at £231 for spot and £223½ for three months' in London, and 50½c. in this market. From this level prices declined quickly, through a reported falling-off in consumption in this country and the renewed activity on the bear side of one of the largest operators who had hitherto been bullish on the metal.

Statistics for May, as far as this country was concerned, deteriorated considerably and were also a very important contributing cause for the decline of the metal. During the second half of June prices were at about £202 for spot and £202¾ for three months in London, and around 45c. in New York.

The aggressiveness of the bear element in the London market did not leave the market very long at this level, and their heavy sales broke prices during the first 10 days of July to £177¼ for spot and £178¼ for three months in London, and 39c. here. The market then steadied a little, as it was found that the Far Eastern

interests were not willing to follow this decline and refrained from sales. This action developed a somewhat stronger tone in the London market and advanced prices about £12 from the previous low point.

There were some fluctuations during August, but in the main the market retained a strong undertone, which was sustained by liberal orders placed from this side. During the first half of September these orders continued, and in consequence thereof prices advanced to about 43½c. in this market. The London market became strong, but as soon as the support from this side was withdrawn prices eased off abroad and were lowered in sympathy with the movement on part of the domestic interests. They attained a level of about 41c. at the beginning of October, and the market remained thereat, with small fluctuations downward, during the entire month.

In November, a serious decline in standard copper acted adversely on the tin market, and as it had become evident that consumption in America was on the down grade, the markets both here and abroad developed a very weak tendency. So quotations were established the beginning of December at about £177¼ for spot and £178½ for three months in London, and 39c. here.

In the course of the month, the decline made further progress and reached the low point of 36¾c. on Dec. 23. With the better sentiment prevalent, buyers of tin became more confident and a large business was done, in which consumers participated to a considerable degree. The London market, which necessarily obtained a good portion of these orders, was also favorably affected. This movement, which advanced prices to 37¾c., was, however, not maintained, and the market closed at the end of the year evincing an easier tendency and with quotations standing at £169¼ for spot and £171½ for three months', and 37c. New York.

## Tungsten Ore Prices in Colorado

DENVER CORRESPONDENCE

The following is the schedule of prices now in force in the Boulder County, Colo., district for tungsten ores and concentrates. The prices are for the material delivered at the mill of the purchasing companies. A sampling and assay charge of \$3 is made on every lot netting less than \$50:

Assay % WO <sub>3</sub>	Price c. per Lb.	Value per Ton	Assay % WO <sub>3</sub>	Price c. per Lb.	Value per Ton
1	4	\$0.80	31	22	\$136.40
2	5	2.00	32	22	140.80
3	9	5.40	33	22	145.20
4	10	8.00	34	22	149.60
5	12	12.00	35	23	161.00
6	13	15.60	36	23	165.60
7	14	19.60	37	23	170.20
8	15	24.00	38	23	174.80
9	16	28.80	39	23	179.40
10	17	34.00	40	24	192.00
11	17	37.40	41	24	196.80
12	17	40.80	42	24	201.60
13	18	46.80	43	24	206.40
14	19	53.20	44	24	211.20
15	20	60.00	45	25	225.00
16	20	64.00	46	25	230.00
17	20	68.00	47	25	235.00
18	20	72.00	48	26	249.60
19	21	79.80	49	26	254.80
20	21	84.60	50	27	270.00
21	21	88.20	51	27	275.00
22	21	92.40	52	27	280.80
23	21	96.60	53	28	296.80
24	21	100.80	54	28	302.40
25	21	105.00	55	29	319.00
26	21	109.20	56	29	324.80
27	21	113.40	57	29	330.60
28	21	117.60	58	29	336.40
29	21	121.80	59	29	342.20
30	22	132.00	60	32½	390.00



# Iron and Steel in 1913

BY FREDERICK HOBART

For many years the course of the iron and steel trade of the United States has resembled the beats of a pendulum, alternately rising and falling. The pendulum continued to rise during the first part of 1913, but later the motion was reversed, and as the end of the year approached, it appeared to be reaching its lowest point.

Notwithstanding this recession, the year 1913 was one of record production and exceeded all of its predecessors in the quantity of raw material used; in the quantity of finished products made and marketed; though not, perhaps, in the total profits of manufacturers. To begin with, the raw material, the approximate total production of iron ore in 1913 was close to 61,770,000 tons, or 2,570,000 tons more than in 1912, and more than in any other preceding year. In addition to this great production, we imported 2,300,000 tons, chiefly from Cuba and Newfoundland, and we exported 1,100,000 tons, largely to Canada, thus adding about 1,200,000 tons to our own production. This ore was used, for at the close of the year, we cannot hear of any large accumulation of stocks at any point, and the furnaces have no greater supplies in their yards than is usual in the early winter. The details are found in the accompanying table.

As for several years past, the Lake Superior region in Michigan, Minnesota and Wisconsin furnished about 80% of the ore supply of the country reporting a total of 49,870,000 tons mined and shipped. The Southern ore banks supplied their own furnaces and there was an increased production of ore from Eastern mines. The last has been a marked feature of the year, and there has been more prospecting, opening and extension of iron mines in New York, Pennsylvania and other Eastern States than for many years past. Apparently, Eastern iron masters are recovering from the belief which possessed them so long, that the Lake Superior region held the trade so strongly that its domination could not be shaken off.

## PIG-IRON PRODUCTION

In pig iron, as in iron ore, the year 1913 established a record, its total exceeding by 1,433,000 tons the output of 29,727,000 tons in 1912, which was the greatest ever reported for a year. For the first half of the year the total as reported by the American Iron & Steel Association was 16,488,600 tons, the greatest make of iron reported in a half year by more than 1,000,000 tons. In the second half production began to fall off, the activity of the furnaces decreased month by month, reaching its lowest point in December. The make for the second half is estimated from the reports of the furnaces was 14,672,800, the total for the year being 31,161,400 long tons.

## IRON ORE PRODUCTION

(In Long Tons)

	1912	1913	Changes
Lake.....	48,211,778	49,870,478	I. 1,658,700
Southern.....	7,500,000	7,950,000	I. 450,000
Other.....	3,485,000	3,950,000	I. 465,000
Total production.....	59,196,778	61,770,478	I. 2,573,700
Imports.....	2,104,576	2,300,000	I. 195,424
Total.....	61,301,354	64,070,478	I. 2,769,124
Exports.....	1,195,742	1,090,000	D. 105,742
Consumption.....	60,105,612	62,980,478	I. 2,874,866

The second table herein shows the production of pig iron by half years for four years past, that for the second half

of 1913 being estimated as stated above. The second table gives a division of the pig iron according to the uses for which it is intended. This division is approximate only, and is based on the assumption that the proportion for the second half of the year was approximately the same as in the first half for which we have completed figures. The large increase in ferroalloys is due to the inclusion of ferrosilicon, which was formerly classed with foundry iron.

## STEEL PRODUCTION

For two or three years past, the production of steel has exceeded in tonnage that of pig iron. This is due to the extensive use in steel manufacture of the openhearth furnace and especially the basic openhearth, in which considerable quantities of steel scrap enter into the charge. Estimating as closely as possible on all the available data, the production of steel ingots in 1913 was 32,760,000 tons, an increase of 1,508,000 tons over 1912. This total of ingots would mean an output of some 26,000,000 tons of finished steel in its various forms. Nearly all of this, it may be assumed, passed into construction in railroads, buildings, and other forms in which steel is finally marketed.

There are no figures by which we can apportion the various finished-steel products. The only thing which can be said is that the consumption of structural steel in buildings, bridges and similar work, was probably larger than ever before. Railroad work, which forms an important item in steel manufacture, was not especially active. The *Railway Age Gazette*, which carefully col-

## PIG IRON PRODUCTION BY HALF-YEARS

	1910	1911	1912	1913
First half.....	14,978,738	11,665,796	14,072,274	16,488,602
Second half.....	12,319,807	11,983,548	15,654,873	14,672,800
Total.....	27,298,545	23,649,344	29,727,147	31,161,402

lects such statistics, reports that the quantity of new rails taken fell off about one-third from 1912. The number of new cars built, into which steel enters as a frame or the whole car, was 208,000, while the number of locomotives built was 3500. The mileage of new railroads built was 3366, to which is to be added new second tracks, making up a total of 4212 miles. In addition to this, there were 2200 miles of railroad built in Canada, for which the material was largely supplied from our mills. In addition to the structural steel, the quantity of small building material—bars, wire, nails, pipe, and the like—was greater than in any preceding year. Ship building was quite active during the year, the trade on the seaboard being stimulated by the prospective opening of the Panama Canal. Ship building on the Lakes was not in excess of that reported in the preceding year.

## NEW WORKS

While no great additions were made to the iron and steel works of the United States during the year, much new work was begun, the most important being the plant of the Minnesota Steel Co., at Duluth, which is controlled by the United States Steel Corporation. These works constitute an important departure from our established practice of many years, which has been that it is better to

carry the iron ore to the fuel than the fuel to the ore. The coke and coal for the new Minnesota works will have to be brought from western Pennsylvania, Ohio and Indiana by Lake, while the ore will be received almost direct from the mines. There are, perhaps, two reasons for this departure from established use, one being that a number of the Corporation's iron-ore boats go up the Lakes in ballast, which might carry coal, while another is that Duluth has some advantages as a central shipping point for the Northwestern trade. Pittsburgh interests do not regard the new plant with especial favor, looking at it as the beginning of a tendency to scatter the work heretofore concentrated in the Pittsburgh district.

#### THE IRON MARKETS

The iron markets showed conditions of increasing activity during the first half of the year; prices increased, though in rather a moderate fashion, and orders were plentiful, involving the employment of almost the full

##### PIG-IRON PRODUCTION CLASSIFIED

	1912	1913	Changes
Foundry and forge.....	6,096,254	6,528,000	I. 431,746
Bessemer.....	11,667,656	11,700,000	I. 32,344
Basic.....	11,394,477	12,210,000	I. 815,523
Charcoal.....	347,025	370,300	I. 23,275
Ferro-alloys.....	221,725	353,100	I. 131,375
Total.....	29,727,137	31,161,400	I. 1,434,263

capacity of the steel mills, is as near that point as is ever actually attained. About the middle of the year, a decline began to be noted in new business, although the mills were already furnished with contracts and specifications sufficient to keep them busy for two or three months ahead. At first there was no falling off in prices, but as time went on there was a gradual decline in quotations, which extended over nearly all classes of material. Pig iron was especially weak, and prices of that material went to so low a point that many of the merchant furnaces considered the necessity of going out of blast, and some of them actually did so. This continued and further uncertainty developed, until in October, mills began to limit their operations and many furnaces were blown out. In other words, it was seen and understood that a period of contraction had begun, and the main question was how long it would last. From present appearances, it seems to have been destined to be comparatively short for there are many indications of improvement already beginning to be manifest. It looks very much as if 1914 would be an excellent year in this country, although its beginning is not altogether auspicious.

The prophets and observers have alleged many causes for the decline of the markets in the latter part of the year. Some are disposed to attribute it to the tariff and the reduced duties on many articles of iron and steel. It does not appear, however, that this has had any serious effect. Since the new law went into effect, there has been no increase in imports, and there are no records anywhere of a greater quantity of foreign material being sold in this country than before, nor has there been any movement to push foreign goods here. The most that can be said of the tariff is that in certain lines it will limit advances in price when demand is active. Moreover, the theory that the tariff has a depressing effect is practically disproved by the fact that the course of business in Great Britain and Germany, our chief rivals, has been almost identical with our own. In the closing half, perhaps rather it should be said the closing quarter, of 1913, the steel business abroad began to decrease in activity, and

at the close of the year the reports are not at all favorable.

The reason for the recession in the iron market cannot be found in local conditions so much as in the general contraction of business and credit which has prevailed throughout the commercial world, and the causes of which are so many and complex that we have not room to go into the matter here.

#### EXPORTS AND IMPORTS

Our exports of iron and steel showed a fair increase in 1913. The total value, as reported by the Department of Commerce for 10 months of the year, was \$251,672,076, an increase of \$12,700,945 over last year. Adding the probable amount of November and December, the total value of our exports of iron and steel will exceed \$350,000,000 for the year. The value of the imports for the same period of 10 months was \$28,291,355, indicating a total of about \$34,000,000 for the year. There was a slight increase in imports, which was found chiefly in heavy steel scrap and in blooms and billets.

#### THE UNITED STATES STEEL CORPORATION

The Steel Corporation continued to hold about the same proportion of the total business that it has had for several years past. In the various finished-steel products, its share ran from 40 to 53%, the general average being about 47% of the total. It mined about 56% of the Lake Superior iron ore and about 50% of the total iron ore produced.

##### PIG-IRON PRODUCTION FOR 10 YEARS

1904.....	16,497,003	1909.....	25,711,846
1905.....	22,992,380	1910.....	27,295,592
1906.....	25,307,391	1911.....	23,049,344
1907.....	25,781,381	1912.....	29,727,137
1908.....	15,936,018	1913.....	31,761,400

The suit brought by the Government to dissolve the Steel Corporation, dragged its slow length along through nearly the whole year, an enormous amount of testimony being taken, much of which was nothing new to people connected with the iron trade. An interesting point to which emphasis was lent was the extent to which Eastern independent companies are preparing to import iron ore. The investment of the Bethlehem Steel Co. in Chile was referred to in the columns of the JOURNAL. Other companies are looking for iron ore supplies in Venezuela and Brazil, at points from which they can be cheaply delivered on the seaboard. Most of these foreign investments are due not to the scarcity of ores in this country, but to the greater cheapness of water freights as compared with the railroads.

#### FOREIGN COUNTRIES

Pig-iron production in Germany for the 11 months ended Nov. 30 was 17,682,140 metric tons, an increase of 1,395,594 tons over 1912. The course of production was much the same as in this country, the make of iron for the last quarter showing a decrease from that of the earlier months of the year.

For the first half of 1913, Great Britain produced 5,411,600 tons of pig iron, 622,870 tons of wrought iron and 4,094,000 tons of steel. In the second half activity decreased and a total make of about 10,200,000 tons of pig iron for the year is indicated, with about 7,500,000 tons of steel. In 1912 the make of pig iron was 8,889,000, and of steel, 6,796,000 tons.



# Pittsburgh Iron and Steel Markets

By B. E. V. LUTY\*

In 1913 was witnessed a complete reversal of the trend of 1912. While in 1912 the iron and steel market strengthened almost continuously, in 1913 the market weakened almost continuously.

While the movements in pig iron and in finished-steel products, respectively, were similar in general character, they were different in detail. The divergence was due to the differing natures of the two markets. Pig iron furnishes a strictly open market, with different prices quoted in different districts, and in pig iron a sale is a sale, delivery and acceptance of the material to occur whether the market advances or declines. In steel products, while there is no agreement, expressed or implied, there is a common basis for almost the entire country, delivered prices being a Pittsburgh base price, plus freight from Pittsburgh. In the case of a majority of the sales, if the market declines before delivery the buyer refuses to permit shipment to be made. The fact of the market price being usually well established, since nearly the whole country is on a common basis, tends to deter mills from cutting prices, while a further deterrent influence is found in the fact that a general market decline will

out of orders and they began to cut prices, particularly on plates.

Soon afterward the larger mills in the Central West began to require additional tonnage and they joined in the cutting, whereby in September there was a slight decline and in October and November the declining tendency was quite marked. In October pig iron resumed its declining, soon reaching a lower point than that of mid-summer. By the beginning of December pig iron was at a very low level, below the cost line of many furnaces, while steel products, though well above the cost line, were at what was considered a low level. As a consequence of the near approach to the cost line, both pig iron and steel products fell off but slightly in December.

The year's decline in pig iron averaged about \$3.50 per gross ton, thus almost balancing the advance which occurred in 1912 and leaving prices within 50c. of the low point of late 1911, which was the lowest point in pig iron since 1904, nine years ago.

The year's decline in steel prices averaged about \$4.50 per net, or \$5 per gross ton, leaving prices an average of about \$2 a ton above the low level of late 1911, which was

AVERAGE PRICES AT PITTSBURGH, 1912

	Pig Iron					Steel					Nails	
	Bessemer	Basic	No. 2 Foundry	Ferromanganese	Bessemer Billets	Beams	Plates	Bars	Black Sheets No. 28	Wire per Keg	Cut per Keg	
January.....	\$18.15	\$17.35	\$18.40	\$67.16	\$29.00	1.50e.	1.50e.	1.40e.	2.32e.	\$1.75	\$1.70	
February.....	18.15	17.22	18.02	67.16	28.40	1.45	1.45	1.40	2.35	1.75	1.70	
March.....	18.15	16.96	17.50	66.16	29.00	1.45	1.45	1.40	2.35	1.76	1.70	
April.....	17.91	16.61	16.56	63.16	27.50	1.45	1.45	1.40	2.35	1.80	1.70	
May.....	17.68	15.80	15.63	63.16	27.00	1.45	1.45	1.40	2.35	1.80	1.70	
June.....	17.14	15.40	15.08	63.16	26.50	1.45	1.45	1.40	2.29	1.75	1.70	
July.....	16.31	15.13	14.78	61.16	26.50	1.45	1.45	1.40	2.25	1.70	1.70	
August.....	16.56	14.95	14.84	58.86	25.75	1.45	1.44	1.40	2.20	1.67	1.60	
September.....	16.65	15.04	14.90	56.66	24.00	1.40	1.40	1.40	2.12	1.63	1.60	
October.....	16.60	14.61	14.73	52.44	22.50	1.39	1.36	1.39	2.04	1.60	1.60	
November.....	16.03	13.91	14.47	52.16	20.50	1.34	1.29	1.30	1.98	1.60	1.60	
December.....	15.90	13.65	14.40	49.16	20.00	1.25	1.20	1.20	1.90	1.55	1.60	
Year.....	17.10	15.55	15.78	60.03	25.55	1.42	1.41	1.37	2.21	1.70	1.66	
Year 1912.....	15.99	14.90	15.16	52.35	22.37	1.30	1.30	1.25	2.00	1.61	1.58	

Prices of pig iron, ferromanganese and billets are per ton, 2240 lb.; of steel products, per lb.; of nails, per keg of 100 lb., base.

impair the validity of contracts already on books. As a rule, therefore, the steel mills do not cut established prices so long as they have enough specifications coming in to operate full, even though further bookings for forward delivery become light.

On account of these conditions the weaker position of the general market which became apparent about the first of the year resulted in an early decline in pig iron, whereas the majority of steel products did not begin to decline until August. During the first seven months of the year pig iron fell off in price a total of about \$3 per ton, averaging different grades of pig iron in different markets.

During this period steel-price declines were inconsequential, occurring in no important lines except wire products and sheets. The reduction in pig iron was so extreme, and consumers were so well out of pig iron by midsummer, that a mild buying movement occurred chiefly in June and July, stiffening the market to such an extent that in August and September there was a definite though slight advancing tendency. By the beginning of August some of the Eastern steel mills began to run

the lowest average level since early 1899, more than 12 years ago.

Pig-iron production by the merchant furnaces reached a maximum early in the year, declining with considerable steadiness thereafter. Activity at the steel works showed little variation during the first half of the year, being practically at capacity, except for a few bessemer-steel departments. In July, August and September the mills turned out about 90% of their full rated tonnage, while during October and November there was a sharp drop, to about 50%, this rate being practically maintained during December, except that there were some important closings of works over the holidays.

The production of pig iron amounted to about 31,100,000 tons, against 29,726,937 tons in 1912. The production of steel ingots and castings was between 32,500,000 and 33,000,000 tons, against 31,251,303 tons in 1912. Production of rolled iron and steel amounted to between 25,500,000 and 26,000,000 tons, against 24,656,841 tons in 1912. Lake Superior iron-ore shipments were about 49,800,000 tons, against 48,211,778 tons in 1912. The year 1912 had easily been a record year in tonnage and 1913 showed a material gain. This gain was accom-

\*627 Oliver Building, Pittsburgh, Penn.

plished in the first half of the year, the output in the second half of 1913 being equal approximately to the average output of the preceding year.

### Minnesota's State Iron Lands in 1913

The 1913 tonnage from the state-owned iron lands, as per statement recently issued from the State Auditor's office, are as follows:

Mine	Operator	Gross Tons
Grant	Jones & Laughlin Steel Co.	687,987
Leonidas	Oliver Iron Mining Co.	558,825
Missabe Mountain	Oliver Iron Mining Co.	321,835
Fay	Oliver Iron Mining Co.	296,058
Hanna	M. A. Hana & Co.	264,312
Seranton	Pickands, Mather & Co.	227,270
Woodbridge	Oglebay, Norton & Co.	163,625
Pool	Oliver Iron Mining Co.	115,469
Cavour	Cavour Mining Co.	71,053
Morton	Tod-Stambaugh Co.	29,990
Helmer	Swallow & Hopkins	25,642
Wacoutah "B"	Pitt Iron Mining Co.	24,350
Wacoutah "A"	Pitt Iron Mining Co.	20,242
Seville	A. B. Coates	24,113
Section 17	A. B. Coates	16,831
Alberta	Minnesota Mining & Dev. Co.	5,219
Eaton	Eaton Mining Co.	3,548
Madeira	B. F. Remer	2,805
Mesaba Chief	Arthur Iron Mining Co.	2,023
Total		2,860,197

Last year the state-lease mines shipped 1,464,736 tons. The 1914 tonnage will show an even greater increase, as several new mines are now opening up, namely, the Hill Annex, with 50,000,000 tons, the Minnewas, with 10,000,000 to 15,000,000 tons, the Philbin, the Wanless, the Buckeye and the Smith, of which the last named will start shipments when the season opens. The state auditor estimates that the 1914 production will not be less than 4,000,000, and probably considerably in excess of that figure.

As a 25c. royalty attaches to all ore mined and shipped from the state-owned lands, the state will receive \$715,049.75 for the 1913 royalties, which sum goes to the school funds.

The state auditor's office figures that the mines on the Vermilion, Mesabi and Cuyuna ranges shipped during 1913 by lake 36,195,187 tons, which exceeds the 1912 output by 2,487,927 tons. In addition, however, in 1913 there were approximately 800,000 tons shipped all-rail. From this it will be seen that nearly one-half the increased tonnage came from the state leases.

The principal difference between state leases and those of independent fee owners is that the state gives no drilling option prior to acceptance of the lease. The lessee must take his lease and begin the payment of advance minimum royalties before he is permitted to begin explorations. State leases provide for a royalty of 25c. per ton, with a minimum tonnage of 5000 tons, which minimum begins five years after the completion of a railroad within one mile of the property. If the railroad be further away, the annual rental is \$100 per year until the railroad be constructed closer or until actual mining begins.

On Aug. 1, 1913, the state had 164 mining leases in force, of which 48 contained iron ore of commercial quality and quantity. The mining leases are scattered over the Mesabi, Vermilion and Cuyuna ranges, but the 19 shipping properties are all on the Mesabi. Several valuable state leases exist on the Cuyuna range, the principal one being a portion of the Inland Steel Co.'s Thompson mine, at Crosby.

The leases, on the average, still have 36 years to run, and state officials estimate an ultimate return of \$200,000,000 therefrom, all of which goes for state educational purposes.

### The Tofo Iron Mines, Chile

By C. A. Buck\*

The Tofo iron mines, about 30 miles north of Coquimbo, Chile, were acquired in 1913 from the Société des Hauts Fourneaux, Forges et Acieries du Chili, by the Bethlehem Chile Iron Mines Co., a subsidiary company of the Bethlehem Steel Corporation.

The Tofo ore deposit occurs near a range of mountains four miles back from the sea coast, and 2500 ft. above the sea level. Ore is exposed from the top of the hill to a depth of 250 to 300 ft. for about a half mile in length, with no stripping whatever of rock or soil. The amount of ore in sight, without any exploration work having been done on the property, is about 25,000,000 tons; the ore showing about 68% iron of a bessemer composition, low in sulphur and any other elements that might make a deleterious iron ore.

The French organization took out a total of about 40,000 tons of ore up to 1913, at which time this property was acquired by the Bethlehem interests. This ore was brought down to a stockpile at the coast by gravity in buckets attached to an aerial tramway, or telpherage system, of 100 tons per hour capacity, built by a German company. Through chutes in tunnels that run under the stockpile, tramway buckets are loaded and carried out to the end of a large steel cantilever bridge, which extends out over the bay where the ore can be spouted at the rate of 300 tons per hour into the hold of a ship anchored for receiving a cargo.

The present policy of the Bethlehem Chile Iron Mines Co. is to begin operations in July, 1914, by installing enough additional equipment for a continuous daily production of 1000 tons of crushed iron ore. Plans are being completed for developing the property to produce 5000 tons of ore per day beginning in 1916 and eventually increasing the output to 10,000 tons per day.

The mining operation will be the ordinary quarrying process by blasting benches 30 ft. in depth, breaking up the ore so that it can be loaded by 6-cu.yd. shovels into 50-ton side-dump cars. These cars will be handled in trains over a standard-gage spiral railroad down the benches to a crushing plant. The ore will be crushed to four inches and passed by gravity to loading bins, from which 70-ton hopper cars can be loaded. From this point ore trains, controlled by electric locomotives, will run 12 miles by gravity down a 3% grade, winding down the side of the hills to the bay at Cruz Grande, where modern ore docks of 30,000 tons capacity will be erected. Current generated by the loaded trains going down the hill will supply power for hauling the empty trains up the hill. The ore will be shipped in 15,000-ton cargoes through the Panama Canal to the Bethlehem Steel Co. A power plant will supply current for the various mining operations. Well equipped machine, boiler and blacksmith shops and foundry will be installed and two villages will be built for the comfort and convenience of the employees.

\*President, Bethlehem Chile Iron Mines Co., South Bethlehem, Penn.



# Lake Superior Iron Ranges

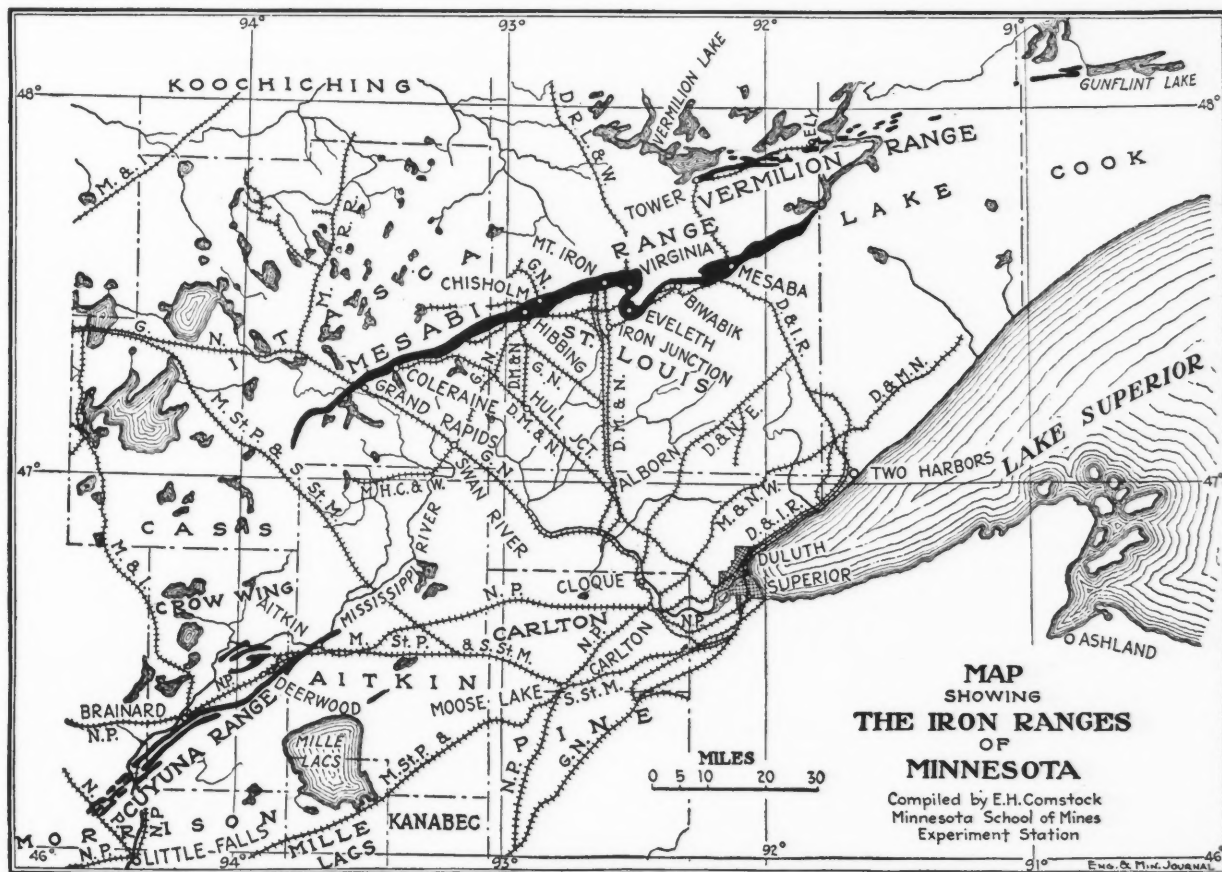
By L. O. KELLOGG

Iron-ore shipment figures for 1913 from the Lake Superior ranges are not yet available, but it is probable that the total fell slightly short of the 50,000,000 tons hoped for at the beginning of the season, at the same time being the greatest in the history of the industry.

## THE MESABI

The year on the Mesabi was marked by heavy production and vigorous development; shipments for the range were a record. The entrance of the Longyear interests into the mining field was noted last year; 1913 saw their first shipments from the Bennett mine, the ore being hoisted through the timber shaft. The mine is being

The Arthur Iron Mining Co., the operating company for the Great Northern ore holdings, was extremely active. The Smith mine was stripped so as to permit shipping if it had been desired. Two shovels were at work stripping the Dean and four on the Dunwoody. At the Hill Annex, the shaft is probably completed and a surface plant is being erected. The shaft is merely preliminary to stripping operations, as the property will be operated as an open pit. The Judd mine of the Oliver company near Coleraine shipped about 100,000 tons in 1913. Near Nashwank, the Quinn is being stripped by Butler Bros., working on their own account. Unusual interest attaches to this operation, as marking the en-



stripped and also prepared for underground mining. Of work begun in 1913, that of Jones & Laughlin near Grand Rapids aroused the greatest interest. The company is sinking and drifting for exploration purposes at the Buckeye and Fargo properties between Grand Rapids and Coleraine. It is also experimenting with a small suction dredge in stripping some land to the northwest of Grand Rapids. The use of the dredge is an attempt to find a stripping method cheaper than steam shoveling and its success will determine whether the option is to be exercised. Mining operations at Grand Rapids will be the most westerly on the range. Jones & Laughlin also almost finished the stripping at the Longyear pit near Hibbing, which will be able to ship 500,000 tons in 1914.

trance into mining of this firm hitherto engaged only in contract stripping.

The Oliver company at the Leonard mine carried on what may be termed intensive mining in the effort to obtain all available ore before the expiration of the Hill lease. The practice, unusual on the range, of stockpiling from an open pit, was begun at the close of the shipping season at this mine as well as at the Alpena. The latter, although not a Hill property, is also held under a short-time lease. The Leonard stockpile must be shipped before the close of the 1914 season; the Alpena can be left indefinitely, as the ore is weighed and royalty paid before stocking. Near Virginia, the Allan mine shipped for the first time in 1913. The royalties paid here were a record for the Mesabi, the commonly stated figure being

\$1.35. Near Eveleth, the Morrow made substantial shipments and the year saw the first shipments also from the Leonidas, held by the Oliver.

This company is sinking five new shafts this winter, two at the Wanless near Buhl, one at the Philbin near Hibbing, one at the Minnewas between Eveleth and Virginia and one at the Section 27 near Chisholm. These shafts in shape, dimension and lining and in much of their surface equipment will be similar or identical and of a high class. West of Biwabik the Oliver prosecuted vigorous drilling on the Higgins property. It is not likely, however, that this means immediate mining operations. The work was rather in the nature of a thorough exploration preliminary to a readjustment of the terms on which the property is held. Near Mesaba, the Vivian and the Graham came into the shipping class, the former, an underground property, shipped 10,000 tons and the latter, 100,000 tons from one of its openpits. Development is continuing on the former, and development, construction and stripping on the latter. To the west a few miles, the Weed is being developed.

The year saw a certain number of properties closed down, among which may be mentioned the Madrid and Madera. The Inland Steel gave up its lease on the Grace. The flooding of the Enclid probably marks the end of that mine. The Gilbert of the Oliver, was largely dismantled.

#### ORE BENEFICIATION AND MINING METHODS

Progress in beneficiation was marked in 1913 and it is probable that 1914 will see still further advance. The Brunt drier was doubled in capacity and experienced a more successful season than in 1912. The Whiteside drier went into commission early in the year and made a remarkably good showing. Additional changes in both plants are announced for 1914; the pioneer work done by these companies, especially M. A. Hanna & Co. in developing an economical method of drying great tonnages, deserves the highest praise. The commercial success of the Whiteside plant is indicated by the report that the Shenango Furnace will put up a second plant to handle the great low-grade Shenango stockpile.

In water concentrating operations, both the Trout Lake and the Nashwauk washeries had their usual successful seasons. The Nashwauk plant of the Wisconsin Steel, as a solution of its difficulties with riparian owners on Swan Lake is constructing a channel to divert the water flowing into O'Brien Lake, so as to leave most of its area isolated and available for tailing dumping, if desired. Many experiments have been conducted in water concentration, by M. A. Hanna & Co., at the La Rue mine, using a Wetherbee separator and a Woodbury jig, by the Republic Iron & Steel Co., and by others. The results of these tests are not published. At the Madrid, the Wetherbee machine did some successful work on certain ores. It is definitely stated that the Cleveland-Cliffs will erect a washing plant next year for its only Mesabi mine, the Crosby; it is believed this will follow the log-washer method developed by the Oliver at Trout Lake. It is a fact that almost every large company on the range has low-grade ore which it would like to render commercially available and most of them are engaged in experiments with some kind of beneficiation.

Minor improvements in mining methods marked the year. The larger and heavier stripping cars of 16 to 20 cu. yd. capacity, are now standard. The success of the

modified stockpiling method at the Harold mine led to its adoption by the Scranton before the latter shut down. More expensive and permanent shaft linings have become the rule, such as creosoted timber, steel sets with concrete lagging, reinforced-concrete sets with concrete lagging, etc. The wooden headframe is practically extinct. The new pin-connected two-post frame, brought out by the Oliver company, is giving remarkable satisfaction. At the Harold, machines for under-cutting and mining the blocks of ore in the rooms were definitely successful. The Jackhammer drill driving an auger bit for use in soft ore, was well received, and is almost sure to become the standard machine for such work. One mine is developing a mechanical loader to do the shoveling in the rooms, which gives excellent promise of success. A steady increase in the quality of the change houses was a feature of 1913, as of former years. A modern change house leaves the miner little to desire.

#### THE CUYUNA

First place in interest for 1913 was held by the Cuyuna range. Shipments for the year nearly tripled and it is believed that they will triple again in 1914. While the area of the district was not definitely extended, much new ore was developed within the old boundaries. Additional ore was found near bodies already known, as in Sec. 22-27 and 32-33, T. 47, R. 29, in Sec. 18, T. 46, R. 29, and north of the Armour No. 1. New discoveries include the E. J. Longyear orebody on Sec. 13, T. 45, R. 30, and additional bessemer ore on the S E  $\frac{1}{4}$  of the S W  $\frac{1}{4}$  of Sec. 1, T. 46, R. 29; in the latter discovery, one hole averaged close to 67% iron and 0.02% phosphorus.

During the year, the Pennington, Cuyuna-Duluth and Barrows came into the shipping class, the latter of special interest as being the first shipper from the south range division, the former important as marking the success of the steam-shovel method in the district. The Adams and Mountain Iron are practically ready to ship at the end of the year, and should make a substantial production in 1914. The Rowe should also be a 1914 shipper. The Brainerd-Cuyuna and Brainerd-Duluth began sinking during the year and stripping at the Pennington and Rowe got fairly under way only in 1913. The Inland Steel Co. began stripping the Thompson and should be able to ship from the pit in 1914.

The prevailing faith that the ore will eventually be found to extend to considerable depth was reinforced by the fact that ore was found at 1017 ft. in a hole of the Carlson Exploration Co. east of the Rowe mine. It is generally held that the north range bodies go deeper than those on the south range. A fair, but conservative estimate of the tonnage now shown up, would be 200,000,000 to 225,000,000 tons with from 50,000,000 to 100,000,000 more strongly indicated. These figures will, in all likelihood, be greatly increased when the range is finally proved up, as large areas remain to be drilled.

The year saw a marked tendency to change over from underground operations to steam shoveling. While the nature of the occurrence of the orebodies is not ideal for open-cut work, the overburden can be handled at an extremely low cost, as has been proved at the Pennington and Rowe mines. The operators, with experience on the other ranges behind them, are following progressive and highly developed methods. Well built plants are the rule and operations are scientifically conducted.



The question of beneficiation is occupying the attention of many of the companies. The problem is not so simple as on the western Mesabi, as the easily separated sandy ores are not found here. It is likely that any solution of the water-treatment problem will involve the use of tables, jigs or other apparatus and that the methods will vary with every ore. It is stated that the Rowe mine will erect a concentrator next year, using jigs. Work on the Jones step-process plant at Aitken was unfortunately discontinued late in the year on account of a lack of funds. The question of the ultimate value of the manganese present in many of the Cuyuna ores is still undecided, although it is a noteworthy fact that the Cuyuna-Mille Lacs disposed of about 35,000 tons of ore with a low or medium manganese content. A most perplexing question is the payment of royalties for the manganese. A great deal of railroad extension took place in the year and the rivalry for traffic between the Soo and the Northern Pacific was strong. The former handled about 85% of the ore, but the aggressive policy of the Northern Pacific in building, leasing and subleasing will probably serve to reverse this situation eventually. The Soo now enters Riverton and is working toward the Iron Mountain. The Northern Pacific has a spur to Ironton and is getting ready to build to the Duluth-Brainerd; it is reported that it is building to the Kennedy and this is held to indicate that it has bought an interest in the Kennedy fee. The fact that Jones & Laughlin took over on option a Northern Pacific lease on land south and west of the Pennington, is significant as marking the entrance of new operators on the range.

#### THE VERMILION

There were no great changes on the Vermilion range in 1913. The Oliver mines continued to be the backbone of the camp. The Section 30 made substantial shipments beside adding greatly to its reserves. Development work by outside interests was carried on at Tower and between Tower and Ely some rather important drilling was done. The Sibley mine of the Oliver will probably raise a new inclined shaft in rock in 1914. If present plans are carried out, this shaft will be raised its full section at one operation and the permanent steel sets will be placed as the work progresses. The cantilever support for the Pioneer A headframe, a unique piece of construction, is giving excellent service since its erection and it is believed that the difficulties experienced with the moving hanging wall are overcome.

#### THE GOGEBIC

The Gogebic range had a successful season in 1913, although not quite equaling its record for shipments. The Ashland was worked intermittently by the fee owners. The Oliver company gave up its lease on the Atlantic group in Wisconsin, having failed to find any commercial ore after extensive drilling. The Newport company engaged in an elaborate campaign of improvements and reconstruction at its Newport mine, and its Anvil and Palms shafts.

Without doubt the most interesting development of the year was the beginning of operations at the Wakefield mine by M. A. Hanna & Co. The discovery of this large orebody on the southern edge of the Wakefield bulge in the ore formation, distant from the string of

mines along the north edge, was a personal triumph for R. S. Rose, whose belief in the existence of the ore was responsible for bringing in the Hanna company to drill. The property is being opened with two shafts, one of them a drop shaft, and is also being partly stripped. A large percentage of the ore is available for steam-shovel mining and the mine, thus opened, will be the first steam-shovel openpit of importance on the old ranges. A fair shipment was made this year.

#### IRON RIVER AND CRYSTAL FALLS

The Iron River and Crystal Falls districts taken together were the equal of the Cuyuna in the importance of their new development. Among new shippers are the Ravenna, the Courtland, and the Forbes. A great deal of development and construction was done in 1913, as at the Carpenter, the Tully, the Bengal and the Homer, as well as others. The complete and well designed electrical equipment of the Bengal is of interest as being the most elaborate yet installed in the region. At the Tully, the new drop shaft is nearly landed. The active development work on the Mastodon find of the E. J. Longyear Co. was noteworthy. Pickands-Mather, as the Balkan company, will mine part of this ore. A shaft was dropped to rock, and underground work as well as surface construction is being pushed. It is practically settled that the property will be stripped and mined by steam-shovel methods, the first of the kind in the Menominee region and except the Wakefield, the only one in Michigan. The Judson, of the Longyear interests, sank a large inclined shaft in rock and will be a shipper in 1914. It will be an underground property and is to have an excellent equipment, largely electrical. The discoveries of the Cleveland-Cliffs and Oliver companies north of the Mastodon are important.

During the year, the Oliver company gave up operations at the Mansfield and Michigan. Work on the Hollister and Groveland was abandoned; Corrigan & McKinney closed the Great Western, pulled the pumps at the Tobin and gave up the lease on the Crystal Falls.

An important feature of practice in the region is the use of purchased electrical power by many companies. The Peninsular Power company intends to add to its hydro-electric plant on the Menominee River and to its steam plant at Iron River so as to double its capacity for 1914. The company sells chiefly in the Iron River district, but is building a line into the Mastodon district to supply the Judson mine. In this particular the region is far in advance of any other range; there is no power sold anywhere else except in small amount on the Cuyuna. The Northwestern road now has a branch into the Mastodon district and the St. Paul branch to Iron River is almost completed. The latter road will be a strong competitor of the Northwestern for ore business hereafter.

#### THE MENOMINEE RANGE

On the Menominee range proper work progressed about as usual. The most important undertaking is that of the Oliver company involving the construction of a hydro-electric plant, the relining of the Chapin shaft and the installation of electric pumps in the mine. The work will probably be completed for the 1914 season.

## THE MARQUETTE DISTRICT

The Marquette maintained its preëminence among the old ranges for 1913, although there were no significant developments. Work on the Athens was begun and the shaft is now in rock. An elaborate surface plant is being erected. The Breitung Hematite is sinking a new shaft. Jones & Laughlin drilled extensively west of Ishpeming, and are sinking south of Lake Sally. The Lake Angeline has probably shipped about its last ore.

In the Cascade district, the Volunteer did some drilling and the Cascade Mining Co., of the Longyear interests, sank its large Isabella shaft. This mine has been excellently handled, and will be developed into a most important property. At Republic, there were no changes of importance, except some new construction. The 1913 shipments from the Republic mine were about 140,000 tons.

In the Gwinn district, the close of 1913 saw the Stegmiller and the Stephenson hoisting, and the Gwinn, Mackinac and Gardner equipping.

## GENERAL CONSIDERATIONS

The Michigan mines are still having difficulty with the Tax Commission. A particular point of dispute concerns the taxing of stockpiles. While the question is not yet settled, it seems likely that the companies will be at least partly relieved of the burden. In Minnesota, the new workmen's compensation act seems to be fulfilling its purpose of saving money for both workmen and employers.

It is rather generally believed that the Interstate Commerce Commission will still further reduce the freight rate from Mesabi points to the Lake port; 40c. is mentioned as the probable figure at which they will be put. An increased interest in safety work was manifested, being largely stimulated by the rescue-car tours and exhibitions of the Bureau of Mines. The copper strike fortunately did not extend to the iron ranges, and the latter, if any thing, rather benefited, in being able to obtain more and better labor. The strike on the Great Northern docks, while of some consequence, was soon settled. Construction work on the Steel Corporation plant near Duluth was pushed. It is now stated that this will be in full blast by the spring of 1915. While these works are great in themselves they will make only a very slight diversion of Minnesota shipments through the Lakes; the capacity of the stacks being given at 1000 tons.

The end of the year saw a distinct feeling of pessimism around the mines. A slow year was expected for 1914, with the result that many underground properties, which usually mine and stock during the winter, were closed down. This was particularly true on the Mesabi and in the Iron River district. While prepared for a slight depression, however, the operators did not seem to expect its extension over more than one season; development and construction are going on as vigorously as ever.

## World's Production of Nickel

(As reported by Metallgesellschaft, Frankfurt a. M. in Metric Tons)

	1910	1911	1912
United States and Canada	10,000	12,000	15,000
England	3,500	4,500	5,200
Germany	4,500	5,000	5,000
France	1,500	2,000	2,100
Others	600	1,000	1,200
Totals	20,000	24,500	28,500

## The Steel Hardening Metals

The principal use of tungsten, vanadium and molybdenum is in the hardening of steel. The Primos Chemical Co., of Primos, Penn., one of the largest manufacturers of these metals and their ferro-alloys, gives the following information regarding the course of that industry in 1913: Molybdenum production showed a small increase over 1912. No molybdenum ore was mined in the United States and the price of the foreign ores imported was the highest on record. The total consumption in the United States is only about 18 tons of contained molybdenum, a quantity too small to warrant the development of such properties in this country. There was an increase of about 25% in the consumption of ferro-vanadium. Domestic ore production is mainly from Colorado; the importation of vanadium ore from Peru was below normal. The tungsten industry in the United States was not in a satisfactory position, owing to the fact that the cost of production is lower in Europe. About 350 tons metallic tungsten and ferro-tungsten were imported from foreign countries in 1913; the domestic production was approximately 400 tons. About 800 tons of tungsten ore or concentrate was imported during the year, which probably exceeded the total domestic production, based on 65%  $WO_3$ ; the average price was about \$7 per unit of tungstic acid.

## Ocean Freight Rates

The following table gives the prevailing freight rates on metals between New York and the principal European ports in 1912 and 1913:

	1912	1913
To Rotterdam	10c.	10c. Jan.-Mar. 15c. Apr.-Dec.
To Hamburg	11c. Jan.-July 12c. Aug.-Dec.	13c. Jan.-Mar. 18c. Apr.-Dec.
To Bremen	10c.	10c. Jan.-Mar. 15c. Apr.-Dec.
To Genoa and Naples	15/ + 5¢	20/ + 5¢
To Liverpool	15/ + 5¢	15/ + 5¢
To Trieste and Fiume	17 6 + 5¢	22/6 + 5¢
To Havre	10c. + 5¢	16c. + 5¢

The above quotations are in terms of cents per 100 lb. and shillings and pence per 2240 lb.

## World's Output of Tungsten Ores

The following table for the world's production of tungsten ores was originally published in the *Journal du Four Electrique*, corrected in several particulars by the *Mining Journal*, of London, and in two items by us. Even now many of the 1912 figures are only round-figure approximations, but, we believe, are nearly correct:

## PRODUCTION OF TUNGSTEN ORES

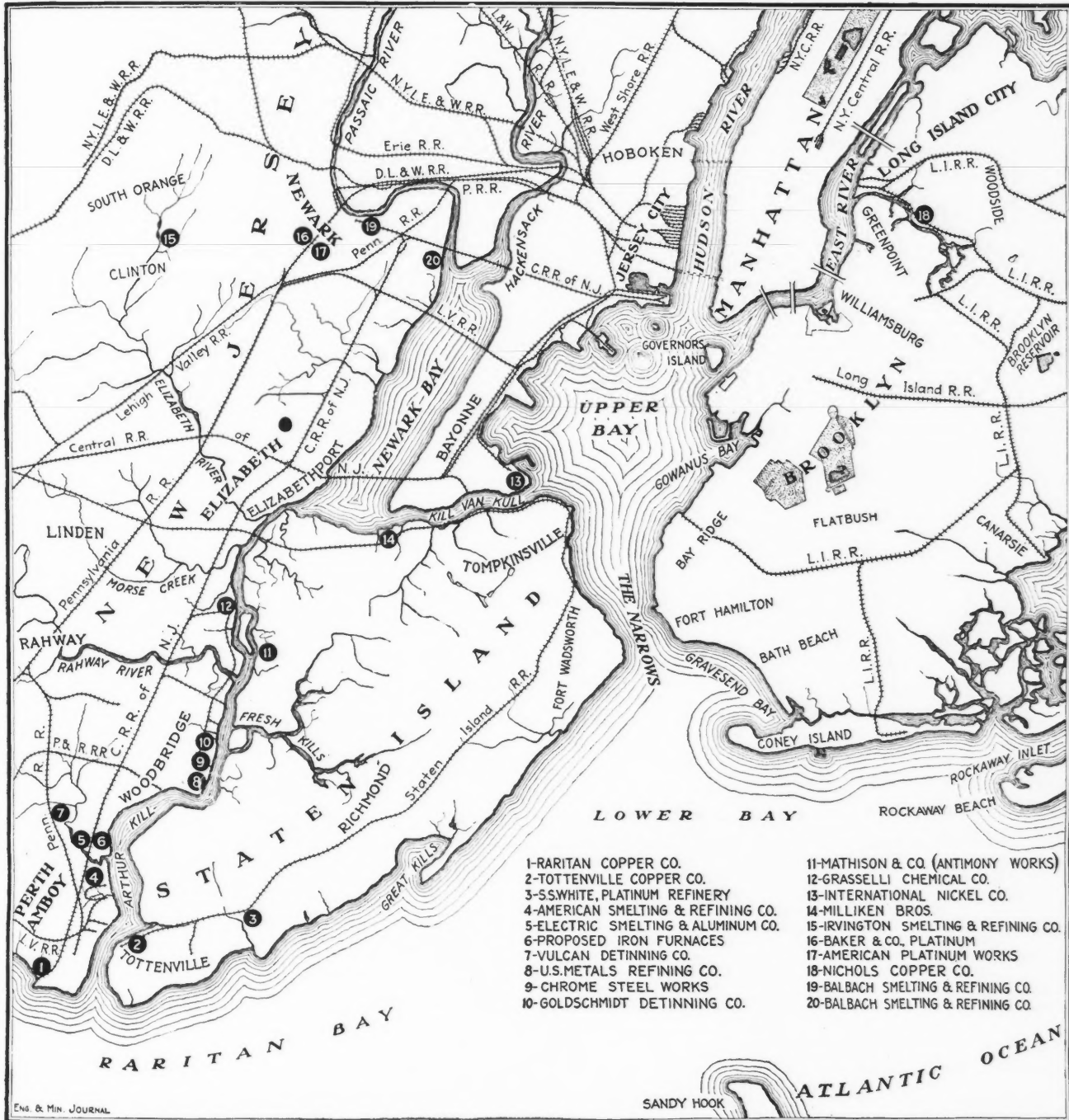
	1909	1912
	Metric Tons	Metric Tons
U.S.A. (Colorado)	1500	1169
Australia	1100	1030
Portugal	700	1250
Argentina	800	700
Great Britain	400	200
Spain	200	200
Bolivia	150	435
Germany	100	200
Detroit	100	250
British India	100	1671
France	50	100
Austria	45	50
Federated Malay States	...	225
Japan	...	150
New Zealand	...	150
Peru	...	135
Tonkin	...	50
Total	5245	7980



## New York as a Metallurgical Center

The environs of New York harbor constitute the greatest metallurgical center of America. The waterways of the great harbor, the excellent railway and dockage facilities, and the unrivaled facilities for distributing the prod-

Constable Hook. At Constable Hook also is smelted the greater part of the nickel product of Canada. There are antimony-smelting works at Chelsea, S. I., but at present they are idle. Lead is refined at Maurer and at Newark. Gold, silver and platinum are refined in numerous works. Plans are now on foot for the inauguration of iron smelting near Perth Amboy.



METALLURGICAL WORKS IN THE VICINITY OF NEW YORK

ucts combine to render New York an unsurpassed locus for metallurgical enterprise.

The major part of the copper product of North America is refined in the great works at Perth Amboy, Maurer, Chrome, Newark, and Laurel Hill. To them also comes crude copper from many foreign countries. Copper ores are smelted at Maurer, Chrome, Laurel Hill, and

The situation of the principal metallurgical works in the vicinity of New York is shown on the accompanying map. This is confined to metallurgical works, pure and simple, and does not show the allied industries, such as petroleum refining, sulphuric-acid making, white-lead manufacture, wire drawing and many other industries of similar character.

### Mining Stocks in 1913 in New York

The accompanying tables show the 1913 quotations on mining stocks listed in New York. On the Exchange stocks, "close" plus "net change" will give the opening price.

#### STOCKS ON THE NEW YORK STOCK EXCHANGE

Sales	Highest	Lowest	Closing	Net Change
201,900	24 1/2	18	21 1/2	+
6,809,600	80 1/2	61 1/2	73 1/2	+ 5 1/2
864,820	74 1/2	58 1/2	64 1/2	- 8 1/2
42,270	107	97	98 1/2	- 6 1/2
8,382	86	79 1/2	81 1/2	- 3 1/2
448,900	41 1/2	30 1/2	35 1/2	- 5 1/2
6,987	13	11	11 1/2	- 1 1/2
19,100	41 1/2	25	29 1/2	- 10
53,150	74	62 1/2	68	- 5 1/2
1,043,500	47 1/2	30 1/2	39 1/2	- 15 1/2
21,870	13	5	8	- 3
2,610	18	11	17	- 3
5,980	44	33	37	- 7
235,000	41 1/2	25 1/2	34 1/2	- 6 1/2
82,230	52 1/2	40 1/2	44 1/2	- 6 1/2
5,600	120	100 1/2	116	+ 4
183,950	19 1/2	13 1/2	15 1/2	- 2 1/2
15,249	49 1/2	29 1/2	30	- 17 1/2
163,900	26 1/2	20 1/2	21 1/2	- 3 1/2
6,900	107 1/2	102	104	- 3
270,800	20	13	15 1/2	- 4 1/2
7,655	34	2	2 1/2	- 20
200	195 1/2	195 1/2	195 1/2	- 10
1,775	100	90	90	- 10
6,385	4 1/2	1	1 1/2	- 2 1/2
5,890	8	2	2 1/2	- 3 1/2
507,500	22	15	18 1/2	- 3 1/2
193,710	28 1/2	17	20 1/2	- 4 1/2
70,862	92 1/2	72	72	+ 6 1/2
117,260	45 1/2	23	28	- 17
1,070	93 1/2	88	89	- 8
240,200	39 1/2	26 1/2	33 1/2	- 5 1/2
1,270	1 1/2	1 1/2	1 1/2	- 1 1/2
800	4	3	3	- 1
15,304,650	69 1/2	49 1/2	58 1/2	- 9 1/2
243,920	110 1/2	102 1/2	106	- 4
929,650	60 1/2	39 1/2	50 1/2	- 8 1/2
16,595	54	36	44	- 22
2,390	21 1/2	11 1/2	11 1/2	- 10 1/2
2,600	90	49	63	- 24 1/2

#### BOND PRICES ON THE STOCK EXCHANGE

1,763	105	101	103 1/2	- 2 1/2
965	92	92	93 1/2	- 5 1/2
1,352	86 1/2	78 1/2	80 1/2	- 32
135	190	122	143	+ 3
11	5	2	5	- 1 1/2
154	100	99 1/2	99 1/2	- 3 1/2
414	89 1/2	81 1/2	84 1/2	- 2
1,399	101 1/2	98 1/2	98 1/2	- 4
1,473	108 1/2	94 1/2	96 1/2	- 3 1/2
1,419	96 1/2	93	94 1/2	- 8
249	96 1/2	90 1/2	91 1/2	- 9
270	80 1/2	71	72	- 12 1/2
130	100	91	91	- 13
1,828	121	97 1/2	107 1/2	- 102 1/2
18	103	102	102 1/2	- 13
445	102	88 1/2	90	- 13
8	27	25	25	- 1
13,863	102	96 1/2	100 1/2	- 2 1/2
1,171	102 1/2	97 1/2	99 1/2	- 4 1/2
168	98	92 1/2	92 1/2	- 4 1/2

#### NEW YORK CURB TRANSACTIONS

Sales	Stocks	Open	High	Low	Last
116,810	Alaska G. M.	14	16 1/2	8 1/2	11 1/2
49,400	Alaska G. M., f. p.	15 1/2	20 1/2	15 1/2	18 1/2
28,520	Alaska Copper	5 1/2	6 1/2	5	5 1/2
341,800	*Arizona Belmont	40	40	3	3
25,200	Bailey	6 1/2	7	5 1/2	5 1/2
84,550	*Beaver Con.	43	44	28	32
566,658	*Big Four	70	94	8	8
2,725	Boston Montana	5	5	5	5
402,665	Braden Copper	10 1/2	10 1/2	5 1/2	7 1/2
105,280	Brit. Col. Copper	4 1/2	4 1/2	1 1/2	2 1/2
65,480	Buffalo Mines	2 1/2	2 1/2	1 1/2	1 1/2
7,100	*Butte & London	30	35	29	32
28,265	*Butte & New York	1 1/2	1 1/2	1	1
690,040	*Canadian Gold Silver	13 1/2	27	10	10
224,895	*Caribou Cobalt	55	72	53	68
56,900	Chesterfield Cop.	9 1/2	14	4	4
225,050	*C. O. D. Cons.	7	8 1/2	2	3
22,200	Con. Ariz. Smelt.	1 1/2	1 1/2	1 1/2	1 1/2
10,667	Cons. Copper Mines	2 1/2	3 1/2	1 1/2	1 1/2
23,610	Davis-Daly Copper	2 1/2	2 1/2	1	2
16,750	*Diamondfield Daisy	4	5	2	4
178,400	*Dia. Black Butte	5	6	1 1/2	2
120,015	El Paso, new	6 1/2	6 1/2	2 1/2	3
2,070	First National Copper	2 1/2	4 1/2	1 1/2	3 1/2
56,926	*Florence	58	58	22	26
1,000	Foley O'Brien	19	19	19	19
356,500	Giroux Mining	3 1/2	3 1/2	1 1/2	1 1/2
372,000	Gold Hill Cons.	1 1/2	1 1/2	1 1/2	1 1/2
120,168	Goldfield Con.	1 1/2	2 1/2	1 1/2	1 1/2
78,874	Greene-Cananea	9 1/2	9 1/2	5 1/2	7
302,995	*Greenw. Cop. M. & S.	6	7	4	5
19,640	Halifax Tonopah	1 1/2	2	1	1 1/2
210	Hollinger	17 1/2	17 1/2	17 1/2	17 1/2
24,400	Jim Butler	73 1/2	73 1/2	66 1/2	66 1/2

466,980	Jumbo Extension	33	40	8	14
183,685	Kerr Lake	2 1/2	4 1/2	2 1/2	4 1/2
136,285	La Rose Com.	3	3 1/2	1 1/2	2 1/2
36,611	Mason Valley, new	10 1/2	10 1/2	3	3 1/2
128,262	McKinley-Darragh	2	2 1/2	1	1 1/2
13,585	Mines Co. of Am., new	3 1/2	3 1/2	2 1/2	2 1/2
6,393	*Montana Tonopah	96	96	88	96
55,150	Mutual Mining Co.	59	71	48	50
200,464	Nevada Hills	1 1/2	1 1/2	*43	*46
83,900	*N. J. Mines Co.	17	19	15	17
13,335	*New Utah Bingham	76	80	41	41
84,680	Nipissing Mines	9	9 1/2	7 1/2	7 1/2
25,930	*North Butte Devel.	28	28	7 1/2	8
67,982	Ohio Copper	1 1/2	1 1/2	7 1/2	8
20,900	Oro	8	8 1/2	7 1/2	8 1/2
39,050	Pacific Smelters	10 1/2	11	10 1/2	10 1/2
4,600	Rescue Eula	10	11	10	10 1/2
31,420	South Utah M. & M.	1 1/2	1 1/2	1 1/2	1 1/2
2,150	Standard Silver Lead	1 1/2	1 1/2	1 1/2	1 1/2
211,925	Stewart Mining	2 1/2	2 1/2	1 1/2	1 1/2
15,800	Temiskaming	13	15	12 1/2	14
1,740,290	*Tonopah Merger	85	11 1/2	48	52
125,136	Tonopah Extension	2 1/2	2 1/2	1 1/2	1 1/2
43,570	Tonopah M. of Nev.	6 1/2	7 1/2	4 1/2	7 1/2
144,500	Tonopah North Star	1 1/2	1 1/2	99	1
78,650	Tularosa	1 1/2	1 1/2	5 1/2	5 1/2
50	Trinity Mining	5	5	5	5
62,630	Tri-Ballion	3 1/2	3 1/2	*6	*8
58,205	Tuolumne Copper	3 1/2	3 1/2	3 1/2	3 1/2
59,900	Union Mines	1 1/2	1 1/2	1 1/2	1 1/2
2,800	United Copper	1 1/2	1 1/2	1 1/2	1 1/2
325,569	West End Cons.	10 1/2	12	1	1 1/2
444,160	*West End Ext.	10 1/2	12	2	4
411,300	*Wettlaufer Silver M.	25	25	7	8
25,842	Yukon Gold	3 1/2	3 1/2	2	2 1/2

#### BONDS

227,500	Braden Copper 6s.	210	210	135	145
162,000	Braden Copper 7s.	205	211	150	157 1/2
68,000	Braden Cop. 7s. new	207 1/2	207 1/2	168	170
2,000	Chile Copper 7s.	98 1/2	98 1/2	98 1/2	98 1/2
206,500	Mason Valley 6s.	105	105	60	60

### Antimony in 1913

Except for the changes made by the new tariff, the antimony industry in 1913 was featureless. The market was quiet throughout the year, prices sagging generally from 10 1/4c. per lb. for Cookson's and 9 1/2c. for outside brands in January to 8 3/8 and 7 3/8c., respectively, in October, when tariff changes began to be reflected in the quotations. The import duty on antimony, which had formerly been 1 1/2c. per lb., was changed to 10% ad

#### AVERAGE PRICES OF ANTIMONY

	(In Cents per Pound)								
	1911			1912			1913		
	Cookson's	U. S.	Ordinary	Cookson's	U. S.	Ordinary	Cookson's	U. S.	Ordinary
January	8.25	7.74	7.45	7.53	7.47	6.88	9.94	9.53	8.97
February	8.38	8.02	7.65	7.27	7.44	6.83	9.47	9.09	8.25
March	9.56	9.13	9.00	7.65	7.56	6.86	9.28	8.85	8.18
April	9.54	9.13	8.52	8.05	7.75	6.94	9.13	8.50	7.98
May	9.50	8.97	7.99	8.02	7.75	7.10	8.88	8.37	7.79
June	8.75	7.42	8.09	7.78	7.21	8.79	8.27	7.64	7.55
July	8.50	7.35	8.42	7.96	7.50	8.54	8.08	7.55	7.39
August	8.44	7.94	7.36	8.59	7.98	7.70	8.38	7.91	7.39
September	8.31	7.84	7.26	9.12	8.50	8.26	8.37	7.93	7.37
October	8.14	7.71	6.96	10.30	9.62	9.30	7.60	7.27	6.49
November	7.97	7.61	6.92	10.39	9.86	9.30	7.62	7.30	6.45
December	7.78	7.50	6.82	10.21	9.62	9.18	7.50	7.25	6.13
Year	8.59	8.16	7.54	8.90	8.26	7.76	8.73	8.22	7.52

*valorem.* This was followed by a corresponding drop. The prices at the end of the year were 7 1/2c. for Cookson's, 7 1/4c. for Hallett's and 6 1/4c. for Hungarian, Chinese and outside brands.

There was no domestic mining or production of antimony ores, though, of course, there was about the usual production of antimonial lead, which is used largely in bearing-metal alloys.

### Borax

The price for borax in 1913 ranged very steady at 3 3/4 @ 4c. per lb. for carloads. The demand, particularly from the enameling industries, was good. No important new sources of supply were reported during 1913, and the mines in San Bernardino and Ventura counties in California continued to supply all the borate minerals required for the entire country's production of borax.



# Mining Dividends in 1913

The tables which follow show the dividends paid in 1911 and 1912, and to date, by the principal mining, metallurgical and holding companies of America. The list includes practically all United States mining companies paying dividends since 1906, except a few which have ceased to have a separate corporate existence.

The total dividends amounted to \$76,215,014 reported in 1913, while those of 1912 were \$68,776,540. In neither year are the figures absolute, nor can they be. Certain corporations, and some of them not the least profitable, will make no public report of their dividends, while, as in the case of Nevada Consolidated and Utah Copper, some dividends are duplications of payments.

The dividends of the metallurgical and holding companies cannot be simply added to those of the mining companies as a gage of total prosperity. For instance, the dividends of the Guggenheim Exploration Co. are to a large extent duplications of various mining companies' dividends. The U. S. Smelting, Refining & Mining Co. and the A. S. & R. Co., however, do not allow the earning subsidiary corporations to be known, except in rare instances, and much of the profits of these corporations should properly show in mining dividends.

However, since the figures are based on the same com-

panies, they are at least comparative, and the increase shown in dividends of \$7,468,474, cannot but be most gratifying in view of the general recession in business which took place in 1913. The prices of metals were, in general, lower, and consequently increased dividends must reflect enlarged operations, unless it be contended that the figures present partial distribution of surplus. Another unfavorable factor in 1913 was the strike in the Lake copper district, which materially cut the profits and dividends of the Lake companies.

Owing to the fact the most mines produce two or more commercial metals, we have attempted no hard and fast distribution of companies as copper producers, lead producers, etc.

The Mexican mines listed are usually those in which United States capital is most interested. Drawing this line is to some extent a matter of opinion, and as drawn, excludes such noted dividend payers as Alacran, Boleo Naica, San Felipe, Santa Maria de la Paz, etc. In the Canadian mines it is believed that the field is covered completely, but in any case, the 1913 and 1912 figures are comparative, and show an increase from \$21,212,929 to \$21,501,930, while metallurgical and holding companies jump from \$91,948,280 to \$99,529,253.

DIVIDENDS OF MINING COMPANIES IN THE UNITED STATES

NAME OF COMPANY AND SITUATION	SHARES		DIVIDENDS PAID		Total	Per Share	Total	To Date Total	Date	Latest Amount
	Issued	Par Value	1912 Per Share	1913 Per Share						
America, g.	1,438,989	\$ 1					\$122,004	Jan. '11	\$0.00 1/2	
Alams, s.l.c.	80,000	10					778,000	Dec. '09	0.04	
Ameeck, c.	50,000	25	18.00		900,000	22.00	1,100,000	Oct. '13	3.00	
Alaska Goldfields.	250,000	5					342,500	Jan. '10	0.15	
Alaska Mexicann, g.	180,000	5	1.25	225,000	1.00	180,000	3,273,381	Nov. '13	1.00	
Alaska Treadwell, g.	200,000	25	3.25	650,000	5.00	1,000,000	13,785,000	Dec. '13	1.20	
Alaska United, g.	180,200	5	1.80	324,360	2.30	414,460	1,376,750	Nov. '13	0.50	
Am. Zinc, Lead & Sm.	107,200	25	2.00	248,860	1.00	172,420	985,820	Apr. '13	0.50	
Anaconda, c.	6,000,000	25	2.25	9,804,375	3.00	12,997,500	81,418,125	Oct. '13	0.75	
Argonaut, g.	200,000	5					1,200,000	June '10	0.05	
Arizona Copper, pf.	1,266,120	1.20		119,221	a	119,221	1,890,621	Nov. '13	a	
Arizona Copper, com.	1,519,896	1.20	b	921,389	b	1,292,669	15,984,474	July '13	0.30	
Bagdad-Chase, g., pf.	84,819	5					202,394	Jan. '09	0.10	
Bald Butte, g.s.	250,000	1					1,354,648	Oct. '07	0.04	
Baltic, c.	100,000	25	7.00	700,000	2.00	200,000	7,950,000	Dec. '12	5.00	
Beck Tunnel, g.s.l.	1,000,000	0.10					940,000	Oct. '09	0.02	
Benton, z.l.	196,607	1					10,949	Oct. '08	0.01 1/2	
Bingham-New Haven, c.	228,690	5	0.30	68,607	0.20	45,738	339,957	Nov. '13	0.10	
Board of Trade, z.	120,000	1					78,000	Jan. '11	0.05	
Bonanza Dev., g.	300,000	1					1,425,000	Oct. '11	0.20	
Boston-Sunshine, g.	150,200	1					27,261	Nov. '11	0.03 1/2	
Boston & Montana, c.	150,000	25					71,825,000	Feb. '11	4.00	
Brunswick, g.	390,000	1	0.03	10,000	0.06	23,400	33,400	Dec. '13	0.06	
Full, Beck & Champ, g.	100,000	10					2,728,100	July '08	0.10	
Butte Alex. Scott, c.	74,000	10	1.00	74,000	1.00	74,000	148,000	Oct. '13	0.50	
Funker Hill Con., g.	200,000	1	0.87 1/2	175,000	0.62 1/2	125,000	711,000	Dec. '13	0.05	
Funker Hill & Sull., l.s.	327,000	10	2.45	752,100	2.50	817,500	14,729,250	Dec. '13	0.25	
Butte & Ballaklava, c.	250,000	10					125,000	Aug. '10	0.50	
Caledonia, l.s.	1,300,000	1					52,000	June '10	0.01	
Calumet & Arizona, c.	650,000	10	4.25	2,534,500	5.00	2,881,764	19,026,805	Dec. '13	1.25	
Calumet & Hecla, c.	100,000	25	42.00	4,200,000	32.00	3,200,000	123,250,000	Dec. '13	6.00	
Camp Bird, g.s.	1,100,051	4.86	0.72	801,900	0.48	534,624	9,650,836	Nov. '13	0.24	
Camp Bird, pfd., g.	650,000	4.86	0.36	221,130	0.26	221,130	502,896	July '13	0.18	
Centennial-Eur., l.s.g.c.	100,000	5	3.00	300,000	3.00	300,000	3,900,000	Oct. '13	1.50	
Center Creek, l.z.	100,000	10	0.25	25,000	0.30	30,000	495,000	Nov. '13	0.05	
Champion, c.	100,000	25	12.00	1,200,000	9.00	900,000	8,500,000	Oct. '13	1.00	
Cliff, g.	100,000	1	0.30	30,000	0.25	25,000	210,000	Dec. '13	0.05	
Cliff, s.l.	300,000	1	0.10	30,000	0.10	30,000	60,000	Jan. '13	0.10	
Cliff Gold Dredging.	100,000	10	0.75	75,000	1.00	100,000	300,000	Oct. '13	0.25	
Colorado, l.s.g.	1,000,000	0.20	0.12	120,000			2,570,000	Dec. '12	0.03	
Columbus Con., l.g.s.	285,540	5					226,832	Oct. '07	0.20	
Commercial Gold.	1,750,000	1					43,750	Dec. '09	0.00	
Comstock Phoenix, s.	800,000	1					40,000	Nov. '11	0.05 1/2	
Chief Con., s.l.	871,384	1					174,277	Aug. '13	0.10	
Chino, c.	858,500	5					1,917,540	Dec. '13	0.75	
Con. Mercur, g.	1,000,000	1	0.03	30,000	0.30	30,000	3,445,313	July '13	0.03	
Continental, z.l.	22,000	25	1.00	22,000	1.00	22,000	297,000	July '13	0.50	
Copper Range Con., c.	384,185	100	2.00	786,892	2.75	1,084,190	13,984,901	Oct. '13	0.50	
Daly-Judge, s.l.	300,000	1	0.75	225,000	0.40	180,000	865,000	Dec. '13	0.15	
Daly West, s.l.	180,000	20	1.20	216,000	0.15	27,000	6,606,000	Jan. '13	0.15	
De Lamar, g.s.	80,000	5					875,000	Aug. '11	0.25	
Dr. Jack Pot Con., g.	3,000,000	0.10					45,000	Mar. '11	0.00	
Doe Run, l.	65,782	100	6.00	394,698	5.00	328,844	3,550,969	Dec. '13	0.76 1/2	
Elkton Con., g.	2,500,000	1	0.06	150,000	0.08	200,000	3,279,460	Nov. '13	0.02	
El Paso, g.	490,000	5	0.13	132,500	0.12 1/2	61,250	1,658,545	Mar. '13	0.12	
Dunkin, g.	200,000	1					10,000	Oct. '13	0.05 1/2	
Eagle & Blue Bell, g.s.l.	893,146	1					178,629	Nov. '13	0.05	
Ernestine, g.s.	300,000	5	0.40	120,000	0.15	45,000	165,000	Mar. '13	0.05	
Federal M. & Sm., com.	60,000	100					2,708,750	Jan. '09	1.50	
Federal M. & Sm., pf.	120,000	100	6.00	749,131	6.00	749,131	8,387,643	Dec. '13	1.50	
Florence, g.	1,050,000	1					840,000	Apr. '11	0.10	
Frances Mohawk, g.	912,000	1					546,000	Jan. '08	0.05	
Free Coinage, g.	10,000	100					180,000	Dec. '09	1.00	







## FOREIGN MINING COMPANIES—Continued

NAME OF COMPANY AND SITUATION	SHARES			DIVIDENDS PAID			To Date Total	Latest Date	Amount
	Issued	Par Value	1912 Per Share	Total	1913 Per Share	Total			
Santa Gertrudis, g.s. . . . . Mex.	1,368,000	4.86	1.20	1,662,154	0.24	364,500	2,090,792	July '13	0.24
San Toy . . . . . Mex.	6,000,000	1	0.01	60,000	0.02	120,000	540,000	July '13	0.01
Seneca-Superior, s. . . . . Ont.	476,830	1			0.52½	309,940	309,940	Dec. '13	0.12½
Sorpresa, g.s. . . . . Mex.	19,200	20					3,979,240	Jan. '11	34.00
Standard, s.l. . . . . B. C.	2,000,000	1	0.21½	425,000	0.30	650,000	1,075,000	Dec. '13	0.02½
Timiskaming, s. . . . . Ont.	2,500,000	1	0.12	300,000	0.09	225,000	1,534,155	Apr. '13	0.03
Tem. & Hud. Bay, s. . . . . Ont.	7,761	1	24.00	186,264	21.00	162,981	1,870,401	Nov. '13	3.00
Tretheway, s. . . . . Ont.	1,000,000	1	0.20	200,000	0.15	150,000	1,001,998	Dec. '13	0.05
Wettlaufer-Lorrain, s. . . . . Ont.	1,416,590	1	0.20	283,318	0.10	141,659	637,465	Oct. '13	0.05
Total . . . . .				\$21,212,929		\$21,501,930	\$146,961,745		

a Two classes. b New series only. c Holding company. d Operating company.

## Chronology of Mining for 1913

### JANUARY

**Jan. 1**—National Zinc Co. took over the Springfield, Ill., works of United Zinc & Chemical Co. under long lease.

**Jan. 3**—Three miners killed in Imperial mine, near Joplin, Mo., by failure of hoisting engine at blasting time.

**Jan. 7**—Fall of roof in Old Jordan mine, Bingham, Utah, killed three men.—Main building of the Canada Refining & Smelting Co., at Orillia, Ont., destroyed by fire.

**Jan. 23**—Labor strike at Witherbee, Sherman & Co.'s iron mines, at Mineville, N. Y.

**Jan. 25**—One man killed and three injured in Pittsmtont mine, at Butte, when hoisting engine failed at blasting time.

### FEBRUARY

**Feb. 1**—Oliver Iron Mining Co. advanced wages at Minnesota mines; independent companies following its example.—About 6500 miners at Lackawanna company's mines, at Scranton, Penn., and 600 at Delaware & Hudson Co.'s mines, went out on strike, refusing to work with nonunion men.—Chambers-Ferland mines, at Cobalt, Ont., purchased by English syndicate.

**Feb. 6**—Explosion of gas in a colliery near Fukuoka, Japan, killed about 150 miners.

**Feb. 8**—Felix Diaz led revolt that ended the Madero administration in Mexico, and placed General Huerta in control.—Suit instituted by minority stockholders of Federal Mining & Smelting Co. against American Smelting & Refining Co., to have smelting contract abrogated.

**Feb. 10**—Fighting between striking coal miners and armed guards in the West Virginia bituminous coal fields, resulted in redeclaration of martial law.

**Feb. 16**—Concentrator of Butte Central Copper Co., at Ophir mine, in the Butte district, started.

**Feb. 19**—Employees of Britannia Mining & Smelting Co., Ltd., in British Columbia, went out on strike because of company's refusal to recognize Western Federation of Miners.

**Feb. 24**—Dredge No. 1 of Yukon Gold Co. dynamited.

**Feb. 26**—Stephen R. Dow found guilty.

**Feb. 27**—Lewisohns relinquished control of the Tennessee Copper Co.

### MARCH

**Mar. 1**—Fire destroyed laboratory at Boston & Montana smelting plant at Great Falls.

**Mar. 2**—Operations at Butte Central cyanide plant begun.

**Mar. 3**—Operations begun in new McIntyre mill, at Porcupine, Ontario.

**Mar. 5**—New mill of Manhattan Big Four Mining Co., at Manhattan, Nev., began operations.

**Mar. 8**—Initial convention of Alaska legislature held at Juneau.

**Mar. 12**—Operations of Swastika mill, at Swastika, Ont., begun.

**Mar. 14**—Julian Hawthorne and Dr. William J. Morton sentenced to imprisonment.—Strike of trammers at Mohawk copper mine in Lake Superior copper country.

**Mar. 15**—American Metal Co. assumed operation of Altoona zinc works, under lease.

**Mar. 18**—Fire at President colliery, near Bochum, Germany.

**Mar. 19**—Stephen R. Dow sentenced.

**Mar. 22**—Suit started against Bunker Hill & Sullivan Mining Co. by Stewart Mining & Milling Co.—Strike at Beaver mine, Cobalt, Ontario.

**Mar. 24**—Strike at iron mines of Empire Steel & Iron Co., at Wharton, N. J.

**Mar. 29**—Hoisting accident at Homestake mine, Lead, S. D.—Strike at Globe smelting works in Colorado.

**Mar. 30**—Consolidated Mercur mines in Utah closed down.

### APRIL

**Apr. 2**—Territorial senate of Alaska passed miners' eight-hour labor bill.—Cananea Consolidated Copper Co. plant closed down temporary as a result of political disturbances.

**Apr. 3**—Strike of miners in Rio Tinto mines, in Spain.—Governor Ammons, of Colorado, signed eight-hour law for miners.

**Apr. 7**—Cave in Miami mine, Arizona, killed two men and injured fifteen.

**Apr. 8**—Strike of miners on Cuyuna range, Minnesota.—Rio Tinto strike settled.

**Apr. 10**—Strike at American Smelting & Refining Co. plant at El Paso.

**Apr. 16**—Chile Copper Co., incorporated in Delaware.—Strike of miners of Amalgamated Asbestos Co., at Black Lake, Quebec.—Strike at Rio Tinto renewed.

**Apr. 17**—Strike at Grasselli Chemical Co. smelting works at Meadowbrook, W. Va.

**Apr. 19**—Strike of coal miners in Upper Silesian mines in Germany.

**Apr. 21**—James S. Douglas driven out of Cananea.—Strike on Cuyuna range, Minn., ended.—Strike of coal miners, Bethuen, Germany.

**Apr. 23**—Explosion of gas in Cincinnati mine of Monongahela River Consolidated Coal & Coke Co., near Courtney, Penn., killed 96 men.

**Apr. 23**—Hoisting accident at Leonard mine, at Butte, five men killed and nine injured.

**Apr. 26**—Mass Consolidated mine, in Lake Superior copper country, shut down on account of labor troubles.

**Apr. 27**—Strike at Perth Amboy, N. J., plant of American Smelting & Refining Co.

**Apr. 28**—Mammoth smelting plant at Kennett, Calif., declared a nuisance and injurious to agriculture.

### MAY

**May 2**—Strike of coal miners in Wales.

**May 3**—Two men killed by fall of ground in Liberty Bell mine, Telluride, Colo.

**May 5**—Strike of coal miners in Wales settled.

**May 8**—Two men killed by fall of rock in Idaho-Maryland mine, at Grass Valley, Calif.

**May 10**—First ore shipped from Eagle, Colo.—Strike of coal miners in Bethuen District, Germany, called off by union.

**May 14**—Arizona mine-tax bill passed.

**May 17**—Fifteen men killed by explosion of gas in Imperial mine of Gates Coal Co., at Belle Valley, Ohio.

**May 21**—Federal investigation of conditions in coal regions of West Virginia authorized by Senate.

**May 20**—Citizens of Denver, Colo., voted for amendment of charter to permit city to issue bonds for Moffat tunnel project.

**May 24**—Two men killed in blasting accident in Hermosa mine at Carthage, Mo.

**May 25**—Miners at Cobalt vote against a strike.

**May 28**—Strikers at Wharton, N. J., returned to work.



## JUNE

**June 2**—Shaft house at the War Eagle mine, Rossland, B. C., destroyed by fire.—Skidoo Mines stamp mill, in Inyo County, Calif., destroyed by fire.—Calumet & Arizona new smelting plant at Douglas, Ariz., blown in.

**June 4**—First trial trip made under electric power on Butte, Anaconda & Pacific R.R.

**June 6**—Strike at smelting plant of United States Zinc Co., at Blende, near Pueblo, Colo.—Two men killed by cave-in at Morris mine of Giroux company, at Ely, Nevada.

**June 7**—President John P. White and 18 other officials of the United Mine Workers of America indicted in the Federal court under charge of violating the Sherman antitrust law, by alleged conspiracy with the coal operators of western Pennsylvania, Ohio, Indiana and Illinois, to raise wages in the West Virginia coal fields so as to prevent its competition with the other four states in the Western market.

**June 10**—Senate investigation of miners' conditions in New River coal field of West Virginia begun.

**June 12**—Strike at Nichols copper refinery, Laurel Hill, N. Y.

**June 14**—Sintering plant at smelting works of St. Joseph Lead Co., at Herculaneum, Mo., destroyed by fire.—Midwest Oil Co. wins suit brought against it by Government, claiming illegal occupancy of public lands.

**June 24**—American Zinc, Lead & Smelting Co. began milling at Mascot, Tennessee.

## JULY

**July 3**—General strike of miners on the Rand.

**July 7**—Rand strike ended.

**July 17**—Forty men killed in fire in a sulphur mine near Castel Termini, Sicily.

**July 23**—General strike of miners in Lake Superior copper country.

**July 24**—Militia called out in Michigan copper country.

**July 27**—Hearings in Government's suit against the Southern Pacific R.R. to recover oil lands in Kern County, Calif., begun.—Two men killed in wreck of hoisting engine at Green Hill mine, Mace, Idaho.

**July 30**—Miners of Cabin Creek coal district of West Virginia settled differences with coal operators, and agreed to ratify an agreement between operators and local officers of United Mine Workers of America.

**July 31**—Lundberg, Dorr & Wilson 100-ton cyanide mill in South Dakota closed down after a long and interesting career.

## AUGUST

**Aug. 1**—Strike of workmen on ore docks at Superior, Wis.—First gold shipped from Chisana district, in Alaska.

**Aug. 2**—Eighteen men killed in East Brookside mine, of Philadelphia & Reading Coal & Iron Co., near Tower City, Penn.

**Aug. 13**—Ten men killed by breaking of cable on Coronado incline, at Coronado mine of Arizona Copper Co., at Clifton, Ariz.

**Aug. 14**—Troops called out to quell rioting at Nanaimo, Ladysmith and Extension, Vancouver Island, British Columbia.—Strike of electrical workers at Butte.—Strike at U. S. Smelting, Refining & Mining Co.'s plant at Midvale, Utah.

**Aug. 16**—Strike of miners in St. Francois County, Missouri.

**Aug. 20**—Quartette mill, at Searchlight, Nev., destroyed by fire.

**Aug. 21**—Forty-two miners killed by dropping of cage in Mysore mine, India.

**Aug. 26**—Lead miners in St. Francois County, Missouri, return to work.—Judgment rendered in favor of New Keystone company, in Inspiration Consolidated vs. New Keystone suit, over right-of-way question of a connecting drift.

**Aug. 27**—Arizona Copper Co.'s new smelting works at Clifton, Ariz., blown in.

## SEPTEMBER

**Sept. 5**—Smelting discontinued at Teziutlan, Mexico.

**Sept. 13**—Strawberry tunnel, of Strawberry irrigation project in Utah, completed.

**Sept. 15**—Strike of Rio Tinto railway men.

**Sept. 17**—Strike of miners in coal mines near Bay City, Mich.—Strike of coal miners in South Wales.

**Sept. 20**—Injunction issued against striking miners in the Michigan copper country, to prevent picketing and parading.

**Sept. 23**—Strike of coal miners in southern Colorado.

**Sept. 25**—Coal miners in South Wales return to work.

**Sept. 26**—Brown Mountain smelting plant, near Ouray, Colo., blown in.

**Sept. 29**—Injunction prohibiting striking miners in Michigan copper country from picketing and parading dissolved.

**Sept. 30**—Disorder among striking copper miners in Michigan.

## OCTOBER

**Oct. 1**—Butte, Anaconda & Pacific Ry. began operating regularly with electric power.—John C. Branner inaugurated president of Stanford University.

**Oct. 2**—First ore from South Cuyuna range, Minnesota, shipped from Barrows mine.—Hearings resumed in suit of Government against U. S. Steel Corporation.—Rudolf Weniger, assistant superintendent of mines for Cia. Minera de Peñoles, killed near Mapimi, Mexico; mines and reduction works subsequently closed down and foreigners left the region.

**Oct. 5**—Nome, Alaska, almost totally destroyed by storm.—Commonwealth mill at Pearce, Ariz., commenced operations.

**Oct. 10**—Washoe smelting works resumed operations after two weeks' general cleanup.—Second injunction issued to restrain disorder among Michigan copper country strikers.

**Oct. 14**—Explosion at Universal colliery, near Cardiff, Wales; 417 men killed.—Colliery explosion in south of France.

**Oct. 17**—Strike of miners at Rio Tinto, Spain.

**Oct. 20**—American Mining Congress at Philadelphia.

**Oct. 22**—Explosion at Stag Cañon colliery, at Dawson, N. M.; 261 men killed.

**Oct. 28**—Governor Ammons declared martial law in southern Colorado coal fields and called out militia.

## NOVEMBER

**Nov. 2**—Fire in Rio Tinto mine, Spain, killed seven men.

**Nov. 12**—Mond Nickel Co. purchased a part of the Levack group of nickel properties in the Sudbury district, Ontario.

**Nov. 14**—Judge Bourquin, in Minerals Separation case against Butte & Superior, rendered decision in favor of plaintiffs.—Smoke lawsuit instituted by Montana farmers for relief from fumes from Anaconda company's reduction works, dismissed.

**Nov. 15**—Salt Lake & Alta R.R. from Midvale to Wasatch, completed.

**Nov. 17**—Rio Tinto strikers resume work.—Explosion of dynamite in Kennedy mine, Jackson, Calif., killed three men and injured one.

**Nov. 18**—Explosion in mine of Alabama Fuel & Iron Co. killed 40 men.

**Nov. 22**—Reduction of 10% in wages in Joplin, Mo., district.

**Nov. 24**—Riot of natives, at the Premier diamond mine in South Africa, in which three were killed and 22 wounded.

**Nov. 27**—S. Pearson & Sons abandoned attempts to secure oil concessions in Colombia.

**Nov. 31**—Government removes restrictions so that Indian laborers may enter British Columbia.

## DECEMBER

**Dec. 1**—Federal indictment of 25 officers of United Mine Workers of America active in Colorado coal strike—Five men entombed in Golden Cycle mine, Cripple Creek district, Colorado; two were rescued.

**Dec. 2**—Sunnyside tramway terminal at Silverton, Colo., destroyed by fire.

**Dec. 3**—Wharton Steel Co. closed down iron mines at Hibernia, N. J.

**Dec. 6**—Two men killed by cave in Little Jonny mine, Leadville, Colo.

**Dec. 9**—Cave in Creighton mine, Sudbury district, Ontario; one man killed.

**Dec. 11**—Attempt to assassinate Sir Lionel Phillips at Johannesburg.

**Dec. 16**—Explosion in Vulcan colliery, New Castle, Colo.; 38 men killed.

**Dec. 18**—Renewal of International Zinc Syndicate, running to April, 1916.

**Dec. 24**—Panic at Christmas celebration in a public hall at Calumet, Mich., 72 killed.

**Dec. 26**—C. H. Moyer, president Western Federation of Miners, driven out of copper country by Citizens Alliance.

**Dec. 28**—Daly-West mill and hoist at Park City, Utah, destroyed by fire.

# Data of the World's Principal Mines

By S. F. SHAW\*

Compiled from Annual Reports of the Respective Companies

Name of Mine	Situation	Year	Tons	Profit	Dividends	Reserves Tons	Develop-ment Feet	Price Rec'd per Ton	Cost per Ton
Abosso Gold	W. Af.	'11-'12	89,322	£16,683		229,128		\$8.95	\$8.08
Ahmeck	U. S.	1912	652,260	1,465,397	1,100,000		9,828	2.17	1.97
Alaska-Mex.	Alas.	1912	233,299	31,353	225,000	1,040,631	3,530	2.91	2.05
Alaska-Gold	Alas.	1912	7,930						0.78
Alaska-Treadwell	Alas.	1912	892,198	548,651	650,000	5,977,958	12,578	2.47	1.92
Alaska-United	Alas.	1912	450,793	323,105	324,360	2,875,794	7,027	2.66	2.16
Alloucz	U. S.	1912	332,618				8,517		
Amalganated Zinc	Aus.	3-1912	278,34	£84,757	£62,500				
Amparo	Mex.	1912	92,365	389,225	240,000	559,099		10.05	4.60
Anacoada	U. S.	1912	4,576,289		9,804,375		34.1 mi.		
Ashanti Goldfields	W. Af.	'11-'12	153,554	£214,425		392,840			
Assoc. Northern Blocks	Aus.	'11-'12	20,476						11.85
Aurora West	Tran.	1912	162,597	£42,382		467,064		6.05	4.78
Balaghat Gold	India	1912	42,435	—£2,421				7.60	7.88
Baltic	U. S.	1912	652,433		700,000		13,462		2.26
Batopilas	Mex.	1912		162,404					
Bibiana	W. Af.	1912	80,154	—£13,731				4.75	6.58
Blackwater	N. Z.	1912	11,538	£7,761				12.12	10.70
Boleo	Mex.	1912	364,850	1,750,000					
Brakpan	Tran.	1912	637,323	£44,117	£300,000	2,457,000	17,348	7.57	4.53
Bantj's	Tran.	1912	286,553	£70,347	£56,509	840,800		7.17	5.97
British Broken Hill	Aus.	3-1912	101,390	£62,067	£60,000				
		3-1912	103,710	£61,836	£46,374	2,000,000	1,955		
		3-1912	443,022	£25,986	£177,512				
British Columbia Copper	Can.	1912	124,540	£91,651	£93,250			8.73	5.15
Broken Hill North	Aus.	3-1912	125,738	£15,104	£160,000	2,186,000		10.08	5.70
		3-1912	47,954	£36,049	£10,000	283,500		8.12	
		3-1912	11,732	£11,603					
		3-1912	14,657	£20,923	£1,000				
Broken Hill Proprietary	Aus.	3-1912	109,619	£186,883	£120,000				
		3-1912	120,839	£164,903	£144,000	2,000,000			
		3-1912	165,532		£120,000		2,515		
Broken Hill South	Aus.	3-1912	180,080	£222,022	£170,000	3,250,000		8.62	4.77
Buffalo	Can.	'11-'12	46,810	451,154	370,000			18.24	4.67
Bunker Hill & Sullivan	U. S.	1912	702,520	1,446,924	1,209,900	3,782,070	11,050	7.68	5.74
Calumet & Arizona	U. S.	1912	337,942		2,534,500			20.39	10.15
Calumet & Hecla	U. S.	1912	2,806,610		4,200,000		31,830	4.02	2.37
Camp Bird	U. S.	'11-'12	66,505	£287,326	1,023,030		2,920	26.15	8.79
Cape Copper	S. Af.	'11-'12	77,995	£55,137	£50,375	36,000			
Carn Brea & Tincroft	Eng.	3-1912	45,444	£7,321				6.00	5.71
Caucasus Copper	Russia	'11-'12		£66,397		3,600,000			
Centennial	U. S.	1912	106,517						2.20
Centennial Eureka	U. S.	1912	117,957		300,000				
Champion	U. S.	1912	765,306		1,200,000		12,721		2.00
Champion Reef	India	1912						11.09	7.75
Chino	U. S.	1912	1,101,463	2,212,169		54,970,640		3.94	1.93
Cinderella Con.	Tran.	1912	211,578	£44,591		573,000	15,509	6.76	6.14
City & Suburban	Tran.	1912	323,934	£253,939	£204,000	773,300		9.33	6.14
City Deep	Tran.	1912	479,630	£255,548	£156,250	2,123,650		8.63	6.05
Cons. Langlaagte	Tran.	1912	295,072	£99,446		2,069,630		6.26	4.62
Con. Main Reef	Tran.	'11-'12	242,716	£94,134	£80,881	610,680		7.02	5.12*
Copper Queen	U. S.	1912	692,985					78.135	
Crown Mines	Tran.	1912	1,920,700	£1,137,605	£1,034,116	10,607,671	23,544	7.78	4.71*
Crown Reserve	Can.	1912		1,136,010	1,061,288				
Daly Judge	U. S.	1912	62,606		225,000		9,784	11.64	6.58
Detroit Copper	U. S.	1912	519,722						
Dome	Can.	'11-'12	101,812				5,572	10.25	4.95
Durban-Roodepoort	Tran.	1912	165,920	£34,957	£31,250	600,000		5.28	4.26
Durban-Roodepoort Deep	Tran.	1912	293,975	£71,074	£44,000	965,300		7.24	6.09
East Butte	U. S.	1912	96,601	£83,701			7,130		
El Paso	U. S.	1912		238,757	122,500				
East Rand Proprietary	Tran.	1912	1,849,290	£848,793	£611,474	6,013,300	57,440	7.80	5.81
Eldorado Banket	Fhod.	'11-'12	87,315	£92,972	£90,000	149,749		12.14	7.40
El Oro	Mex.	'11-'12	302,698	£182,149	£143,437	301,934			
Esperanza	Mex.	1912	124,888 tailing ore			506,250	166,618		6.00
Esperanza Sulphur & Cop.	Spain	1912	97,566	£36,062	£17,500				
Federal Mace	U. S.	1912	154,920	172,997				8.41	7.53
Federal Wardner	U. S.	1912	250,000	56,081				5.04	4.41
Ferreira Deep	Tran.	'11-'12	558,920	£521,560	£402,500			9.70	5.59
Franklin	U. S.	1912					5,134		
Gaika Gold	Rhod.	'11-'12	34,243	£13,921	£13,674	57,758		8.73	6.78
Geduld Proprietary	Tran.	1912	168,740	£49,338		1,475,000		6.50	5.08
Geldenhuis Deep	Tran.	1912	628,210	£125,563	£87,862	1,904,700	29,459	7.33	6.35
Giant	Rhod.	'11-'12	13,209	£120,572	£98,720			8.02	3.65
Ginsberg	Tran.	1912	167,922	£63,845	£68,250			7.29	5.46
Glencairn	Tran.	1912	236,685	£34,022	£27,500	205,418		3.75	3.05
Giroux	U. S.	1912	141,287						
Globe & Phoenix	Rhod.	1912	72,923	£299,814	£280,000	170,945		32.08	12.10
Glynn's Lydenberg	Tran.	'11-'12	37,325	£42,500		69,200		11.46	6.18
Golden Horseshoe	Aus.	1912	280,868	49,000		714,141		9.768	
Goldfield Con.	U. S.	1912	415,786	4,886,400	5,694,637	300,000	49,146	18.40	6.72
Granby	Can.	'11-'12	721,719	—17,183		6,433,418			
Great Cobar	N. S. W.	'11-'12	347,317	£34,356		2,738,547			
Great Boulder Perseverance	Aus.	1912	234,636	£25,681	£34,986	498,260		5.61	5.08
Great Boulder Proprietary	Aus.	1912	193,451	£307,744	£262,500	652,916	2,419	14.34	
Great Fingall	Aus.	1912	67,177			51,459			
Greene Con.	Mex.	1912		2,280,709	1,400,000		72,403		
Grenville	Eng.	3-1912	20,166	£13,794	£13,912			11.33	
Hainalt	Aus.	'11-'12	63,542	—£2,901		100,000		6.03	6.25
Hecla	U. S.	1912	138,588	335,612	300,000			7.65	5.23
Hedley Gold	Can.	1912	70,455	385,880	360,000	413,000	1,340	11.19	5.14
Hercules	U. S.	1912	34,195	715,763				6.36	4.26
Hollinger	Can.	1912	45,195	391,803	270,000	644,540	5,201	21.44	11.99
Homestake	U. S.	1912	1,528,923		1,310,400		15,908	4.32	2.96
Horn Silver	U. S.	1912	9,030	8,606			1,433		
Hutti Gold Mines	Ind.	'11-'12	17,485	£4,510	£3,480	20,000		12.89	11.64
Inspiration	U. S.	1912	59,467		370,000	45,000,000	32,953		
Iron Blossom	U. S.	1912	46,412		200,000		7,518		
Iron Silver	U. S.	1912					8,343	39.80	
Isle Royale	U. S.	1912		430,045					

Note—Abbreviations used in above table: Alas., Alaska; Aus., Australia; Braz., Brazil; Can., Canada; Eng., British Isles (Cornwall); Hon., Honduras; Ind., India; Malay, Malay States; Mex., Mexico; N. S. W., New South Wales; N. Z., New Zealand; Port., Portugal; Rhod., Rhodesia; Sib., Siberia; S. A., South Africa; Tas., Tasmania; Tran., Transvaal; U. S., United States; W. Af., West Africa.  
 — Loss for the year. \* Cubic yards. All profits and dividends are in dollars except where otherwise noted.  
 \* Superintendent, Charcas Unit, National Metallurgical Co., Charcas, S. L. P., Mex.



DATA OF THE WORLD'S PRINCIPAL MINES—(Continued)

Name of Mine	Situation	Year	Tons	Profit	Dividends	Reserves Tons	Development Feet	Price Rec'd per Ton	Cost per Ton
Ivanhoe	Aus.	1912	237,266	960,000	912,000	1,080,000	3,602	\$9.44	\$5.40
Jumbo Gold	Rhod.	'11-'12	38,210	—£27,459		9,690		8.01	11.50
Jupiter	Tran.	1912	476,902	£63,632	£50,710	1,270,000		4.96	4.39
Kalgurli	Aus.	'11-'12	123,800	£95,768	£96,000	250,000		5.65	4.98
Knights Central	Tran.	1912	286,600	£54,427		647,000		4.23	3.05
Knights Deep	Tran.	'11-'12	727,700	£177,475	£176,969	1,477,414			
Kyshtim Corp.	Sib.	1912	338,379		£296,421	2,565,000			
Lahat Mines	Malay	1912	270,927*	£23,687	£23,500			0.99	0.65
Lake Copper	U.S.	1912	83,109	—\$2,441				2.64	3.27
Lancaster West	Tran.	1912	247,390	—£492		335,500		5.28	5.30
La Rose	Can.	1912		1,023,142	1,000,547				
LeRoi No. 2	Can.	'11-'12		40,112	58,320		5,845		12.18
Lonely Reef	Rhod.	1912	37,655	£81,860	£81,302	124,142	3,701	20.67	10.11
Lucky Tiger	Mex.	1912	69,595	711,681	336,208	152,411			12.99
Main Reef West	Tran.	'11-'12	185,731	£84,045	£73,678	685,720		7.55	5.85
Mason & Barry	Port.	1912	350,733	£85,665	£64,810				
Mason Valley	U.S.	1912	98,912						
May Consolidated	Tran.	1912	169,080	£62,759	£72,187	133,000		5.79	3.99
McKinley-Darragh-Savage	Can.	1912	70,370	1,153,848	1,123,846	152,800		20.83	4.44
Mex. Mines of El Oro	Mex.	'11-'12	142,205		£144,000	395,000		10.89	5.95
Meyer & Charlton	Tran.	1912	168,970	£160,107	£120,000	363,548	4,937	10.40	5.80
Miami	U.S.	1912	1,040,744	2,094,805	1,100,112	20,800,000		5.30	3.06
Moctezuma Copper Co.	Mex.	1912	628,012	5,087,201	2,118,570		16,206		
Modderfontein B.	Tran.	1912	388,570	£272,136	£140,000	2,594,000		9.07	5.67
Mohawk	U.S.	1912	787,941	656,435	350,000		15,404	2.44	1.61
Montana-Tonopah	U.S.	'11-'12	53,874	214,375	160,000	32,000	10,076	13.81	8.77
Morning	U.S.	1912	402,600	324,790				5.13	4.35
Mt. Bischoff Tin	Tas.	1-1912	117,328	£12,135	£39,000				1.46
Mt. Boppy	N.S.W.	1912	53,990	£5,922				6.52	7.06
Mt. Elliott	Aus.	'11-'12	39,333	£158,443	£110,638	208,597		49.50	27.70
Mt. Iyell	Tas.	1-1912	161,908			4,044,934			6.74
Mt. Morgan	Aus.	'11-'12	351,857		£200,000	3,526,000			10.44
Mysore	Ind.	1912	299,660	£428,083	£381,250	1,337,998	30,262	14.66	7.74
Namaqua Copper	Cape Col.	1912	38,335	£78,264	£70,748	99,598		22.01	
Nevada Con.	U.S.	1912	2,852,515	4,823,839	3,908,837	38,853,551		4.08	2.57
Nevada Hills	U.S.	1912	29,984	438,909			5,866	28.63	9.60
New Goch	Tran.	1912	324,399	£58,911		957,571		4.92	4.10
New Heriot	Tran.	1912	137,680	£104,287		590,742		9.01	5.32*
New Kleinfontein	Tran.	1912	549,730	£223,919	£121,250	1,190,663		6.92	4.87
New Primrose	Tran.	1912	289,000	£175,580	£178,750	413,033		6.56	3.83*
New Reifontein	Tran.	1912	189,287	£38,783	£45,756	135,887		6.24	5.24*
New Unifield	Tran.	1912	132,100	£56,490	£50,000	275,028		7.23	5.16*
New York & Honduras Rosario	Hond.	'11-'12	39,258	179,890	70,000	352,716		24.01	
Nigel	Tran.	1912	156,500	£34,831	£23,310	178,765		7.31	6.23
Nipissing	Can.	1912			1,800,000	188,477	13,023		
North Butte	U.S.	1912	425,248		697,000	710,920			
North Star	U.S.	1912	101,181		300,000			10.26	
Nourse	Tran.	'11-'12	609,750	£224,623		1,969,000		7.41	5.45
Nundydroog	Ind.	1912	100,562	£133,578	£117,916	138,440	12,943	16.00	9.54
Ooregum	Ind.	1912	145,558	£149,969	£120,231			11.62	6.61
Oriental Con.	Chosen	'11-'12	342,956	672,720	644,085	802,280		5.17	2.53
Oroyo-Black Range	Aus.	'11-'12	41,800		172,800	114,537	5,799	9.21	6.37
Oroyo Links	Aus.	1912	131,880		135,000			5.80	4.83
Osceola	U.S.	1912	1,246,557	1,163,289	1,153,800			2.44	1.53
Ouro Preto	Brazil	1912	68,485	£9,235	£3,663			7.57	6.93
Pahang Con.	Malay	'11-'12	102,797					7.05	6.04
Penhalonga	Rhod.	1912	45,233	£9,006		42,824		5.35	4.39
Poderosa	Chile	1912	11,318	£54,705		15,760		65.11	41.18
Portland	U.S.	1912	173,361	325,510	240,000		7,681		
Preston Block A	W.Af.	1912	172,119			835,014		8.34	7.68
Princess Estate	Tran.	1912	281,769	—£1,000		637,000		6.25	6.37
Quincy	U.S.	1912	1,309,253	960,770	550,000		31,405	2.58	1.85
Ray Con.	U.S.	1912	1,565,875	1,929,262		80,656,973	133,262	3.49	2.34
Rezende	Rhod.	1912	49,380	£16,011	£17,764	101,570		7.53	
Rio Tinto	Spain	1912	2,406,969	£1,929,144	£1,759,750				
Robinson	Tran.	1912	579,950	£697,545	£618,750	2,533,180		10.61	4.72
Robinson Deep	Tran.	1912	594,800	£361,163	£325,000	1,141,000		7.73	4.46
Roodepoort United	Tran.	1912	362,439	£42,710		379,283		4.90	4.37
Rooiberg Minerals	Tran.	'11-'12	20,799	£33,547	£27,000	21,300		24.68	16.84
Rose Deep	Tran.	1912	782,200	£410,358	£315,000	3,695,100		7.00	4.46
Round Mountain	U.S.	'11-'12	54,915	70,202		145,820	7,508	6.24	4.96
Santa Gertrud.	Mex.	'11-'12	269,839	£252,421	£205,200	586,000	16,249	12.84	6.83
San Toy	Mex.	1912	7,324		60,000				
Selukwe & Columbia	Rhod.	'11-'12	29,929	£1,397				9.52	9.30
Seoul Mining	Chosen	1912	74,432	356,347	180,000		5,264		3.52
Shannon	U.S.	'11-'12	263,975	150,000			11,031		
Saeba Gold Mines	Tran.	'11-'12	68,865	£42,796	£40,460	127,000	7,603	10.45	7.43
Simmer Deep	Tran.	1912	595,656	£35,546		1,430,693		4.25	3.97
Snowstorm	U.S.	1912	71,992	88,778	75,000			9.36	8.12
Sons of Gwalia	Aus.	1912	155,603	£59,493	£69,062			8.27	6.48
Spassky Copper	Sib.	'11-'12	23,759	£162,735	£148,832			74.90	41.60
Standard Con.	U.S.	1912	16,569	tailings 8,150 ore	7,730	17,893		6,216	11.72
Stewart	U.S.	1912	179,505	395,347				8.20	5.99
St. John del Rey	Brazil	'11-'12	192,600		£64,626	1,000,000		9.92	7.88
Sudan Goldfield	S.Af.	1912	14,826	£513		27,000		11.63	11.45
Sulphide Corp.	Aus.	'11-'12	218,365	£311,227	£278,750	2,499,000			
Superior	U.S.	1912	172,322						
Talisman Con.	N.Z.	'11-'12	47,920	£113,532	£119,898	56,791	3,219	23.95	12.52
Tasmania Gold	Tas.	'11-'12	51,839	—£4,165				8.51	8.90
Tekka	Malay	1912	889,845*		30,000				
Temiskaming	Can.	1912			300,000		13,020		
Tennessee	U.S.	1912	444,289	1,095,875	1,000,000	3,691,000			
Tharsis Sulphur	Spain	1912	364,802	253,066	250,000				
Thistle-Etna	Rhod.	1912	7,300						
Tomboy	U.S.	'11-'12	107,577	450,941	148,800	490,000		8.87	5.17
Tonopah-Belmont	U.S.	1912	43,478			563,924	3,498	26.55	7.71
Tonopah Extension	U.S.	'12-'13	54,618		47,172		11,172		8.62
Tonopah Mining	U.S.	'12-'13	173,336		1,600,000	200,702			7.19
Treasury Gold	Tran.	'11-'12	80,133	£5,832					
Trethewey	Can.	1912		127,834	100,000	31,172			
Trinountain	U.S.	1912	336,663		300,000		10,180		2.25
Troitzk Gold	Sib.	1912	23,793	—£14,028		26,270		5.31	
Tronoh	Malay	1912	496,495	£157,798	£120,000			3.42	1.88
Tuolumne	U.S.	1912	46,683				2,423	15.84	12.95
U. S. S. R. & M. Co.	U.S.	1912	1,166,857	4,232,965	2,579,882				
Utah Apex	U.S.	'11-'12	82,064			100,000	2,927		
Utah Con.	U.S.	1912	183,386		450,000	287,600			
Utah Copper	U.S.	1912	5,315,321	6,307,243	4,729,747	257,584,500	35,473		
Van Roi	Can.	1912	54,115				4,488	6.39	4.00
Van Ryn	Tran.	'11-'12	460,740	£222,597	£225,000	2,064,444	20,007	6.74	4.39
Village Deep	Tran.	1912	596,900	£269,708	£185,617	2,235,300		7.25	5.04
Village Main Reef	Tran.	1912	470,981	£443,175	£165,200			9.60	5.02
Vogelstruis Estate	Tran.	'11-'12	125,128	£7,236		120,120		5.76	6.05

DATA OF THE WORLD'S PRINCIPAL MINES—(Continued)

Name of Mine	Situation	Year	Tons	Profit	Dividends	Reserves Tons	Develop- ment Feet	Price Rec'd per Ton	Cost per Ton
Waihi.....	N.Z.	1912	147,828	£94,281	£148,772	760,634	7,274	10.95	7.84
Waihi Grand Junction.....	N.Z.	1912	41,712	100,000	.....	187,750	.....	8.63	.....
Wanderer.....	Rhod.	'11-'12	219,400	£7,902	.....	350,925	8,647	2.05	1.88
Wasp No. 2.....	U.S.	1912	158,200	115,519	85,000	.....	.....	1.95	1.24
West Rand Con.....	Tran.	1912	334,420	£67,720	.....	1,116,733	.....	6.62	5.64
Wettlaufer-Lorraine.....	Can.	1912	17,068	283,318	.....	.....	.....	.....	11.01
Winona.....	U.S.	1912	181,148	—84,871	.....	.....	.....	2.07	2.37
Witwatersrand Deep.....	Tran.	1912	451,000	£178,522	£131,500	1,492,257	.....	6.78	4.55
Witwatersrand Gold.....	Tran.	1912	453,989	£149,710	£148,750	1,331,540	10,088	5.79	4.19
Wolverine.....	U.S.	'11-'12	401,308	600,000	.....	.....	.....	.....	1.58
Worcester Exploration.....	Tran.	1912	59,293	£16,851	£16,751	110,000	.....	5.16	3.78
Yukon Gold.....	Alas.	1912	8,297,363*	1,272,591	1,050,000	.....	.....	0.59	0.47
Zinc Corporation.....	Aus.	1912	345,425	£232,831	£206,433	1,841,748	.....	.....	.....

The accompanying tabulation of data obtained from annual reports and abstracts of annual mining reports published in the principal mining magazines, was compiled for the purpose of securing relative data on the costs of production of the various metal-mining companies operating in different parts of the world.

These data cover for the most part the calendar and fiscal years ending in 1912. Since the reports of many mining companies for the year 1913 will not be published before June, 1914, it is not possible to cover the year 1913 at this date.

The column headed "tonnage produced" refers to the tons of ore actually shipped to the smelters or treated locally and does not include waste which was sorted out of the ore hoisted. It is customary among the Rand mines to note the amount of waste so hoisted and sorted out, but this applies to but few American mines. Some English companies use the long ton of 2240 lb., but as no distinction is made between the long and short ton in many of the abstracts published, there has been no attempt to distinguish between same in this table. However, it is generally probable that the Australian companies are speaking of long tons, the American of short, while the others may use either.

Where sufficient data were given to enable it to be done, the profits are figured as the amount remaining after all expenses of operation, administration, depreciation, development, taxes, etc., were paid. Such money as was put into the capital account, however, is not included.

In figuring the cost per ton, all items in the nature of expenses of operation, administration, depreciation, etc., are included exactly as in the case of computing the profits.

The reserves are, of course, those given in the official report as the number of tons of ore remaining blocked out at the end of the year under review. Probable ore is not so included, neither is that portion of the vein which, though blocked out, is too low grade to return a profit.

I have compiled this table for several years for my own use, publishing it for the first time in the JOURNAL of Jan. 13, 1912, and in the future expect to publish it annually, and if the various mining companies will send me a copy of their reports a greater degree of accuracy will be insured. It will be seen that English companies form a large percentage of those enumerated, as there is a greater tendency for these companies to make public the items of production, cost, ore reserves, etc., than is the case with American companies.

The omission of any figures in the above table, such as dividends paid, or profits made, is of course, not to be taken as signifying that there were no such dividends or profits. It may simply mean that these figures were not available to me.

## State Geological and Mining Officials

The following lists of the directors of state geological surveys and of the chiefs of state mine-inspection bureaus, constitute a convenient reference:

### STATE MINE INSPECTORS, COMMISSIONERS, ETC.

State	Name and Address
Alabama.....	C. H. Nesbit, Chief Mine Inspector, Birmingham.
Alaska.....	Sumner S. Smith, Mine Inspector, Juneau.
Arizona.....	G. H. Bolin, State Mine Inspector, Phoenix.
Arkansas.....	G. B. Tucker, Commissioner, Bureau of Mines, Manufactures and Agriculture, Little Rock; Tom Shaw, State Mine Inspector, Midland.
California.....	F. McN. Hamilton, State Mineralogist, San Francisco.
Colorado.....	T. R. Henahan, Commissioner, Denver. James Dalrymple, State Inspector of Coal Mines, Denver.
Idaho.....	R. N. Bell, State Mine Inspector, Boise.
Indiana.....	Edgar A. Perkins, Chief Mine Inspector, Indianapolis.
Iowa.....	E. M. Gray, Pres., State Mining Board, Des Moines.
Kansas.....	Francis Keegan, State Mine Inspector, Pittsburg.
Kentucky.....	C. J. Norwood, Chief Inspector of Mines, Lexington.
Maryland.....	Wm. Walters, State Mine Inspector, Midland.
Michigan.....	R. M. Andrews, Commissioner of Mineral Statistics, Calumet.
Minnesota.....	F. A. Wildes, State Mine Inspector, Hibbing.
Missouri.....	George Bartholomaeus, Sect., Bureau of Mines and Mines Inspection, Jefferson City.
Montana.....	George Hill, Chief Mine Inspector, Bevier. W. B. Orem, State Mine Inspector.
Nevada.....	John Sanderson, State Coal Mine Inspector, Eed Lodge. Ed. Ryan, Carson City.
New Mexico.....	Rees H. Beddow, State Mine Inspector, Gallup.
North Dakota.....	Jas. W. Bliss, State Engineer, Bismarck.
Ohio.....	J. C. Davies, Chief Inspector of Mines, Columbus.
Oklahoma.....	Ed. Boyle, Chief Inspector, McAlester.
Oregon.....	H. M. Parks, Director, Bureau of Mines, Corvallis.
Pennsylvania.....	James Roderick, Chief, Department of Mines, Harrisburg.
South Dakota.....	Otto E. Ellerman, State Mine Inspector, Lead.
Tennessee.....	Geo. E. Sylvester, Chief Mine Inspector, Rockwood.
Texas.....	I. J. Broman, State Mine Inspector, Round Rock.
Utah.....	J. E. Pettit, State Mine Inspector, Salt Lake City.
Virginia.....	Capt. Richard B. Roanoe, Mine Inspector, Richmond.
Washington.....	Jas. Bagley, State Inspector of Coal Mines, Seattle.
West Virginia.....	Earl Henry, Chief, Department of Mines, Charleston.

### STATE GEOLOGISTS

State	Name and Address
Alabama.....	Eugene A. Smith, University.
Arkansas.....	N. F. Drake, Fayetteville.
Connecticut.....	Wm. N. Rice, Hartford.
Colorado.....	R. D. George, Director, Boulder.
Florida.....	E. H. Sellards, Tallahassee.
Georgia.....	S. W. McCallie, Atlanta.
Illinois.....	F. W. DeWolf, Director, Urbana.
Indiana.....	Edward Barrett, Indianapolis.
Iowa.....	Geo. F. Kay, Des Moines.
Kansas.....	Erasmus Haworth, Lawrence.
Kentucky.....	J. B. Hoening, Frankfort.
Maryland.....	William Bullock Clark, Baltimore.
Michigan.....	R. C. Allen, Lansing.
Mississippi.....	E. N. Lowe, Jackson.
Missouri.....	H. A. Buehler, Rolla.
Nebraska.....	E. H. Barbour, Lincoln.
New Jersey.....	H. B. Kimmel, Trenton.
New Mexico.....	Charles T. Kirk, Albuquerque.
New York.....	John M. Clarke, Albany.
N. Carolina.....	Joseph Hyde Pratt, Chapel Hill.
N. Dakota.....	A. G. Leonard, Grand Forks.
Ohio.....	J. A. Bownocker, Columbus.
Oklahoma.....	C. W. Shannon, Norman.
Pennsylvania.....	H. C. Demming, Harrisburg.
S. Carolina.....	Earle C. Sloan, Charleston.
S. Dakota.....	E. C. Perisho, Vermillion.
Tennessee.....	A. H. Purdue, Nashville.
Texas.....	W. B. Phillips, Austin.
Vermont.....	G. H. Perkins, Burlington.
Virginia.....	Thos. L. Watson, Charlottesville.
Washington.....	Henry Landes, Seattle.
West Virginia.....	I. C. White, Morgantown.
Wisconsin.....	W. O. Hotchkiss, Madison.
Wyoming.....	L. W. Trumbull, Cheyenne.

The above lists were compiled in December, 1913, from the latest information available at that time.

From the above it will be seen that of the 48 states of the Union, 34 have organized geological surveys, these comprising nearly all of the states in which the mining industry is important.



# The Metallurgy of Lead in 1913

BY H. O. HOFMAN\*

The changes which have taken place during 1913 in the treatment of lead ores and lead bullion have been mainly improvements in details of operating. The advance made is due, in part to the more definite knowledge of the branches of the processes involved obtained through chemical and thermal studies carried on in the laboratory, in part to the practical experience gained in the works. With a review of this part of last year's endeavor there will be given details of some of the operating plants which have been made public.

## HISTORICAL AND STATISTICAL

The "Historical Note on Smelting Lead and Silver" attached by the Hoovers to their splendid translation of Agricola's classic work speaks of the existence in the British Museum of a leaden figure from Egypt antedating 3800 B. C., and gives 1500 B. C. as the earliest record of the mention of lead. After 1200 or 1300 B. C. evidences of lead became more frequent; the lead mines of Laurium, Greece, worked extensively about 500 B. C., were reopened in recent years and furnish considerable ore and rich slag which are smelted at present in Greece and in France. The authors have come to the conclusion that in prehistoric times there must have existed the knowledge of the reduction of silver-lead ores, of silver ores with lead ores, and of the subsequent separation of precious metal from the lead bullion.

The treatment of secondary lead materials, as distinguished from primary lead ores, is receiving increasing attention. Thus a report of the U. S. Geological Survey notices in its enumeration of the 33 active and 15 inactive lead plants of the country, the existence of four works confined to the working of secondary lead materials. Most Eastern lead works treat some secondary lead with their primary; further such manufacturing plants as the Westinghouse Electric & Manufacturing Co. (*Foundry*, 1913, XLI, 129), have important divisions for working their secondaries, among which lead is well represented.

## RESEARCH

Among the many of last year's investigations relating to the metallurgy of lead, two have a bearing upon the smelting of lead ores; they are by Kohlmeyer (*Metall und Erz*, 1913, X, 447, 483) on the system  $PbO-Fe_3O_4$ , and by Proske (*Metall und Erz*, 1913, X, 415) on that of  $PbSO_4-Fe_2O_3$ .

Starting with red  $Fe_2O_3$ , Kohlmeyer found that upon heating to 920 to 950° C. the oxide turned black, that at 1370° C. it fritted, lost O and formed the first chemical compound  $FeO \cdot 3 Fe_2O_3$ ; that it fused at 1470° and formed  $3 FeO \cdot 5 Fe_2O_3$ ; that the loss in O increased up to 1520° when there was formed  $3 FeO \cdot 4 Fe_2O_3$  and that at 1600° the fourth and last compound  $FeO \cdot Fe_2O_3$  was formed which corresponds to the common  $Fe_3O_4$ . A ferro-ferrite heated with access of air to 500° C. was found to take up O.

In the series  $PbO-Fe_2O_3$ , there were determined three chemical compounds  $3 PbO \cdot Fe_2O_3$ ,  $3 PbO \cdot 2 Fe_2O_3$ ,

$3 PbO \cdot 3 Fe_2O_3$ , all of which are decomposed upon fusion and form ternary mixtures of  $PbO-FeO-Fe_2O_3$ ; their form cannot be accurately determined on account of the unavoidable decompositions caused by the volatilization of  $PbO$ .

In the series  $PbSO_4-Fe_2O_3$ , Proske found that  $Fe_2O_3$  assisted the decomposition of  $PbSO_4$  at temperatures at and above 900° C., also that the action of  $Fe_2O_3$  was less energetic than that of  $SiO_2$ , and that at 1100° C. the entire  $SO_3$  was driven off; he also showed that  $Fe_2O_3$  heated to 1200° C. was a more powerful decomposing agent than the ordinary red oxide. If  $FeO$  in contact with  $PbSO_4$  is heated in a current of air up to 800° C. the  $FeO$  is oxidized by the O of the air, while above 800° C. it robs the sulphate of part of its O.

## NEW PLANTS

The leading features of the lead-smelting department of the International Smelting & Refining Co., Tooele, Utah, have been referred to last year (*ENG. AND MIN. JOURN.*, 1913, XCV, p. 97). Additional facts as to details of construction (H. N. Thomson-L. T. Sicka, *Bull.*, A. I. M. E., 1913, p. 1209) and of operating (L. S. Austin, *Min. & Sci. Press*, 1913, CVI, 136) have been made public. There are two blast furnaces 45x180 in. at the tuyeres and two 60x180 in. treating blast-roasted ores; the height of the charge ranges from 10 to 12 ft. A furnace has on a side three steel water jackets each with four tuyere-openings; the forehearth of a furnace is 10 by 5 ft. and 5 ft. deep. A charge contains 16.7% Pb and 12.4% coke; the slag aimed for has the composition  $SiO_2$ , 31;  $FeO$  and  $MnO$ , 35.5; and  $CaO$ , 17.5%. Of special interest is the "reverse-current bag-shaking system" employed, in which the gas-main is shut off from a division of the bag-house, when the bags are to be cleaned, and connection made between the division and an exhaust flue which causes the suspended bags to collapse. Repeating the two operations several times effectively shakes the bags in the most simple manner. The matte produced is tapped from the hearth into a ladle and poured into a basic converter to be blown to blister copper.

## BLAST ROASTING

The preliminary partial oxidizing roast to which ore and matte are subjected previous to blast roasting has so far always been carried on in a single-hearth reverberatory furnace; with matte, mechanically raked furnaces have always given trouble owing to the caking of the charge. At Herculaneum, Mo., and Midvale, Utah, U. Wedge has introduced a two-hearth form of his MacDougall type of furnace. He has overcome the difficulty of caking by a provision which allows careful regulation of temperature and of air. The furnaces have been working successfully for a considerable time, and have furnished the practical evidence that as long as air and temperature are under control there is no difficulty in obtaining an effective roast with material which is readily fusible.

In blast-roasting at Cerro de Pasco, Peru, which has an elevation of 14,000 ft., in a Dwight-Lloyd straight-

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line sintering machine, R. L. Lloyd (*Min. & Sci. Press*, 1913, CVI, 908) found that the ignition flame had to be hotter, that the charges could be worked with a higher sulphur-content (25% S) than at lower levels and that, when once ignited, the speed of sintering was only a little lower than under ordinary conditions. Another interesting phenomenon observed was that the S from pyritic ore which collects in the form of flower in the fan and has to be removed periodically, does not ignite. The contrary has recently been experienced at the lower altitudes of Midvale and Tooele, Utah (*Metal. and Chem. Eng.*, 1913, XI, 426) where the flowers of sulphur and flue dust ignited, caused an explosion, and the destruction of the roaster flue and of a large number of bags. Such accidents can and are now avoided by watching the temperature of the flue and allowing the gases to escape into the open, when the pyrometer registers near the danger point.

#### BLAST FURNACE WORK

The temperature of the slag flowing from the blast furnace is usually judged by the eye. Clevenger (*Met. and Chem. Eng.*, 1913, XI, 448) measured the temperatures of the following lead blast furnace slags: Slag (1), SiO<sub>2</sub>, 31.0; FeO, 38.5; CaO, 12.0; Al<sub>2</sub>O<sub>3</sub>, 8.0; ZnO, 12.4; 1126° C.; slag (2), SiO<sub>2</sub>, 34.0; FeO, 30.5; MnO, 3.7; CaO, 15.0; MgO, 1.3; Al<sub>2</sub>O<sub>3</sub>, 6.4; ZnO, 7.2; 1170°

C.; slag (2a), SiO<sub>2</sub>, 32.0; FeO, 31.0; Mn, 3.8; CaO, 14.5; MgO, 1.3; Al<sub>2</sub>O<sub>3</sub>, 6.6; ZnO, 7.2; 1149° C.

#### DESILVERIZATION

The plant of the International Smelting & Refining Co., East Chicago, Ind., of 200 tons capacity, which was started in October 1912, desilverizing lead bullion from Tooele, Utah, by means of the Parkes process, has been in continuous operation since then.

The electrolytic lead refinery of the Consolidated Mining & Smelting Co., at Trail, B. C., continues to desilverize the lead bullion of the company by means of the Betts process (J. F. Miller, *Met. and Chem. Eng.*, 1913, XI, 463). The works have been repeatedly described. Formerly the antimony which collects in the anode mud was practically wasted. A new process has been worked out for the recovery of this metal. The mud is boiled with sodium sulphide which extracts 80 to 90% of the antimony and 50% of the arsenic; the solution is filtered and electrolyzed in iron tanks using sheet-lead anodes and sheet-steel cathodes with a current density of 8 amp. per sq.ft. of cathode area at a pressure of 1.5 volts per tank. The antimony removed from time to time contains about 2% arsenic which is eliminated by fusion with alkali fluxes when the cathode deposit is cast into ingots.

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## The Metallurgy of Copper in 1913

BY LAWRENCE ADDICKS\*

While 1913 brought forth no radical departure from standard practice in the smelting of copper ores, there has been decided development in the use of existing methods and particularly in the better understanding of the limitations of particular processes. Wet concentration followed by leaching at Anaconda, flue dust settling with wires followed by electrostatic precipitation at Garfield, and, stepping for a moment into lead practice, Wedge roasters followed by Dwight-Lloyd sintering at Midvale, are illustrations of the appreciation that each process is at its best in a more or less limited field, local conditions often calling for the successive use of two processes in series, if the maximum economy is to be obtained.

In the matter of new construction, the general rebuilding of the old plant at Great Falls, Mont.,<sup>1</sup> and the work done by Repath & MacGregor for the Calumet & Arizona company at Douglas and for the United Verde Copper Co. at Jerome<sup>2</sup> were the principal items of interest. Many other companies are modernizing their plants gradually in the light of the results obtained by the large-scale experiments in plant design, conducted chiefly at Anaconda and Great Falls and so generously published.

The year was particularly notable for the amount of information of great value regarding copper metallurgy, which was published. No one interested in the subject should fail to examine the year's transactions of the American Institute of Mining Engineers where Montana practice from mining to refining is discussed in the greatest detail by those actually engaged in the work, and the

monograph on the nickel industry at Sudbury<sup>3</sup>, which is really copper practice as the ores all carry copper values, published by the Canadian government.

#### ROASTING

The multiple-hearth mechanical roaster of the McDougal-Herreshoff-Wedge type continues to monopolize the field of roasting prior to reverberatory smelting. Some interesting work in the substitution of air for water-cooling has been done at the Nevada plant of the Steptoe Valley Smelting & Mining Co.<sup>4</sup> A forced-blast fan rated at 25,000 cu.ft. per min. delivers air at 3½-in. pressure to sixteen 18-ft. eight-deck (including drying floor) McDougals. The floor of the first hearth was built of cast iron, and all water cooling cut out. The result has been to double the capacity of the furnaces.

Many roasters are now being equipped with an open drying floor on top. The argument that this work is done by waste heat and that the floor pays for itself by increased economy does not seem sound in that such a floor gives a poor utilization of the heat in the gases, depending as it does for transmission through the hearth. As the open floor is equipped with arms, the expense is almost equal to that required for the construction of an additional standard hearth, which would be a much more effective dryer. The real difference is that in the first case any moisture driven off is taken up by the outside air while in the second it enters the flue with the gases where it sometimes causes trouble from acid corrosion.

\*Superintendent, U. S. Metals Refining Co., Chrome, N. J.

<sup>1</sup>Eng. and Min. Journ., Vol. 96, p. 677.

<sup>2</sup>Eng. and Min. Journ., Vol. 96, p. 287.

<sup>3</sup>"The Nickel Industry," by A. P. Coleman, Mines Branch, Can. Dept. of Mines, Ottawa, 1913.

<sup>4</sup>Eng. and Min. Journ., Vol. 95, p. 1273.



It is also conceivable that with very wet ore the flue gases might become saturated with moisture while yet quite hot.

The Dwight-Lloyd sintering machines have made some progress in the copper field, plants now being in operation or building at Cerro de Pasco, Peru, Thompson, Nev., Coniston, Ontario, Butte, Mont., Norfolk, Va., Copperhill, Tenn., and Chrome, New Jersey. The opinion of Western metallurgists is almost unanimous that blast-roasting followed by blast-furnace smelting cannot compete with mechanical roasting followed by reverberatory smelting for the treatment of fine sulphides. This means the limitation of the sintering machine to agglomeration as distinguished from roasting in copper work. Most of the installations listed above are where reasons exist against the use of a reverberatory and a blast furnace has to deal with fine ores. A notable exception to these statements is the new plant of the Mond Nickel Co. at Coniston, Ontario, where a Dwight-Lloyd unit has just been put into operation on rather coarse ( $\frac{3}{4}$  in. down) copper-nickel sulphides. The plant of the Canadian Copper Co. at Copper Cliff, but 10 miles away, uses roasters and a reverberatory, on similar ores, so that a fair comparison of the two methods may be possible. One of the arguments used at Coniston is that a blast furnace with coarse ore plus sinter is expected to give better results than when run on coarse ore alone. It may be said in passing that the Sudbury ores offer a somewhat different problem from ordinary copper ores as shown by the fact that it has so far been found impossible to apply pyritic smelting where analyses indicate a typical case. At Thompson and Butte, fine dust is treated. At Tennessee the acid plant complicates matters and at Norfolk and Chrome agglomeration only is desired, sulphur not being present in excess. To date, therefore, the reverberatory seems firmly entrenched, although sintering has driven an entering wedge.

An interesting installation of a 60x6-ft. rotary kiln has been made at the U. S. Metals Refining Co.'s plant at Chrome, N. J., for nodulizing blast-furnace flue dust. It has been found possible to make an excellent product at a cost of about 80c. per ton when running at 60 tons per day. The principal item of cost is fuel oil, about 12 gal. of oil per ton of flue dust being required. As a Dwight-Lloyd unit is now being installed for the general treatment of fine ores, it will be possible to make an interesting comparison of the two methods.

#### REVERBERATORY SMELTING

The most economical size of a reverberatory furnace is now pretty well established as about 19x100 ft. or possibly 110 ft., and the general type of construction with a magnesite hearth and waste heat boilers is also fairly standardized. One novelty is the development at Great Falls of a system of bracing that eliminates tie-rods,<sup>5</sup> and greatly reduces the expense of the iron work as well as improves the appearance of the furnace. The furnace is inclosed in an armor of steel plates and the buckstays supported by props and jack screws. These furnaces are 22x102 ft., and hot-blast stoves operating on the regenerative principle are to be substituted for the customary waste-heat valves. The firebox has been separated from the furnace and is operated as a gas producer.

At the Copper Cliff works of the Canadian Copper Co. pulverized-coal firing of a reverberatory has been meeting

with such success that it deserves special mention. The furnace is 19x112 ft., and the waste-gas passages are unusually free. Coal is passed through a cracker which breaks lumps down to  $\frac{1}{2}$ -in. size and then to a Ruggles-Coles dryer. The dried coal is then ground to 200 mesh in Raymond pulverizers. The fine coal is screened by a vacuum separator and fed by variable-speed screw conveyors to five burners, which are simple air-blast nozzles such as are used in standard cement-kiln practice. There are additional air ports, and both air and coal supply may be varied at will. Some very high rates of smelting have been obtained—an average of 460 tons in 24 hr. with a coal ratio of nearly six to one, if I remember the figures correctly. The secrets of success appear to be fine grinding of the coal to give flash ignition free gas passages, and a rather basic slag—below 34% silica—which effectually fluxes the coal ash, about half of which probably remains in the furnace. In fact it is questioned whether siliceous slags would not give trouble from an ash blanket as in the case of earlier trials of this method of firing. It is difficult to see where any improvement over oil firing can be obtained except that 200-mesh material can be efficiently sprayed more readily than a liquid and, of course, pulverized coal is a cheaper fuel than oil in most localities.

#### BLAST-FURNACE SMELTING

At Great Falls a number of different shapes of furnace have been tried from time to time. It was here that Mr. Klepetko tried different widths across the tuyeres and his conclusions have long been accepted as the basis of a standard type of furnace. Recently all this work has been gathered together and published<sup>6</sup> and a new type of furnace with lines similar to those of an iron blast furnace is being tried out with very promising results. In a brick furnace the lines soon change, by incrustation and burning out, to what the work of the furnace demands, but with a water-jacketed shaft and vigorous barring-down it is possible to maintain quite artificial lines. The most recent furnace at Great Falls is 84 in. wide at the tuyeres, spreading outward as the shaft rises to 120 in. some 3 ft. above the tuyeres. The bosh then reverses and the width contracts to 96 in. at the top, about 18 ft. above the tuyeres. It is proposed to build the next furnace with the same lines except that the hearth will have vertical sides until the tuyeres are passed, thus closely imitating an iron furnace, although retaining a rectangular horizontal section instead of the typical circular section of the iron blast furnace. This unit is smelting faster and is using less coke and giving less trouble from crusts than the adjacent old-style furnaces, and those in charge are enthusiastic about its future. The reverse bosh gives an opening wedge for the dropping of crusts and provides for the diminishing volume of the ascending gases as they cool as well as for the swelling of the descending charge (lime is more bulky than the equivalent limestone). The old idea of imperfect penetration of the blast in a wide furnace is met by having a sufficient depth of burden on the charge to make the pressure head rather than the velocity head of the entering blast the governing factor.

#### CONVERTING

The large 20-ft. vertical converters at the Great Falls plant continue to give satisfaction and one has now been installed at Anaconda, where it will be in direct competition with horizontal ones.

<sup>5</sup>Eng. and Min. Journ., Vol. 96, p. 677.

<sup>6</sup>Trans. A. I. M. E., August, 1913.

In the matter of basic converting it is surprising how easy it is to run a shell under almost any condition of shape or practice now that the work has become familiar to the general run of converter men. Five years ago it seemed impossible. Three years ago it required great skill. Today it is much easier to handle than the old acid practice ever was, and many of the precautions have either been found unnecessary or have become second nature.

One of the early rules was to cover the surface of the shell with a coating of "slag," and if the cracks between the brick could be seen when the shell was turned down, the lining was considered to be in danger. This practice has now been developed into the deliberate formation of a protective coating of magnetite and a patent<sup>7</sup> has been issued to Messrs. Wheeler and Krejci, covering this method. A new basic shell is given a charge of matte which, with certain precautions, is blown without silica and the iron oxidizes to  $Fe_2O_3$ , instead of to a silicate. This freezes and adheres to the lining, and as it does not fuse below  $1500^\circ C.$ , a temperature far above that of normal operation, and as it is not acted upon chemically by the matte, the lining should be very durable. It is proposed to try cheaper material than magnesite for a backing, as the monolithic magnetite is the real lining.

It used to be claimed that silica would not dissolve in molten matte and that in acid converting nearly all of the silica was supplied by the lining. Now that basic converting has upset this theory, a large amount of silica is being fed into acid shells, where they are still used, and it has been found commercial to convert 20% matte direct in an acid shell.

A weak spot in handling material in most plants has been the breaking up and recharging of skulls from converter slag ladles. At nearly every plant—exceptions at Garfield and at Jerome—these are dumped on the floor and broken up by hand and then picked up piece by piece and loaded in cars. The Macgregor (patented) machine for handling this problem is likely to be generally adopted. The skulls are released from the ladle by bumping against a block and fall upon a slide leading to a heavy grizzly. They are then broken up by a sort of stamp carried by an overhead traveling crane and the pieces fall through onto an elevator belt, which carries them to a charging bin.

#### FUME CONDENSATION

The smelter-smoke question has three aspects: (1) The recovery of valuable metals; (2) the avoidance of damage to agriculture; and (3) the meeting of damage suits. By refusing to recognize (2) as the proper basis and insisting upon (1) the smelter has, unfortunately, been forced over to (3), which is largely unknown territory. Until it is definitely and finally settled what (3) is, the smelter will hesitate to accept any system of condensation involving a large investment, and we have a great variety of processes and opinions.

The chief methods are: (A) Dust chamber; (B) suspended wires; (C) bag house; (D) electrostatic condensation; (E) thiogen process; (F) sulphuric-acid manufacture. We also have propositions involving B + D and D + C, which look quite attractive.

The Great Falls installation of suspended wires has

proved a great success and must be reckoned with at least as a preliminary method. The bag house at Kennett, Calif., continues to do good work. The Cottrell process of electrostatic condensation has made remarkable progress. The thiogen process, in some ways the most interesting of all, is awaiting a favorable opportunity for a large-scale trial.<sup>8</sup>

In addition to some small installations such as that at the Raritan Copper Works on silver refinery fumes, the Cottrell process has had a serious and successful trial at Garfield, where an installation is now in course of construction to handle the gases from the entire converter plant. If this fulfills expectations the roaster and blast furnace gases will be similarly treated.

The disappointing results at the old Balaklala Cottrell installation were apparently due to a failure to understand the necessary conditions involving: (1) Quantity of dust; (2) moisture; (3) velocity; (4) temperature. The gases must not carry too great a quantity of dust per unit of volume, there must be sufficient moisture for ionization; the velocity must not be too rapid for perfect "clearance"; and the temperature must not be too high. As the temperature is lowered first we get the so called "values," then the impurities, and finally the acid. The fact that another large-scale installation is to be tried is very encouraging.

#### REFINING

Basic refining furnaces<sup>9</sup> have been developed at the Chrome plant of the U. S. Metals Refining Co. The customary vault has been abandoned and a magnesite hearth used in conjunction with chromite walls and roof. The result has been to suppress the formation of silicate slags of the metallic bases present in refining and to make possible the treatment of leady and other foul bullion without danger to the furnace.

[The question of copper leaching has become increasingly important, and a separate article will be found upon this subject on p. 101.—EDITOR.]

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### New Slime Treatment at Anaconda

Apart from the mere fact that concentrator slime is to be treated and a recovery made from a hitherto valueless metallurgical waste product, the magnitude of the Anaconda Copper Co.'s installation makes it of interest. The slime is to be partially dewatered and the dewatered product treated on buddles.

An "experimental" plant capable of treating 220,000 gal. of waste water daily was installed and worked successfully. This plant, which would have been a full-size one for some works, was then demolished, to make room for the new plant.

This will treat 20,000,000 gal. of water per 24 hr., carrying 2% of solids. Partial dewatering will be accomplished in Dorr thickeners and Olive filters, bringing the solids up to 12%. This material is then to be sent over twenty 20-deck buddles. As we have previously remarked editorially, multiple-deck tables for slime treatment seem to be the present metallurgic fashion.

<sup>7</sup>U. S. pat. No. 1,068,470, July 29, 1913.

<sup>8</sup>Eng. and Min. Journ., Vol. 95, p. 369.

<sup>9</sup>U. S. patents just issuing.



# Copper Leaching

The great subject of interest in the metallurgy of copper in 1913 was the extraction of copper from low-grade ores by leaching. Most of the important American copper-producing companies are working on this problem. There is going to be a new hydrometallurgy of copper, and it is going to be very soon. The Butte & Duluth company is already treating ore in this way on a small scale. The Braden plant is nearly completed, and it will not be very long before the Chuquicamata works are a going concern. In both those cases the preliminary experimental work has been of such a character and has been done in such a way that there does not remain much doubt respecting the working of the new processes upon a large scale.

In the experimentation with hydrometallurgical methods of copper extraction, attention is largely concentrated upon the best way of precipitating the copper from solution. Sulphuric acid is generally considered as the leaching agent. The obtaining of the solution of copper seems to be no great difficulty. The porphyry ores especially turn out to be small wasters of acid, not much going into solution except the copper and a little iron and alumina, wherefore the consumption of acid is small. In most cases the percentage of copper extraction runs over 90.

With regard to the precipitation, electrolysis and iron are the principal ideas. Cappelen Smith, Van Arsdale, Canby, Channing and Fields pin their faith to electrolysis; with insoluble anodes, of course. The acquirement of improved anodes, especially anodes of fused magnetite, and the introduction of sulphur dioxide into the electrolyte, reducing the electrical energy required, at but little expense otherwise, have put an entirely new and promising phase upon this kind of precipitation. Croasdale, Laist and Mathewson are exponents of the old idea of precipitation by means of metallic iron, in which the use of sponge iron reduced directly from iron ore obviates the old difficulty of insufficient supply of iron scrap and introduces advantages of its own. The exposition of this idea is perhaps due most to Croasdale and he seems to have been the first to use it in the experimental plant of the Calumet & Arizona, at Douglas.

The preparation of sponge iron consists in roasting pyrites, using the sulphur for the acid needed to extract the copper, mixing the burned pyrites with coal, reducing the iron, and using the iron to precipitate the copper from the sulphuric-acid solution. It is well known that the reduction of iron oxides takes place at about 800-900° C. The difference between that temperature and 1300° C., or so, represents the saving of fuel, plant, etc., by not having to scorchify the gangue and fuse everything.

Mr. Croasdale thinks that the preparation of sponge-iron precipitant can be arranged as a simple, foolproof process, and that the cost need not be more than \$6 per ton of iron and perhaps much less, not figuring any cost for the ore, even in such parts of the country as Arizona. This sponge iron is an ideal precipitant, offering a large surface and acting very quickly. Any gangue will, of course, settle with the copper precipitate. If low-grade pyrites be the only thing available, it will, of course, be a matter of balancing whether a preliminary separation of the gangue by magnetic separation, or otherwise, or a subsequent slagging of the gangue be the cheaper.

As for the rest, the trend of present ideas is to introduce into the hydrometallurgy of copper mechanical contrivances heretofore unknown in that art. At Chuquicamata the leaching is to be done in vats holding 10,000 tons, 16 ft. deep, 100 ft. wide, and 150 ft. long. In general the copper leachers tend to adopt the methods brought to so high perfection in the cyaniding of gold and silver ores.

Some of the work that is now going on is briefly summarized as follows:

*Arizona Copper Co.*—This company has, for many years, used a leaching process, consisting of sulphuric-acid lixiviation and precipitation by scrap iron, for the treatment of some of its ores. Experiments on the treatment of the slime from the concentrating mills are now being conducted. Much was dependent, here, it is understood, on having a neutral solution to precipitate from. Smith, in his work at Braden and Chuquicamata, also seems to feel that this is important.

*Anaconda*—The metallurgists of the Washoe works have developed a process, which is now being tried out in a plant of 80-tons daily capacity. Tailings are roasted in a special McDougal with outside fireboxes and are now leached with dilute sulphuric acid, but without the salt that was originally used. The chloridizing roast incurred metal losses and about as good a recovery of both copper and silver is made without it. Salt is carried in the leach liquor and this assists in collecting the silver. The copper is precipitated by iron sponge made by metallizing iron sulphide in a McDougal furnace operated partly as a roaster and partly as a reducer. The final product is practically a concentrate and is fed to the reverberatories. The plant is being run at present to determine at what stage the product of the concentrating mill may be best delivered to the leaching plant.

*Braden*—The concentrates are roasted in such a manner as to eliminate practically all the sulphur and at the same time oxidize all iron to the ferric state. The roasted product is then leached with dilute sulphuric acid in two stages—a neutralizing leaching, and an acid leaching. The solution from the neutralizing leaching is electrolyzed directly, and that from the acid solution is neutralized by the following batch of calcines. The development of this process, and also the Chuquicamata process (to be referred to subsequently) has been done under the direction of E. A. Cappelen Smith.

*Bradley*—Charles S. Bradley erected a plant at Anaconda, Mont., to treat the slime from the Washoe concentrator by his ingenious process, which consists in sulphate-roasting, leaching with calcium-chloride solution, and precipitation of copper from chloride solution by means of calcium oxide, regenerating calcium chloride which is used as lixiviant. When tried at Bayonne, N. J., this process is said to have worked well, but at Anaconda difficulties were experienced, and after a large sum of money had been expended and only a few hundred tons of ore had been treated, the plant was closed. However, Mr. Bradley has great confidence in his process and hopes to resume work at Anaconda.

*Butte & Duluth*—This company has a deposit of decomposed granite mineralized with oxidized copper, close to Butte, Mont. The ore is being leached with dilute sul-

phuric acid and copper deposited from the solution by electrolysis in the main, but foul solutions are switched off for precipitation by means of scrap iron. The plant is of something like 100 tons daily capacity and is being run on commercial basis.

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Reports have reached us of some interesting things in European zinc-smelting practice and experiment, but inasmuch as the JOURNAL will shortly publish a special article about these, I shall in the present article confine myself to things especially American.

Our great problem at the present time is without doubt the treatment of flotation concentrate. This is excessively fine, ranging from 80- to less than 200-mesh, and produces the troubles that fine ore always does metallurgically and in addition thereto some that are peculiar to the metallurgy of zinc. It is difficult to roast such ore, and there are also troubles in the distillation of it. The loss of zinc in roasting is particularly large. This appears to be due not merely to dusting, but also to reduction and volatilization. How to get around the difficulties is not yet known, but our metallurgists are philosophic about the matter, recognizing that the supply of flotation-concentrate is bound to increase and that they have got to learn how to treat it.

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Sweden, where several thousand tons of electrically smelted spelter are produced annually. A new plant which is to have 17 furnaces of 1000 hp. and eight furnaces of 500 hp. is about being completed at Trollhattan. The company owning these Scandinavian works reported recently that its smelting operations have not yet proved commercially profitable, but the results in August, 1913, were better than in any previous month, and it is hoped that things will eventually turn out well.

#### HYDRO-METALLURGICAL PROCESSES

Among processes of this kind, the chief attention in 1913 was devoted to the so called bisulphite process, and to S. E. Bretherton's ammonia process. Reports that reach me from Great Britain indicate some measure of success with the bisulphite process, which has been carefully worked out. Mr. Bretherton does not appear yet to have put this process in commercial, or even semi-commercial, operation. From the theoretical standpoint,

both of these processes are rational. I imagine that their future depends upon their ability to obtain a sufficient proportion of the zinc in solution and the cost of performing the several steps of the process. These factors are likely to vary according to the ore.

Another class of hydro-metallurgical processes is those in which the zinc having been obtained in solution, precipitation is effected by electrolysis. The Siemens & Halske, and Isherwood processes are of this class. Experimental work in this direction has also been done at Bully Hill, Calif. There seems to be no longer any difficulty in obtaining a dense coherent zinc cathode, if the electrolysis be conducted in the right way. However, the same remarks made with reference to the other hydro-metallurgical processes, apply to these also. Experiments were conducted at the Raritan works, Perth Amboy, with the Isherwood process, during a considerable part of 1913. No account of the work there has been published, which is a pity, for it was without doubt of great interest.

## Iron and Steel in 1913

BY BRADLEY STOUGHTON\*

The building of a smelting plant in Texas will have an important bearing on the large supplies of ore in that state, and the treatment of some of the Northern titaniferous ores on an industrial scale, as noted in an earlier issue of the JOURNAL, will doubtless revive interest in these enormous potential supplies of ore. Although Swedish iron ore continues to be imported into the United States, the acquisition of large Chilean deposits by the Bethlehem Steel Co., which had contracted for several million tons of Swedish ore, has again turned attention to the great resources of South and Central America, including Brazil, Venezuela, Colombia, etc. The chromiferous iron ores of Greece and the Chrome iron ores of Northern Caucasus are again attracting attention. The former bear a striking similarity in analyses to the chromiferous ores of Cuba. India is leading Russia and Brazil as an exporter of manganese ore. In the first-named country, American interests are prominently represented.

#### BLAST-FURNACE DEVELOPMENT

The improved type of blast-furnace construction devised by Johnson has already been described in the JOURNAL. There is a steady increase in the use of dry blast, and also in the use of blast-furnace blast, as well as bessemer blast, enriched in oxygen. There seems to be no doubt of the industrial importance of this practice, which will constantly increase as the price of oxygen is reduced. In the matter of thin lining there seems to be a slow but certain return to a lining midway in thickness between the extreme nine inches used in some cases and the 24 to 36 in. thickness of earlier days. Twelve to 14 in. seems to be more generally adopted at the present time.

Important developments have occurred in the cleaning of blast-furnace gas, and especially in cleaning by means of bag processes, and other methods which do not introduce moisture. There is also a constant increase in blast-furnace gas used in gas engines, and especially in mixtures of blast-furnace gas with coke-oven gas. A discus-

sion of more than ordinary interest is taking place between the advocates of gas engines and steam engines as to relative efficiency and economy.

#### IMPROVEMENTS IN FOUNDRY PRACTICE

A new method of dephosphorizing iron in the foundry, which is similar in principle to the Bell-Krupp method, has been patented in Sweden. An American inventor has also patented a process which is said to reduce sulphur. It consists in blowing air through a bath of molten iron in such a way as to produce a gentle ebullition with the purpose of causing the manganese sulphide slowly to rise to the top, but, at the same time, avoiding the bessemerization of impurities. The process is differentiated from the ordinary bessemer process in that it decreases, instead of increases, the temperature. There have also been several scientific studies made of the cupola processes, indicating the possibilities of greater fuel efficiency by reducing heat losses, most of which take place out of the top of the stack. The heat lost by radiation through the walls is said to be less than 4%, and that carried away in escaping gases is 25 to 40%. A German foundry is melting turnings and borings by blowing them in through the tuyeres by the blast.

A patented combination furnace containing some of the features of the bessemer converter, the openhearth furnace and the electric furnace, has been put in operation in a steel-casting plant in Maryland. A interesting investigation carried on in the bessemer converter developed the wholly unexpected fact that no more than 0.074% of oxygen could be permanently retained in the steel.

There are 19 electric furnaces for the manufacture of iron and steel in operation in the United States, but only one of them operates continuously so far as I am aware. There are about 150 active electric steel furnaces in the world, the largest of which is said to be of 30 tons capacity. The use of electric furnaces for annealing, hardening and other operations requiring exact control is in-

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creasing much more rapidly than the use of furnaces for melting, smelting and refining.

#### ELIMINATING PIPES IN INGOTS

The making of sound steel ingots has occupied a great deal of attention in England and America during 1913. In the former country, Sir Robert Hadfield and Benjamin Talbot have devised processes, the first of which consists in placing a charcoal fire on top of the melted steel, after interposing a layer of insulating slag, and then using combustion of this charcoal for heating the steel and drawing the shrinkage cavity to a higher point. A fireclay top in the ingot mold also decreases the radiation from this part. The Talbot process consists in passing the steel ingot through a pair of rolls before the interior has solidified, and, by thus reducing its size, closing up the shrinkage cavity. The same principle has been used by P. H. Dudley in America. Emil Gathmann, an American inventor, casts his ingot with the large end up, and also hastens the cooling of the lower part by increasing the metal of the ingot mold at that point. An ingenious process is then used for stripping the ingots without turning them over.

#### FUELS

The increase in the price of petroleum has caused a great decrease in the number of melting, annealing and heating furnaces using this type of fuel. In some cases great inconvenience has been caused. The result has been to draw attention very strongly to the use of pulverized fuel, and this subject has been ably discussed at more than one meeting in the United States. Pulverized coal is now employed in many puddling and heating furnaces, openhearth furnaces, annealing furnaces, etc. It is said that pulverized coal gives a higher temperature than can be obtained in any other way outside of the electric furnace, and the control of the combustion is described as excellent.

Simultaneously in France, England and America researches have been in progress upon the critical points of steel, and especially upon the  $A_2$  point, and upon the *beta* allotropic modification. The existence of the  $A_2$  critical point has been reestablished upon a firm foundation by Howe and Burgess, although Carpenter and others in England declared that such a point did not exist. The English metallurgists have, however, brought forward some evidence tending to discredit the existence of the hard *beta* modification, which, if substantiated, will require some changes in some of the theories maintained at present to account for the hardness of tempered steel. J. E. Stead has described a new method for the determination of the  $A_1$  point, and H. M. Howe describes a new method for the determination of the  $A_2$  point.

#### ALLOY STEELS

It is said that some extraordinary results have been obtained by the addition of cobalt to steel, and especially to high-speed steel. Sir Robert Hadfield has published some new data on the magnetic properties of manganese steel, and upon the heating and cooling curves of manganese steels.

#### COPPER STEELS

Steels containing from 0.1 to 0.5% of copper continue to attract a good deal of attention because of their al-

leged rust-resisting properties and greater durability in rails and steel sheets. Clevenger has shown that copper-steel forges well up to the content of 4% of copper, and good welds were made with as high as 0.8% copper. The effect of the copper is to lower the  $A_1$  critical point, to increase the elastic limit and hardness of the steel. A scientific study has also been made of the ternary alloys of iron, manganese and copper.

#### GASES IN STEEL

The injurious effect of nitrogen remaining dissolved in steel, which has been debated somewhat hotly for the past two years, received further confirmation in a lengthy research published in 1913. A much-needed method for the rapid determination of nitrogen in steel was also described; it depends upon the use of dimethylglyoxime. Attempts have been made to introduce oxygen into steel upon the supposition that it will benefit strength and ductility, and, as said above, it has been shown that not more than 0.075% oxygen may be retained in the steel bath. Upon the much-discussed question of the rapid determination of oxygen in steel, several investigations have been published. We are nearer a solution of that important problem without yet having reached it. In this connection a sharp distinction must be drawn between the oxygen united with, or held by, the iron, as distinguished from the oxygen united with manganese, silicon, etc., and mechanically occluded by the steel. The whole question of the effect of oxygen on both cast iron and steel is being considered with a degree of attention that indicates very important developments in the near future. Charpy and Bonnerot announce that, when hydrogen is made to diffuse through iron at a red heat, none of the gas is absorbed by the metal, and that sulphur, phosphorus and carbon are removed as hydrides, the strongest effect being noted in the case of sulphur.

#### LIQUID AIR IN THE STEEL INDUSTRY

The cheap production of oxygen through the manufacture of liquid air and the constantly decreasing cost of this manufacture through lowering the cost of producing power, one important means of which is the power produced by iron blast-furnace byproducts, augments each year the amount of oxygen used for enriching blasts, not only for the blast furnace, but also for the bessemer converter. As noted in an earlier issue of the JOURNAL,<sup>1</sup> the use of liquid oxygen for enriching the blast of a basic bessemer converter raised the temperature from the normal of, say, less than 1700° C., to about 2000° Centigrade.

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#### Selenium

Metallic selenium is produced by several of the electrolytic copper refiners. The use of this metal fails to increase and production is limited to what can be marketed. Exports amounted to about 9000 lb. of this metal, and 60 of tellurium. Naturally there can be no great changes in the metallurgy of so little a commercial metal, but it is worth noting that whereas selenium was formerly recovered from the fluedust of the slimes-smelting furnaces, it is now attempted by some makers to recover a seleniferous fluedust immediately by roasting the slimes. Prices have ruled steady at about \$2.75@3.50 for large lots, \$4.50@5.50 retail.

<sup>1</sup>Vol. XCV, p. 1054.

# Stamp Milling' in 1913

BY LOUIS D. HUNTOON\*

The result of correspondence with many metallurgists and a review of the literature of 1913 reveals the fact that the erection of new stamp mills in this country is practically at a standstill, and improvements in the general metallurgy of gold were along the lines of increasing the efficiency for handling slimes and the recovery of gold from the concentrates at the mills, thereby saving freight and treatment charges. Attention was also called to the successful treatment of many low-grade ores which but a few years ago would not have been considered.

## NEW MILLS

The Commonwealth mill at Pearce, Ariz., the erection of which was well under way, serves as an illustration of latest practice and embodies many features which are not found in the older mills. Gates crushers served as preliminary breakers, followed by 1500-lb. gravity stamps. It will be noted that the weight of these stamps exceeds by 100 lb. the installation at the MacNamara and Nevada Wonder mills in Nevada, which were recently erected. I understand the new type of mortars, with removable fronts, similar to those installed at the Cinco Minas of Mexico were specified. Following the stamps are Caldecott diaphragm cones, Hardinge mills, Dorr classifiers, tube mills, Dorr thickeners, agitators, counter-current Dorr thickeners, and Oliver filters. Attention should be called to the Hardinge mill, which has been adopted by several gold mills, the Dorr machinery, which is being adopted by most of the gold mills of this and foreign countries, and especially to the counter-current Dorr thickeners followed by Oliver filters. This latter innovation was adopted by many mills which, together with Dorr agitators, will probably be our standard practice for the next few years.

## PRELIMINARY BREAKERS

For preliminary breaking of ores the Symons disk crusher has been introduced into a few gold mills and many copper mills. These machines were not only built to handle 6-in. material as formerly, but were built this past year to receive a feed of  $1\frac{1}{2}$  in. to 2 in., and reduce same to  $\frac{3}{8}$  in. After extensive tests the Chile Exploration Co. placed an order for four 48-in. crushers to be used instead of rolls, and it is very likely within the next few years we will find stamps replaced by them. At the Blue Flag mill, Cripple Creek, the crushing operations consist of jaw breakers, Symons disk to  $\frac{3}{8}$  in., and Chilean mills. The Symons crusher has also been introduced into the following gold mills: The Portland, Cripple Creek, 36-in. crusher; the Ajax Gold Mining Co. a 24-in. crusher, and the Alaska-Gastineau Mining Co. a 36-in. crusher. An order was received late last year for three 36-in. disk crushers for the Mount Morgan mines in Australia.

## HAND SORTING

At most of the Rand mills from 10 to 20% of waste was discarded by hand preliminary to stamping. The claim was made by several engineers that with large installations hand sorting is not warranted, but local conditions

must determine this. At the East Rand, where 52,000 tons per month were milled in 1912, 13% of waste was discarded, and at the Crown Mines, milling 182,000 tons per month, 12% was discarded. At the new mill of the Knights Deep with an estimated capacity of 100,000 tons per month on ore estimated to give a recovery of \$4, hand sorting has been omitted.

The hand-sorting installations at the West End and Belmont Mills of Tonopah, where the mine run is sized and washed preliminary to hand sorting, gave most satisfactory results. In most cases where milling costs are from \$1 to \$2 per ton, or more, the advisability of hand sorting should be carefully considered as the cost of the necessary installation is far less than the cost required to increase the mill capacity an amount equal to the waste discarded. A second advantage is less gross loss in the tailings.

## STAMPS

The weight of stamps appears to have reached a maximum on the Rand. The new mill of the Van Ryn Deep installed 80 stamps weighing 1900 lb. each and expects a capacity of 20 tons per stamp. Most of the installations in the United States are from 1000 to 1200 lb. per stamp. On the Mother Lode of California they vary from 850 to 1250 lb., with an average, for 24 mills containing 1090 stamps, of 1000 lb.. Heavier stamps, 1400 lb., have been installed in the United States, and last year 1500-lb. stamps were specified for the Commonwealth mill, Pearce, Ariz. Installations were made of 20 stamps at the Cobalt Lake mill, Cobalt, and 40 stamps at the Dome mill, Porcupine, Ontario. Nissen stamps were specified for the new Shamva mill, Rhodesia, where a daily mill capacity of 2000 tons is expected.

To increase accessibility to the mortars, removable fronts, similar to those installed at the Cinco Minas of Mexico by G. D. Doveton, have been received with much favor. These mortars differ from the old type in that instead of the front being cast solid with the rest of the mortar, it is a separate plate of steel secured in place by heavy keybolts. By removing this plate the whole of the interior of the mortar is accessible. They were installed at the Trethewey mill, Cobalt, Ontario, and I understand were specified for the new mills at Pearce, Ariz., and the Aurora Mill in Nevada.

## PULVERIZING

Standard practice for pulverizing ores before cyaniding was by tube mills shorter in length and larger in diameter. In some cases these were preceded by Chilean or Hardinge mills. Specifications for the Van Ryn Deep mill on the Rand called for eight tube mills, 6 ft. by  $16\frac{1}{2}$  ft. At the Roodeport mill, tube mills 6 ft. by 16 ft. were installed. At the low-grade mill of the Nipissing Mining Co., which started operations November, 1912, four 6-ft. by 20-ft. mills were installed. In Nevada all recent installations of tube mills have been short: West End mill, 5 ft. by 18 ft.; Tonopah Extension, 5 ft. by 18 ft., and MacNamara, 5 ft. by 16 ft. It is claimed at the MacNamara that the fineness of the product of the short mill

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is equal to that of a 22-ft. mill, and that the wear and tear is much less per ton.

#### AMALGAMATION

The tendency during the past few years has been toward elimination of amalgamating plates following the stamps, the introduction of these plates following tube mills, a reduction of plate area per ton milled, and the entire elimination of plates when the values can be extracted by cyanide solution. At the Prince's Estate mill on the Rand, the plate area was 1.4 sq.ft. per ton milled, whereas at the Homestake it was 12 sq.ft. per ton milled. In Grass Valley, Calif., and at the Homestake mine, both inside and apron plates were used. At the Lluvia de Oro mill, Chihuahua, Mexico, plates were discarded and tube mills added before cyaniding. Pan-amalgamation of concentrates was abandoned at the Hollinger mill, and the concentrates are now pulverized and cyanided.

#### CLASSIFIERS

The Dorr classifier preceding pulverizing machinery was introduced into many gold mills and gave most satisfactory results, especially when used in a closed circuit with the tube mill. During the past year triplex counter-current Dorr classifiers were installed in several mills to remove the pregnant cyanide solution from sand tailings. Its success has been established.

#### CONCENTRATION

Multiple-deck concentrating tables were introduced in 1913 into copper mills and will probably be introduced into gold mills this year.

The recovery of the values from the concentrates at the mill, to reduce freight and treatment charges, was carefully investigated at several properties. The former practice at the Hollinger, pan-amalgamation of concentrates containing \$150 per ton, was abandoned and fine grinding of the concentrates in a 10-lb. cyanide solution introduced. A 94% extraction is reported.

The Goldfield Consolidated of Nevada increased its net profits 50c. per ton of ore milled by roasting its concentrates in Edwards furnaces and recyaniding the tailings from the raw-concentrates treatment plant. This plant was started during 1912 and has been most successful. The annual report of the Alaska Treadwell for 1912 states that from concentrates assaying \$60 per ton a recovery of 97% is made by pulverizing and cyaniding. At the Globe & Phoenix mill, Rhodesia, concentrates assaying \$90 are roasted, slimed in pans, and agitated in cyanide solution, resulting in a 96% extraction. Many cyanide experiments have been conducted on the concentrates produced at Tonopah, but so far the saving by treatment at the mill is too slight to warrant the installation necessary.

The Liberty Bell company, which has always shipped its concentrates, has installed a system of separate treatment, consisting of tube milling, agitation and a separate counter-current decantation treatment to recover separately the large amount dissolved. The tailings from this plant join the mill pulp for final filtration.

#### FILTRATION

For the Commonwealth mill of Arizona, Oliver filters were specified. These will be preceded by Dorr counter-current thickeners. This practice appears to be widely

indorsed and will probably be adopted by many mills in the near future. Vacuum filters of the Butters type were first installed on the Rand at the Crown Mines in 1910, and since that date they have been adopted by many mills; they are specified for the new mill of the Van Ryn Deep. The total capacity of these filters on the Rand at the close of 1913 was approximately 8000 tons of slimes per day. At the Shamva mill, Rhodesia, Butters filters were specified.

#### PRECIPITATION

The practice of clarifying pregnant solutions by passing them over excelsior or wood shavings preliminary to precipitation appears to have been common practice. Zinc either in the form of dust or shavings is commonly used for gold, and aluminum is used for the strong silver solutions of Cobalt. Precipitation by aluminum was fully described in the JOURNAL of May 10 and June 28, 1913.

#### PRECIPITATE TREATMENT

At the Hollinger mine the method of refining was changed. The precipitates are now fluxed without acid treatment and run through a lead stack; the resulting lead bullion is cupeled and the litharge produced skimmed from the cupel. The gold bullion is then melted down in a Steele-Harvey furnace with a small amount of oxidizing material. The final bullion is 970 fine combined gold and silver. At the Independence mine, Cripple Creek, the precipitates are dried, sampled and shipped to the smelter in sealed cans, although it is generally considered better practice to treat the precipitates at the mill. This innovation is worthy of careful consideration when mills are located near a smelter. At the Nipissing mill, Ontario, where shipments of bullion exceeding 4,000,000 oz. are annually made, the precipitates are briquetted with a small percentage of flux and melted in a reverberatory furnace, producing bullion 997 fine.

#### LOW-GRADE MILLS

Improvements in metallurgical treatment and the mechanical handling of ores has made it possible to treat commercially ores which a few years ago would not have been considered. The operators at Cripple Creek, Colo., deserve a review. Rich ore, of which the production is small, is shipped to the smelter. The Claney cyanide process which was installed at the Ajax mill, cyaniding without preliminary concentration, proved a failure. Concentrating tables were installed last year. At the Portland mill it was also necessary to introduce concentration to separate the sulpho-telluride minerals, which in turn are shipped to the smelter. The annual report of Strattons Independence for 1912-1913 will contain the following figures: Ore milled, 104,111 tons from dump and 25,999 from mine; assay, 0.1538 oz. gold per ton; concentrates produced, 1429 tons first grade, assaying 4.118 oz., and 545 tons second grade, assaying 1.847 oz.; total milling cost, including moving of dump ore, \$1.44 per ton. The treatment consists of crushing through rolls, chilean mills, and tube mills for coarse sands, followed by classification, concentration, leaching of sands, and air agitation and vacuum filtration of slimes. The slimes are treated with cyanide solution followed by a separate treatment with bromo-cyanogen.

The Wasp No. 2, located in the Black Hills of Dakota, treated at a profit ore assaying \$2.66 per ton, and the Treadwell, of Alaska, ore assaying \$2.67 per ton.

# Analysis of Cyanide Practice

BY HERBERT A. MEGRAW

The year just ended has been in some ways an important one for the cyanide process. In an art as highly developed as this, it is not to be expected that improvement will be revolutionary, but rather that progressive development will grow gradually into accomplishment. As much as it is within the realm of possibility, however, improvements have taken place which are really notable. The one charged with the greatest importance for the process is the adoption of aluminum dust as a precipitant, a step which has been taken at the new mill of the Nipissing Mining Co., at Cobalt.

## AN IMPORTANT INNOVATION

It is not the fact that aluminum will precipitate gold and silver from cyanide solution which is new, for that has been long known and even practiced for some years, but it is the definite knowledge of how and why it may be used, and the lucid explanation of its value by E. M. Hamilton, who is responsible for its use at the Nipissing, which constitutes a gist of the advance. The fact that aluminum forms no compound with cyanide, and that when the metals are removed from solution, all the cyanide used in dissolving is returned to the solution for further use, seems to me to be extremely significant and of infinitely greater importance than the mere successful treatment of a difficult ore. It is important too, to know that the zinc precipitant in the presence of arsenic in the ore under consideration, resulted in a cumulative fouling of the solution and a reduction of the extraction, while the use of aluminum avoided both troubles. This is chemical improvement such as was to be expected and I hope for still further developments in a similar direction.

## POSSIBLE DEVELOPMENT OF A NEW PRACTICE

The investigation into the use of aluminum as a precipitant is of great importance because it points toward a practical process by means of which ore containing soluble base metals may be economically cyanided. Large amounts of ore exist which contain copper or other metals in soluble form to such an extent that their gold or silver contents cannot be economically extracted by cyanide because of the great chemical consumption. If, however, the cyanide used in dissolving these base metals can be returned to the solution without loss, or with small loss, a new and profitable metallurgical field is at once opened. The one obvious step necessary to put such a process in tangible form is a method of precipitating the various metals in the solutions separately so that they can be marketed without penalties. There are several promising possibilities by means of which such a system may be worked out. The reward awaiting the metallurgist who puts such a process into practical working is great, and I believe it will be claimed before long.

## THE QUESTION OF GRAVITY STAMPS

Stamp mills have made another step toward the backwoods. The last year has brought to light much discussion upon crushing and grinding which has tended to bring more efficient machines to the front. Methods of

scientifically comparing the virtues of various machines have been advanced, notably by Del Mar and Gates. Later commentators have made use of the methods of these two, and additions are being made so that an adequate system of efficiency comparison will be forthcoming. When this does appear, the stamp mill, as we now know it, will probably be very largely displaced. Some important plants have been built lately without stamps, and their efficiency, economy and satisfactory results in general, have done much to demonstrate the value of other crushing machinery.

## MACHINES TO REPLACE STAMPS

In the use of machines to replace stamp mills, there is a marked difference of opinion. In a great many cases rolls are being used to perform this function, but in others, ball mills or chilean mills are recommended. In a large installation which is to be properly taken care of, it is difficult to find machines which will give more satisfactory results than rolls. Their use is undoubtedly widening a great deal.

Ball mills have not yet reached the point where they may be safely recommended for general use. They may serve in some cases, but as machines of wide application, they cannot be endorsed. Chilean mills, on the contrary, have a long and honorable history of good work. The division into high- and slow-speed mills is essential when chileans are considered, because the two are of different character and produce different results. Examples of successful use of the high-speed mill are found in many plants and have already been referred to in other articles on this subject. The same is true with the slow-speed mills, but these have not yet received their merited amount of public confidence and I expect to see them more popular within a short time. Where a slimed product or a product which consists principally of slime is required, particularly in small installations, the slow-speed chilean mill is bound to procure a wide field of usefulness.

## A NOTEWORTHY CHANGE OF SYSTEM

A feature of particular interest to all cyanide workers is the change of system which is to be instituted at the Dome mill in Porcupine, Ontario. This mill was designed by C. W. Merrill as a total sliming plant and has been operated by crushing in water, amalgamating on plates, thickening, agitating in Pachuca tanks, and filtering in Merrill sluicing filters. The change which is to be made is from total sliming to a slime-agitating and sand-leaching process. This will, of course, cut out a large portion of the regrinding and will greatly increase the capacity without a material increase of machinery in the plant, about the only thing necessary being the leaching tanks. Amalgamation, it is understood, will be continued as before.

Agitation has progressed somewhat during the year, but there have been no important or astonishing developments. The Dorr agitator, which has been offered to metallurgists during this time, has achieved a noteworthy success and seems to be in line for widening its field of



application. Trent agitators and other designs have also been installed during the year, but the Pachuca tank is not making its usual rapid advance in the larger plants. It is understood that the Liberty Bell mill at Telluride, Colo., has removed its Hendryx agitators and replaced them by Dorr machines, a step which has resulted in a saving of power. The total capacity of the Dorr agitators is greater than that of the Hendryx machines formerly used, but this is explained in view of the fact that amalgamation on plates is to be discontinued and the entire extraction of both gold and silver from the ore is to be performed in the cyanide department. For this reason, naturally a somewhat larger agitation capacity is required.

#### CONTINUOUS AND CHARGE AGITATION

Agitation in continuous systems, as opposed to that in the charge system, has not made any great strides during the year, although some plants have changed over from the charge to the continuous system. There is a great deal to be said upon each side about this matter, and it is not suitable to attempt to make a general rule apply. Some plants do very well with continuous systems and others have clearly demonstrated that the charge system gives them better results in dollars and cents. This, of course, is what is desired by all workers.

#### THE FILTER SITUATION

The situation with the two principal vacuum filters is about as it has been for the past year or two. A good many plants treating silver ores, which are considered to require filtration, have adopted the rotary continuous system, using Oliver-type machines. These have proved satisfactory. A recent development in the filter situation is the invention of a new type of leaf by Charles Butters, already mentioned in the JOURNAL, in which the essential point is that the leaf is open at the bottom so that when vacuum is applied, the flap of canvas comes together and makes it practically an ordinary filter leaf, but when vacuum is withdrawn, the canvas flap parts and there can be no difference of pressure inside and outside the leaf. The discharge is effected by applying water through a perforated pipe on the outside. The cake is thus sluiced off. Operators at the Belmont and Desert mills, Tonopah, claim that a final reduction of moisture can be obtained, which is somewhat less than could be obtained with the leaf of the original form. The new leaf is not sewed at all and may be taken apart in a short time without any trouble. It seems that this would do away, to a large extent, with acid treatment, as the canvas cover of the leaf could be set out to dry, and when dry, thoroughly shaken or beaten and finally roughly washed in water so as to get rid of practically all the lime accumulation.

#### COUNTER-CURRENT DECANTATION

Filtration in general, however, is getting a severe jolt in the rapid strides made by continuous counter-current decantation. This is a process which is likely to take a pretty strong hold on the metallurgical fraternity, and has already made appreciable inroads into the filter field. The filter at the Goldroad mill, Arizona, has been discarded and the counter-current decantation process used instead, consisting of units of Dorr thickeners. The same applies to the plant of the Tom Reed at Oatman, Ariz., and the Lluvia del Oro, Chihuahua, Mexico. The

Vulture mill at Wickenburg uses nothing else and had no filters installed. Apparently this system will work perfectly well on gold ores in which low cyanide solutions are permissible. Where silver is treated, stronger cyanide solutions have to be used, and in that case, either an extended series of decantations would be necessary, or a more moderate one followed by filtration. In this case, filtration is used not so much to recover metal, but to save the cyanide in solution. To accomplish this, continuous revolving filters of the Oliver type are satisfactory and may be very largely used. In fact, they are being included in the installation at one of the largest and best equipped new mills in Mexico.

#### THE SITUATION IN OTHER COUNTRIES

Cyaniding in Mexico has not presented any great developments of importance during the year. The reason for this is, of course, found in the political condition obtaining there, which has precluded progress of any kind. Cyanide-plant construction has been going on to a limited extent probably the most important being the Cinco Minas mill in Jalisco and the San Pedro Anasco, both of which have been designed and constructed in spite of the unsettled condition of the country in general. One or two other plants have been constructing as best they could during the year.

In South Africa, construction has not been particularly rapid and no metallurgical novelties have been introduced. Vacuum filtration is receiving additional impulse and has been making a place for itself. Zinc dust as a precipitant, the Merrill process, has been studied by some operators and promises to make some headway.

In Rhodesia, thickeners have been installed, but nothing metallurgically new has been produced. Developments have been along the conservative lines and freak processes or machinery have been accorded scant attention.

Porcupine has acquired several new mills during the year. These have followed standard practice and have made use of the most modern machinery. The Dome, as has already been mentioned, has an additional 40 stamps and changes from all sliming into a separate treatment plant. This is a change of special importance to cyanide operators and will give them something to think seriously about. The Hollinger mill no longer amalgamates the concentrates it produces, but gives them a special cyanide treatment.

Aside from the Nipissing low-grade mill, which practically began its operations during 1913, Cobalt has not attracted particular notice in cyaniding, but that one development was quite sufficient to center the attention of the cyaniding world. The treatment of the so called "low-grade" ores and aluminum precipitation will not be soon forgotten.

#### TUBE MILL DEVELOPMENT

Tube milling continues to be the approved method of producing slime, but dimensions are in the midst of an evolution leading to maximum diameter and minimum length. A diameter of five or six feet, and length of 16 or 18 ft. is no longer unusual. A. O. Gates believes in the adoption of mills of large diameter and only one or two feet long. The theory is that material ground is immediately discharged from the mill without having any more energy wasted on it. The idea is then, to

classify the pulp and regrind that portion which needs it. Thus a series of units is proposed, with classifiers between them, for a highly specialized system of stage reduction.

The calculation of extraction by different methods has

received a good deal of attention through discussion in the JOURNAL, and it is probable that there will be more of it before the subject is dropped. With it all, however, it seems altogether likely that few opinions have been changed.

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## Gold Dredging in 1913

By ROBERT E. CRANSTON\*

In glancing over the records of dredge operations in the United States during 1913, one is impressed with the fact that there has been little actual progress made either in increased equipment or improved methods. Several small new areas have been equipped and a few new dredges built on old properties, but this is nearly if not quite counter-balanced by the working out or abandonment of other areas. Several old dredges have been rebuilt to operate on the same or other areas and there is demand for properties suitable for operating with old equipment taken from worked out or abandoned properties. The search for new areas continues with unabated persistence but the result is not encouraging.

Alaska and the Yukon territory show more new development than any other districts which have come to my notice. What is to be expected from Siberia is still uncertain. Much work is being done in South America, particularly in Colombia, but the future of this country is still doubtful. We hear of progress being made in New Zealand, Australia and Africa but the data available are not complete enough to form an intelligent opinion as to their future dredging possibilities.

### CALIFORNIA

On January 21, 1913, the Natomas Consolidated put into commission its No. 8 reconstructed dredge. It has 15-cu.ft. buckets, was built in 1910 and burned in October, 1911. The rebuilt dredge has a steel hull, otherwise differs but slightly from the original. It is digging 55 ft. of rather hard ground at the rate of 220,000 cu. yd. per month. No. 7 dredge of Natomas Consolidated was reconstructed with a new steel hull, moved to Blue Ravine on the American River and put in commission May 13. This dredge was originally built in 1904, was reconstructed in 1908 and again this year. The last rebuilding required 130 days. It is now digging ground 55 ft. deep and handling 180,000 cu.yd. per month. Much of new machinery was used; the hull is 134 ft. long, 9 ft., 6 in. deep and 46 ft., 6 in. beam on the water line. The digging ladder is 122 ft. long between centers and carries 97 nine-cu.ft. buckets. The dredging spud is near the center line with a stepping-up spud 11 ft., 8 in. to starboard. The old dredge had 7-ft. buckets and was equipped with motors aggregating 320 hp., while the present dredge has 778 hp. and 9-cu.ft. buckets.

Natomas No. 6 dredge was first put in commission during March, 1908, and operated to May, 1913, at which time it was dry-docked in order to make necessary extensive repairs to the hull and at the same time overhaul some of the machinery. The work was completed and the dredge again put in commission July 31. This

dredge has a wooden hull and is equipped with 9-cu.ft. buckets. Natomas No. 5 dredge was placed in commission during December, 1905, and was sunk June 8, 1913. The accident is said to have been caused by a loose bolt and rotted planks. The dredge pit was pumped out and the dredge righted and ready for repairs on July 15. The hull was in service 7½ years and was found to be in better condition than the hull of No. 5, which was in service only 5¼ years. It is thought that this difference is to be accounted for by the fact that No. 5 was built during the summer, of seasoned lumber, while No. 6 was built during the winter, of wet lumber. This dredge is equipped with 9-cu.ft. buckets. The Ashburton dredge at Folsom was put out of commission in December, having worked out all its ground. No new dredges were built in the Folsom district during 1913.

In Butte County, the Butte Creek dredge has been remodeled. The El Oro company is said to be contemplating redredging some of its ground. Low water caused considerable trouble during the year. The Ophir dredge has only a small amount of ground to dig before the second boat goes out of commission.

On the Yuba, the Yuba Consolidated has built No. 14, an all-steel, 16-cu.ft. dredge which will be still heavier than their No. 13, and is probably the largest gold dredge in the world. The hull is 155x58 ft. and the dredge is designed to dig 75 ft. below water level, and will handle 10,000 cu.ft. per day. Beside being the largest dredge, it is the only one provided with a steel deck. A record was made in constructing the dredge, the elapsed time being four months and four days. It was ready for digging on Dec. 17, 1913. The Tarr Mining Co. with its freak equipment came to its inevitable end when Superintendent Paser reported the grade of gravel too low to warrant further development or the taking up of their options. In Nevada County, a dry-land dredge has been installed on Deer Creek.

The Pacific Gold Dredging Co. reconstructed one of its 7-ft. dredges formerly operating at Oroville, and placed it on the American River at Mammoth Bar, near Auburn. Part of this property has been worked for the last 30 years, necessarily by an hydraulic elevator. The Gaylord dredge at Whiskey Bar, on the American River, has been partly remodeled and is now working. The Cache Rock dredge, still further up the American River, has worked out its ground and been dismantled. Much prospecting has been done along the upper forks of the American River and I expect to see one or more dredges built there during the coming year.

In Siskiyou, Shasta and Trinity Counties much prospecting has been done during the past year and several dredges and other placer mining devices are reported as about to be installed. The only actual new equipment

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so far as I can learn, consists of a drag-line excavator at Igo and a bucket dredge near Lemiston on the Trinity River.

In Calaveras County, the Oro Water, Light & Power Co. has had built by the New York Machine Shop of Oroville, a 7-ft. dredge for their property on the Mokelumme River, near Comanche. The Western Dredge, Mine and Construction Co. has built a one-bucket dredge on the Calaveras River near Valley Springs. The Isabella and the Calaveras dredges, near Jenny Lind, have been overhauled during the year. Considerable delay has been caused by shortage of water in this district during the fall months.

La Grange dredge on the Tuolumme River overturned on March 21. The accident was caused by the hull striking a hard point of bed-rock and punching a hole in the planking. The boat was righted and is now operating again.

#### OTHER STATES

A news item states that two dredges are to be installed in the Cripple Creek district at the foot of Mineral Hill. There are some small placer deposits in this district, but I do not believe there is enough area there for one dredge to say nothing of two. The Colorado, Reliance and French Gulch companies are operating steadily in the Breckenridge district, Colo., and report some very rich cleanups.

[Announcement was made late in December that the Colorado Gold Dredging Co. and other operating companies in the Breckenridge district had been taken over by the Tonopah Placers Co., an affiliated company of the Tonopah Mining Co. of Nevada. It is understood that hydraulicking operations will be undertaken, as well as dredging.—Editor.]

The Tin Cup Gold Dredging Co. has completed its power plant at St. Elmo and has recently launched its Marion dredge in Bertha Gulch, Gunnison County, Colo. While overhauling the Pierce dredge, Clearwater County, Idaho, on Sept. 25, it took fire and was destroyed. Two new dredges are being built near Salmon City, Lemhi County. In Oregon, a Nome Beach type dredge is being installed near Randolph, 12 miles from Brandon, Coos County, and the Champlain dredge, two miles above the mouth of Footh Creek, is to be put in operation after several years of idleness. The Bohannon Bar Dredging Co. started a 6-cu.ft. dredge, built by the Yuba Construction Co., on Sept. 10, near Salmon, Idaho. This is an electrically operated machine, and has a capacity of 3500 cu.yd. per day.

#### ALASKA AND THE YUKON

The Kotzebue Mining Co. has installed a 3-ft. combination screen-and-flume dredge for its property on the Inmachuck River. The hull is 62 ft. x 30 ft. x 5½ ft., the revolving screen 13½ ft. x 4 ft., with 2½ in. perforations, the belt is 24 in. wide and 37 ft. between centers and placed on the port side of the screen with a flume on the starboard side 75 ft. long and 42 in. wide with undercurrents. The conveyor is on the same grade as the flume, viz; 10 in. in 12 ft., and serves to carry the oversize, thus relieving the sluice and allowing less water to be used than would otherwise be required. The main drive is a 50-hp. gasoline engine, and a 7-in. high- and 8-in. low-pressure pump are used. On the Kugruk

River a 3½-ft. sluice dredge, without conveyor, has been built for Iver Johnson and associates. This and the Kotzebue were built by the Union Construction Co., of San Francisco. On Bessie Beach, Nome, one large dredge has been built this season and others are being arranged for in the Innoko country and Moore Creek. The Canadian-Klondyke Mining Co. built two more 16-ft. dredges this year in Bonanza Basin.

The Arctic Gold Dredging Co., of Nome, placed in operation a 2½-cu.ft., open-connected bucket dredge, with machinery furnished by the Union Construction Co., which company also furnished a similar machine for Flodin & Hutton, Shismaref, and a 3½-ft., close-connected bucket dredge for Riley & Marston, Iditarod.

#### OTHER COUNTRIES

The Pato dredge of the Oroville Dredging Co., Limited, has been operating successfully during the past year. It is of standard California type with steel hull and 7-ft. buckets, and is working on the Nechi River near Zaragoza, Colombia. It is reported that the Anglo-Colombian Development Co. has contracted for a 7-ft. dredge for its gold-platinum property on the San Juan River in western Colombia.

There have been several large exploring parties in the field in Brazil, Dutch Guinea, Honduras, Peru, Bolivia and other parts of South America, but little is known of their investigations except that some of the results were not as favorable as hoped for.

There has been little change in dredge costs during 1913. The larger companies operating several dredges of varying sizes report costs from 5 to 6c. per cu.yd. The 13- and 16-cu.ft. boats made record runs of from 2½ to 3½c. and 3- and 5-ft. sizes range from 6 to 10c. A medium size dredge (7 to 9 ft.) under favorable California conditions will do the work for about 5c. per cubic yard. During the year there has been some agitation in regard to land damage done by the dredges. In several instances injunctions have been served, but as a whole, there has been very little serious litigation.

The Yuba Construction Co. furnished a dredge, now approaching completion, for Ingersoll & MacDonald, on the Malagait River, Luzon, P. I. It is a 5-cu.ft. bucket, flume-type, steam-operated machine, of 2500 to 3000 cu. yd. per day capacity. The Bucyrus Co. furnished a 7½-ft. placer dredge for the Andrada Mines, Ltd., Portuguese East Africa. It has a steel hull 108 ft. long, 40 ft. wide, and 9 ft. deep, and is driven by a 150-hp. digging motor, and the screen pump by a 10-hp. motor. It was designed for handling exceptionally sticky material, which accounts for the size and power of the pump. The winches are designed to handle side lines 1000 ft. long, and either spuds or headlines may be used. This dredge was shipped by rail 300 miles inland to Maceque, and from there to Andrada, four miles, it was hauled by oxen in wagons constructed of steel by the Bucyrus Co. for the purpose.

The Portuguese-American Tin Co. placed in operation a 4-cu.ft., close-connected bucket, steel-hull dredge, with Union Construction Co. machinery. It is operating at Belmonte, Portugal, on a placer tin deposit. Also a 5-cu.ft. bucket dredge for the Balkans and a 7-cu.ft. one for the Malay States are building by the Union Construction Co. and Fraser & Chalmers.

It does not appear that the future of gold dredging in the United States is encouraging for new or more extensive work. The old companies with large tracts will continue to produce well, but I see no reason to expect any great increase. I look for a large production and increased equipment in Alaska and the Yukon. Si-

beria, Africa and South America are still in the prospective stage, but so far no large tracts have been proven, although I hear of several promising districts which may develop into large producers later, but which require more thorough and systematic prospecting before anything definite can be said of them.

## Economic Geology in 1913

BY ADOLPH KNOPF\*

Among the most notable features in the progress of economic geology during 1913 was the appearance of a number of highly important treatises on mineral deposits. Of these, the great work of de Launay, "The *Traité de Metallogenie*," is of encyclopedic scope. The somewhat unusual character of this treatise is indicated by its title.

Metallogeny, according to de Launay, is the study of the mineral deposits of the chemical elements, of their groupings, and especially of their abnormal concentrations in industrially utilizable proportions. It may be considered as a particular phase, and, in fact, as the most interesting phase of petrology. The metallization of a region, that is, the kind and character of mineral deposits formed in it, depend (1) on the composition of the fundamental magma forming the intrusive core beneath the region; (2) the tectonic movements to which the region has been subjected; and (3) the time that has elapsed since these movements. These may be said to constitute the fundamental laws of metallogeny. Since their first promulgation by de Launay in 1897, they have found wide acceptance, especially by American investigators.

The classification by types of deposits, which is that most generally adopted in current treatises, says de Launay, offers in spite of important advantages, the grave fault of scattering the descriptions of deposits of the same substance according to a system necessarily somewhat hypothetical and arbitrary. In consequence such a classification is not practical and is not adapted to a study of the economic and commercial conditions of each substance, which he believes is essential. De Launay, therefore, describes in succession the deposits of each chemical element, the elements being grouped according to his metallogenetic classification, which is a modification of the well known periodic system of Mendeléeff. For each element is given: (1) Its applications and sale; (2) centers of production and statistics; and (3) descriptions of the deposits grouped in accordance with the principles of his theoretical classification. This scheme is as follows:

- A. Disseminated magmatic deposits; such as diamonds in kimberlite, or platinum in peridotites.
- B. Magmatic oxide segregations.
- C. Peripheral sulphide segregations.
- D. Diffuse impregnations at extreme depths.
- E. Contact-metamorphic deposits of the Banat type.
- F. Hydrothermal deposits.
- G. Detrital deposits.
- H. Deposits of chemical deposition.

Probably of more direct interest to American readers is the recently issued treatise by Lindgren entitled "Mineral Deposits." This is a careful and remarkably judicious summary of existing scientific knowledge of mineral deposits, exclusive of the fuels and structural materials. The treatment of the subject is consistently from the

genetic point of view, the descriptions being by types of deposits.

The classification differs in an essential way from all previous attempts in that it takes account of the physical as well as the chemical conditions under which mineral deposits originate. It attempts to set fairly precise limits to the ranges of pressure and temperature under which the different types have formed. It is interesting to note, as showing the convergence of ideas on the genesis of mineral deposits, that this physical factor is also recognized in part by de Launay, who, under his hydrothermal group, discriminates deposits formed at three different depth-zones; at great, moderate and shallow depths. The precision given to this idea and its careful articulation with observed facts and experimental data are, however, the eminently distinguishing features of Lindgren's mode of treatment.

During the year, the second volume of Beyschlag, Krusch and Vogt's work on mineral deposits has appeared. In its scheme of classification and mode of description of the deposits it does not differ fundamentally from the well known treatise of Professor Beck.

The large number of excellent articles on the subject of downward sulphide enrichment has been the most remarkable feature of the year. The principles of sulphide enrichment, comprising what is perhaps more widely known as the theory of secondary enrichment, were first definitely formulated in 1900 by S. F. Emmons, C. R. Van Hise and W. H. Weed. Since that time, owing to their inherent scientific interest and their great practical importance, the many problems connected with the application of these principles to metalliferous ore deposits have held the attention of geologists. A comprehensive exposition of these processes and their application to a large number of mining districts, has recently been published by Prof. W. H. Emmons.<sup>1</sup> He has assembled the large mass of information scattered through the American literature on the subject; he has set the facts in order, and has illuminated them by his own studies, and as a result the treatise is not only an invaluable reference volume, but is also an important contribution to science.

The paper by H. C. Cooke<sup>2</sup> is a record of an experimental investigation of the chemical reactions involved in the downward enrichment of silver ores, and affords a notable example of the increasing tendency to apply the laws of physical chemistry to the problems of economic geology. Chase Palmer and E. S. Bastin have investigated the precipitation of gold and silver from solution by the action of metallic sulphides and arsenides.<sup>3</sup> Although these pre-

<sup>1</sup>The enrichment of sulphide ores, U. S. Geol. Survey Bull. 529, 1913.

<sup>2</sup>The secondary enrichment of silver ores, "Journ. Geology," Vol. 21, No. 1, 1913.

<sup>3</sup>Metallic minerals as precipitants of silver and gold, "Econ. Geol.," Vol. 8, pp. 140-170, 1913.

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ipitative reactions have long been known, they are now being studied quantitatively and with special reference to their bearing on the problems of sulphide enrichment.

Bastin has also contributed a paper in which metasomatic replacement (a term applied to the transformation of one mineral into another of different chemical composition, effected by concomitant solution and precipitation) is shown to be an important process in the downward sulphide enrichment of certain Colorado and Montana silver veins.<sup>4</sup> It is believed by him that no change in volume is involved in the replacement; if this is true the process appears to violate the stoichiometric laws of chemistry, and it becomes a problem for future research to explain this apparent anomaly.

The processes whereby the mineralized porphyry at Ely, Nev., one of the most important of the so called porphyry copper orebodies, was sufficiently enriched by the deposition of copper brought down by surface waters and precipitated upon the lean sulphides of the primary mineralization, have received philosophic exposition by A. C. Spencer.<sup>5</sup>

Among the more signal features of this study is the recognition that the Stokes equation, which is commonly accepted as expressing chemically the change of pyrite to chalcocite, is incompatible with the actual volume relations observable. The conversion of pyrite to chalcocite according to the Stokes equation is as follows:  $5 \text{FeS}_2 + 16 \text{CuSO}_4 + 12 \text{H}_2\text{O} = 8 \text{Cu}_2\text{S} + 5 \text{FeSO}_4 + 12 \text{H}_2\text{SO}_4$ .

This reaction calls for an expansion in volume of the transformed pyrite of from 54 to 75%, actually, however, the reaction seems to proceed according to the law of equal volumes, that is, the pyrite is replaced by the chalcocite "metasomatically." As in the silver enrichment described by Bastin, so here the term metasomatism is customarily employed to denote a change effected through chemical processes of whose real nature we know little. Spencer, however, makes the suggestion that the main reaction summarized by Stokes' equation is accompanied by a concurrent reaction that provides the excess volume demanded by the chalcocitization of the pyrite. But this merely throws the difficulty one step farther back; the regulative mechanism that governs the nice balance between solution and precipitation is still unexplained.

The effectiveness of metallographic methods in facilitating the study of the enriched copper ores has been strikingly demonstrated by the work of Graton and Murdoch.<sup>6</sup> This investigation was commenced primarily: (1) To ascertain the mode of occurrence of the copper in cupriferous pyrite; (2) to discover the relation of chalcocopyrite to pyrite in pyritic orebodies; and (3) to arrive at criteria for distinguishing primary and secondary copper ore.

Although the present paper is mainly a report of progress, it contains a number of important empirical generalizations, which are thought to be supported by sufficient data already to rank as valid inductions. Of interest is the establishment of a criterion whereby it is believed primary chalcocite can be distinguished from secondary chalcocite; until recently chalcocite, which now

furnishes more than one-half of the world's supply of copper, was considered to be secondary in all occurrences. The practical importance of this work is so great that a number of the larger copper-mining companies of the United States have recently financed a geological commission for the study of the problems connected with the downward sulphide enrichment of copper. This investigation has been put in charge of Prof. Graton.

The paper of Reno H. Sales is a notable contribution to the genesis of the ore deposits at Butte, Mont.<sup>7</sup> Mr. Sales, who, as chief of the geological corps of the Amalgamated Copper Co., has had unrivaled opportunity to study these deposits, has put forth several new conceptions, little short of revolutionary. He believes that only the so called sooty chalcocite at Butte, which is essentially restricted to a shallow zone, is of secondary origin, and that the massive steely chalcocite persisting down to the greatest depths yet attained, is of primary origin. As Butte has long been cited as a striking, though it must be confessed, somewhat disconcerting example of the depth to which secondary enrichment may extend, it will at once be realized how subversive of accepted belief this conception is. The different vein systems are shown to have received their metalliferous fillings during a single epoch of mineralization, and the manganese-silver veins, whose relation to the copper veins has not hitherto been satisfactorily explained, are clearly demonstrated to be genetically coeval with the copper veins and to be connected with them by gradual transitions along the strike.

The report on the "Geology and ore deposits of the San Francisco and adjacent districts, Utah," by B. S. Butler (U. S. Geol. Survey Professional Paper 80, 1913), contains a notable study of sulphide enrichment. Most important is the establishment of the fact that wurtzite, the hexagonal sulphide of zinc, is a common product of the action of downward-moving acid solutions on the primary sulphides of orebodies, in conformity with the result of recent researches at the Carnegie Geophysical Laboratory.

Krusch has discussed the origin and significance of colloid or "gel" ores.<sup>8</sup> Ores of this kind, such as, for example, chrysocolla, copper pitch, etc., are often of great importance in the belt of weathering; this is a line of research to which no attention has yet been paid in America. An admirably lucid exposition of the principles of this subject and its application to mineralogy has been given by R. Marc, and is of much interest to students of ore deposits.<sup>9</sup>

The genetically important type of tourmaliniferous silver-lead ores has been described from Montana by Adolph Knopf;<sup>10</sup> the derivation of these ores from an igneous source seems unusually clearly indicated by the field evidence, leading to the conclusion that they represent a final differentiation product of the intrusive quartz monzonite magma.

Special interest attaches to the paper on "The hot springs and mineral deposits of Wagon Wheel Gap, Colo." (*Econ. Geol.*, Vol. 8, pp. 235-246, 1913), by W. H. Em-

<sup>7</sup>"Trans. A. I. M. E." 1913.

<sup>8</sup>Primary and secondary ores considered with especial reference to the gel and rich heavy-metal ores, "Min. & Sci. Press," Vol. 107, pp. 418-423.

<sup>9</sup>"Fortschritte Mineral, Krist. und Petrographie," Vol. 3, pp. 11-31.

<sup>10</sup>Ore deposits of the Helena mining region, Montana, U. S. Geol. Survey, Bull. 527, 1913.

<sup>4</sup>Metasomatism in downward sulphide enrichment, *Ibid.*, pp. 51-63.

<sup>5</sup>Chalcocite enrichment, "Econ. Geol.," Vol. 8, No. 7, 1913.

<sup>6</sup>The sulphide ores of copper. Some results of microscopic study. "Trans. A. I. M. E." 1913.

mons and E. S. Larsen, as affording an additional example of the scant number of hot springs at which the metaliferous vein formation is now in progress. The demonstration by A. L. Day and E. S. Sheperd<sup>11</sup> that the molten lava of Kilauea contains large quantities of magmatic water and the actual collection of this water, together with its associated gases uncontaminated by combustion products and atmospheric gases—a feat never before accomplished at any volcanic center—have been matters of extreme interest to economic geologists, for in recent years the origin of ore deposits has been increasingly referred to the agency of magmatic waters. It is to be noted, however, that the water and gases from Kilauea are emanations from a basic igneous magma, whereas the ore-forming solutions that are supposedly of magmatic derivation are, as a rule, genetically related to siliceous magmas.

Although not strictly to be placed under the category of economic geology, mention may be made here of the "Report of the committee on the nomenclature of faults," by H. F. Reid, W. M. Davis, A. C. Lawson, and F. L. Ransome.<sup>12</sup> The committee has brought forward a carefully elaborated, systematic nomenclature, which should go far to obviate much of the current looseness in the description of faulting.

During August, the 12th International Geological Congress held its sessions at Toronto, Canada. This meeting was signalized by the preparation of an inventory of the coal resources of the world.<sup>13</sup> An original reserve of 7,397,553 million metric tons<sup>14</sup> for the entire world is estimated.

The data for the United States were assembled by M. R. Campbell, who estimates that the original reserves of coal, in seams of 14 in. thickness and over, to a maximum depth of 3000 ft., aggregate 3,225,394 million metric tons, of which 11,220 million metric tons have been exhausted. For Alaska, Brooks and Martin conservatively estimate a reserve of 19,593 million metric tons; in this computation no beds less than 3 ft. in thickness were included and depths considerably less than those for the United States were assumed.

The closing installment of J. J. Stevenson's exhaustive investigation on "The Formation of Coal Beds" made its appearance early in the year.<sup>15</sup> The evidence for the two rival theories, the growth in place as against the drift theory, are carefully weighed and the conclusion is reached that the coal beds and the associated rocks are of land origin, and that the coal beds in all essential features bear remarkable resemblance to peat deposits, some to the treeless moor, but most to the Waldmoor. The series of papers, of which this number is the final issue, has recently been reprinted in book form, and this important work has thus been rendered more easily available.

In closing, mention should be made of the volume on "Ore Deposits," by the late S. F. Emmons. This is a compilation of contributions to the science of ore deposits from the Transactions of the American Institute of Mining Engineers, with a critical introduction and synopsis. A feature greatly enhancing the value of the volume is the appended bibliography of the science of ore deposits by J. D. Irving, H. D. Smith, and H. G. Ferguson.

<sup>11</sup>"Bull. Geol. Soc. America," Vol. 24, No. 3, 1913.

<sup>12</sup>"Bull. Geol. Soc. America," Vol. 24, pp. 163-186, 1913.

<sup>13</sup>"The Coal Resources of the World," 3 Vols., 1266 pp., and 1 atlas.

<sup>14</sup>A metric ton equals 2204.6 lb.

<sup>15</sup>"Proc. American Philosoph. Society," Vol. 52, pp. 31-162, 1913.

## Molybdenum, Tungsten and Uranium Ores

DENVER CORRESPONDENCE

Practically all of the tungsten-ore production of Colorado was milled in Boulder County,<sup>1</sup> as usual, but a few small lots from Arizona, Montana and other states were treated in Denver.

In November, 50 tons of the low-grade pitchblende ore from the Kirk mine at Central City was shipped to Paris. It assayed 1.49% U<sub>3</sub>O<sub>8</sub> and brought \$1.25 per lb. of U<sub>3</sub>O<sub>8</sub>, f.o.b. Denver. It was not purchased as an ore profitable to treat abroad, but more to determine certain questions as to residues. This is presumably the largest single shipment made from the United States. It was shipped with nearly 100 tons of uranium ore that came from Chihuahua, and was mentioned in the New York papers as a "Radium cargo valued at \$1,500,000." The Mexican ore is of interest, as its gangue is a very clean calcite.

Pitchblende and carnotite are attracting much attention in Colorado at present, more than any other ores. Nearly every known property of this nature has either been purchased or is under option. These deposits are fully described in Thomas F. V. Curran's "Carnotite" (ENG. AND MIN. JOURN., Dec. 20 and 27, 1913).

A mine in a section of British Columbia that shows much of molybdenum ore is loading a carload of high-grade, desirable ore for milling at Denver. About 500 lb. 80 to 90% MoS<sub>2</sub> was milled from an Arizona ore, which is of interest. It is an ore carrying chalcopyrite, which floats almost as readily as molybdenite. Its presence renders the molybdenite concentrates unsalable. One of the difficulties in the treatment of copper sulphides by surface tension is their extreme sensibility to partial oxidation, in which condition they float only to a limited extent. As the old saying about poor rules is well known, I tried to reverse on this lot. After grinding the ore to 40-mesh, it was dampened and dried. Under these conditions 90% of the MoS<sub>2</sub> will float and practically every particle of the chalcopyrite sinks. This furnishes a cheaper method than to roast the mixed flotation concentrates with the intention of removing the copper ore magnetically.

All authorities claim that lack of satisfactory methods for the treatment of molybdenite ores has retarded the production of this valuable mineral. I am positive that this difficulty has now been removed, and its recovery is as simple as it was formerly complex. There will now be an incentive for the development of such ores. Present prices are nearly double what they were three years ago, a condition partially due to Mexican affairs, as it was from there that the chief supply came, and that from hand-assorted ores which had to exceed 50%.

It is now profitable to treat 3% ores, provided no other contaminating sulphides are present, and the gangue is a favorable one for flotation. A concern in France offers to take 100 tons per year at prices scaled from \$6 per unit for certain low grades up to \$12 per unit for the highest obtainable. Several other equally strong demands are reported. There is a rumor that the demand is due to its use as a base for smokeless powder, but as to the reliability of this I am uninformed.

<sup>1</sup>Cf. "Eng. and Min. Journ.," July 19, 1913, p. 99.



# Mining in California in 1913

BY LEWIS H. EDDY\*

The approximate total value of gold produced in California in 1913 was in excess of \$20,000,000, which is an increase over 1912 and 1911. The silver production for 1913 was estimated at approximately \$800,000, possibly an increase over 1912. The latest estimate of copper production showed a decrease from 1912, or a total of 32,000,000 lb. for 1913. The chief producer of copper was the Mammoth mine in Shasta County and while copper was produced in a large number of counties the only important copper-producing county outside of Shasta was Calaveras.

There has been notable advancement in the Mother Lode region particularly in Amador County. All the large producing mines with the exception of the Zeila have been deepened and new orebodies disclosed. At the Kennedy a vertical shaft was deepened to approximately 4000 ft., and two levels were opened below the 3450-ft. level, one at 3600 ft. and one at 3750. A fine body of ore was disclosed on the 3600-ft. level. The Argonaut opened up new ore in the 3950-ft. level. The Oneida, which was taken over by the South Eureka in 1912, has been connected by drift with the South Eureka and large orebodies disclosed. Twenty stamps of the old Oneida mill were put in commission, making a total of 100 stamps in operation by the South Eureka Mining Co. The Central Eureka, Bunker Hill and Fremont were also deepened and new ore found. The Hardenberg installed a 20-stamp mill. New steel headframes were installed at the Bunker Hill and Fremont mines. The South Eureka installed a plant for the disposal of tailings from the stamp mills, and the Kentucky plant will be ready for operation early in 1914. The Argonaut is preparing for the installation of a tailing plant. Development at the Plymouth Consolidated and Keystone progressed satisfactorily. The West Eureka was reopened at the close of the year, new orebodies disclosed. The East Eureka closed down the mine and 20-stamp mill in the first half of the year. The apex suit of the Kennedy Extension Gold Mining Co. vs. the Argonaut Mining Co. went to trial on Sept. 15, and the taking of evidence was concluded on Nov. 6. The arguments of the attorneys will be heard in January.

Eldorado County advanced in the development and operation of a number of the mines. The most interesting item of development was at the Pacific mine at Placerville in the deepening of the shaft to 2000 feet.

In Calaveras County the Melones, the Utica and the Gold Cliff were the only steady producers among the large mines. The Lightner was interrupted by the failure of the prospective producers to take the mine over and the original owners resumed operation. The 40-stamp mill of the Dolling mine was closed down most of the year.

In Tuolumne County deep mining advanced during the year. The Dutch and the Harvard mines were deepened, new orebodies opened up and the mills were kept in steady operation. The Jumper, an old mine that is being reopened, was reported to have found some new ore of good value and the prospect was good for continuing the

operation and reestablishment of the permanency of the mine. The App mine is still idle, but the prospect of a sale was renewed in the latter part of the year. The Black Oak mine on the east belt had a good year, the new cyanide plant proving entirely satisfactory. The Eagle-Shawmut was operated satisfactorily with the exception of the time annually occupied in overhauling and planning for the succeeding year.

In Kern County there has been a general movement toward the establishment of electric power and with the prospect that electricity will supplant steam in all mining operations. The Consolidated Mining Co. was the first to adopt electric power, which was applied to a new five-stamp mill installed in about the middle of the year. The Southern Sierras Power Co. extended its system to Randsburg and the Randsburg district in the first half of the year. At the close of the year the Yellow Aster mine was completing the installation of electric power for pumping to the mills, hoisting and milling. It is believed that the establishment of electric power in this district will lead to the deepening of the mines. The quantity and quality of the ores extracted and treated in the past year have equaled if not exceeded former years.

The Cerro Gordo mine in Inyo County was reorganized, and zinc as well as lead was produced. The Skidoo water pipe line, damaged by cold weather early in the year, was repaired; and the 15-ton stamp mill destroyed by fire was replaced by a new 10-stamp mill.

The Tecopa Consolidated mined and shipped a large amount of ore. The Wilshire Bishop Creek installed a new 20-stamp mill electrically driven and a cyanide plant was ordered, but the property has been idle in the latter part of the year. The Gunsite made some large shipments in the early part of the year. The Saline Valley Salt Co. completed the installation of an aerial tramway, grinding machinery and warehouse. A new tube mill was installed at the Tiptop mine, with a capacity of 1200 tons per month. In the Dale district in San Bernardino County the United Greenwater Copper Co. installed a Symons roller-crushing process, the first installation of this process in the state.

The prospecting and development of tungsten ores in both San Bernardino and Kern counties has attracted a good deal of attention during the year. A number of claims were located and there have been some shipments made of high-grade ores from these prospects and new mines. The Atolia Mining Co. in the latter part of the year was reported to have found the extension of the Papoose ledge below the 200-ft. level. The largest percentage of ore treated in the last half of the year came from Union No. 1. The legal troubles over the Searies Lake deposits seemed to have been settled in favor of the California Trona Co. A survey was made for a railroad from the town of Searles on the Southern Pacific to extend a distance of 32 miles to Searles Lake.

In Shasta County the only smeltery in operation is the Mammoth, and an effort was made by the farmers in the first half of the year to close it down but without success. At the Balaklala the Hall desulphurizing process was being installed in the last half of the year. Some experiments were also made with the Hessewood process in

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the county. A plant was being installed at Redding for the demonstration of still another process. Experiments in zinc extraction at the Bally Hill and the Afterthought mine progressed satisfactorily during the year. The Mountain Copper Co. has opened up new orebodies in the Iron Mountain mines and largely increased the shipments of ore in the last half of the year. A new electric hoist was being installed at the Gladstone mine the latter end of the year.

Notable advancement in deep mining in Nevada County was marked by the consummation of the sale of the Champion mines to the North Star Mines Co. High-grade ore was disclosed on the 2400-ft. level of the Champion; and other development in this group amounted to 9000 ft. of underground work and the installation of a 100-ton cyanide mill. The Pennsylvania mine was taken over by the Empire. The Oustomah and Eagle Bird were reopened. The Delhi completed the five-mile flume and ditch. The Gaston removed 10 stamps to lower ground, but continued work during the winter at the upper mill.

The Golden Center installed a 10-stamp mill in the center of the town of Grass Valley where an old mine has been reopened. There were a number of installations of power and pumping and other machinery during the year.

The Tightner mine in Sierra County added 10 stamps to the 10-stamp mill installed in 1912. The mine has been a large producer of values, the ore generally running high grade. The new wagon road from North Bloomfield in Nevada County to Allegheny in Sierra County was completed. This reduced the distance traveled from Nevada City to Allegheny from about 32 miles to 24 miles. About one-half the cost of the construction of this road was donated by the North Star Mines Co. and associated interests.

In Plumas County there were some installations of stamp mills and power plants and general advancement in mining throughout the county. In Trinity County the new stamp mill installed by the Globe mine and the building of the new ditch in the La Grange gravel mine were the principal features outside of dredging.

## Metal Mining in Colorado in 1913

BY GEORGE E. COLLINS\*

There were comparatively few new developments of importance in Colorado in 1913. In the spring new discoveries of high-grade silver ore near Eagle, and of gold in the vicinity of the old district of Summitville, gave rise to the usual optimistic forecasts, but they have not materialized, despite a summer's work. The Lady Belle mine in the Eagle district is producing high-grade ore, and encouraging assays are reported from a number of prospects; but there is no reason to expect that a new district of the first rank will result. The Gilmore-Platoro area may eventually make a considerable production from milling ore, but is clearly going to require a long time before reaching this stage.

Generally speaking, it may be said that the feeling of depression which has existed now for several years, since the strikes at Telluride and Cripple Creek, was continued and somewhat intensified. Taking the State as a whole, ore is being mined faster than it is being developed, and the production, while still large, does not yield profit in proportion to the difficulties encountered and the risk.

Cripple Creek and Telluride were the most prosperous districts. In the former all the large mines maintained an uninterrupted production: no unusual trouble being encountered. The Golden Cycle and Portland mills handled the larger portion of the output: Stratton's Independence and the Ajax mill (in which the Clancy process has now been definitely abandoned) leading the smaller plants. A new concentration mill is being built to handle the Vindicator dumps.

A consolidation of the El Paso with the Golden Cycle and other properties, projected by the management of the former, and intended to form the basis of a flotation on the European market, fell through. The sale of the Golden Cycle to other interests has frequently been reported, but such reports seem to be without foundation. The Vindicator and Golden Cycle are in liti-

gation over orebodies said to have been mined in the Christmas claim, now owned by the Vindicator company.

In the Telluride district the Tom Boy, Liberty Bell and Smuggler-Union maintained a large production. The last mentioned mine, which now has to depend on a grade of ore very near the commercial limit, was fortunate in securing final judgment in a large amount against the Liberty Bell for trespass.

Apart from its three big mines, the output from the Telluride district was not large. The Black Bear was shut down all the year; and the Humboldt is still developing. A new mill for the Junta Consolidated, 1½ miles from town up Bear Creek, is nearly completed.

Silverton remains dull, and the inhabitants appear to be resting their hopes on such innovations as the establishment of a local station for experimental metallurgy by the U. S. Bureau of Mines. The Sunnyside continues to be by far the largest producer. Unfortunately, the upper terminal of the tramway was destroyed by fire in the beginning of December, and it is doubtful whether operations can be again resumed until spring. The Silver Lake and Gold King are being operated under lease by Otto Mears and J. H. Slattery, mostly through sub-lessees. The Intersection, in Maggie Gulch, was successfully operated. The Buffalo Boy, believed to have a large tonnage of cyaniding ore exposed, is the subject of litigation between the owners and parties who recently held an option, during which they located surrounding claims believed to be essential for its successful working.

At Ouray the Camp Bird is virtually exhausted, with nothing to take its place. The Atlas is probably the largest producer. Hinsdale County is comparatively inactive. The La Plata Mountains have several small rich mines, of which the Idaho and May Day are at present the most productive.

In Gilpin County suspension of operations by the Topeka and Frontenac, of which the latter was the largest producer in the county, leaves the output smaller and the activity less than for a generation. The water from

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the Kansas and Burroughs veins has continued to flow into the Argo tunnel, through the boreholes which were drilled last year, and has now been drained nearly to the bottom; but work has not yet been resumed. The Pittsburg has been, as for years past, a very profitable producer. A new mill has been completed, and has just commenced operation, on the London, in the Twelve Mile district.

In Clear Creek County the Little Mattie and Gem were the chief producers. In each case most of the ore is being mined by leasers, some of whom are doing well. A considerable production is also being made from the Specie Payment, and the Golden Age, an extension of the Sun and Moon. At Georgetown the Capital employs a considerable number of men; the rest of the population being supported mainly by leasing. The heaviest snow-storm on record in this district, which occurred from Dec. 3 to Dec. 5, completely tied up railway and other traffic for a week, and will largely curtail the output of Gilpin and Clear Creek Counties for the entire month.

At Leadville, there is little change in the precious-metal output. Lessees on the Ibex, together with the Monarch, are the chief contributors. The Mount Champion mine, in the Lackawanna Gulch district, is believed to have a promising future.

At Aspen the Smuggler consolidation has maintained a considerable tonnage. The unwatering of the Free Silver shaft has rendered available a considerable tonnage of ore, which is supplying the mill at its full capacity, and it is understood will probably maintain this production for several years.

At Creede the future depends largely on what may be encountered in the Amethyst vein, below the level of the Commodore tunnel. The discovery of a rich pocket of free gold in the Dunkin, at Breckenridge, called attention to the fact that the possibilities of that district are far from being exhausted.

In Chaffee County the Mary Murphy, near St. Elmo, has made a large output, probably more than any other mine in the State outside of Cripple Creek, Leadville and the San Juan. The Madonna, at Monarch, is still awaiting the result of exploratory work in depth.

The gold dredges in the vicinity of Breckenridge are all reported to have done well this year. The only other dredging operation in the State is at Tincup, where a dredge was installed in the late fall, making only a single clean-up before the breakage of the spud led to suspension of work for the winter. This dredge obtains its power from a hydro-electric plant on the other side of the range, near St. Elmo.

It has become increasingly apparent that Colorado producers of lead and zinc can, as a rule, make money only when prices are high, unless the zinc and lead are regarded merely as byproducts from the mining of gold and silver.

The continual drop in spelter has resulted in limitation of output, particularly at Leadville, where only the better-grade carbonate ores can be marketed at a profit. The Wolf Tone and other properties of the Western Mining Co. have been the chief producers of such ore. Of low-grade lead-silver ores the Iron-Silver Co. and the Yak Tunnel have as usual shipped extensively.

At Breckenridge, the Wellington has shut down its wet-concentrating mill, partly because of low metal prices, partly because of increased freight rates and ex-

haustion of the best lead-carrying orebodies. In the meantime the magnetic plant has been steadily at work on an old accumulation of zinc-iron middlings. The Iron Mask at Red Cliff, the Tomboy at Telluride, the Sunnyside at Silverton, and the Mary Murphy at St. Elmo, have all been active shippers of zinc and lead concentrates, the first from magnetic separators and the two last mentioned from electrostatic plants using Huff machines. The Tomboy is still shipping its zinc middling without separation, but is experimenting with selective flotation and electrostatic separation.

The Rico district has maintained a notable output of lead and zinc concentrates, and has also shipped a large quantity of copper ore.

The tungsten industry in Boulder County, near Nederland, has been active, and the ore has sold throughout the year at a fair price. No other district in the State has reported any tungsten production.

A great deal of attention has been devoted in the technical and non-technical journals to the production in Colorado of uranium-bearing ores, of which there are two distinct varieties, the carnotite impregnations in sandstone of the southwestern part of the State, in the Paradox Valley and elsewhere, and the pitchblende of Gilpin County. The former occurs in pockets, of which the richer are easily exhausted. It is, however, believed that leaner impregnations may be worked with local metallurgical treatment.

In Gilpin County, the German and Belcher mines are being worked by A. I. du Pont, and a considerable quantity of high-grade pitchblende ore is being stored. Other claims producing pitchblende are the Calhoun, Kirk and Wood, all on Quartz Hill. As previously stated in these columns, the pitchblende occurs as stringers and small lenses in veins containing iron, zinc and lead sulphides accompanied by gold and silver.

The principal legislative act affecting mines was a measure passed by the State Legislature providing for their assessment on the basis of one-half the gross output, plus the entire net output and the cash value of the improvements. This was intended to offset an increase in the valuation of other property, which is to be assessed on the basis of the entire cash value. Such was heretofore the legal basis of assessment, but the law was always openly ignored—the county assessors using figures varying from one-third to one-fifth of the cash value. However stringent the provisions of the law, it is probable that assessors will, to some extent at all events, continue their old practice, and as a result mines will bear far more than their fair share of the burden of taxation. It may indeed be questioned whether, in their determination to tax the mining industry in proportion to what the representatives of the farming districts believe to be the real value of the mines, the limit of endurance has not been reached. The industry has found its nemesis in the extravagant claims of flamboyant promoters, whose statements as to the value of mines are being reflected in the assessment rolls. The situation is aggravated by a recent decision of the State Supreme Court, which holds that "gross value" means, not the gross value on the ground as actually received by the producer, but the value of the metals contained in the ore, without any deduction for freight or smelting charges. A petition for rehearing is being filed with the Court.

The strike of coal miners, called by the United Mine

Workers in October, has so far inconvenienced the metal miners only in respect of expense; the price of coal having been sharply advanced, particularly by so called "independent" coal operators who conceded the terms de-

manded by the Union officials, and immediately proceeded to fleece their customers. Should the strike continue much longer, however, it will inevitably result in closing down many of the mines.

## Mining in Idaho 1913

BY ROBERT N. BELL\*

Copper in Idaho in 1913 shows a marked increase over 1912 through the steady operation of our two principal producers, the Empire Copper Co. at Mackay in Custer County, and the Snowstorm mine in the Mullan district in Shoshone County. Added to this is a month's run with a small smeltery at the Lost Packer mine in Custer County and a small tonnage of rich ore from the Seven Devils district.

The Empire mine carries a series of contact metamorphic deposits of a type of some important producers in Arizona and northern Mexico. This property is developed to a depth of 900 ft. and is showing sulphide ores in the bottom level, and a deeper crosscut tunnel now extended in over 2000 ft. should cut the deposits at an additional depth of 900 ft. when completed.

This mine produced an average of about sixty 50-ton cars of ore per month carrying between 5 and 6% copper to \$5 in gold and silver per ton, which was shipped to the Salt Lake smelters, where, owing to its fluxing value, it is handled at reasonable cost. The operation affords considerable profit with encouraging prospects of a convergence of its numerous ore channels and resulting large segregations of sulphide mineral at the new deep level.

The Lost Packer mine is a small fissure vein carrying sulphides rich in gold. It is equipped with a hot-blast smelting plant of about 70 tons daily capacity and the ore accumulated through two seasons' operations afforded a smelting run during the past summer of 30 days, giving matte of gross value of \$103,000 in gold and copper.

The Snowstorm mine operated steadily. The former leaching plant was transformed over a year ago into a concentrating mill which has given a good extraction considering the ore grade which averages 2% copper and 4 oz. of silver per ton. In addition to the ore treated locally, a considerable tonnage was shipped crude from the oxidized horizons of the mine and used as siliceous converter lining.

Extensive development has been carried to an additional depth of 1000 ft. where crosscutting is now in progress. Some encouragement has been found in the way of small ore occurrences looking to the picking up of the original orebody below the fault, but it will take considerable work to determine whether or not this important mineral channel can be recovered below the fault.

In the strike of the Snowstorm vein, 1½ miles farther east, the National mine has developed an ore deposit almost identical in character with the original Snowstorm body. This new National orebody was opened through a crosscut tunnel nearly a mile in length at a depth of 1700 ft. It is 60 ft. wide and proved for several hundred feet in length and carries an average value of about 3% copper with 7 oz. silver and 50c. gold per ton.

\*State mine inspector, Boise, Idaho.

This property has been equipped with electric haulage from the inside of the mine to the mill, about three miles distant, and a new mill erected of 500 tons daily capacity to employ wet-gravity concentration and flotation. This handsome new plant is expected to be in operation in about 30 days.

Some interesting deposits of disseminated copper-sulphide ores occur in the Hoodoo mining district in Latah County, Idaho, where recent development at considerable depth shows promising evidence of commercial deposits of large capacity at the Mizpah mine. A few carload shipments of high-grade bornite ore were made last summer from the Blue Jacket mine in the Seven Devils district.

In 1913, lead-silver ore development in Idaho outside of the Cœur d'Alene district has received considerable attention and some important resources of ore have been developed and put into shape.

The most flattering result in this connection has been at the Wilbert mine in the Dome mining district, 40 miles north of the nearest railway shipping point at Arco, Blaine County, Idaho. This property developed an ore-shoot nearly 300 ft. long and 3 to 10 ft. wide that has been opened to a depth of 300 ft. and affords an average mill feed of from 25 to 30% lead. This ore is low in silver but the mill product averages about 50% lead and affords employment for 40 six-horse teams for hauling to the railroad, and has yielded 1000 tons per month of this class of mineral throughout the greater part of the year.

At the Gilmore district in Lemhi County, the ore shipments have aggregated about 22,000 tons of crude oxidized ores carrying a little better than 30% lead and 15 oz. silver per ton with 50c. gold. Most of this ore was derived from the Pittsburg-Idaho and Latest Out mines, but shipments have been retarded on account of the necessity of some extensive permanent development plans and new equipment. Both the Pittsburg-Idaho and the adjoining mine, the Latest Out, show strong ore manifestations in the deepest levels.

In Custer County, the Red Bird mine, owned by the Clayton Mining & Smelting Co., 60 miles from the nearest railway shipping point at Mackay, has been undergoing development throughout the summer, under option to M. L. Ditto and associates and the result of this operation has disclosed a magnificent resource of relatively high-grade lead-silver smelting ore. The deposit has been developed to a depth of 900 ft. through a series of crosscut tunnels and shows 100,000 tons of lead-carbonate ore carrying an excess of iron oxides that will average about 20% lead and 20 oz. silver. The property is being equipped with a smelting plant of 100 tons daily capacity and with motor-truck haulage can be handled at a handsome margin of profit in spite of its isolated position.

The Continental mine in Bonner County is Idaho's



Farthest North mine, adjoining the International Boundary Line, and 24 miles from the nearest railroad shipping point. Its merits have been appreciated for the last 10 years, but, owing to inaccessibility, it has been idle until the last year. This mine has one of the most flattering surface evidences of lead-silver ore deposit that has been discovered in Idaho. The enterprise has been financed through the assistance of the International Smelting Co. The deposit gives eminent evidence of deep-seated permanency and affording an important and profitable production of desirable smelting ore during the coming years.

In the same county, 7 miles east of Bonner's Ferry, the Idaho-Montana Amalgamated company has equipped its property with a 50-ton daily capacity concentrating mill which has recently been put in operation. This property carries an interesting deposit consisting of a pronounced quartz vein in a quartzite formation, the orebody is localized to a wide zone of intrusive rock, resembling diabase and is several hundred feet long with two shallow surface openings showing 10 to 20% lead associated with an excess of coarse iron sulphides containing gold and silver.

At Clark's Fork in the same county, 1½ miles north of the Northern Pacific main-line station of that name, the Lawrence Mining Co. equipped its property with a concentrating mill of 50 tons daily capacity which operated during a part of the year with a resulting product of several cars of very clean high-grade lead concentrates practically free from zinc and containing carload shipping values of 70% lead with 12 oz. of silver.

Another property in this same county, locally known as the Webber Mine, at Lakeview, has been opened through a long crosscut tunnel in the sulphide-ore horizon and is showing some shipping mineral carrying high values in silver and lead.

#### GOLD AND OTHER MINE ACTIVITIES IN IDAHO

The gold production in Idaho in 1913 shows a slight falling off as compared to the previous year.

This deficiency will be partially accounted for by the closing of the Delamar mine and mill in Owyhee County which has been a steady and important producer for the past 20 years and has a recorded output of over ten million dollars.

The Delamar is an extensive property with some interesting unsolved geological problems, but the grade of ore available and its refractory character during recent years has not shown much profit, and the company has also been harassed by the unjust persecution of the federal government in its effort to penalize them at full value for the lagging and cordwood used off the public land during the number of years of past operation, aggregating a quarter of a million dollars in value. This material consisting essentially of desert growth of mahogany, juniper and scrub wood, which the character of the country affords, was bought and paid for at an average rate of fully \$12 per cord from the local wood rustlers of the district, who accumulated it largely by pack animals from the neighboring mountain slopes. This unfair persecution by the government authorities under the guise of conservation has thoroughly disgusted this old reliable mining company which has been a steady producer of gold bullion to the country and employing an average crew of 200 men for the past 20 years. The enterprise is now

reduced to a crew of 15 men and seems likely to be abandoned in the near future.

The principal source of gold production in Idaho during the past year has been from placer deposits operated by dredging methods.

The Boston & Idaho Gold Dredging Co., at Idaho City, in Boise Basin, has been the principal contributor. The two dredging plants of this company are handling from 12,000 to 14,000 cu.yd. per day of gravel that is said to average from 10 to 20c. per cu.yd. Their operation is continuous throughout the year and is seldom closed down more than two or three days in the worst winter weather encountered.

In Lemhi County, the Kirtly Creek Gold Dredging Co. has operated its plant successfully throughout the year, and a new plant has been installed and put in operation by the same construction company at Bohannon Creek in the same county with definite prospects of still a third being constructed on the near-by Gertson Creek, where extensive drilling operations have been carried on during the past summer that are said to give very encouraging results.

The extensive development and equipment on large deposits of \$1.50 gold ore in southeastern Alaska by such conservative and responsible operators as Fred W. Bradley, D. C. Jackling and their associates have stimulated interest in and demand for a similar class of investment and has resulted in an active investigation of Idaho's ore deposits of this class.

In Big Creek mining district, in Idaho County, we have a belt several miles long showing sheared deposits of quartz and altered granite gangue carrying iron sulphides and \$2 to \$5 per ton in gold in width ranging from 100 to 300 ft. on half a dozen different properties on which shallow work has been done.

A prominent California firm did 500 ft. of crosscutting on one of the best showings last summer, disclosing an ore deposit with a floor-plan section of 220x200 ft., but, owing to a controversy with the owner of the property, operations were suspended.

The district has since been visited by representatives of some of the leading mining institutions of the United States and negotiations are now in progress for extensive development on several of the claim groups of this great zone.

Unfortunately, this district is situated 70 miles from the nearest railroad point, but the local conditions in the way of economical tunnel development, gravity handling, water power and timber resources are exceptionally fine and it is believed that some big low-grade mining and milling enterprises will result from the further development of this district.

Idaho has several other districts in which wide bodies of low-grade gold-bearing material exists and is attracting its full share of attention from big operators in this connection.

#### INCREASED ZINC OUTPUT

The zinc output for Idaho for 1913 shows a tremendous increase over 1912, which is accounted for by new discoveries in the Cœur d'Alene district and the increased output of the Federal M. & S. Co.'s Morning mine. The new ore showings in this line are susceptible of greatly multiplying present production in the future if the de-

mand for the mineral warrants the operation of further development of the resources now known.

The most marked increase of this mineral during the past year was from the property of the Interstate-Callahan Consolidated Mining Co. at Nine Mile Creek near Wallace, where a zinc orebody from 5 to 45 ft. wide in Pritchard slate and now developed for a continuous length of over 900 ft. at a depth of 1200 ft. has been opened up with its full lineal extent yet undetermined. The values in this great orebody will range from 10 to 25% zinc with 2 to 3% lead. The west and largest end of the shoot now being drifted upon shows a marked increase in lead. The middle section of this great ore showing carries 4- or 5-ft. bands of clean zinc sulphide that has afforded numerous carload shipments of hand-picked crude ore averaging better than 50% zinc.

In a near-by property, owned by W. A. Clark, some preliminary development now down 400 ft. is disclosing evidence of another big resource of zinc milling ore.

This vein seems to be carrying its high zinc values where it is now being opened and its surface exposure indicates an ore channel nearly a half mile long by 10 to 30 ft. wide. The famous old Friseo mine, at Gem, in this same county, which has been purchased by the Federal Mining & Smelting Co., has been unwatered and equipped with a milling plant of 150 tons daily capacity which is nearly completed. This old mine has some extensive reserves rich in zinc in its bottom levels and should become an important producer during the coming year.

At the Success zinc mine, in this same county, development has been carried to a total depth of 1000 ft., where the values have been continued and the orebodies more extensive in length than in the upper horizons of the mine.

This property has maintained a steady production throughout the year and has made some additions to its 250-ton milling plant in the way of electric separating machinery for recleaning the concentrates. Increased facilities have been added to the Morning mill of the Federal company, which makes an important product of zinc from the treatment of its complicated lead ores and a handsome margin of profit is being derived from the re-treatment of the slimes by flotation processes in this big mill.

There are several other flattering prospects for zinc-ore development in the slate formations of the Cœur d'Alene district and if market conditions warrant, this district will ultimately cut a large figure in the zinc-ore product of the country.

The Wood River district in Blaine County had two mills in operation separating zinc values from large tailing piles at the Quincy Jr. mine, near Hailey and the Minnie Moore mine near Bellevue. This district has some extensive resources of zinc-lead ore that have been idle for years but are susceptible of profitable treatment under present-day methods, and are well worthy of attention of investors in this class of mineral as the associated lead values in these deposits are invariably rich in silver.

#### PHOSPHATE ROCK RESOURCES

Idaho, in three of its southeastern counties, has the most extensive deposits of high-grade phosphate rock that are known of in the world. These deposits occur in a fossiliferous thin-bedded limestone of the middle carboniferous period. They are uniform in size and as regular as coal veins and traceable in outcrop for hundreds of miles in veins or beds from 4 to 7 ft. thick, containing average of from 70 to 75% calcium phosphate and low in iron and alumina.

## Mining in Montana in 1913

BY F. L. FISHER\*

The Anaconda Copper Mining Co. operated the following copper mines during 1913: Mountain View, Pennsylvania, Leonard, West Colusa, East Colusa, Badger State, Tramway, Berkeley, J. I. C., Silver Bow, West Gray Rock, Belmont, Bell, Diamond, High Ore, Neversweat, Anaconda, St. Lawrence, Mountain Con, Original, Moonlight, Stewart, Gagnon, and Buffalo. Other copper producing companies which operated during the year were the North Butte Co., East Butte Co., Tuolumne, Pilot-Butte, Elm Orlu, Butte-Alex Scott, Davis-Daly, Bullwhacker, and Butte & Duluth. The latter company constructed a mill and began the treatment of a large body of low-grade silicate and carbonate ore by leaching with sulphuric acid. The Bullwhacker mine was operated by lessees until the latter part of the year, after which the company installed an electric generator and tanks for the electrolytic treatment of their ore.

The Pittsmtont property of the East Butte Co. was operated continuously, and work upon the long proposed enlargements of the blast furnaces was commenced late in the year. The Butte-Alex Scott Co. sold a portion of

its ground near the West Colusa shaft to the Anaconda company. It sank its shaft a short distance, and shipped from 100 to 150 tons of ore daily to the East Butte smeltery. At the North Butte company's property, mining was carried on steadily and the ore shipped to the Washoe smeltery at Anaconda for treatment. The Granite Mountain shaft was sunk to the 2700-ft. level, and the work of installing a new hoist was begun, in order eventually to use this shaft in the place of the Speculator shaft for hoisting purposes. Under a new management the Colorado mine of the Davis-Daly company began to pay expenses and make a profit. The shaft at the Tuolumne mine was continued for some distance, and a large amount of development work done, without, however, finding any large bodies of ore. At the Elm Orlu mine, owned by Senator Clark and associates, considerable development work was done. The copper ore was shipped as fast as mined, but large bodies of zinc ore were blocked out and left unmined until the new concentrator, now in the course of construction, is completed. At the Pilot-Butte mine, the shaft was sunk to the 2000-ft. level, and some good ore opened. Injunction proceedings were begun in

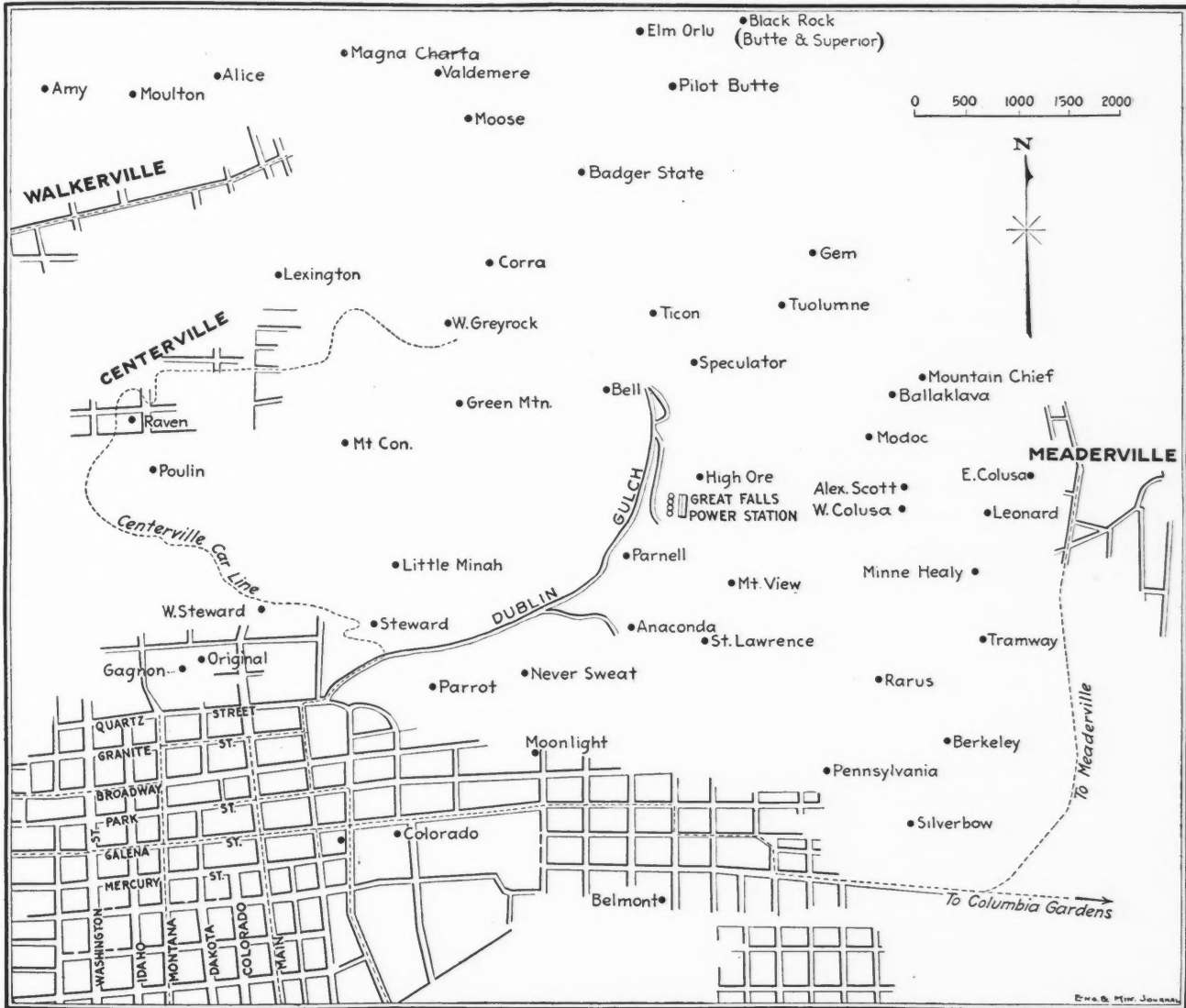
\*Mining engineer, Hennessy Building, Butte, Mont.



October by the Anaconda company to establish the ownership of a portion of the vein operated on by the Pilot-Butte company; the trial which was scheduled for the latter part of October, was by mutual consent postponed until the spring of 1914, in order that more definite data might be gathered. The work of electrifying the Butte, Anaconda & Pacific R.R. between Butte and Anaconda was completed early in the fall. The Anaconda company enlarged the ore bins of a number of its more important properties in order to have better ore-storage facilities to avoid delay in mine operations caused heretofore by delays in transportation of ore.

of the Anaconda company against the Butte-Ballaklava company over the ownership of an important vein, was settled out of court. The company was allowed to mine the disputed orebody inside a vertical plane dropped on the north boundary between Butte-Ballaklava and Anaconda company territory. As a result the company began operations again after a shutdown of three years.

The Montana Public Service Commission served notice to the Montana Power Co. that a hearing would be held in November, at which the company might present reasons why electric light and power rates in a number of cities and towns should not be radically reduced. The



MAP SHOWING SHAFTS IN VICINITY OF BUTTE, MONT.

Based on a map prepared for the 105th meeting of the A. I. M. E.

The Washoe smeltery at Anaconda was closed 10 days for repairs during the first part of October. The concentrator, however, was kept running and the concentrates stored, so that no curtailment of output was caused. The company erected an 80-ton experimental leaching plant at the Washoe smeltery for the purpose of testing a new method for recovering copper and silver from concentrator tailings. Late in the year the Anaconda company began operations at the Nettie, a silver mine in the northwest part of the Butte district, preparatory to developing that part of the district. About Dec. 1 the injunction suit

commission, after argument, then made up a new schedule of reduced rates affecting 31 cities and towns, with the order that they should go into effect Dec. 1. Early in the year the Anaconda company added to its possessions in Montana by the purchase of all of the Northern Pacific Ry.'s holdings in Lincoln County and the northwest part of the state, consisting of nearly 150,000 acres of timber and agricultural land.

The Corbin Copper Co. acquired the Gambrinus claim and two fractions in the western part of Butte and sank a shaft 200 ft., also doing a small amount of development

work. The mill at the Ophir mine of the Butte Central Copper Co. was completed early in the year and operations commenced. Work was continued only a few days, however, when the plant was closed by order of the court at the instigation of creditors, and lay idle the remainder of the year. The Rainbow Lode Development Co. sunk a shaft 800 ft. deep on its property in the northern part of Butte and ran a long crosscut at that depth for development purposes. Late in the year the company began making preparations to continue sinking the shaft at the Butte & London property from the 1100- to the 1600-ft. level, preparatory to crosscutting north and south to the end lines.

The importance of the zinc-mining industry at Butte increased through the successful installation by the Butte & Superior Mining Co., of oil-flotation concentration of its sulphide ores, and owing to the fact that Senator Clark had nearly completed the construction of a similar mill at the Elm Orlu mine. During the last few months of the year the mill of the Butte & Superior Co. was operated close to capacity, about 1100 tons of ore being treated daily. The suit of the Minerals Separation Co., Ltd., of London, for an injunction restraining the Butte & Superior Co. from using an oil-flotation process, upon alleged infringement of patent, was tried in the Federal court at Butte, finding in favor of the complainant. By the filing of a \$75,000 bond, however, the defendant company was allowed to continue operations, pending the result of a similar suit, known as the Minerals Separation Co. vs. James M. Hyde, now being tried in the Supreme Court.

There was a markedly increased activity in gold and silver mining throughout the state during 1913. A number of new companies were formed, and many old properties were again the scene of operations. The Butte, Wisdom & Pacific Ry. Co. was incorporated late in the summer by Montana and Eastern men for the purpose of constructing a railway from Divide to Wisdom, in the Big Hole River valley, and a branch line to the Elkhorn mining district, Beaverhead County. The survey of the proposed route was commenced shortly after. A 20-stamp mill was erected at the Hecla mine, south of Melrose, in Beaverhead County, and mining operations commenced. At the Ohio-Keating mine in the Radersburg district, Broadwater County, an electric pump was installed on the 500-ft. level. A shoot of ore was opened by the crosscut on this level and regular wagon shipments were made. A change of management took place in the fall at the Keating mine and arrangements were made to sink the shaft from 800 to 1200 feet.

Early in the year operations were commenced by the Anaconda company at the Southern Cross mine in the Georgetown district, Deer Lodge County, and regular shipments of ore were made to the Washoe smeltery, where the ore is in demand on account of its fluxing properties. Considerable development work was done at the Baltic Combination mine at Georgetown. The North Moccasin mine at Kendall, Fergus County, was operated profitably during the year by the Barnes-King Mining Co. The ore was treated at the mill at the mine and nearly the entire purchase price, \$150,000, was paid from the proceeds. The company also did considerable development work at the Piegan-Gloster mine, Lewis & Clark County. A mill was erected for the treatment of the tailings from the Granite-Bi-Metallic mine, situated near Phillipsburg. The Royal Mountain Mining Co. developed the Sunday mine by driving a tunnel. The shaft was sunk a short distance and some development work was done at the Swastika mine near Phillipsburg. The Royal Basin Mining & Milling Co. operated a leaching plant at its property near Maxville.

The Boston & Corbin property in the Corbin-Wickes district, Jefferson County, changed management, but continued operations throughout the year. Helena men operated the Golden Curry mine in the Elkhorn district, shipping to the East Helena smeltery. A number of shipments of ore were made from the Crystal mine in the Cataract district by A. C. Ray, who operated under a lease and bond. At the Valley Forge mine, situated 16 miles from Helena, in Lewis & Clark County, a crosscut tunnel was driven 2200 ft., where it cut the vein at a depth of 900 ft. A two-compartment shaft was sunk several hundred feet at the mine of the Copper-Silver Montana Mining Co. in the Scratch Gravel Hills, near Helena. The Magpie Placer Mining Co. operated a dredge on Lake Sewall, 20 miles northeast of Helena, handling about 70,000 yd. of gravel monthly. The St. Louis Mining & Milling Co. operated the St. Louis and Drumlummon mines at Marysville, reconstructed the stamp mill, and installed a new cyanide plant, but later was forced to suspend operations.

During the summer months the Conrey Placer Mining Co. operated four large dredges in Alder Gulch, near Ruby, Madison County, during which time Madison County led in the production of gold in Montana. At the Easton-Pacific mine owned by the Ellings, of Virginia City, a new cyanide plant was constructed and operated steadily on the ore mined there. The Missouri mine on North Meadow Creek was also operated by the Ellings.

## Arizona in 1913

Arizona experienced an active year in 1913, maintaining its place as the premier copper-producing state in the Union. There were important developments in progress in the newer districts, such as Ajo and Superior; new reduction plants put in operation and other works started or planned represented an expenditure of between \$10,000,000 and \$15,000,000. These developments in copper mining are reviewed elsewhere in this issue by James Douglas and J. Parke Channing.

The Kingman district prospered in 1913, improvements

being made at the three leading gold producers, the Tom Reed Gold Mines Co., the Gold Road Mines Co. and the Frisco Gold Mines Co. At the mills of the first two companies, changes were made introducing continuous decantation in place of vacuum filtration. The Frisco company installed two Kelly filters and otherwise increased its milling capacity.

Lead and zinc mining in Arizona declined in 1913. In Mohave County, the Tennessee mine of the U. S. Smelting, Refining & Mining Co., mined silver-lead-zinc ore,



which was shipped to the Needles concentrator, the zinc-lead concentrates being further separated at the electrostatic works at Midvale, Utah. The main shaft at this property is down 900 ft., and during the year a crosscut to the vein was driven at the 700-ft. level, where stoping was done. The Banner mine of this company was not operated. The Rainbow mine shipped to the Needles concentrator, and a mill was completed in February at the Midnight mine. The Union Basin Mining Co. re-timbered its shaft at Golconda and a 6-ton Saurer truck was purchased to haul the ore to the railroad for shipment to Oklahoma smelters.

In Maricopa County, the famous old Vulture mine, reopened about five years ago by the Vulture Mines Co., operated steadily in 1913. The ore production for the year amounted to approximately 33,000 tons, the average value of which was about \$20, and the yield approximately \$17.40 per ton. About 5000 ft. of development work was done in 1913, and a winze is now being sunk below the 1050-ft. level. A new Lidgerwood hoist was set up at the 850-ft. level for the purpose of handling the product of the levels below. The hoisting winze was equipped with a headframe and cage for hoisting cars without re-handling the contents. Among other new machinery installed during the year were a Word drill-sharpening machine, a new Nash engine and an air compressor for the power plant; in the mill, two new Nash engines were installed in March, and three Deister slime tables; in the bullion refinery a second retort furnace was added; also a Donaldson tilting furnace for melting bullion. To reduce the cost of freighting from Wickenburg, 16 miles, wagons and teams were supplanted by a Moore motor truck of six tons capacity. The reduction works consists of a 20-stamp mill with concentrating and cyaniding adjuncts.

In the Pima mining district, the most interesting development of the year was that of the Empire Zinc Co., in exposing an important orebody between the 200- and 300-ft. levels of the San Xavier mine, which this company bought late in 1912. About 60 men were employed and 1500 tons of copper-silver-lead ore were shipped monthly to the El Paso Smelting Works, the ore being hauled seven miles to Sahuarita by two 6½-ton Saurer motor trucks. A third Saurer truck was ordered late in 1913. Besides the above shipments, the company has been blocking out the blende ore, which will not be stoped until a suitable concentrator is erected. In July, 1913, E. G. Bush leased the Morgan mine of the Twin Buttes Mining & Smelting Co., and shipped about 1000 tons monthly to the Copper Queen smelting works. The ore was high in iron and desirable for fluxing purposes. The Copper Glance mine, of the Twin Buttes company, was developed on company account, and in a winze sunk 30 ft. below the 400-ft. level, a body of rich sulphide ore was exposed for 20 ft. The width of the orebody was not known as neither wall was in sight, when operations had to be abandoned because of a large flow of water. The company expects to complete the raising of the new vertical shaft from the 400-ft. level, after which suitable pumping machinery will be installed to explore the new orebody.

The Tueson Mining Co. built at Olive a 100-ton concentrator to treat the silver-lead ore of that camp, the principal ore supply being from the Wedge and the Swastika mines. Kidney pneumatic jigs are included in the equipment of this mill.

The Chesterfield Copper Co. completed during the year the sinking of a two-compartment shaft to the 800-ft. level, drifts from which are being run to find the high-grade oreshoots worked in the upper levels.

## Mining in Utah in 1913

BY EDWARD R. ZALINSKI\*

The year was one of steady production. The tonnage was normal or greater than normal. The output of Park City decreased somewhat as compared to last year, while the productions of Bingham, Tintie, and Beaver County all increased.

The ore market was good. There was a steady production of ores from the various camps throughout the year, with few marked fluctuations. During the winter months a good tonnage was shipped, as hauling conditions were favorable. There was no decided falling off in the spring, except possibly from Alta and the Cottonwoods. The tonnage held up during the summer, with increased shipments by all the camps. During the latter part of September ore and bullion settlements were especially heavy.

The shipments from Park City, Tintie, and Beaver County were obtained through the courtesy of the railroads. The output of Bingham averaged at least 23,000 tons a day. This is an estimate based on the output of the Utah Copper Co., which averaged approximately 20,142 tons a day during the first three-quarters, and on 3000 tons a day for the other mines of the camp, including ore milled by the Utah Apex, Ohio Copper, and Bing-

ham-New Haven. Taking 23,000 tons a day, the tonnage for the year (362 working days) amounted to approximately 8,326,000 tons. It probably exceeded this amount, on account of the heavier output of the Utah Copper during the last quarter. Between 25,000 and 30,000 a day were shipped quite frequently from the camp.

There was increased activity at Stockton, Dry Cañon and Ophir. The output of the Cottonwoods was less than

PARK CITY, TINTIC AND BEAVER COUNTY ORE SHIPMENTS IN 1913

	Park City Tons	Tintie Tons	Beaver County Tons
Jan.....	7,105	34,908	8,225
Feb.....	6,063	30,913	6,350
Mar.....	6,765	37,114	5,650
Apr.....	7,575	26,554	6,300
May.....	6,576	34,613	9,000
June.....	6,819	32,497	6,960
July.....	6,386	29,592	6,050
Aug.....	6,453	29,194	5,050
Sept.....	6,701	24,555	7,150
Oct.....	7,743	29,494	7,800
Nov.....	6,818 (a)	30,853 (a)	6,803 (a)
Dec.....	6,818 (a)	30,853 (a)	6,803 (a)
Total for 1913.....	81,822 (b)	370,240	81,641 (c)
Total for 1912.....	91,837	363,363	49,272

(a) Shipments for November and December are estimated, but will be about the same as for the previous months. The average of the first ten months has been taken.

(b) Crude ore and concentrates.

(c) These shipments include 14,800 tons of slag from Frisco. Deducting this there would be 66,841 tons of copper, lead-silver ores.

The Beaver County shipments are from Milford, Laho, Hickory, Frisco and Newhouse.

\*Mining engineer, Newhouse Bldg., Salt Lake City, Utah.

the year preceding. American Fork produced about the same tonnage. Beaver County shipments of both high- and low-grade ore increased. Some silver-lead ore and an occasional car of lead-zinc ore was shipped from the Santaquin and Nebo districts in Utah County. In addition to the local ores a considerable tonnage was shipped to the valley smelteries from surrounding states.

#### SMELTING OPERATIONS

The United States Smelting, Refining & Mining Co. at Midvale ran five furnaces on lead ore. The American Smelting & Refining Co. at Murray had five lead furnaces in operation, and one furnace on matte concentration. The Garfield smeltery of the A. S. & R. operated two blast furnaces and five reverberatories, smelting 2300 tons or more of ore and concentrates daily. All of the reverberatory furnaces were equipped to burn California crude oil. A number of improvements, including arrangements for additional slag dumping ground, a new stack, etc., were provided for. The International at Tooele had two lead furnaces in blast the first of the year, treating about 500 tons of lead ore daily. Two additional lead furnaces were completed and blown in in February; a fifth lead furnace was added in August, giving the company a capacity of 1250 tons of lead ore daily. Copper ores were also received, but the copper furnaces, which were closed down at the time of the Bingham strike, were not operated at capacity. Three copper furnaces were fired in February. In May eight furnaces were in blast, four on copper ores, and four on lead. Both lead and copper ore was received from the Utah Consolidated at Bingham, while the South Utah shipped copper concentrates. Ores from outside of the state were received, and a large tonnage was stockpiled.

Labor at Bingham was scarce during the early part of the year, following the strike which occurred toward the end of 1912. The strike was not officially declared off until summer, though it was broken last November.

The operations of the Utah Copper were curtailed during the first quarter. There was produced in this quarter 23,884,467 lb. copper. Operations were steadily increased, the output in the second quarter being 31,785,448 lb. and 32,287,452 lb. in the third, making a total production of 87,957,367 lb. of copper in the first three-quarters, as compared to 95,105,391 lb. during the whole of 1912. The tonnage handled during the third quarter was the largest in the history of the company, the mills having averaged 22,000 tons per day during this time. In September the average was 24,000 tons. A high record of handling 29,000 tons of ore from the mine to the mills in a day was made. In the second and third quarters a total of 3,945,605 tons of ore was treated, and 2,647,627 cu.yd. of capping removed. The ore averaged 1.2549% copper in the third quarter and 1.28% in the second. The cost per pound, without crediting miscellaneous income was 9.068c., as compared with 8.933c. for the second quarter. The Magna plant milled 56% of the tonnage, and the Arthur 44%. A recovery of 64% was made during the third quarter.

#### GOLD

The gold output was below normal, on account of the closing down of the Consolidated Mercur, which occurred Mar. 30. The grade of the ore had become too low to operate at a profit. Gold was produced from low-grade

copper ores and from Tintic mixed ores. There was practically no production from straight siliceous ore, except to a small extent by the Sheep Rock in Beaver County. The Bull Valley district, 40 miles south of Modena in Washington County, attracted some attention.

#### SILVER AND LEAD

The Silver King Coalition, Daly-Judge, and Daly-West, of Park City, producing silver-lead ores; the Utah Apex, Bingham-New Haven, United States properties and Utah Consolidated at Bingham producing lead-silver ores, were the principal silver and lead producers in 1913. The Centennial-Eureka, Iron Blossom, and Gemini in Tintic added to the output from siliceous copper-gold-silver ores, from siliceous silver ores, and from silver-lead ores, respectively. The Chief Consolidated produced siliceous silver-gold-lead ore. The Mines Operating Co. leasing on the Ontario at Park City, treated low-grade ore and stope fillings in its new mill handling up to 150 tons a day. The process consists of a chloridizing roasting with a large excess of salt, and with powdered coal, leaching with water, and precipitating on copper and scrap iron. The American Flag and Silver King Consolidated opened new orebodies, and the Thompson-Quincy was an added shipper to the camp.

The Knight mill at Silver City was built to treat low-grade Tintic ores by the Christensen leaching process, consisting of a salt roast of the ore (with pyrite), and leaching with the acid liquors resulting from the condensation of the roaster fume, followed by precipitation on copper and scrap iron. Experimental work was carried on at this plant during the latter part of the year.

#### ZINC

Shipments of zinc ore were curtailed on account of the lower price of spelter. Tintic zinc shipments decreased from between 1500 and 2000 tons a month at the close of 1912 to a very small tonnage in April, 1913. The Yankee, May Day, Gemini, and Scranton were the principal shippers. At Park City the Daly-Judge produced zinc middlings and concentrates, which were shipped east. The larger part of Utah zinc ores go to the Kansas and Oklahoma gas belt. The Daly-West shipped a small tonnage. The Grasselli mill did not operate. Lessees worked the small tailing plants below the Grasselli mill, and made some shipments of zinc concentrates. Stockton made occasional shipments of crude zinc ore, and some lead-zinc was shipped from the Nebo district. The Huff electrostatic plant of the United States Co. treated 45 tons of zinc middlings from the company's wet concentrator daily.

#### URANIUM AND VANADIUM

The production of uranium and vanadium ores amounted to between 125 and 150 short tons, as compared to approximately 300 short tons during 1912. The grade of the ores ranged from 1 to 1.75%  $U_3O_8$  and  $2\frac{1}{2}$  to 3%  $V_2O_5$ . This is slightly higher than during the year preceding, owing to the fact that more accurate data and analyses in regard to the material are available to shippers, and furnished a guide for more careful sorting. Most of the output came from Grand and Emery counties in the southeastern part of the state, the principal fields being reached from Green River, Table Mountain, Richardson, Thompsons and Moab. The ores are largely carnotite.



They occur in the upper part of the La Plata sandstone at the same horizon as at Placerville, Newmire, and the Paradox Valley country in southwestern Colorado. The

ore has to be carefully sorted. In the Green River section the cost of mining, sorting and sacking is \$25 and upward a ton.

## Mining in South Dakota in 1913

BY JESSE SIMMONS\*

While both tonnage and bullion yield of the gold mines of the Black Hills, South Dakota, show a slight decrease from 1912, still 1913 was a year of marked progress, and its lessons will place mining on a more stable, profitable and permanent basis. With many other gold-mining districts, the Black Hills felt a shortage of money for development purposes. Active and worth-while exploitation was confined to few properties in comparison with some of the past years. The producers have, however, with but one or two exceptions, worked full time. It is believed that the decrease of production will be found to rest almost solely with the Homestake, which, according to the State Mine Inspector's report for the year ended Oct. 31, shows a falling off of over \$300,000; the production of the other mines is practically normal.

For many years the Homestake has engaged in a campaign of improvement and betterment. In March, 1913, improvements to the extent of \$3,276,000 were capitalized by the issuance of stock. The shares were divided as a stock dividend of 15% among the holders. In addition \$7.80 per share was paid.

Ability to earn these dividends is due to a number of factors, among which might be mentioned cheapening of operations through the application of electric energy developed on Spearfish Creek; cheap mining, by a caving system, of ores from the upper levels; slightly increased capacity and a general improvement of mining and milling methods the natural result of years of work.

In January a bonus system was inaugurated, whereby all men on the payroll at the end of 1912 received an amount equivalent to 7% of their earnings during the year. This distribution will be duplicated for 1913. By the addition of 20 stamps to plant during the summer, the total was increased to 1020 stamps in operation. At the Ellison shaft a change house with lockers and accommodations for 474 men was completed. From early spring work has been pushed on the construction of Recreation Hall, a free club house for the men, which will cost in excess of \$200,000 when completed and furnished.

For 1914 the improvements will include a large boiler plant, convenient to the railroad tracks, from which steam will be furnished for an auxiliary electric-generating station and for the new hoisting plant, which is to be erected at the Old Abe shaft. This shaft is now five compartments, and is to be increased in efficiency for ore hoisting and development by the installation of a hoisting engine capable of raising rock from a depth of nearly a mile. With the change to the new engine, skips will replace cages for ore hoisting. It is understood that additional stamps will be erected. Ore developments are stated to be ample to justify a large increase in milling capacity.

Golden Reward enjoyed one of the most prosperous years in its history, the production approaching the half-

million dollar mark. The mill at Deadwood operated continuously at full capacity. The leasing system, by which numbers of segregated properties are operated, was enlarged during the year, and a big proportion of the ore supply was furnished by leasers. Further exploration was conducted on the big Astoria shoot, the new roaster given a test, and the roasted product subjected to exhaustive experimentation. The company plans the erection of an additional mill, but its situation, whether at the Astoria mine, or at Deadwood, remains undecided.

Trojan continued the exploitation and equipment of its properties and now has one of the best equipped mines in the Bald Mountain district. Early in the year connections were made and the machinery installed at the Portland tunnel, from which workings in the upper contact furnished a good quality of ore. The Decorah continued a good producer, and the Empire was drawn upon for a share of the mill supply. The mill was equipped with a number of important labor and money-saving devices; the plant now ranks with the best in the country, but plans are practically matured for increasing both its efficiency and capacity by the installation of tube mills and additional slime-handling equipment.

Mogul, which had the misfortune to lose its mill at Pluma, by fire, in March, 1911, in the summer commenced work on the erection of a plant near the head of Nevada Gulch. The location is such that ores will be delivered by short haul on tramways from a number of the producing properties of the company. The equipment of the plant with some of the late developments, metallurgically, which are expected to effect a material saving in costs and increase in recovery, and the saving of the railroad haul on the ore, should enable the plant to operate at a good margin of profit. Much of the equipment in the Pluma mill was not damaged, and its use is making construction work easier. The mill will have a capacity of 150 tons daily. It will use fine grinding, probably sliming the entire product, and recovery will be effected by continuous decantation and counter current system.

Early in the year the Bismarck Cons. Mines Co. started its mill at Flatiron, adjoining the Wasp No. 2. Since that time the plant has been operated continuously at full capacity, about 300 tons daily. The plant is a model dry-crushing cyanide mill. The mine is opened on the glory-hole system, and total operating costs are as low, if not lower, than any in the Black Hill.

Wasp No. 2 was forced to suspend operations during March, when snow and cold weather interfered with work. Again, on Oct. 20, a shortage of water caused work to be stopped, and until the end of the year nothing was produced after that date. In the 8 months and 20 days that the property was operated, the normal production was made, and dividends aggregating \$55,000 were paid. In addition a number of expensive improvements were in-

\*Deadwood, S. D.

stalled, the most important of which was a conveyor system for handling the tailing between the leaching tanks and the dump.

New Reliance operated steadily the entire year at about 75 tons daily. The ore is hard, and is stamped to pass 0.024 and 0.023 screens. Continuous decantation, with counter-current solution system is used in the slime department, the tailing being dewatered on a Portland filter. Dorr thickeners are used in the decantation system, and the thickened pulp is transferred from tank to tank by diaphragm pumps. The metallurgical practice at this property is highly commendable, and is of great local interest, as it is the first in the Black Hills to use successfully the process mentioned.

A modern mill of 10 stamps, to embody the latest practice, and to use a Hardinge mill for fine grinding, is being constructed near Galena by the Rattlesnake Jack Mining company.

Important among the development ventures is that promoted by the Deadwood Business Club, whereby the Heidelberg group, on Two Bit Creek, is being exploited by local capital. The funds were raised among the business men and others of Deadwood, who, in return for \$5000, which is being expended on the property, receive a one-half interest in it. Developments have been highly encouraging.

At Carbonate camp, which 25 years ago was the scene of successful mining of high-grade silver-bearing lead carbonates, the Titanic company has started a shaft to the 300-ft. point, to explore an untouched section which old timers declare contains ore. A good plant of machinery has been installed, and all preliminary work advanced, so that mining will proceed more briskly in the near future.

In August, the Lundberg, Dorr & Wilson mill, at Terry, suspended operations, quietly and unostentatiously closing the career of one of the Black Hills' most success-

ful mills. Exhaustion of ore supply was the reason advanced for the suspension. The Black Hills, and the mining world at large, has reason to remember this mill, for it was here that some of Mr. Dorr's devices originated and were developed. The plant had an excellent record from inception of operation, and it is to be hoped that it will some day resume work.

Local parties secured a long-time lease on the Ironsides property, on Squaw Creek, and several shipments were made to smelters and local cyanide plants. The property is at present being opened by a long tunnel, which it is expected will tap the ore by the time the roads are in good condition for hauling.

In Custer and Pennington counties, the "Southern Hills" district, considerable active development was done. In Custer County the Hartwell company received new machinery for shaft work. In Pennington County the greatest activity was in the neighborhood of Hill City and Keystone. The Hill City M. & D. Co. installed a first-class mining equipment, and will sink to 300 ft. The First National company resumed work on the Forest City property. The Continental Copper Co. has just resumed work after several years' idleness. The shaft, which is several hundred feet deep, is to be continued to the bottom of the copper ash. The Golden Summit was worked in a small way. Several mill runs of selected high-grade ore were made in the small mill. At Keystone, mica and the lithia minerals, amblygonite, spodumene and lepidolite, were mined. There appears to be a better market for scrap mica than for some time past, and a number of small producers are taking advantage of this fact, and regular shipments are being made. The Etta mine continues to be the United States' principal source of lithia minerals, and was worked continuously. The Otho company is erecting the first 150-ton unit of its mill at Spokane, and hopes to operate it before summer. At Rochford the Gold King company did considerable development.



## New Mexico in 1913

The most important mining operation in this state is that of the Chino Copper Co., which entered the list of dividend payers in June, 1913, and distributed in its three dividends \$1,917,540. The company steadily increased its production, more than doubling its copper output in 1913. In the third quarter the company milled at Hurley 507,650 tons of ore, yielding over 15,000,000 lb. of copper, or more than half its total production in the previous year. The extraction in the third quarter was about 67% and the mill averaged 5500 tons per day. The general conditions at the property continued favorable and an additional water supply was assured. The ore tonnage for the year approximated two million, with the grade of the ore slightly under 1.9% copper.

The Phelps-Dodge interests made active preparations for the operation of their Burro Mountain copper properties. The railroad extension from Whitewater to the Burro Mountain district, a distance of 17 miles, was completed, including a 7000-ft. transportation tunnel connecting the underground workings at Leopold with the railroad near Tyrone. This tunnel will handle standard-gauge cars which will be hauled by electric locomotives. Ground was broken for a mill about five miles east of

Tyrone. Water will be obtained from the Chemung mine. The Phelps-Dodge interests purchased the Huston group, the Fortuna, and the Parker claims at Tyrone.

There was considerable activity at Pinos Altos in 1913; several mills were built or remodeled and it is understood that the reopened Hearst properties can be operated profitably with improved metallurgical treatment. The Empire Zinc Co., a subsidiary of the New Jersey Zinc Co., increased its holdings in Grant County. The Colorado Fuel & Iron Co. shipped about 600 tons daily from the Bessemer Iron Associated Companies' properties to its reduction works at Pueblo, Colo. The meerscham mines on the Sapello River, the only known meerscham mines in America, discontinued operations in midsummer, but it is understood that these mines have been adequately financed and will be reopened in 1914 in a miner-like manner, ore extraction in the past having been without consideration to future production.

The Mogollon district, in Socorro County, had a successful year in 1913, and much new equipment was installed. The Ernestine Mining Co. sunk its main shaft and added materially to its equipment; late in the year



it began milling custom ore. The Socorro company added two De La Vergne engines and continued the treatment of the old dump. The Pacific Mines Co., the Treasury, the Lincoln and the Maud companies also increased their equipments. At the end of the year, there was a report of a consolidation of several properties in the Mogollon district.

The Santa Fé Gold & Copper Co. at San Pedro in Santa Fé County ran its smelting plant continuously from January to August, when operations were temporarily discontinued for the purpose of making improvements. Development work, however, was continued in the mine during August and September, and ore of higher grade was opened up in a new part of the property. During this period the mine shaft was also retimbered. The smelting furnace was rebuilt, and in October was started and run continuously to the end of the year.

A serious accident occurred at the Stag Cañon Fuel Co.'s No. 2 colliery, at Dawson, on Oct. 22, when 261 men were killed as a result of an explosion.

#### MAGDALENA DISTRICT

The Ozark Smelting & Mining Co. leased all the old workings of its Graphic mines and a steady production of lead and zinc carbonates was maintained. This company also erected a mill of 4000 tons monthly capacity to treat the mixed sulphides occurring in the lower levels of the Graphic property. The breaker plant is situated near the mouth of the Waldo tunnel and the broken ore sent by a Leschen aerial tram to the mill, about a mile distant, on the slag dump of the old Graphic smelting

works, to which a spur from the Socorro-Magdalena Ry. extends. The shipping ore is delivered direct from the aerial tram to the railway cars, the milling ore to the mill and the concentrates are loaded from the mill into standard-gage railroad cars, thus reducing the expense of transporting low-grade ores to a low figure. The mill, a steel structure uptodate in all particulars, ran steadily after May, sending out regular shipments of zinc concentrate. The Ozark Smelting & Mining Co.'s operation is now the largest in the Magdalena district.

It is interesting to note that the Ozark power plant consists of a 360-hp. De La Vergne internal-combustion engine, running on crude oil. This engine operates a General Electric alternator, distributing power to the mine one mile distant, and to the mill adjoining. This power plant is said to produce electric current at an exceedingly low cost, closely approximating that from a good water power.

The Tri-Bullion company, which has been the principal producer at Kelly for some time past, ceased operation in the summer of 1913, and most of its claims were purchased by the New Jersey Zinc Co., which had some other holdings adjoining. The Tri-Bullion company mined zinc-lead sulphides, concentrated, roasted the zinc-pyrite concentrate and operated same by low-tension magnets.

Of the several small producers of lead carbonate and zinc carbonate in the district, probably the Juanita, operating under lease, made the largest output in 1913. It is reported to have large reserves opened and will undoubtedly make heavy shipments when the price of lead and spelter justifies the production.

## Mining in Nevada

Nevada occupies an important position among the mining states of the Union, and during the last year progress has been at a rate consistent with its best traditions. There are many important camps within the state, some of the most famous older ones and some that are expected to be famous in the future.

#### MANHATTAN AND HAWTHORNE

Manhattan had a fairly active year, about one-fifth of the production being from placer operations. The general trend is toward mining low-grade ores on a larger scale. The most important operators were the Manhattan White Caps Mining Co., the Big Four Mining Co., the Riley Fraction, the Wittenberg & Mushett operations on the Big Pine and Mayflower claims, and the operations of Mr. Brady and associates on the Union No. 9, the Jumping Jack and the Earl claims. Most of these properties are operating on free-gold ore. The latter part of the year was quiet owing to pending negotiations for the consolidation of several properties. The treatment of the low-grade orebodies offers the best field at present, and it is expected that these will be exploited in 1914.

The Pittsburgh Silver Peak Gold Mining Co. continues to be the largest producer in the Silver Peak and Red Mountain districts. The company milled about 15,000 tons monthly in its 120-stamp mill and cyanide plant at Blair. There were one or two small "excitements" during the year, but nothing of importance was opened.

At Lucky Boy, seven miles southwest of Hawthorne, a long drainage and exploration tunnel was under construction in 1913, and about 2000 of the 5700 ft. calculated as necessary to drain the Mountain King workings, was completed. Much water was encountered about the middle of October, and driving was temporarily abandoned, though it was resumed later in the year. The Excelsior Copper Mining Co. continued the development of its claims at Whiskey Flat.

At Anrora, the Aurora Consolidated Mines Co. began to build a 500-ton cyanide plant that is to be completed in April, 1914. This company owns about half the property in this district and is driving a drainage tunnel to tap the vein at 300-ft. depth.

#### BUCKHORN AND GOLDFIELD

At Buckhorn, the Buckhorn Mines Co. erected a 350-ton mill and cyanide plant, and the Cortez Mining & Reduction Co. erected a 30-ton silver-lead concentrator mill at Mill Cañon, about four miles from Buckhorn.

The United States Smelting, Refining & Mining Co. continued development in a small way at its Richmond-Eureka property, pending the settlement of its suit with the Eureka-Nevada R.R. for a reasonable rate.

In Goldfield, the Consolidated company operated throughout 1913 with only slight interruptions, operations being curtailed in April to make changes in the filter plant. The production for the year will amount to

about 350,000 tons, and the profit to about \$3,000,000. It seems that this profit, however, was made in the first quarter, during which the ore treated averaged over \$21. The grade of the ore treated in the last three quarters of the year was much lower, the monthly profit averaging less than \$200,000. The cost per ton was reduced from about \$7 at the beginning of the year to slightly over \$6 for the later months. Albert Burch was appointed manager, succeeding J. F. Thorn, who went to Salvador.

#### ROCHESTER AND OTHER DISTRICTS

The most important developments were in the White Cloud mining district, Copper Kettle, Table Mountain, Antelope, Jessup, Sacramento and Spring Valley districts. Some high-grade copper ore was shipped during the year from the White Cloud, Copper Kettle and Table Mountain camps. The greatest attention was given to the Rochester district, and it is estimated that in its first year it produced 20,000 tons of ore, for which an average value of \$25, or a total of \$500,000, was claimed. This ore was extracted by lessees and hauled eight or ten miles to Nenzel station, on the Southern Pacific.

In the Indian, or Spring Valley district, the Federal Mining Co. proceeded with its dredging project, and in the Antelope and Table Mountain districts cinnabar deposits were opened. Lead ore was also encountered in the Antelope district. In the Seven Troughs district an event of importance is reported in the successful drilling for the faulted vein of the Coalition property, and this district may enter upon renewed activity. In the Table Mountain district the Boyer mine encountered some rich ore in the lower workings; the Thies-Sullivan property has produced some high-grade copper ore, and it was reported at the end of the year that the property would be extensively drilled for secondary deposits.

The Salt Lake Copper Co., at Tecoma, Nev., has been operated during the year mainly by lessees. The small amount of development was performed by the company during the year with a view of opening orebodies by means of tunnels. This work has not yet been extended far enough to determine whether the orebodies will be cut by the tunnels.

#### MASON VALLEY

Among the producing mines of the Mason Valley mining district in 1913 were the Nevada-Douglas Copper Co., the Mason Valley Mines Co., McConnell Mines Co., Malachite, Empire-Nevada, Blue Jay, New Yerington, Montana Yerington, Yerington Mountain, Yerington Copper, Smith Valley Mines Co., and others of lesser importance. The district produced approximately 220,000 tons of ore containing 15,000,000 lb. of copper, 9800 oz. gold, and 120 oz. silver.

The entire production was treated by the Mason Valley Mines Co., at its Pompton, Nev., smelting plant, which was improved by the installation of a converting plant. Hereafter the company will ship blister copper to Eastern refineries. In consequence of this installation the plant will be able to treat more siliceous ores. The company's own mines operated steadily in 1913 and shipped about 115,000 tons of ore. Development work was vigorously pushed and satisfactory results were obtained in diamond-drill prospecting.

The Nevada-Douglas Copper Co. produced about 77,000 tons of ore, containing approximately 7,000,000 lb. of cop-

per. The Ludwig main inclined shaft was sunk a distance of 135 ft. to the eighth level, where development work indicated several bodies of high-grade ore and was still in the oxidized zone. The main shaft of the Casting Copper workings was sunk to the 350-ft. level. The work in this property has opened a large body of high-grade oxidized ore now proven from the surface to the 200-ft. level. Exploration during the year was continued, by means of diamond and hand drills.

The New Yerington Copper Co. shipped about 5 cars of 14% copper ore during the year. A good deal of development has been accomplished and about 1500 tons of 15% copper ore is said to be ready for shipment now.

The McConnell Mines Co. shipped about 1200 tons of copper ore and the developments during the year were satisfactory. The Malachite property was purchased in the summer of 1913 by Grant Snyder and associates from Salt Lake. The Smith-Kelly Mines Co. employed about 10 men and installed a new hoist, a 6-drill compressor and a 60-hp. gasoline engine.

#### YELLOW PINE

The largest producer of the Yellow Pine district, as in former years, was the Yellow Pine Mining Co., which operates the Bybee group, four miles west of Goodsprings. The company shipped about 1000 tons of crude zinc ore, 3000 tons of lead concentrates and 16,000 tons of zinc concentrates; \$218,500 was distributed in dividends. During the summer the concentrating plant was enlarged, and the mine developed so that now the company has a larger ore reserve than ever before.

The Potosi mine, 10 miles north of Goodsprings, was purchased by the Empire Zinc Co., from Mahoney Bros. This property produced about 750 tons monthly of crude ore, averaging 38% zinc.

Two concentrating plants were erected in the Yellow Pine district, in 1913, at the Singer and Hoosier properties. These plants are of particular interest in that they are using the Stebbins' dry concentrators. They were started late in the year and have made shipments of medium-grade, lead-zinc concentrates to the smelteries.

The Anchor mine was sold to Frank A. Keith and associates, of Los Angeles, and a 2000-ft. aerial tramway was constructed. Yount & Fayle, of Goodsprings, owners of the Bullion mine, have constructed a similar tramway and their mine is shipping lead ore. Ore was shipped by lessees in 1913 from the Accident, Palace & Monte Cristo group. The Columbia, two miles west of Goodsprings, shipped about 30 cars of copper ore to the Salt Lake smelting plant. Other developing properties from which occasional shipments were made are the Pilgrim, Blue Jay, Volcano, Mountain Top, Milford, Azalea and Hale group. Vanadium ore was discovered in the Westminster & Bill Nye group.

#### LINCOLN COUNTY

Producing companies in Lincoln County during 1913 included the Prince Con., Day-Bristol Con., Nevada-Utah, Mendha-Nevada, Providence M. & C. Co., Bamberger-Delamar and Silver Comet; 73,547 tons were produced, valued at \$709,977. Prince Con., the largest producer, was abandoned by Knox interests and reverted to Godbe's. Day-Bristol is a consolidation of the old Bristol Con. and the Bristol and Jack Rabbit of the old



Nevada-Utah. Several leasers in the Bristol district have a good quantity of ore ready for shipment.

Nevada-Utah is now operating under the name of Amalgamated Pioche, which in turn is controlled by Consolidated Nevada-Utah. Some old slag and tailings have been shipped and development is now going on. Mendha-Nevada installed a pipe line and Hancock jig. With increased value and decreased freight charges, this company's prospects are bright.

The Virginia Louise sank to 460 ft and developed 250,000 tons of ore. There are two companies working in Comet district, but no production yet. At Silver Park, leasers tried to handle ore in motor trucks, but were unsuccessful.

#### RAWHIDE, EUREKA, ELKO

The Nevada New Mines Co., which succeeded the Rawhide Coalition Mines Co. and the Rawhide Queen Mines Co., worked about 40 men at its mines and mills. The company treated about 30 tons daily in its mill, and during the coming year will sink the Victor shaft to 1000 ft. The Black Eagle Gold Mining Co., two miles west of Rawhide, continued its development, the ore taken out being milled by the National Mining & Milling Co. The ore taken out from development work at the Croskey Regent Mining Co., 1½ miles northwest of Rawhide, was treated at the same plant. Some high-grade silver ore was encountered on the Backlin and Flynn properties, west of Rawhide. A new hoist was installed by the Last Hope Mining Co., and the shaft was sunk. The company shipped about 100 tons monthly of \$40 ore to the mill of Nevada New Mines Co. The ore contains silver.

Mining in the Eureka district continued to be restricted by the high transportation charges for ore. The Nevada Transportation Co., which leased the old Eureka & Palisade Ry., and changed the name to the Eureka-Nevada R.R., placed its rates so high that the largest mining company, the Richmond Eureka, has made formal complaint to the Nevada Railroad Commission requesting a reduction of rates. This company ceased mining, and the only ore shipped was high-grade that would stand the cost of sacking and the excessive freight rates. There were several shipments of high-grade silver-gold-lead ores from Hamilton in White Plains County.

The Nevada Central Copper Co. sunk its two-compartment shaft to a depth of nearly 800 ft., the ultimate intention being to explore the ground below water level. The company installed a 60-hp. oil engine and hoist, and a 310-cu.ft. air compressor at its property in the Antelope district. The Mineral Hill Consolidated Mines Co., five miles east of Mineral, inaugurated a new policy of development and very late in the year made a strike of rich ore which is expected to prolong its life.

At Bullion, the Nevada-Bunker Hill Mining Co. continued work on its long crosscut tunnel, which is to reach 800 ft. below the deepest of the old shafts. On the Key claim of this company, lessees Kerr and Peterson developed a wide vein of silver-lead-copper ore, from which shipments were made during the latter part of the year at the rate of three cars per week.

Developments were carried on in Bullion-Nevada Copper Co.'s property, the Helen End, and in the Sylvania and Sweepstake group of the Nevada-Bunker Hill Mining Co., under lease to Kinnie and McConaghy. About 70

men were employed. At Lone Mountain, about 28 miles northwest of Alta, the Ely Consolidated Copper Co., of Ely, Nev., leased the Copper Queen and the Baltimore groups. The Montana Gold Mining Co.'s property, at Edgemont, was reopened. At Tuscarora, the Nevada-Tuscarora Mines Co. that controlled most of this famous old gold camp was still in the hands of the receiver and the work in 1913 was done entirely by leases.

#### GOLD CIRCLE, CONTACT, JARBIDGE

In the Gold Circle mining district, the Eastern Star Mining Co., the Elko Prince Development Co., and the Gold Circle Queen Mining Co., continued development work, the latter two companies installing hoisting machinery. A hoist was also installed at the Esmeralda property, and a new shaft was sunk. The old mill handled all the ore above the tunnel level. The Rex mill was remodeled to handle ore from the Rex, Colorado Grandes, Old Judge and other custom ores.

#### COMSTOCK

The Mexican continues to be the most progressive operation on the lode. During the year, the mill treated ore from the Mexican mine and also from the Monte Cristo and other leased properties. The mines upon which operations were carried on were the Mexican, Chollar, Crown Point, Comstock Phoenix, Monte Cristo, Beecher, Hale & Norcross, Yellow Jacket and C. & C. The pumping association installed a new pump in the 2500-ft. level of Con. Virginia.

#### ELY

The Nevada-Consolidated Copper Co., the principal operator in the Ely district, mined nearly three million tons of ore in 1913, having an average content of about 1.6% copper. In the latter part of the year the tonnage was about equally divided between the Eureka and Liberty pits, though a small proportion, 7 to 10%, was obtained by underground mining from the Veteran property. The company had a prosperous year and continued its drilling, 9 drills being employed in December, at which time 5 steam shovels were working on ore and the remainder stripping. The company directed much attention to metallurgical improvements. The Consolidated Copper Mines Co., which is a consolidation of the Giroux and other properties, had an active year, and in the latter part, the operations of the Nevada-Consolidated's steam shovels disclosed ore in the Ora claim of the Giroux property and resulted in a directing of greater attention to the steam-shovel mining and away from underground mining. The loose ore from the Ora claim was sent to the Bechtel mill.

At Fairview, the Nevada Hills property has been working both mine and mill as usual. No changes of importance have been made. At a point between Fairview and Wonder, uranium minerals was said to have been found. The Nevada Wonder, at Wonder, operated mine and mill as usual during the year.

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### Tonopah in 1913

BY FREDERICK BRADSHAW\*

Tonopah produced in 1913 about 120,189 oz. of gold and 11,973,540 oz. of silver from 551,710 tons of ore

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of a gross value of \$9,721,727, as against an output in 1912 of approximately 112,642 oz. of gold and 11,027,736 oz. of silver (or about 2.49% of the gold and 17.3% of the silver produced in the United States and Alaska for the same period) from 474,521 tons of ore of a gross value of \$9,110,955. Dividends paid in 1913 amounted to \$3,353,482, as against \$3,331,550 in 1912 and \$3,060,624 in 1911. The Tonopah-Belmont Development Co. paid \$1,650,000; the Tonopah Mining Co. of Nevada, \$1,300,000; the Tonopah Extension Mining Co., \$165,000, and the West End Consolidated Mining Co. paid \$88,400 in dividends.

The total profit earned in 1913 by the producing companies was about \$4,350,000. The decrease in the grade of the ore produced, from \$19.21 in 1912 to \$17.62 in 1913, was compensated for by reductions in operating costs, and although the total value of the production showed an increase of but 6.7% over the previous year, the profits won have nearly or quite kept pace with the increased tonnage—of 16%—over last year. The year's production in tonnage and value, the value of the total production, and the dividends paid during the life of the camp are shown in the accompanying tabulation, in which the production of the last two months of 1913 is estimated.

	1913 Tons	1913 Gross Value	Approximate Total Production	Dividends Paid to Jan. 1, 1914
Tonopah-Belmont Dev. Co.....	171,960	\$3,268,956	\$16,285,149	\$5,618,002
Tonopah Mining Co. of Nev.....	168,330	3,029,940	29,346,831	11,100,000
Montana-Tonopah Mines Co.....	54,106	811,590	4,950,118	530,000
Tonopah Extension Mg. Co.....	54,618	750,749	4,047,182	518,832
West End Cons. Mining Co.....	50,475	920,741	2,500,526	88,424
Jim Butler-Tonopah Mg. Co.....	20,566	421,603	844,079	.....
Tonopah Merger Mining Co.....	11,647	200,738	200,738	.....
MacNamara Mining Co.....	10,278	.....	1,406,273	43,999
Tonopah Midway Mining Co.....	.....	.....	1,281,874	250,000
Tonopah-North Star T & D Co.....	10,993	339,715	282,532	.....
Halifax-Tonopah Mining Co.....	.....	.....	22,307	.....
		\$9,744,034	\$61,167,615	\$18,049,258

The Tonopah Mining Co. in 1913 prosecuted extensive development work, including the sinking of its Sand Grass shaft to over 1000 ft. of depth, and in the latter half of the year, opened one or two important new orebodies. During the last months of 1913 the grade of ore milled showed a marked improvement. The Tonopah-Belmont, by reason of its new mill at Tonopah, greatly increased its tonnage over previous years. A large amount of development work, which included the continual sinking of the main operating shaft, was done on this property and various new veins were developed. The company operated its 60-stamp mill at Millers on custom ores of the district and for the last half of the year was run at full capacity. The West End Consolidated installed a large new electric hoist and will double the capacity of its shaft, which will be sunk to greater depth. The West End company is enlarging its 20-stamp mill by the addition of 10 stamps, a tube mill, agitators, additional refining and boiler equipment, which will bring the mill to a capacity of 225 tons per day. The grade of the increased ore reserves in this property is about \$20 per ton. The Tonopah Extension company sunk its new shaft to a depth of 1000 ft. and at the 950-ft. level is developing a large vein of profitable milling ore. The shaft is being equipped with permanent head works and ore bins and will be connected with the company's 30-stamp mill by an electric (third-rail) railway. This company added largely to its reserves.

The Montana-Tonopah produced about 4500 tons per month and operated its 40-stamp mill with good results.

Late in 1913 several new orebodies were encountered. The Jim Butler-Tonopah Mining Co. had the most profitable year of its existence. This company will now work other portions of its large territory, where ore has been developed. The MacNamara Mining Co. operated its 10-stamp mill successfully throughout the year. The Tonopah Merger was a continuous shipper and added to its ore reserves. The North Star company in 1913 had a calamitous experience, during which overproduction depleted the ore reserves but, under a new management, the property is again being properly worked. The Tonopah Midway is sinking a new shaft and making occasional shipments. The Halifax-Tonopah sunk its shaft to the 1700-ft. level and on the 1000, 1100 and 1400 levels is developing a large body of quartz. There is a flow of water in this property, amounting to about 150,000 gal. per day. The Mizpah Extension has completed over 4000 ft. of development work on its 1000, 1060, 1160, 1400 and 1475 levels, but nothing of importance has as yet been discovered.

Various deep shafts are being sunk in the district, among these being the shafts of the Cash Boy company, the Great Western Consolidated, Gypsy Queen, Monarch-Pittsburgh, Umatilla-Tonopah and other companies are carrying on vigorous prospecting campaigns.

## Oregon Mining in 1913

BY W. B. HARTLEY

The State Bureau of Mines created by the Legislature last spring, has accomplished much in investigating mineral resources, H. M. Lawrie, of Portland, is chairman. The blue-sky law that was put into effect is not liked by the mining men of the state, as it is retarding development of the mines somewhat by useless investigations and queer rulings.

Oregon made the best record for gold production this year since the placer-mining days of 1865.

Eastern Oregon produced the bulk of the gold for this year, and Baker County was in the lead. The Powder River gold dredge was kept in operation all year and was a good producer. The mines making the principal production are Union-Companion, Columbia, Rainbow, Humboldt, Ben Harrison, Bonanza, Cornucopia and Highland. Each of these produced from \$10,000 to \$48,000 a month. A nugget weighing 6¾ lb. was found by Armstrong & Sturton, on their claim in the Susanville district.

The West Coast mines, in Lane County, western Oregon, made a steady production. The Revenue, Bill Nye, Bart Group, Whitney-Long and other mines made good production in southern Oregon. The Alameda is being developed under the management of Receiver Burley, and new concentrators will be installed. Thomas Wilson, of Nevada, has purchased some rich placer ground on Sucker Creek, in Josephine County, and will develop it.

A number of attempts have been made this year to mine the black sands of the Ocean beaches. Some expensive machinery was installed and a considerable saving of concentrates is being made, but the gold is so fine that it is hard to save from the concentrates. Platinum and the larger gold are saved and some of these plants are paying expenses while experimenting. The year has been satisfactory and the state is rapidly gaining in production of metals.



## Alaskan Mining in 1913

Alaska for 1913 presented the anomaly of a decreased production combined with the greatest activity and the rosiest promise for the future of any time in its history. The decrease in the value of the mineral product is the result of a combination of unfavorable circumstances affecting the gold- and copper-mining industries and, through them, the silver production. The setback is only temporary and of no significance. Unquestionably, Alaska is only entering on its career as a mining region. Interest for the year centers on the extraordinary development in progress around Juneau, the scale and significance of which are only now beginning to be generally appreciated, and in the new discoveries in the Chisana region and the upper Matanuska basin, particularly the former.

Alaska has produced to date \$228,200,000 in gold, \$16,580,000 in copper, \$2,060,000 in silver, \$360,000 in coal, while tin, lead, marble, gypsum, petroleum, etc., bring the total to \$248,300,000. It is estimated that the total output in 1913 was \$18,900,000, compared with \$22,537,831 for 1912. The gold is estimated at \$15,450,000; that of 1912 was \$17,145,951. The copper is estimated at 19,700,000 lb., valued at about \$3,014,000; that of 1912 was 29,230,491 lb., valued at \$4,823,031. The silver output, largely a byproduct of gold and copper is estimated at \$220,000 in 1913, as against \$316,839 in 1912 and other minerals at \$220,000, about the same as in 1912. The gold decrease is largely due to the condition of the placer-mining industry which still furnishes two-thirds of the gold output; 60% of this is produced by hand methods and marked fluctuation in output is inevitable, due to exhaustion of bonanzas, on one hand, and the discovery of new districts, on the other. Moreover, these small operations are far more dependent on the local water-supply than are the large plants. Under such conditions no stability of placer-gold production is to be expected. The exceptionally dry summer of 1913, and the partial exhaustion of the Fairbanks bonanzas account for the decrease in placer-gold output. The falling off in copper output is due solely to the fact that the Kennecott-Bonanza was closed down for about one-third of the year.

### GOLD

The returns from placer mining, while far from being complete, indicate a production of about \$10,600,000 compared with \$11,990,000 in 1912. At Fairbanks, in the Innoko-Iditarod region, and on the Seward Peninsula the sluicing season was probably less than one-half the normal. The decrease from these three regions is estimated at over \$2,250,000. On the other hand the Ruby district showed an increase of more than \$500,000. So far as known, the output from other camps did not greatly change. It is estimated that 35 dredges were operated in 1913, producing about \$2,650,000, an increase of \$450,000 over 1912.

The auriferous lode mines produced about \$4,700,000, a decrease of \$300,000. Curiously enough, this decrease, if final figures bear out the estimates, must be charged to the Juneau district, the most prosperous and active in Alaska. The explanation is that energies there were

directed toward the installation of large plants, with a disregard for immediate returns. Most of the other camps increased their lode output, notably Fairbanks. The value of the lode silver output is estimated at about \$20,000. Including only those that produced ore to the value of \$5000 or more, there were in Alaska in 1913 about 27 gold lode mines, besides six to ten properties worked in a small way.

### COPPER AND MISCELLANEOUS

Eight copper mines produced in 1913; it is estimated that 42,000 tons of ore were hoisted and yielded about 19,700,000 lb. of copper valued at about \$3,014,000, \$160,000 worth of gold, and \$150,000 worth of silver.

Tin dredging in the York district was continued during 1913 and at the lode tin mine on Lost River a small concentrating mill was erected and some concentrates shipped.

The coal situation remained the same as in previous years; Alaskans are still using British Columbia coal and California oil as fuel and that at heavy cost. A mine operated at Port Graham produced lignitic coal for local use and a little lignite was mined at several other places for the local communities. The 800 tons of coal mined in the Bering River field in 1912 was recently tested by the Navy Department, but the report on this test has not yet been made public. In cooperation with the Bureau of Mines, 900 tons were mined by the Navy Department in the Matanuska field. This will be sledded to the coast during the winter and similarly tested. The Katalla oil field continues to be the only scene of any development of the petroleum industry in Alaska. Here another well was drilled in 1913 to a depth of about 800 ft. This and some of the old wells by pumping furnished petroleum for a small refinery. The gasoline, which is of a high grade, finds a ready market at the settlements on Prince William Sound and Cook Inlet.

### SOUTHEASTERN ALASKA

The year in the Juneau district saw the operations of the Alaska-Treadwell chain of mines continued full blast, development work and construction on the Alaska Juneau brought almost to the point of production, a great amount of preliminary work completed by the Alaska Gastineau, and the taking over on option of the Ebner property by the United States Smelting, Refining & Mining Co. A few years more should see Juneau transformed from a one-mine camp to a district inclosing with small limit four of the greatest gold mines of the world. The district will soon become the greatest gold producer in North or South America, while challenging the supremacy of the Rand in point of tonnage if not in point of actual yield of metal. Of the three new companies, the Alaska Juneau is farthest advanced; it is controlled by the Alaska Treadwell interests and will be operated by the remarkably skillful and successful Alaska Treadwell management. The Alaska Gastineau is the operating company for the Alaska Gold Mines Co. controlled and managed by a Hayden Stone-Jackling combination. In the original examination and flotation of this property, A. F. Holden, of the United States Smelting, Refining & Mining Co., was concerned. Since his death, it is not known what connection exists between the two compan-

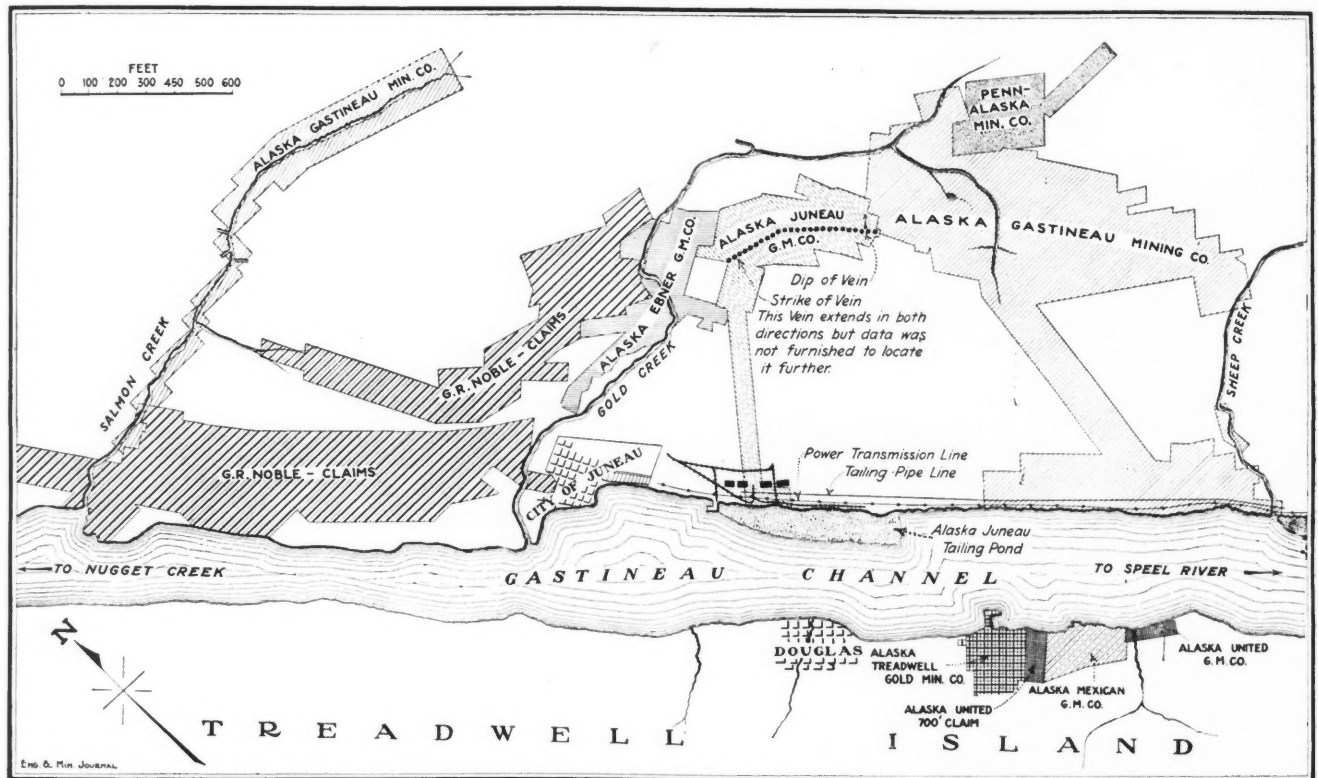
Note—In the preparation of this article the preliminary report of Alfred H. Brooks to the Director of the U. S. Geological Survey has been freely used.

ies. The most important property held by the Gastineau is the old Perseverance mine. The Gastineau will come into the producing class soon after the Alaska Juneau. The option taken on the Ebner property by the United States company was of more than usual importance as marking the entrance into the district of that company as a separate interest. It was reported that \$250,000 would be spent in development and exploration on the property, and it seems extremely likely that it will eventually be taken over. These three properties are all situated on one large persistent, gold-bearing lode, the Gastineau being on the south, the Juneau next, and the Ebner on the north. This lode, several hundred feet wide, consists of quartz stringers in the country rock, being different geologically, from that exploited by the Alaska Treadwell mine, although of similar dimensions.

ments are reported on the Hubbard-Elliott property and on the Berg claim.

The Ellamar and Beatson copper mines were operated to full capacity in 1913 and shipments were made from the Fidalgo properties. The Cliff Mine in the Port Valdez district was operated throughout the year. Four small mills were erected in the district during 1913, three in the Shoup Bay region at the Gold King, Cameron & Johnson, and Minnie properties, and one at the Mountain King in the Mineral Creek basin.

The two small mills of the Kenai Alaska Gold Co. and the Skeena-Lechner were operated part of the year, and underground developments continued. A five-stamp mill was erected by the Gold Stamp Mining Co. and a small prospecting mill was built by the Moose Pass Mining Co. About 15 placer mines were operated on the Kena;



THE MINES AND PROPERTIES AROUND JUNEAU, ALASKA

From the point of view of mining, it will have the great advantages of being easier to break and of requiring neither hoisting nor pumping.

At Berners Bay, development work was continued on both the Jualin and Kensington mines. In the Sitka district the Chicagof and Golden Gate were operated. In the Ketchikan district, the Jumbo and Rush & Brown copper mines shipped and development work was done by the Northland Development Co. The small stamp mills at the Valparaiso and Harris River gold mines were operated and some development done on the Londevan and Bugge properties.

There was no great activity in the Kotsina-Chitina copper belt during 1913. The Kennecott-Bonanza, the only productive mine, lost its tramway and compressor plant by a snow slide and fire, although these were rebuilt later in the year. An air compressor was installed on the Jumbo claim; a tramway is in course of erection on the Mother Lode. At the western end of the field, develop-

ments were reported on the Hubbard-Elliott property and on the Berg claim.

#### SUSITNA AND MATANUSKA BASINS

During the summer considerable local excitement was caused by the discovery of auriferous gravels in the region adjacent to the upper Matanuska basin and 75 to 100 prospectors were attracted to this region. Gold was found on Albert Creek, mining was confined to one claim and about \$1000 worth of gold recovered. Mining in the Willow Creek lode district continued on about the same scale as last year. Placer-mining operations were conducted in the Yentna district on most of the claims which were productive last year. On Valdez Creek, a large hydraulic plant was installed for the recovery of gold in a buried channel.

The drought was specially pronounced in the Seward Peninsula. Even some of the dredges could not operate, and for others it was necessary to make artificial basins



by cutting into the bedrock or by building dams. As a result the gold recovery was only \$2,500,000 in value, compared with \$3,000,000 for 1912. The dredges operated for part or all of the summer numbered 31, with an estimated gold recovery of \$1,800,000. These dredges had a combined daily capacity of 33,300 cu.yd. Four new dredges were installed; several others were in course of construction, the building of others is contemplated, while six were idle.

#### CHISANA DISTRICT

In May, William E. James and Peter Nelson found gold placers on a small stream called by them Little Eldorado; it flows into Bonanza, tributary to Chatenda, or Johnson Creek, which is an easterly fork of the Upper Chisana River, locally called the Shushanna. During the summer, mining was done on the discovery and on some other claims in the neighborhood. The value of the total output from the district is variously estimated between \$40,000 and \$70,000. Gold was also found on several tributaries of Chapolda or Wilson Creek, which lies across the divide north of Johnson Creek and flows westward into the Chisana. The information at hand indicates that the discoveries thus far made occur in an area about 5 to 8 miles square and that the prospected gravels are shallow. Some bench gravels have been found, said to be auriferous. Most of the claims thus far opened up are above timber line. The deeper gravels at lower altitudes, while known to be locally auriferous, have not been prospected.

#### IDITAROD, RUBY AND OTHER YUKON DISTRICTS

The shortage of water in the Iditarod-Innoko district greatly hampered mining operations. This condition, with the fact that certain claims being combined into large holdings were not worked, led to a great curtailment of gold output. Preliminary estimates indicate a production of about \$2,000,000.

Placer mining in the Ruby district as a whole showed considerable advancement. The distribution of profitable placers proved more irregular than was expected. The most significant new development was the discovery of valuable placer ground on several creeks in an area about 30 miles south of Long Creek.

Twenty mines, including two hydraulic plants, were worked for a whole or a part of the season in the Birch Creek district. One dredge was operated on Mastodon Creek. In the Fortymile region about 25 mines were worked in the winter and 15 in the summer. One dredge was operated on Franklin Creek. In the Chandalar district there are two placer mines operated in a small way on Big Creek. The developments of the quartz mines in this district were continued and other lode claims were prospected.

Quartz mining made steady progress in the Fairbanks district; 13 lode properties produced more or less. It is estimated that \$400,000 to \$450,000 was produced from the quartz mines, against \$200,000 in 1912. About 150 placer mines were operated for a whole or a part of the year. Preliminary estimates indicate that the value of the placer-gold production was about \$3,450,000.

There was no railway construction in Alaska during 1913 and of the 466 miles of track previously built only about 260 miles were operated. This is largely due to the high cost of fuel and to the tax of \$100 per mile on

all operating lines. In 1913, the White Pass & Yukon, the Copper River & Northwestern, and the Tanana Valley roads were the only lines continuously operated. Some excitement was caused by the discovery of a feasible railway route from Portage or Passage Bay, on the west side of Prince William Sound, to Turnagain Arm, which, by use of a tunnel about two miles long can avoid the glaciers and yield low grades for both in- and out-bound traffic.

Communication with Fairbanks was improved; during the summer several automobile trips were made over the military wagon road and a new direct steamboat service established between upper Yukon points and Fairbanks. Wagon road and trail construction was continued by the road commission in different parts of the Territory, thereby reducing costs of transportation to various mining camps. The results attained in building railways and wagon roads and the establishment of steamboat service are of incalculable advantage to the mining industry of Alaska, but at best, the service is inadequate, and unless it be extended, no great advancement in mining, except along the coast, can be expected. Therefore, railway construction is of first importance to Alaska, and second only is the building of a system of tributary wagon roads.

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### Yukon Gold Company

This company closed its operations at Dawson, in the Yukon Territory, on Nov. 1. Eight dredges were in operation during the season and 15 hydraulic mines. The total production from the Dawson operation was \$3,780,000, of which the dredges produced over \$3,000,000.

The dredge at Iditarod was still in operation on Nov. 15. It produced over \$800,000 for the season, which is probably a record production for a gold dredge. The new dredge of the Pacific Gold Dredging Co., a California subsidiary, was put in operation on Oct. 1 on the American River, near Auburn.

This property consists of a series of bars on the Middle Fork of the American River, embracing the Davis properties, formerly worked by hydraulic elevators, and the properties known as the "Kennebec," "Hoosier," "Buckeye," and "Philadelphia" placers. The total yardage is something over 6,000,000. The new dredge is of the California type, especially designed for this work. It has a capacity of 120,000 cu.yd. per month.

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### Canadian-Klondyke Mining Company

#### SPECIAL CORRESPONDENCE

The Canadian-Klondyke Mining Co. operated four bucket-elevator dredges in the Bonanza Basin near Dawson, Yukon Territory, in 1913. Three of these dredges have 16-cu.ft. buckets, and the first dredge, built in 1907, has 7½-cu.yd. buckets. The company began dredging late in March, continued through the season with slight interruptions and is still operating on Dec. 12. Dredges Nos. 3 and 4 were finished early in 1913, and except for slight accidents in the autumn, operated successfully throughout the season. It is understood that in 1913 about 3,000,000 cu.yd. were washed. The normal clean-ups during the season were about 3000 oz. per week, when all dredges were operating.

# Mining in Ontario in 1913

BY THOMAS W. GIBSON\*

The production of gold for 1913 was about 210,000 oz. of bullion, worth, say \$4,300,000. The past was the first full year for the Porcupine camp, which is now demonstrating its capabilities. The producing mines there are the Hollinger, Dome, Porcupine Crown, and McIntyre Porcupine. The Hollinger is now down to 447 ft. in depth, at which point the vein is 8 ft. wide, and carries \$17 per ton. The profits from Jan. 1 to Nov. 4 were \$1,395,773, out of which dividends were paid amounting to \$990,000. During October the ore treated averaged in value \$15.07 per ton, the approximate extraction being 96.1 per cent. For a total of 13,401 tons of ore milled, the cost per ton was \$5.055, of which \$2.763 was for mining and \$1.407 for milling. The equipment is of 40 stamps. The Dome mines have also a 40-stamp mill, the capacity of which is at present being doubled. The ore at the Dome is somewhat lower in grade, averaging about \$10 per ton, but occurs in large quantities, the method of mining so far being by open-cut. Both these mines, as well as several others in the camp which have not yet reached production, are operated by electric power derived from the Mattagami River.

Outside of Porcupine the production for the year was not in excess of \$225,000, the principal districts being Kirkland Lake, Long Lake, Larder Lake, Sturgeon Lake and Swastika. At Kirkland Lake there is being developed what seems likely to be an important field, where narrow but rich gold-bearing veins have been found in the conglomerate and greywacké near the contact with porphyry and in porphyry. The Tough-Oakes mine, owned by C. A. Foster, is reported to have been sold in England for a large sum of money. There is a small mill on the property, which treats about 13 tons of \$30-ore daily, while the high-grade ore from the vein is hand-picked and sacked. Several carloads of the latter have been shipped carrying an average of over 23 oz. of gold per ton. This ore contains a small proportion of tellurium. There are levels at 100 and 200 feet.

## SILVER

The output was about 31,000,000 oz., or practically the same as in 1912. The value, however, was somewhat less on account of the lower price of silver. The mines of Cobalt well maintain their production, considering the unusually rich character of their ores. Concentration of low-grade material is now universally practiced in the camp. During the nine months ended Sept. 30, Nipissing led with a production of 4,387,765 oz., followed by Coniagas with 2,662,678 oz.; La Rose with 1,903,345 oz., and Cobalt Townsite with 1,826,422 oz. Kerr Lake, McKinley-Darragh-Savage, Buffalo and Crown Reserve also yielded heavily. Seneca-Superior, on the bed of Cart Lake, and Casey Cobalt, situated on an outlying area of conglomerate northeast of Cobalt proper, came into prominence during the year by the richness of their ores and large yield. Gowganda and South Lorrain fell below their 1912 record.

A feature of the year was the draining of Kerr Lake, the bed of which is mainly owned by the Crown Reserve

\*Deputy minister of mines, Toronto, Ont.

and Kerr Lake companies. Several new veins were uncovered, one on the Kerr Lake property, consisting of 9 or 10 in. in silver, being spectacularly rich. The chief advantage of the unwatering will be to permit of the stoping of the veins up to the surface. It is also proposed by the Cobalt Lake Mining Co. to drain Cobalt lake, and an application for permission to do so is now under consideration by Mining Commissioner Godson.

The Nipissing and Buffalo mines now ship their product almost entirely in the form of merchantable bars, the former sending out 4,749,936 oz., and the latter 1,240,608 oz. up to Oct. 11. The total bullion shipments from the camp up to that date were over 7,000,000 oz. The Northern Customs concentrator has been purchased by the English syndicate, which controls the Cobalt Townsite, Casey Cobalt, Cobalt Lake, City of Cobalt and Townsite Extension, to treat the low-grade ores from these properties. The selling company is putting up a new mill, which will soon be in a position to handle ore. The number of silver-refining works was lessened last year by the burning down of the Canada Refining Co.'s plant at Orillia, and the closing of the Canadian Copper Co.'s works at Copper Cliff to the Cobalt ores.

## NICKEL AND COPPER

The Sudbury mines had a production of about 700,000 tons of ore, most of which came from the Canadian Copper Co.'s properties, chiefly the Creighton. Number 3 mine, now generally called the Froid, has again come into operation after lying idle 10 years, hoisting having been resumed in September. Diamond drilling has proven the existence of an enormous body of ore in the Froid, variously given at 35,000,000 to 50,000,000 tons. It is of lower grade than the Creighton, averaging when last worked about 2.66% nickel and 1.39% copper. The remainder of the ore treated is from the Mond Nickel Co.'s properties, chiefly in Garson township; a number of carloads were also received by that company from the Alexo mine on the Temiskaming & Northern Ontario Railway.

The matte product for the year contained about 24,000 tons nickel and 12,000 tons copper—a record output. In the matte form the nickel was worth about \$5,000,000, and the copper \$1,700,000. The Mond company has come into possession of an extension of the Froid deposit, to work which a shaft is now down 850 ft. in expectation of striking the ore at 1000 ft. This company has also purchased the Big Levack mine, formerly owned by R. J. Tough and associates. The Dominion Nickel Copper Co., whose drilling on the old Murray mine turned out so satisfactorily, has apparently changed the location of its proposed smeltery from Norman to Snider township, where it is acquiring a considerable tract as a site. The new smelter of the Mond company at Coniston began work during the year. It is a well equipped and modern plant.

## IRON

Five mines were worked during the year, namely the Helen, Magpie, Moose Mountain, Bessemer and Belmont. The first two are in the Michipicoten district, and are



owned by the Lake Superior Corporation. The ore of the Helen is hematite, and of the Magpie siderite, which is roasted to expel the carbonic acid and sulphur. The product is of fine blast-furnace quality. The Moose Mountain ore is magnetite, which undergoes concentration and sintering previous to shipment. Bessemer and Belmont are magnetite mines in eastern Ontario. The ore of the former is concentrated at Trenton, and from the latter the ore is shipped to the new blast furnace recently erected by the Buffalo Union Furnace Co. at Port Colborne. The total output of ore for the year was about 200,000 tons.

The production of pig iron in 1913 was about the same as in 1912, or, say 600,000 tons, valued at about \$8,000,000. Five companies were operating, namely, at Sault Ste. Marie, Midland, Deseronto, Hamilton and Port Colborne. A new furnace is being built at Parry Sound.

#### COBALT OXIDE

The silver refineries at Thorold and Deloro, now practically control the world's trade in cobalt oxide, which they manufacture from the silver ores of the Cobalt camp. The Ontario government pays a bounty of 6c. per lb. on

the metallic contents of the refined cobalt oxide and nickel oxide. These substances were produced during the year to a value of about \$385,000.

Petroleum and natural gas are produced in southwestern Ontario, the former in diminishing, and the latter in increasing quantities. In 1912 the yield of petroleum was 8,432,730 imperial gallons, and in 1913 it was less. The yield of natural gas in 1912 had a value of \$2,268,022; the production for last year will show an increase.

Other branches of the mining industry, such as the raising of iron pyrites, talc, corundum, graphite, feldspar, gypsum, salt, etc., were carried on on about the same scale as in former years.

The only labor troubles during the year were at Porcupine, where an ill-advised strike ended unsuccessfully. Labor is now more plentiful than in recent years. The eight-hour underground law comes into effect on Jan. 1, 1914. Speaking generally, the mining industry of Ontario is in a flourishing condition. The production of 1913 is again the highest attained, and Ontario now furnishes about 45% in value of the total mineral production of the Dominion of Canada.

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## Mining in British Columbia in 1913

BY E. JACOBS\*

An estimate of the value of the mineral production of British Columbia for 1913 makes it \$30,000,000, which is \$2,440,000 less than for 1912. The decrease is attributed chiefly to a smaller production of copper, coal and building material which, together with lower average prices for some of the metals, accounts for a decrease of nearly \$3,000,000, offset to only a small extent by increases in gold, silver and zinc.

Preliminary figures indicate a smaller yield of placer gold than in 1912, which, however, is more than compensated for by an estimated increase in lode gold of 8000 oz. Production of silver seems to have been larger by 200,000 oz., and of zinc by 650,000 lb. Lead is estimated at practically the same quantity as in 1912, but copper is placed at nearly 1,500,000 lb. less. The decrease in net production of coal, after allowing for the quantity made into coke, is thought to have been more than 600,000 long tons, though the loss in values is reduced by an increase of 20,000 tons in the quantity of coke made.

The following figures show approximate quantities of minerals produced in 1913 with amounts for 1912 in parentheses: Placer gold, 26,400 oz. (27,775 oz.); lode gold, 265,000 oz. (257,496 oz.); silver, 3,300,000 oz. (3,132,108 oz.); lead, 45,000,000 lb. (44,871,454 lb.); copper, 50,000,000 lb. (51,456,537 lb.); zinc, 6,000,000 lb. (5,358,280 lb.); coal, 2,000,000 long tons (2,628,804 tons); coke, 285,000 long tons (264,333 tons). Clay products building stone, cement and other miscellaneous materials, have been estimated at a total value of \$3,000,000, as compared with \$3,435,722 in 1912.

Pending receipt of revised returns, the yield of placer gold is placed at a total of \$528,000, against \$555,500 for 1912. In the Cariboo district, for which the estimate is \$196,000, there appears to have been a suffi-

cient decrease in Quesnel division to largely account for a lower total recovery in 1913, of about \$42,000. Atlin division, Cassiar district, is estimated to have made an increase of about \$20,000—\$310,000 in 1913 as against \$290,000 in 1912. The remaining \$22,000 for all other parts of the province compares with \$27,500 for 1912.

An increase of about 10,000 oz. of lode gold is credited to Rossland, Boundary and Similkameen mines, while a decrease of 2000 oz. is estimated against mines in Nelson division. There does not appear to have been much change in the production of other parts of the province. The chief gold-producing mines were: In Rossland camp, the Center Star--War Eagle group, Le Roi and Josie (Le Roi No. 2); in Boundary district, the copper-gold mines of the Granby, British Columbia Copper and New Dominion Copper companies; and in Similkameen district, the Nickel Plate group of the Hedley Gold Mining Co. These districts produced about 260,000 oz., leaving only 5000 oz. for other parts of the province.

Of the total 3,300,000 oz. of silver, more than 400,000 oz. came from East Kootenay, nearly all from the Sullivan group mines. The Ainsworth division of West Kootenay yielded about 300,000 oz., Slocan, 1,800,000 oz.; Nelson, 145,000 oz.; Rossland, 120,000 oz., and Lardeau, 30,000 oz. From mines in Boundary district approximately 385,000 oz. was obtained, and from the Coast district, 120,000 oz.

Preliminary returns show a production of about 49,000,000 lb. of lead. Of this, 20,000,000 lb. was in ores from East Kootenay, practically all from the Sullivan mines. From Ainsworth division mines, about 9,000,000 lb. was shipped, most of it from the Bluebell mine. From Slocan mines reports show about 18,000,000 lb. in ores shipped, chiefly from the Standard mine, while ores from Nelson division contained the greater part of the remaining 2,000,000 lb. The actual production of metallic

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lead, however, seems to have been about 45,000,000 lb.

A total output of 50,000,000 lb. of copper is estimated. Of this quantity about 30,000,000 lb. was from the mines of the Granby, British Columbia Copper, and New Dominion Copper companies, all operating in Boundary district. From Rossland and Nelson mines there was about 2,000,000 lb., and from Coast mines, chiefly the Britannia, an output of something like 18,000,000 lb. of copper.

Of a total of 6,000,000 lb. of zinc contained in concentrates shipped to Bartlesville, Oklahoma, more than four-fifths was from the Standard Silver-Lead Mining Co., at Silverton, and the remainder from the Van-Roi and Rambler-Cariboo mines, also in Slocan district.

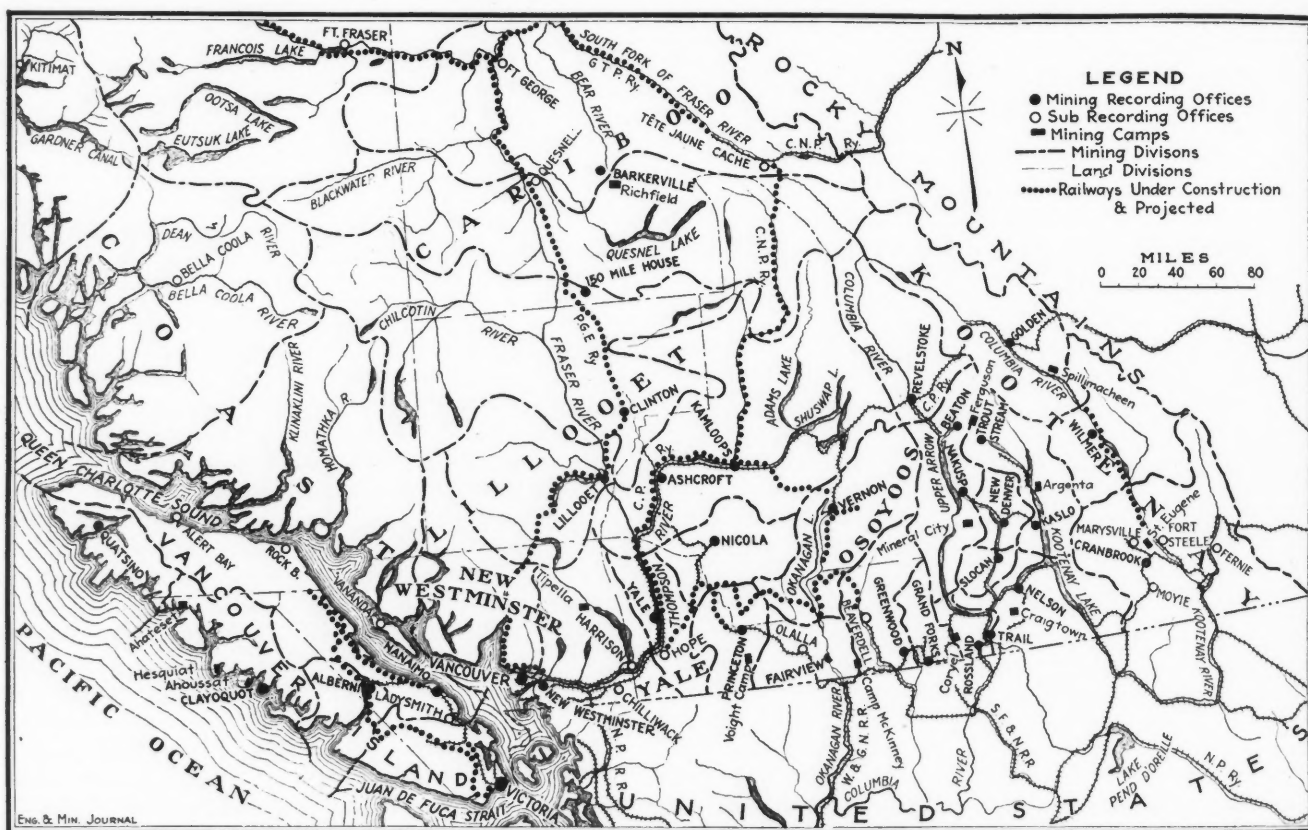
The gross output of coal in 1913 is estimated at between 2,400,000 and 2,500,000 long tons, of which there were made into coke about 430,000 tons. The net output was approximately 2,000,000 tons. This compares with

Coal Co., and one-fifth at those of the Hosmer Mines, Ltd.

The year was marked by progress in the several mining districts. While recovery of placer gold was not large in Cariboo district, preparations were made for extending hydraulic-mining operations in all of its divisions; Cariboo, Quesnel and Omineca. In Cassiar, beside recovering more placer gold, lode gold had attention, with promise of an increasing yield in the future.

In East Kootenay, developments at the Sullivan group mines were decidedly satisfactory, while some of the coal mines in this district had their best year as regards production.

West Kootenay mining divisions made progress generally, notably in Ainsworth, Slocan and Trail Creek (Rossland). Deep-level development in several Slocan mines greatly improved their position for ore-production. In the gold-copper mines of Rossland camp, there were



CHIEF MINING DISTRICTS OF BRITISH COLUMBIA

a production in 1912 of 3,025,000 tons gross and 2,628,000 tons net. In Crow's Nest district, Southeast Kootenay, there was an increase of about 90,000 tons, but labor troubles at Vancouver Island collieries extended over eight months and caused the year's output of Island mines as a whole to be considerably less than that of other recent years.

Of the net production of 2,000,000 tons of coal, the mines of Crow's Nest district gave 920,000 tons, of those in Nicola Valley and Similkameen, approximately 250,000 tons. On Vancouver Island, 830,000 tons were produced.

Returns of coke production show a total of about 285,000 long tons, which is the largest quantity produced in any year since coke-making was commenced in the province. All this coke was made in Crow's Nest district; about four-fifths at the ovens of the Crow's Nest Pass

opened oreshoots that insure profitable working of the mines there for years, while improvements at the Consolidated company's smelting works at Trail, provide for more effective and economical metallurgical results there.

In Boundary district, shipment of ore from Franklin camp was commenced on a small scale; the Jewel mine and stamp mill were working the whole of the latter half of the year after long inactivity; and the big copper mines were worked to full producing capacity. The Hedley company commenced to prepare for development of more power to admit of an extension of mining and milling operations. In Kamloops division, the Iron Mask mine was productive, and an electrically operated power plant was put in. In Lillooet division there was some gold-ore milling done.

The chief features of the year's metalliferous mining in



the Coast district were the enlarged operations of the Britannia company, which put in a Minerals Separation flotation-process plant in connection with its copper-ore concentrator, and of the Granby Consolidated company at its Hidden Creek mine, Observatory Inlet, where much more development work was done underground, and the work of installing power plant for mine and erection and equipment of a 2000-ton copper smeltery were well toward completion. Shipment of silver-lead ore from mines in Hazelton district, Skeena country, was commenced, and

some important deep-level development was done in Portland Canal mining division.

A larger total amount was paid in dividends in 1913 by metalliferous mining companies operating in the province than for many previous years. These included the British Columbia Copper, Consolidated Mining & Smelting, Granby Consolidated, Hedley Gold, Le Roi No. 2, and Standard Silver-Lead companies. The outlook is good for nearly all of these companies continuing to distribute profits among their shareholders.

## Mexican Mining in 1913

The present war in northern Mexico against the Huerta regime may be characterized as the most disastrous in property loss since the capitulation of Maximilian, the destruction being many times that of the Madero and Orozco revolutions combined. Mining and smelting operations are at a standstill in a good many northern localities, several corporations in Coahuila and Chihuahua closed their mines and several properties were abandoned. The only operating plant of the A. S. & R. Co. is that at Aguascalientes. Many companies in Sonora operated at 30 to 40% capacity, Zacatecas was producing meagerly and intermittently according to the latest reports, while operations are almost completely suspended in San Luis Potosi. The central and southern sections of the country, however, can tell a different tale. Mexico's three greatest camps, Pachuca, El Oro and Guanajuato, were able to maintain a steady output for the year, Campo Morado in the heart of the *Zapatista* country is stated to be operating at capacity and the same is probably true of most of the smaller camps and mines in the states of Mexico, Michoacan, Guerrero, Oaxaca, Guanajuato, Hidalgo and Jalisco.

In summarizing briefly the situation of the past year, it may be said:

(1) That the present movement against Huerta in its destructive effects is the most general and serious revolution of the last 40 yr.; (2) transportation in the North is unsafe and almost impossible, due to the destruction of railroad property and the lack of fuel; (3) the revolutions and brigandage of the past three years caused the native farmers in some sections to devote but little time to their occupation, with the result that food is scarce and prices are high; (4) suspension of mining and milling operations in many localities deprived a great number of a means of livelihood and such men joined the rebel army; (5) 80% of the Americans present in Mexico three years ago have left the country and millions of dollars worth of property has been destroyed.

### SONORA

The Cananea Consolidated Copper Co. closed the year 1912 with a five-days' strike of the Mexican laborers, who demanded shorter hours, an increase of wages, and native bosses. An 8-hr. day shift was granted and 90% of the strikers returned to work on Jan. 2, 1913. The Cananea company had been producing between 6,000,000 and 7,000,000 lb. of blister copper per month from the treatment of company ore, Miami concentrates and custom ores. Railroad communication with the United States was cut early in March through the operations of the opposing armies and on Mar. 22 the 4000-ton concentrator

was closed owing to a shortage in the fuel supply. Work was discontinued in the mines producing concentrating ore and a large exodus of Americans resulted. The camp was attacked by the constitutionalist army on Mar. 26 and surrendered after a three-days siege. Conditions became so serious during April that a complete shut-down was expected due to the lack of oil to run the smelter and power plant. Four of 12 mines, the Elisa, Eureka, Capote and Kirk, were operating on reduced shifts, all developments had ceased and 2500 Mexicans had been thrown out of work. The reverberatories and 50% of the blast furnaces had been blown out or banked and the output fell to 3,000,000 lb. of blister per month. Many cars of Miami concentrates, accumulating at Naco, were shipped to Phelps-Dodge smelting plants in the United States for treatment. The production of 3,000,000 lb. was maintained until gradual improvement of political conditions warranted a return to normal. Although 6,000,000 to 7,000,000 lb. are being shipped at present, the company is operating at only 40% capacity, since one-half of this production is obtained from the treatment of Miami concentrates and custom ores. Four of eight blast furnaces, two reverberatories, three converters and part of the concentrator are now operating.

The Democrata Mining Co., in the Cananea district, was compelled to close down for a short period early in the year, but normal operations were later resumed. The Calumet & Sonora was similarly affected.

The Moctezuma Copper Co., at Naco, was not seriously affected by the revolution. The Naco Consolidated Copper Co. operated almost continuously and reports excellent ore in the breast of the main tunnel. A new 100-ton concentrator was erected. The Moctezuma-Arizona Development Co. was threatened with a shut-down but latest reports indicate a return to almost normal conditions. The Mines Company of America closed the La Dura but is operating the Creston Colorado; the San Antonio Copper Co. suspended operations. At the Cieneguita Consolidated and in the vicinity, everything is at a standstill.

### CHIHUAHUA

The state of Chihuahua has been the storm center of revolution during the last two years. The result is noted in the suspension of nearly all mining operations at the present time. A few concerns, including the mines at Santa Eulalia, worked spasmodically for several months during 1913 but after the American Smelting & Refining Co. was forced to close its plants for lack of supplies and fuel due to the condition of railroad transportation, all production ceased, pumps were pulled in several proper-

ties and the mines abandoned. Some companies in the Parral section ceased production but the Alvarado Mining & Milling Co. operated continuously. All work at Guadalupe y Calvo was completely suspended. The Montezuma Lead Co. maintained a small production throughout the year, but during a portion of the time was unable to ship, and therefore limited its operations to development and stockpiled the ore. It is not at all unlikely that the situation will change for the better in eastern Chihuahua. Latest reports state that Villa will rebuild the railroads destroyed and thus remove the chief obstacle to mining and smelting operations. This will indirectly help the isolated mines in the Sierra Madres, which were forced to close chiefly because of the inability to obtain necessary supplies. So far as known all of these properties, including Sierra Consolidated, Yoquivo, Concheño, Dolores, El Rayo and Republica, are closed, although Rio Plata is working in a small way. No reliable information on Cusiuhiriachic has been obtained. In view of the conditions prevailing it is a fact that relatively little looting or forced contributing of funds has gone on, although Lluvia de Oro reports trouble of this nature.

#### COAHUILA

Practically all of the coal companies in Coahuila were closed at the end of the year. Early in the year, the properties of the Lampacitos, the Agujita, the Minor and New Sabinas companies were either totally or partly destroyed during rebel attacks or depredations. The Mexican Coal & Coke Co., under the direction of A. J. Ruckman, at Las Esperanzas, was compelled to stop shipping about Feb. 1, owing to the railroad connections having been cut. The mine was continued in operation until July, during which period the product was stockpiled. After July, no mining of consequence was attempted, although the mine was kept in readiness to produce at 12-hr. notice; up to early in December, there was no serious physical damage at this property by the revolutionary forces. The smelting plants of the Mazapil Copper Co. in Saltillo and Concepcion del Oro are closed and the mines of the company are inactive.

#### ZACATECAS

Conditions in Zacatecas were worse than during 1912. While a few of the larger companies were able to maintain operations, the production was greatly curtailed. Small operators, remote from railroads or industrial centers, abandoned their properties as the result of brigandage. The Fresnillo company operated its hyposulphite plant throughout the greater part of 1913, and completed its cyanide works. Work, however, was suspended in June, and again in October, with no resumption to date. A test run showed the plant to be satisfactory. At the plant of La Fe company, near Guadalupe, construction was delayed by interruptions to transportation. There was little trouble at the mine, although the rebels commandeered some horses and other effects.

#### SAN LUIS POTOSI

The Compañia Metalurgica Mexicana operated its smelting plant at about 40% capacity in 1913. The plant was not closed entirely except for about a month in the summer when railroad communication was interfered with and no coke could be obtained. Three furnaces

were in operation at the beginning of December.

#### DURANGO

The smelting plant at Mapimi was operated for a short period and then closed down in the middle of the year. Mines shipping to this plant were consequently forced to curtail and finally suspend work. The mines and smelter at Velardeña had a similar history. Some properties were able to operate intermittently but the general status of the mining industry is similar to that obtaining in Chihuahua.

#### GUANAJUATO

Operations were continued in the camp of Guanajuato throughout the year and considerable exploration and development work was done.

#### JALISCO

There was more rebel activity in the state of Jalisco during 1913 than in the previous two years of political disturbances, and the mining industry was affected to some extent. A rebel band operated in the important Hostotipaquillo district, and some mining concerns were called upon to contribute money and supplies. Following a call by the band at the Cinco Minas camp in October, an anti-foreign outbreak occurred and Thomas Barrett and William Kendall, American mining men, were killed. Camps in the San Sebastian, Parnaso and Ayutla districts were raided by rebels and some foreign property destroyed. The Amparo Mining Co., in the Etzatlan district, suffered no interruptions, and increased production by adding mill equipment. Due to the smelting situation in Mexico, Amparo arranged to export its concentrates, and recently made a shipment of 250 tons to the Selby plant. The El Favor Mining Co., in the Hostotipaquillo district, became a dividend payer early in 1913, and during the year, disbursed \$140,000 to stockholders. A second mill unit was recently completed, and this will work on ores from the Mololoa mines, which, up to this time have shared the first unit with El Favor. The Cinco Minas Co. built a 250-ton reduction plant in 1913, and will soon have it in operation. At the Casados mine in the Hostotipaquillo district a small experimental plant was placed in operation, and work on a 100-ton plant was well advanced. Development at the properties of the Amajac Mines Co. opened bodies of high-grade ore. This company started work on a 50-ton cyanide plant, but in November, following two rebel raids, it was decided to suspend operations temporarily, pending improved conditions. The Espada Mines Co. continued mine and mill operations, and shipped bullion and concentrates. The San Pedro Analco mines were taken over on a working basis by the San Rafael y Anexas Co., of Pachuca, and plans made for extensive development and a new reduction plant.

In the Amecca district the Magistral-Amecca Copper Co. remodeled its concentrating plant and resumed operations, with good results. Late in the year a scarcity of labor, due to disturbed conditions in the district, interfered with production. E. A. Montgomery, of Los Angeles, surrendered an option on the Zapote copper mines, owned by the Mutual Mining & Milling Co., of Mexico City, and that concern decided to proceed with the development and the erection of a concentrating plant. Work on the plant is under way. The Almoloya y Anexas Co.

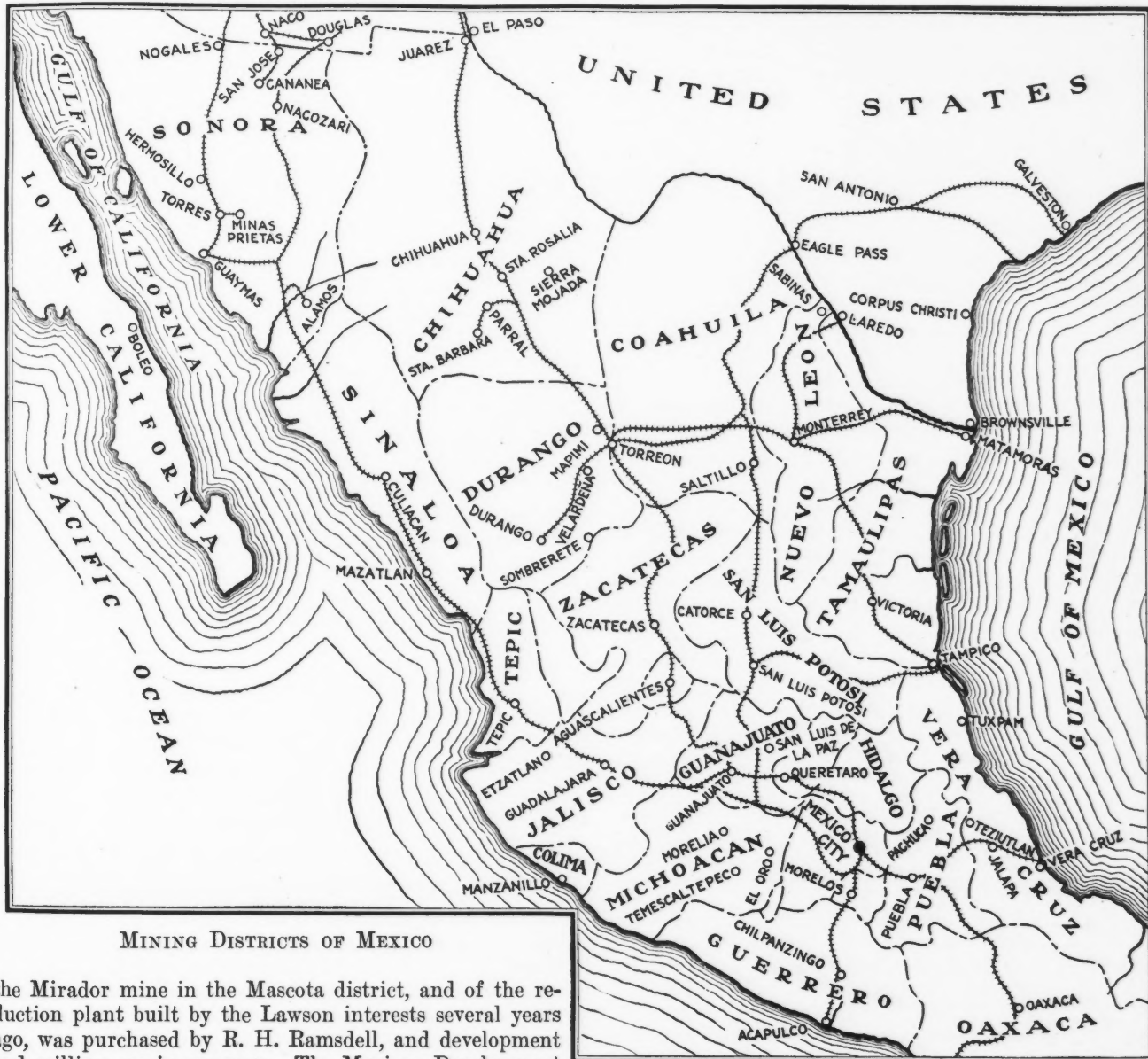


continued to produce and ship concentrates during the year. A small reduction plant was built at the mines of La Union Mining Co. Shipments of rich copper ore were made from the Cerritos mine.

The Mexican Mines Co. abandoned work temporarily at the famous old Bolaños mines, due to the impossibility of taking in machinery and supplies. Generally disturbed conditions defeated a deal for the transfer of the Zuluago, Condesa and Rosario mines in the Bolaños district to the Tonopah-Belmont interests. Control of

HIDALGO

Pachuca produced steadily and heavily throughout the year. The Santa Gertrudis, La Blanca, San Rafael, and the mines of the Real del Monte company as usual were responsible for a large percentage of the output and so long as these concerns are able to continue their operations, considerable shipments of bullion may be expected. A shortage of dynamite and mill supplies is a contingency which might arise in the future owing to the present status of transportation agencies. The Santa



MINING DISTRICTS OF MEXICO

the Mirador mine in the Mascota district, and of the reduction plant built by the Lawson interests several years ago, was purchased by R. H. Ramsdell, and development and milling are in progress. The Mexican Development Co. continued development at the Quelitlan copper properties in the Autlan district.

MEXICO

The camp of El Oro was able to maintain a steady production. The El Oro Mining & Ry. Co., the Esperanza, the Dos Estrellas and the Mexico Mines of El Oro produced continuously and declared satisfactory dividends. The Esperanza reports no interruption to transportation to the smelter but had difficulty in getting equipment in through the congested ports of entry.

Gertrudis was subjected to some bitter criticism in England following the disclosure of the fact that the grade of the reserves was not coming up to the sampling returns. The criticism was directed not so much against the original over-estimating of the ore grade as against the failure of the officers to inform the stockholders of the discrepancy immediately after the discovery. The Compañia Real del Monte y Pachuca had an unusually successful year and increased its monthly tonnage and profits. This company's mines were not disturbed by the miners' strike which affected the La Blanca and Santa Gertrudis mines. The tonnage in both the Loreto and

Guerrero mills was increased until at the end of the year these plants were crushing between 48,000 and 49,000 tons monthly. The company planned to increase the capacity still further, and it is expected that about 50,000 tons will be crushed monthly in 1914, if there are no political disturbances in the district.

The operations of the Cortez Associated Mines were closed down temporarily in April last, although there has been no direct interference with operations either at Jacala or Zimapan, by either rebels or federals. After closing, however, the Jacala headquarters were destroyed by Federals and the entire town razed or burned. The Mexican Metallurgical Co. suspended operations at Flojonales on Jan. 1, 1913. At the present time, it is be-

lieved, that there is running in Zimapan one small lead stack owned by the Cia. Fundidora y Minera of Mexico City, and probably also one small copper-matting furnace owned by the Hidalgo Copper Mining Co. Construction of the "Pachuca, Zimapan & Tampico R.R." was recently discontinued on account of rebel activities.

#### PUEBLA

The Teziutlan Copper Co. was interrupted in its operations in 1913 by the revolutionary disturbances, but it maintained part of its working force at the mines and smelting works throughout the year. In December, conditions pointed to a resumption of operations at this property.

## Central America in 1913

Latin America in 1913 received increased attention from the large mining operators and while much of this was directed to South America, Central America was not neglected.

#### SALVADOR

The precious-metal production of Salvador in 1913 amounted to about \$800,000 in gold and \$300,000 in silver, this output being principally from the Butters properties in the departments of La Union and Jocorro. At the Butters Salvador Mines, Ltd., the capacity of the filter plant was doubled in 1913, and operations increased generally. This property is at San Sebastian, in the department of La Union. At the Butters Divisadero Co., at Divisadero, in the department of Jocorro, plans were made for increasing the mill capacity and orders placed for five new Allis-Chalmers 1250-lb. stamps. Additional equipment was also installed at the mine, including a new Ingersoll-Rand air compressor, which will be used for both mine and mill purposes. A Goulds 8x16-in. triplex pump operated by a special Westinghouse 75-hp. motor was also ordered for the mine, which is exceedingly wet. The output at the Divisadero mine is about 700 tons per day, while that at the Salvador is between 800 and 900 tons per day. The Butters Potosi Consolidated Mines, Inc., is the title of an interesting development operation, where favorable results were obtained during the year and it is likely that an equipment will be put upon this property.

Besides the Butters operations, which are the principal ones in Salvador, Mackay, Pullinger & Co. placed some small equipment on the Encuentros property in the department of Morazan. Some work was done during the year by the Comacaran Gold Mining Co., near Jocorro but in the department of San Miguel. Additional equipment was added by the Monte Mayor Mining Co. in the department of La Union.

#### HONDURAS

The principal mining interest in this republic is the New York & Honduras Rosario Mining Co., at San Juancito, where the company operated its property at increased capacity, owing to improvements made in 1912. The new mill, comprising twenty 1800-lb. stamps and an all-sliming cyanide plant, was started in August, 1912, and has worked satisfactorily since that date, the tonnage

being gradually increased until at the end of 1913 about 8500 tons were being handled monthly. The company's property comprises about 26 sq.mi., the mining area is practically a mile square, and the vertical distance between levels about 1550 ft., the mine being opened by tunnels. During the year, mining by the shrinkage system was inaugurated and the management installed a number of B.C. 21 Ingersoll-Rand stopping drills, as it was impracticable to mine by hand the tonnage required by the new mill. The property is under the general direction of A. R. Gordon, general manager in Honduras. The production in 1913 probably amounted to 75,000 tons, and the yield about 10,500 oz. of gold and 1,500,000 oz. of silver. The company has had in hand in 1913, a complete geological study of its property, by V. F. Marsters, and a geological map of the property is being prepared.

It is understood that the Olancho placers in the southern part of the Republic were operated in a small way, as usual. In the copper-silver district of Minas de Oro, the Antigua Copper Mining Co. did a little work. It is understood that desultory work was done by the Cacamuya company and by El Transito and Aramesina, gold-silver properties in the department at Nacaome. Some prospecting was done on the Agalteca iron mountain, about 40 miles from Tegucigalpa, presumably under the Ricardo Strauber concession. The Honduras Oil Co., of Ceiba, did some prospecting during 1913, but no commercial production was obtained, so far as can be learned.

#### NICARAGUA

The most interesting event of 1913 in Nicaragua was the acquisition by Canadian Agency, Ltd., of a bond and lease on the Bonanza, Lone Star, Siempre Viva, Mars and Colonia mines in the Pis-Pis district in the north-eastern part of the country, about 100 miles from the Caribbean coast. The Canadian Agency, Ltd., offered a 40% interest in the negotiation to Camp Bird, Ltd., and a 20% participation to F. W. Baker, both of whom accepted. A working bond with full possession and right of working for one year without payment except an annual rental of \$72,000 was secured with option of renewal for one year if clear title to all property and water rights cannot then be conveyed. Two-thirds of the rental can probably be returned from operating present plants. The consideration for the properties is about \$1,125,000.



Orvil R. Whitaker reported for the syndicate that known oreshoots have an aggregate length of 20,500 ft., an average width of 15 ft., the ore assaying about \$6.50 per ton, approximately 2,400,000 tons of ore of this grade are assured, from which a profit of \$5,000,000 may be made, with indications that 2,000,000 tons further reserves can be developed for every 100 ft. of depth gained below present deepest workings.

The ore occurs in veins and shoots in the hills and is mined by open cutting, or milling, bringing the ore out through adits at or a little above the water level. No sinking below the general level of the adits has been done worthy of mention. All ore so far mined has been won without the necessity of hoisting or pumping. The ore was soft, readily mined and crushed. Harder ore is now encountered.

The first mine opened in the district was the Siempre Viva which Paul Rener began operating about 20 years ago, eventually turning over the property to a company of Bluefields and New Orleans men. Workmen from the Siempre Viva discovered other important properties in the region of the Siempre Viva and through obtaining credit and some cash have worked the properties so successfully that they have made comfortable fortunes. The Bonanza was discovered by Joe Lapierre, a workman at the Siempre Viva, who had previously found and sold another claim, and with that money he developed the Bonanza into one of the biggest properties in the district. The Lone Star has a similar history.

Siempre Viva was equipped with a 20-stamp mill, very light stamps, and a sand-leaching plant. The mill was in a dilapidated state two or three years ago when the mine was shut down. The property has a splendid hydro-electric plant at Pis-Pis falls, where enough power to supply all the mines of the district can doubtless be generated.

Lone Star has been operating a 30-stamp mill and cyanide plant and Bonanza several 3½-ft. Huntington mills and cyanide plant. Soft, easily milled ore has been treated in these plants so that light equipment, which could readily be brought in to the rather difficultly accessible region, has enabled profitable operations.

All freight and supplies have now to be transported from the Caribbean coast from 100 to 150 miles up the Wanks River and its tributaries from the port of Cape Gracias or up the Banbana River from Prinzapolca. All this freighting has been done in dug-out canoes which could carry but 6000- to 8000-lb. loads to the Pis-Pis district. From the river banks the supplies have had to be hauled six or eight miles over rough trails. The transportation problems should be readily solved by properly meeting the conditions imposed in navigating the head-water shallows of the rivers in which there are several small rapids and by properly built roads or trams connecting the various properties with the river banks.

#### COSTA RICA

The three leading mining properties in Costa Rica, the Abangarez, the Aguacate and La Union, had a year of successful development in 1913. La Union, one of the oldest properties in the Republic, was in bonanza ore and it is understood was able, without interfering with the mine production, to devote part of its attention to the dumps, this material being treated in the cyanide plant.

The Abangarez Goldfields, on the western slope, was crushing at the end of the year at the rate of about 6000 tons monthly. The company was engaged in installing heavier stamps, and its output in 1913 was somewhat restricted by interruptions occasioned by these changes. Forty stamps were crushing in November and ten more were being erected. By May, 1914, it is expected that 60 stamps will be ready, and the company will then have a crushing capacity of about 12,000 tons per month. The cyanide plant, however, will reach its limit in capacity at about 8000 tons, and additional equipment will probably be needed in this department, if it is decided to operate at the full capacity of the crushing plant. The largest orebody, the Tres Hermanos, is opened on three levels; the first level, however, has been worked out, and mining is confined to levels Nos. 2 and 3. All ore is hoisted, but there is a drain tunnel which unwaters the property. In 1913 the company began the development of the San Rafael property, which contains a small but high-grade orebody. The developments of 1913 were entirely satisfactory to the company.

The Aguacate Mines reached an important period of its history when, on July 4, 1913, its crosscut tunnel cut the vein at the seventh level, and in a few days unwatered the mine below the fifth level to which point it had been previously worked out. This company has an extensive property of 2500 acres on the Aguacate Mountains, about three miles from the Transcontinental R.R., and about 30 miles from San José, the capital of Costa Rica. This company was incorporated in 1907 to operate the old mines at this place, but had an unfortunate experience in that it soon developed that practically all the high-grade ore above the fifth or water level had been extracted by the old miners. Additional pumping equipment proved inadequate to unwater the mine below the fifth level, but the president of the company, W. F. White, by personal advances made possible the driving of the drainage and transportation tunnel at the seventh level. Until the present tunnel was completed, the company was able to mill only a small tonnage, to apply to the development expense. With the opening of this tunnel and the development work done from the two shafts, the company reports an orebody, approximately 1500 ft. long, between the fifth and seventh levels, a distance of 225 ft., that is expected to average above \$20 per ton for a width of five feet; the vein is much wider than this and contains other high-grade streaks. The ore is a honeycombed quartz and contains much manganese dioxide. The 10-stamp mill and leaching plant were closed in June, owing to an accident at the power plant, but were restarted in November on ore taken out in development. With further blocking of the orebody disclosed by the tunnel, it is probable that extensions will be made to the milling plant; the new slime plant and hydro-electric power installation will be completed at an early date. The outlook for Aguacate Mines is exceedingly promising as a result of 1913 development.

#### GUATEMALA, PANAMA AND THE WEST INDIES

There was little mining in Guatemala in 1913. The most important mining operation in this country at present is the marble quarries of the Guatemala Mining & Development Co., which is preparing to secure a foreign market for its white marble. The quarries are not far from the city of Guatemala. In the Republic of Panama,

some petroleum, copper and gold placer denouncements were made but little actual mining was done. The Darien Gold Mining Co., which has been the principal operator in this country, has not been very active during the last few years. The government statistics for 1912 show the exportation of gold bars having a value of \$5175, and weighing 24.832 kilograms.

In the West Indies, Cuba was the most important mining state, although its iron mines were not so active as in previous years; the work of the Cuba Copper Co. is reviewed elsewhere in this issue of the JOURNAL. From Porto Rico, a little gold and silver-lead ore was shipped in 1913 to smelters in the United States. In the Dominican Republic, an alluvial deposit near the city of Santo Domingo was under exploration for Philadelphia interests but operations were abandoned late in the year, the

earlier drill results having been "salted" presumably through the women who did the panning and other natives who helped with the drilling. In the Isle of Trinidad, prospecting for oil was continued by several companies in 1913. The Venezuelan Oilfields Exploration Co., Ltd., was active in the vicinity of Picton and brought in several producing wells, two of which were only 982 and 990 ft. deep. Trinidad Leaseholds, Ltd., in which the Central Mining & Investment Corporation, Ltd., and the Consolidated Gold Fields of South Africa, are interested, acquired the assets of a number of local oil companies and undertook active development. The United West Indies Petroleum Syndicate in August in August took over the operations of the Trinidad Oilfields, Ltd. Difficulty was experienced in this field from wells sanding up after a short period of production.

## South America in 1913

Mining in South America in 1913 presented accumulated evidence of the important development work of the last few years. Chile now offers in Braden and Chuquicamata two of the world's largest copper mines, and in Tofo an iron mine of the first magnitude. Colombia came to the fore by the proving of two rich dredging areas, the one by the Oroville Dredging Co., in central Colombia, and the other on the West Coast, by the Anglo-Colombian Development Co., a subsidiary of Consolidated Gold Fields, of South Africa; the Pato dredge of the Oroville company made a remarkable record, returning from five months' work in its tested area about \$365,000, or an average of over 75c. per cu.yd.; the Anglo-Colombian company, after developing 13,000,000 cu.yd. in the gold-platinum region, decided upon the installation of its initial dredge and will probably become during the next few years the most important producer of platinum outside the Russian Empire.

Ecuador and Bolivia, while not developing any new enterprises of great magnitude, enjoyed a year of progress in 1913. Peru's production declined, but the two leading mining interests, the Cerro de Pasco Mining Co. and the Backus & Johnston Co., made extensive improvements that will permit of increased production in the coming year at lower costs, due to the greater application of electric power from their new hydro-electric plants.

In the Atlantic Coast countries of South America, agriculture is the dominant interest and mining as a whole made but little progress in 1913, though the established companies operated about as usual in the Argentine Republic, in Brazil, and in the northern states. Evidences of petroleum along the eastern and northern coasts indicate important possibilities that may compensate for the lack of other mining. At all events, it is certain that mining in the Andean republics will see a great development in the coming decade, especially in those countries that provide stable political conditions and favorable mining laws. The local conditions militate against the operator of limited capital, but large operations that are amply financed and have competent technical direction, will eventually bring a large return.

The approaching opening of the Panama Canal foreshadows greater activity not only in the West Coast countries, but in South America generally. North American

engineers will find it to their advantage to give increased attention to the mineral resources of the Andes; the experience gained in the exploitation of the mineral deposits of the United States should prove of benefit in the South-ern field.

### CHILE

The three leading mining developments in Chile in 1913 were those of the Braden Copper Co., in the province of O'Higgins; the Chile Exploration Co. operation at Chuquicamata, province of Antofagasta; and the acquisition by the Bethlehem Steel interests of the Tofo iron mine, in the province of Coquimbo. The first two of these operations are backed by the Guggenheim interests, and promise to take a place among the largest copper mines of the world. The Tofo iron operation and the developments at Chuquicamata are reviewed elsewhere in this issue of the JOURNAL.

Braden Copper Co., after several trying years, has been gradually overcoming its metallurgical difficulties and rounding into an important copper producer; its importance in this respect will continue to increase with the installation of further treatment capacity, warranted by its great ore reserves now assumed to approach a hundred million tons. In April, 1913, Consulting Engineer Pope Yeatman, on returning from the mines, suggested that 60,000,000 tons of 2.5% ore might be reasonably expected, but the developments in the remainder of 1913 were highly satisfactory and this tonnage is likely to be considerably exceeded. Although no special effort was made to block out new ore, such work as was done in 1913 indicated a large tonnage of ore of a higher average grade than was anticipated. The Teniente No. 1 tunnel was completed and it is now possible to go entirely around the crater in the company's workings. The ore milled in 1913 amounted to 780,000 tons, and at the end of the year, the company was producing at the rate of about 2,400,000 lb. of copper monthly. It is expected that when the present improvements are finished, the company will produce, in 1914, at the rate of about 1500 tons of copper per month, or, approximately, 36,000,000 lb. for the year.

The officials directed especial efforts in 1913 toward solving the treatment problems of the Braden ores. The



mills of the company, embodying wet concentration followed by flotation, are now making a better extraction, that of the old mill having averaged in recent months over 79%; in the new mill the extraction has approached 70%, and when the additional Hardinge mills are installed, it is expected that the extraction will approximate that in the old mill. The recoveries in the flotation plants in November were for the old mill, 77.8%; for the new mill, 69.9%; the recovery of copper sulphide in these plants was 90.5% and 82.3%, respectively. No leaching was done in 1913 on account of the changes in the acid works; the tower, formerly used, is being supplanted by a regular chamber plant. New sintering apparatus was shipped to the property late in 1913, after an extended test demonstrated that a good sintered product could be made. Besides the regular basic converters for treating the matte from the blast furnaces, the company will add a special, long Peirce-Smith converter, in which it is planned to conduct experiments with a view of smelting a large amount of ore direct.

Work at Chuquicamata is reported elsewhere in this issue.

It is understood that the older companies in Chile operated as usual, such as the Cia. Minera Poderosa Collahuasi, in the province of Tarapaca, the Copiapo Mining Co., Ltd., in Atacama, and the Central Chile Copper Co., at Panuleillo, province of Coquimbo; according to reports, the last company expects to increase its output materially in the near future. It is reported that William Braden was engaged in the development of another large copper deposit, and El Oro mining interests sent an engineer to Chile late in the year to inspect a copper property about 60 miles from Santiago.

The nitrate production was large in 1913 but prices were low; toward the end of the year an effort was made to rehabilitate the old syndicate and regulate production.

#### COLOMBIA

Mining in Colombia received a great impetus in 1913 from the remarkably successful operations of the Oroville Dredging Co.'s Pato dredge, and from the decision of the Anglo-Colombian Development Co., a Consolidated Gold Fields of South Africa subsidiary, to proceed with its operation in the San Juan gold-platinum district. The definite entrance of two great mining interests in this country and the practically assured success of their operations will give new enterprises in this country a *cachet* they have lacked for years, and have already had the effect of directing the attention of other large mining operators to the great placer deposits of this country. Colombia is not without lode-mining possibilities, but the lack of transportation, except by rivers, will prevent for years any general development of the lode mining, whereas the country already gives evidence of becoming the world's next great placer field.

The Pato placer, in the Nechi River Valley, made a wonderful record in 1913, its tested area yielding more than double the results indicated by the drill prospecting, and averaging, in actual dredging, over 75c. per cu.yd. In the tested area, estimating the last half of December, about 480,000 cu.yd. were washed with a yield of approximately \$365,000; for three successive weeks, recoveries of over a dollar per cubic yard were obtained; one weekly cleanup averaged \$1.23 in ground where a drill hole

had indicated 34c. In digging a channel to the tested area, the dredge dug 474,428 cu.yd. and recovered over 14c. per cu.yd., occasional weeks showing much higher results and indicating the possibility of rich channels that may be later dredged. An engineer, of extended experience in hydraulicking, was sent down during the year to study California Hill, and report upon the hydraulicking of this gravel deposit of the Pato property, on which a test run has already given favorable results. Pato Mines, Ltd., was so successful in its first year of operation that the Oroville Dredging Co. directors were able to announce the resumption of dividends.

The Pochet dredge operated successfully on the east bank of the Nechi River, below Zaragoza. The cleanup for 1913 is not known, but it is generally understood that in the past a profit of about \$400,000 has been made by this little dredge. The rich area of the Pochet property has been nearly all worked and Mr. Pochet was considering plans for an operation farther down the Nechi. The Farley hydraulic mine on the Caceri, a tributary of the Nechi River, is understood to have operated successfully in 1913. At Anori, about 50 miles southwest of Zaragoza, the Vallecitos Hydraulic Mining Co. has an extensive ancient gravel channel about 150 ft. in depth, on which some washing was done during the year. The company expected to have its first ditch completed by December, and washing was to be started with about 1500 cu.ft. per min. of water. A second ditch of nearly double the capacity is to be constructed. The gravel is reported to carry gold from the surface, with a much enriched layer along bed-rock. The Sambenigno Mines & Estates Co. owns an adjacent portion of the same gravel channel and did some washing in 1913, preparatory to larger operations.

On the Porce River, McGuire Brothers operated La Clara hydraulic mine and cleaned up about \$60,000 during the 1912-13 season. They brought in more Empire elevators in the summer to work La Clara mine at greater capacity and to open a deposit on the opposite side of the river.

The Marquette-Magdalena company, a subsidiary of the Breitung Mines Corporation, had a number of men in the field in 1913, but abandoned its placer explorations on the Cauca and Nechi Rivers, and at the end of the year was devoting its attention to the drilling of a property on the Porce River, a reconnaissance of the West Coast country, and the development of some quartz properties. In December, the company had three drills at work at La Leona placer, owned by Adam Umholz and associates, on the Porce River.

On the Rio Grande, a branch of the Porce River, the Rio Grande Mining Co. installed a hydraulic elevator preparatory to beginning operations in December. Below this property is the Gabina mine, owned by Colombians, and equipped with one hydraulic elevator. The Colombian Gold Mines Corporation was making preparations in December to begin drilling the Putal and Icabo tracts on the Cauca River, in the vicinity of Caceres, where rich showings have been obtained by surface panning.

There was active exploration on the West Coast and in the upper Atrato region. Numerous placer properties in this section were offered for negotiation in 1913, but only a few actually changed hands. In the Choco Valley, the Lewisohn interests sent an engineer to this district and did some preliminary prospecting.

The Anglo-Colombian Development Co., Ltd., continued its explorations on the San Juan River and tributaries, especially near Novita, on the Condoto River. This is in the platinum region of the West Coast, and the company promises to become an important producer of platinum as well as of gold. The results of prospecting were so favorable that the company extended its holdings, and paid out in 1913 on account of property over \$200,000. The directors reported to the parent company in London in the mid-year that it had developed 13,000,000 cu.yd. of gold-platinum-bearing sand of good grade and that plans were being prepared for a 7-cu.ft. bucket-elevator dredge, to be erected as soon as possible. Doubtless the company has increased this yardage of developed gravel since the date of its report.

The Tolima Mining Co., Ltd., a lode-mining operation about 30 miles from Honda, paid a dividend of 6d. per share and reported favorable results in its exploratory work, especially in the Frias mine. Development was also done in the Plaza mine, and in the Calamonte property, which is under option to this company. There were several other high-grade quartz operations, but no large producers have yet been developed. Emerald mining in the Muzo district, north of Bogota, by the Colombian Emerald Co., of London, was restricted by the government, as heretofore.

There was much interest in supposed petroleum areas in the northern part of the country. Owing to political agitation, Lord Cowdray announced that his company would probably relinquish the broad concession practically granted to the Pearson interests. Near Turbaco, the Cartagena Oil Refining Co., early in January began drilling its third well, two previous wells having encountered only small quantities of gas.

#### ECUADOR

The most important mining operation in Ecuador is that conducted by the South American Development Co. Its mines are situated in the extreme south of the Republic, in the district of Zaruma, about 50 miles from the Pacific port of Puerto Bolivar. This gold-mining enterprise furnishes employment for about 500 men. During 1913 development was vigorously continued, and the 40-stamp mill and cyanide plant were in operation throughout the year. The slime now stored in ponds below the present leaching plant will be treated in a slime plant, which it is proposed to erect in the future.

At the close of the year, a new water-power plant was being put in service. By means of a 60-in. concrete tube, the water of the Amarillo River is conveyed a distance of  $2\frac{1}{2}$  miles to the mill, where, with a vertical head of 150 ft., 1000 hp. will be furnished. An interesting feature of the new power installation is the fact that the water will be brought to the mill in a concrete pipe or tube built on the ground; "Blaw" collapsible steel forms were successfully employed in its construction. The crushers and the stamp-mill line shafts will be directly driven by water wheels, the water from which will then continue to the present water wheels near the river, where air is compressed for the mine drills, and power for other operations is now transmitted by rope. It is interesting to note that under the new system the water power is supplied directly wherever possible.

This company has paid a great deal of attention to sanitation at its camp, and recently built some all-con-

crete cottages for its staff, this construction having been evolved from a start with native mud huts, then frame cottages, followed by frame-and-concrete construction, and, finally, by the all-concrete cottages. The effort and accomplishment in sanitation give the camp an enviable reputation for healthful conditions. The serious coast diseases have been kept out, not one member of the staff having been lost from these causes; there has never been a case of yellow fever in the camp. A system of prevention is conducted; homes are made bug-proof, and sleeping quarters screened; care is taken to remove all garbage; the ground is kept dry and clean; and an adequate sewerage system is provided.

#### BOLIVIA

The output of tin, which is still the leading metal product of Bolivia, was handicapped in 1913 by a shortage of labor, but, notwithstanding this difficulty, it about equaled the production of the previous year, when 38,378,696 kg. of *barilla* (about 60% Sn) were exported. Silver is the next most important metal, the principal producer being the Huanchaca company, which is also the largest producer of zinc; the greatest problem at this company's mines near Uyuni was the handling of a large flow of hot water. Silver is produced by most of the large tin-mining companies, and in some cases copper, tungsten and bismuth. One of the notably successful companies in Bolivia in 1913 was Aramayo, Francke & Co. This company produced in its last fiscal year 3694 tons of black tin and milled in its various plants 37,660 tons of ore; after liberal reservations for depreciation and redemption of debentures, the company paid a dividend of  $17\frac{1}{2}\%$  and prepared its properties for increased production. The greater part of the bismuth supply of the world comes from Aramayo, Francke & Co.'s Espiritu mine, in Santa Barbara, and is smelted at the Quechisla works, where a new fume-condensing plant was completed in 1913; the company also produced in its last fiscal year about 109 tons of tungsten and 157.42 tons of copper.

The largest tin producer in Bolivia was S. I. Patiño, whose Uncia mines for the first three-quarters of 1913 were producing at the rate of over 200,000 quintals of *barilla* per annum. Besides the Uncia, Japo and Kami mines, Señor Patiño now controls the Huanuni mine, having an annual output of about 35,000 quintals of *barilla*. Other important tin producers were the Avicaya mine of Dante, Abelli & Co., El Balcon company, the Araca mine of Harrison & Böttiger and the Cia. Minera de Llallagua; the latter company was particularly successful during certain periods and its shares were the subject of much speculation.

#### ARGENTINE REPUBLIC

Mining in the Argentine Republic is confined mainly to the Western provinces on the eastern slope of the Andes; those of particular importance are Mendoza, San Luis, San Juan, Rioja, Catamarca, Tucuman, Salta, Jujuy and the territory of Los Andes. The most important mining operations in the Republic are those of the Famatina Development Corporation, in the province of Rioja; this company was expected to increase its copper output in 1913, owing to the enlargement of its smelting capacity in 1912. La Concordia mine, in the territory of Los Andes, is another important operation in the north, its mill producing lead-copper-silver concentrate.



The mineral production of the Argentine Republic in 1912, the latest official statistics, was as follows: Copper in bars, 316,983 kg.; copper ore, 304,402; lead ore, 39,670; lead ore containing silver, 6850; silver ore, 2000; tin ore, 15,800; tin ore containing iron, 16,500; vanadium ore, 40,543; tungsten ore, 637,170; zinc ore, 72,300; mica, 3161; borate of lime, 557,156; onyx, 228,612 kg. The tin production was mainly from Rioja, Catamarca and Salta; vanadium ore from Rioja; tungsten ore from Jujuy, Cordoba and San Luis; borate of lime from the territory of Los Andes and Salta. Onyx from San Luis has been used in the grand staircase of the Jockey Club, at Buenos Aires, and in the Grand Palais des Champs Elysées, in Paris.

The Argentine oil fields received increased attention in 1913. At Comodoro Rivadavia there are 12 wells, having an average depth of 1700 ft.; there are eight private companies engaged in the petroleum industry in this field; the output for 1913 is locally estimated at about 28,000 metric tons. The Argentine government reserved for the state 5000 hectares of oil lands, of which 350 are now being explored, with a view of providing a supply for the navy; an appropriation of approximately \$6,000,000 has been recommended for a refinery, tankage and other equipment. Oil areas have been reported from time to time in the northern provinces, but there has been thus far no important commercial development.

#### BRAZIL

The most important mining operation in Brazil, the St. John del Rey, crushed during the first half of 1913 at the rate of 13,750 tons per month, with an average recovery of \$11.52 per ton; production during this period was restricted by a serious labor shortage, relieved later by the importation of Japanese and by the general financial stringency releasing native laborers from other enterprises. After August, the monthly crushing averaged over 15,000 tons. The rich orebody at the eastern end of the lode has continued from the 14th horizon down to the 18th and the "G" shaft is being extended to Horizon 19. The Onro Preto Gold Mines of Brazil, operated throughout the year and was crushing in the autumn nearly 6000 tons monthly with a yield of about \$5.88 per ton. The Conquista-Xicao Gold Mines, Ltd., of 48 Avenida Rio Branco, Rio de Janeiro, installed at Campana, Sao Paulo, a 1000-hp. hydro-electric plant and hydraulic equipment, including several giants, three 15-in. centrifugal pumps for sluicing, pipe lines, and about one mile of steel sluiceway, using a high-carbon steel plate as a wearing plate within the frame of the steel sluiceway. The company began sluicing in the autumn of 1913, but we have received up to date no report of the results of their operations.

The important iron deposits in the state of Minas Geraes continued to be held back by the absence of suitable shipping facilities. The manganese deposits in this state are similarly handicapped, but a number of properties, of which the Morro mine is the largest, are able to ship ore carrying 50 to 53% Mn. There are other manganese deposits in the states of Bahia and Matto Grosso. The diamond and semi-precious stone industries were not so active in 1913 as previously.

#### OTHER ATLANTIC COAST COUNTRIES

Paraguay and Uruguay have had little mining development, though a few properties have been operated inter-

mittently for a number of years. In Uruguay, a geologic study of the mineral resources has been in progress for two years, under the direction of Dr. Maurice A. Lamme, formerly of Columbia University, who recently reported petroleum indications along the Atlantic Coast section of Uruguay; a new mining code embodying some much needed reforms was promulgated in March.

The most important event in the Guianas was the building of an all-steel dredge on the upper reaches of the Rivière Approuague by the Compagnie française de Mataroni; the dredge has buckets of 150 l. (5.3 cu.ft.) capacity, and began digging in October; it was started in ground estimated to run 1 to 1.3 grams per cubic meter. In British Guiana, where the gold production has declined for several years, more gold was sent out in 1913 than previously; this was from numerous small hand operations.

#### VENEZUELA

The petroleum possibilities both of Venezuela and Colombia attracted much attention in 1913 and were the subject of many lurid articles in the daily press, which printed cablegrams late in December announcing that "a great oilfield was being opened under the auspices of the Shell and Standard Oil groups in the Maracaibo region." Development of a substantial character was undertaken by the Venezuelan Oil Concessions, Ltd., a British company that has a concession covering over 3000 square miles. An extensive reconnaissance of Venezuela was made by the General Asphalt Co., of Philadelphia, which had twelve parties in the field each under the direction of an engineer or geologist. In metal mining, the most important operation was that of the Canadian-Venezuelan Ore Co., which was engaged in completing its contract to deliver 304 cargoes of its Imataca iron ore to the Lan Wood Steel & Iron Co., of Philadelphia. The Rio del Oro Co., Ltd., operating El Amparo mine in the Yuruary River district in the State of Bolivar, sank its main shaft to the 200-ft. level; the production for October was 120 tons, containing 518 oz. Mining concessions were granted to Augusto Pinaud for La Victoria and El Choco gold mines, in Roscio district, in Bolivar. The South American Copper Syndicate of London shipped regularly from its Oroa group of mines.

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#### Peru in 1913

BY LESTER W. STRAUSS\*

The year 1913 marked no important new enterprises as becoming productive, or being carried through, although interest was displayed as to the possibilities of Peru's mineral industry. The established copper companies effected improvements in their plants which will mean increased output in the coming year and the petroleum and borax industries are likely to prove more important factors in the products exported.

Copper continued to be the most important of the country's mining industries and will undoubtedly show an increase over the 1912 (i.e., 27,500 metric tons) production. The Cerro de Pasco Mining Co. and the Backus & Johnston Co. contributed over 90% of the total. The former company (responsible for about 75% of the copper output) did not average 50% of its smelting capacity,

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principally because of the shortage of coal which affected its coke production. Its subsidiary, the Morococha Mining Co., in Morococha, has increased its shipments, but the maximum results have not yet been attained and vigorous development is under way. The new 12,000-hp. hydro-electric plant, near Oroya, is expected to be in service early in 1914, and will serve both the Cerro de Pasco and Morococha districts, as well as the coal fields at Goyllarisquisca and Quishuarcancha; the coal consumption in the Cerro de Pasco steam plants will be materially reduced, and the railway may be electrified. The company's coal mines at Quishuarcancha were more actively exploited after the railroad branch to that camp was opened for traffic; the Goyllarisquisca camp has heretofore been the principal source of coal.

The Backus & Johnston Co. has about completed its extensive construction campaign; the new 2000-hp. hydro-electric plant is operating satisfactorily and preparations to blow in the new 52x160-in. furnace, and the two 96x150-in. barrel converters, are under way at this writing (Dec. 10). Blister-copper shipments will be made in 1914 instead of the present matte and ores exported to the United States. The company obtains copper ores from the mines it controls, and from custom ores bought in the Morococha district. Electric power will be transmitted to replace the present steam equipments.

The plant of E. E. Fernandini, several miles west of La Fundicion, continued as a silver-copper smelting plant, the matte averaging 1500 oz. silver per ton and 55% copper; the year's output was about 1,500,000 oz. The silver ores are brought from the Colquijirca mine and the copper ore from Cerro de Pasco.

The minor shipments of copper ores were somewhat increased with the higher price of the metal. Several properties were under development besides those producing in a small way. The Sociedad Cuiivre de Huaron continued developing its properties 35 miles southwest of Cerro de Pasco; there are said to be 100,000 tons of 12% copper ore "in sight." The Ferrobamba region was practically inactive; the treatment problem was studied, but without commercial results. Several properties in different parts of the country were optioned by various foreign syndicates and sales may eventually be consummated.

The gold possibilities of Peru have attracted considerable attention abroad, principally as to the alluvial deposits. Investigations have been under way near the Ecuadorean boundary in the north, and in the department of Puno in the south, also in the central section within several days' ride from Cerro de Pasco. In the last mentioned region, the Ambo Gold Mines Co., formed by parties interested in the Amazon-Pacific R.R., was apparently salted in its exploration work on the Huallaga River. An American company was floated to operate on the Marañon River, about four days' ride from Cerro de Pasco. La Compania Aurifera Argentina-Peruana was the only successful hydraulic company in 1913. The Aporoma Goldfields, Ltd., in the same department (Puno) did not produce as expected, owing to the lack of water.

The important vein mines in operation are the New Chuquitambo Gold Mines, Ltd. (six miles eastward from Cerro de Pasco), which milled during its last fiscal year 23,673 tons; Andaray-Pasco company (in the province of Condesuyos, department of Arequipa), output about

\$3000, U. S. currency, per month; Cotabambas Auraria (in the department of Apurimac), output \$8000 per month. The Santo Domingo mine of the Inca Mining Co., in the department of Puno, is under option. The development work on several properties in the Pataz region (department of Ancachs) and near Nazca (department of Ica) appeared to be giving gratifying results at the close of the year.

Silver mining, as practiced independent of copper smelting, was not carried on extensively, barring the operations of the Sociedad Explotadora de Caylloma, in the department of Arequipa, and various small pan-amalgamation and hyposulphite plants. Lead ores carrying silver in excess of 150 oz., were more actively exploited with the higher prices of the metal. The shipments were not heavy. Lead bars from the Vesubio smelter, in the department of Ancachs, were exported; these carry over 700 oz. silver per ton.

#### VANADIUM, FUELS AND BORAX

Of the lesser metals shipped abroad, vanadium was not so important as in previous years, due to the policy of the American Vanadium Co., which controls the Minasragra property. Tungsten ores and concentrates, to the extent of probably 300 tons, were exported from the Conchucos district, "inside" from the port of Chimbote, department of Ancachs. Bismuth concentrate shipments, from E. E. Fernandini's property, near his Huaracaca smelting plant, were less than 200 tons. Zinc shipments in 1913 were small. Tin deposits were reported near Canta, several days' ride from Lima, but authentic confirmation of the existence of the metal cannot be obtained.

The petroleum industry developed only in the northern coastal region, received considerable stimulus through the entry of the Standard Oil (which controls about 95% of the country's production) and the growing demand for the product. The output for 1913 will probably be near 3,000,000 bbl. The Standard Oil controls the Lobitos Oilfields' output and through purchase, the controlling interest in the London & Pacific Petroleum Co., Ltd., and the Lagunitos Oil Co. The West Coast Fuel Co., Ltd. is the selling agent and is also controlled by the Standard Oil Co. The only independent producer was Faustino G. Piaggio & Co., Ltd., with a production of about 110,000 bbl. annually. Oil lands were withdrawn from denouncement; several localities, taken up prior to this decree, were being drilled by local capital.

The conservation of coal lands was given consideration by the present government and several regions, covering seams of good coal, were withdrawn from denouncement. The government hopes eventually to interest outside capital to open these districts. The Cerro de Pasco mines produced over 90% (i.e., about 300,000 tons) of the coal mined in Peru. Probably 100,000 tons of coal and coke are imported annually into the country.

The borax fields, near the town of Arequipa, owned by the Borax Consolidated, Ltd., are to be more actively exploited, not only because of the recent concession granted by the government, but also in view of the heavy export tax contemplated by the Chilean government, which will affect the company's operations at their Ascotan deposits, inside from Antofagasta, Chile. The investigations of nitrate ground in the department of Arequipa did not prove commercial deposits.



# Russian Mining

BY J. P. HUTCHINS\*

Last year was one of general prosperity in the Russian Empire, with a continuation of good prices and a steady demand for the products of mines and metallurgical operations. Most notable was the great lack of coal and oil, the scarcity of these being such as to result in almost famine prices.

Anthracite coal is selling at a figure twice as high as two years ago, and oil is higher than in a long time, partly because of the partial exhaustion of many wells and partly because of increasing demand resulting from the expansion of industry. The iron business was good and it was necessary to import much foreign iron to supply local consumption. Producers of copper had a good year, the duty of about 7c. per lb. being ample protection against foreign competition. The gold mines did fairly well, the total production being about the same as last year and somewhat less than in 1911. Platinum, under the stimulus of continued high prices, had a good year without discouraging fluctuations in the price.

## GOLD

The estimated gold production in 1913 was about \$30,000,000, of which about 90% came from Siberia; about 95% also came from placers. This is somewhat disappointing, as being less than predicted. No important discoveries of new gold fields were chronicled, although active searching for deposits near present rich, deep placers was conducted. Explorations of the extreme north-eastern part of Siberia, opposite Nome, Alaska, are said to have shown the existence of placers of a character and richness similar to those on the Alaskan shores. But, owing to prohibitions of several kinds imposed for strategic and other reasons, and also because of their inaccessibility and other hostile conditions, no notable addition to gold production resulted.

The extension to the southern part of Siberia of transportation facilities by railroad and steamer and the opening of new country by the Amur railroad should soon help to increase the production of gold. Mongolia, now being assimilated by Russia, will eventually contribute. Heretofore it has been dangerous country, but several important expeditions are contemplated to explore its gold-mining possibilities and these will be sent out as soon as the process of assimilation is sufficiently advanced.

Instead of intolerant restriction a beneficent liberality has dictated the Russian policy of treating its alien peoples; Russia is much more liberal than popularly supposed. This has an important bearing upon the future of gold mining. As the southern boundary of the Russian Empire continues to be pushed south, a region that produced gold before historic times, as evidenced by the discovery of numerous ornaments in prehistoric gravels, will again be exploited and by modern methods, after centuries of unproductiveness due to its occupation by nomadic and warlike tribes.

Drift mining in the Lena River region increased over 1912, but is still below the level of 1911, when nearly \$10,000,000 was produced. In 1912, a serious strike in this region resulted in decreased production, and the

exhaustion of some of the richest ground, which contained about \$15 per cubic yard over a width of pay channel of about 1300 ft., has helped the decline. It is possible that the Lena region has passed its zenith. The regions of the Amur, Yenisei and Ob Rivers and of the Ural Mountains, about held their own, but the lack of new developments indicates a gradual future diminution in yearly yield. It had been hoped that the installation of dredges would result in a large increase but this did not prove to be the case, principally because most of the dredges were failures, the result of fitting with machinery too weak to meet even the generally easy conditions. Dredges were also installed where the conditions made success impossible.

The mistake of assuming, without proper investigation, that ground adjacent to formerly rich areas is workable and that worked areas have been so carelessly worked as to still contain important amounts of gold both in the workings and in the tailings, has been made again and again. In the Russian Empire, particularly, it is best to avoid mines once worked by open-cutting, when considering the installation of dredges.

Several dredges are now being installed in Siberia where the conditions make failure certain. Poor, frozen gravel, big boulders and hard bedrock are unfavorable factors, and the dredges themselves are so poorly adapted to combat the conditions under which they must work, that they could not succeed, even in ideal ground. The success of the heavy American type of dredge, under difficult Siberian conditions, has been more noteworthy than ever. One American dredge with a log washer, such as is used in North Carolina, was worked in extremely clayey but rich gravel, much of which averaged more than 50c. per cubic yard.

## GOLD QUARTZ MINING

No important developments of gold vein mines were made in 1913. The few in which foreign capital is invested had a precarious year. The future for quartz mining in the Russian Empire is not thought to be brilliant.

## PLATINUM

The platinum industry had a prosperous year, the high prices of about \$40 per oz. continuing. The marketing of platinum is in the hands of a group which both produces and controls about 75% of the Russian production, or 67½% of the world's production. Thus the price has been controlled and the violent fluctuations of 10 years ago are past. No new and extensive platiniferous gravels have been discovered. Reports come frequently of the discovery of lodes which have all proved to be only small gash veinlets of chromite in the dunite, which seems to be the important matrix.

Dredging operations for platinum in the Urals had a good year. The physical conditions here, except for a considerable content of clay, are favorable to dredging; the gravel is free, shallow, has few big boulders and rests on an easy bedrock. The dredges used in the Urals are generally of a poor type; the best is an American design

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of over 10 years ago. The introduction of proper clay disintegrating devices is badly needed, for it is not unlikely that more than 25% of the platinum is lost with the inefficient devices now in use. It is not difficult to disintegrate clay with machinery of proper design.

About one-third of all platinum sold is used in dentistry, one-third in jewelry manufacture and the rest in making scientific apparatus and for miscellaneous purposes. Platinum alloyed with about 25% iridium makes the strongest and hardest of precious-metal settings for jewels.

#### COPPER

The estimated copper production for 1913 is 44,000 tons, or about 10,000 tons more than in 1912. The price of copper in Russia, due to the heavy demand and the protective duty, runs 25 to 33 $\frac{1}{3}$ % higher than in London and New York. Foreign capital is largely interested in copper mining and produces about one-half of the total amount. Of the copper produced, about 60%, 25%, 12% and 3% came from the Urals, Caucasus, Kirghiz Steppes and from chemical works as byproduct, respectively.

#### IRON

Good business conditions were mainly responsible for a prosperous year in iron but there are being placed large orders for armament and railway equipment; the next few years promise prosperity, for billions of dollars are to be spent for these purposes. South Russia, by its fortunate juxtaposition of good iron ore and coking coal, controls the industry; the estimated production is 2,500,000 tons pig iron, 2,200,000 tons billets, blooms, etc., and about 1,500,000 tons of iron and steel finished products. The Ural Mountains region makes excellent iron with charcoal; the estimated production is 1,000,000 tons pig iron, 750,000 tons billets, blooms, etc., 725,000 tons finished iron and steel products. Poland produced about 410,000 tons pig iron, 525,000 tons blooms, billets, etc., and about 408,000 tons finished products. The Moscow region produced about 90,000 tons pig iron, 156,000 tons blooms, billets, etc., and 140,000 tons finished products.

#### COAL

The estimated coal production for 1913 is 33,000,000 short tons, a considerable increase over 1912. The high price of coal, due to industrial expansion and decrease in oil output, had a stimulating effect, and at present there is great activity in opening coal mines; coal now sells for about twice as much as two years ago. The region tributary to the Don River produces about two-thirds of all the coal mined in Russia and about one-sixth of this is anthracite of good quality.

Siberia has no first-class coal mines, though good coking coal is said to exist on Saghalien Island. A lack of good seaports and the fact that the island is surrounded by deep ice for several months, together with other obstructions to easy transportation, have discouraged intensive exploitation to date.

#### OIL

The estimated production of oil was 516,000,000 poods (one pood equals 36.11 English pounds). The annual production of the Baku region further decreased in spite of rather intensive drilling in the attempt to find more oil deposits.

The demand increased and the supply diminished with a resulting high price. Much is said of a so called fuel famine during 1913, and it would appear that the diminishing supply of oil will cause present users to change to other fuel such as coal.

Much wood is still burned in Russian cities and towns; St. Petersburg, for instance, burns more wood than coal. This fuel is transported by canal from the extensive forests and is still cheap, costing in St. Petersburg about \$8 per cord, delivered. Wood is burned on the railways from St. Petersburg to the German frontier, and also to Siberia. As these forests are cut, the demand for other kinds of fuel grows, and with the expansion of industry it may be said that the future for fuel prices is particularly bright.

#### LABOR

The problem of getting enough good labor is a difficult one everywhere in the Russian Empire. Due to an emasculating paternalism, civil and religious, the laborer has been treated in such a way as to lose all self-reliance and enterprise. "God will take care of us" is his creed, and inefficiency is the result. The Russian laborer should be the finest in the world. Only the fittest of the babies survive, due to exposure and lack of care, and existence in a climate where one must work hard during a short summer to be able to survive during a long winter, makes for efficiency. As an instance, the laborer in Klondike is the best I have ever employed, while the tropical laborer is the most inefficient. The Russian laborer, curiously, is rather more like the tropical than the arctic laborer.

Furthermore, he is encouraged to keep the too numerous holidays, and being ignorant of how to read or to amuse himself otherwise, he gets drunk. Drunkenness is the curse of the Russian laborer.

The efficient foreman is hard to find in Russia. Individual enterprise is not encouraged, and as a result, even where labor is often only 25c. per day, the cost of work, particularly where some skill is required, may be more per unit than where wages are \$2.50 per day.

Probably more than 90% of the 112,000,000 peasants in Russia are illiterate. It will be only when education becomes more general and Ivan Ivanovich has the chance to learn to cultivate an aptitude quite as great as that of any other European peasant, that working costs will decrease greatly here.

#### POLICY TOWARD FOREIGN CAPITAL

Russia needs foreign capital more, probably, than any other civilized country. No country has so great undeveloped resources in agriculture, grazing and manufacturing, and nowhere are there greater opportunities for making improvements even in such elemental processes as simple agriculture. One needs 10 days to travel across the Russian Empire, from the Baltic to the Pacific; and it all is fertile and capable of producing huge crops; still only a small part is cultivated and this in a most primitive way. There is being built in east Siberia a railway 1200 miles long without one mechanical excavator being used, nor even a drag scraper. Many similar instances could be quoted. But when one begins to investigate with the idea of investing capital to take advantage of the apparent opportunity, a discouraging array of obstacles is found. One of the principal is the policy toward foreign capital, which, while intended to be friendly, is



in reality hostile, since it allows to exist a mass of laws which limit and harass the foreigner. For instance, a foreign mining company in certain regions must have a Russian manager. In other regions only a small number of foreign laborers can be employed and in other parts no foreigners at all can be employed without first

petitioning the governor. Naturally, a foreign corporation wants its affairs administered by a man it knows, and is discouraged by such laws. Mining laws are awe-inspiring in their number, complexity and the variety of their interpretations and administrations. The duties on foreign mining machinery are often prohibitive.

## Mining in Australasia in 1913

By W. P. GEARY\*

The aggregate value of the mineral production of Australasia during 1913 will fall considerably short of that for the previous year. The gold yield of all the states shows a falling off, but both New South Wales and Queensland show satisfactory advances in the production of industrial metals. Operations were checked for a time at various centers, but generally work proceeded steadily. The same degree of attention was not given to the mineral industry as in previous years the favorable seasons causing a diversion of energies to other channels, and consequently prospecting operations were more or less neglected.

### GOLD

The accompanying statement shows the gold yield of Australasia for 1912 and 1913, the figures for 1913 being estimated from the production of the first ten months.

Western Australia is still the largest contributor, the

GOLD PRODUCTION OF AUSTRALASIA  
Fine Ounces

	1912	1913
Western Australia.....	1,282,658	1,280,000
Victoria.....	480,131	429,000
Queensland.....	347,946	264,000
New South Wales.....	165,295	147,000
Tasmania.....	37,973	34,000
South Australia and Northern Territory.....	11,335	9,000
Commonwealth.....	2,325,338	2,164,000
New Zealand.....	316,667	354,000
Total ounces.....	2,642,005	2,518,000

output being large, but showing a considerable decline compared with previous years; although there have been some recent developments, they have not been of such extent as to indicate cessation of the downward tendency.

Victoria is next in importance for its output of gold, but in this state also developments at the deeper levels have shown reduced values, and consequently the yields from the mines on the old-established fields, such as Bendigo and Ballarat fall considerably below the average.

In Queensland the decrease in the production was particularly noticeable, but the deficiency was more than counterbalanced by the increased output of the industrial metals. There was again a falling off in the returns from all the principal fields, such as Charters Towers, Gympie, Mount Morgan, and Etheridge, and under existing conditions any immediate improvement cannot be hoped for. The deep sinking proposed at Charters Towers was turned down by the government on the ground that the report of the Board of Inquiry showed that the financial proposals were inadequate, and the scheme or its suggested alternative would affect only the two applicant companies, and only remotely benefit other mines if successful.

In New South Wales there were no new developments of significance during the year, and as in Queensland,

mining for the industrial metals commands most attention. The yield was mainly contributed by the established mines on the Cobar and Wyalong fields, and by the dredging plants. In this state as in the other Eastern States, the waning productiveness of the gold mines and the absence of any discoveries which are likely to arrest the decline are matters of much concern when the future of the industry is considered.

The output from Tasmania and South Australia, as also from the Northern Territory compares unfavorably with that of previous years. The yield from the Dominion of New Zealand, as disclosed by the returns for the first ten months, shows an increase on that for the previous year. This is mainly due to the advance in the output from the Waihi mine. The latest news indicates favorable development in the reef struck between the No. 5 and No. 4 shafts at the 1300-ft. level, which is believed to be the Dreadnought. Considerable work was being carried out on the upper levels with the object of attacking the arches on the Martha and Welcome lodes.

### SILVER AND LEAD

The preliminary returns indicate that the value of the output from the silver-lead mines of New South Wales for the year 1913 will show an advance over 1912, which was a record for the state. As usual, the chief contribution is from the mines on the Broken Hill field, where operations have had satisfactory results.

The accompanying statement shows the output of silver and lead from the mines in New South Wales.

### SILVER AND LEAD

Year	In Bullion		In Concentrates Exported	
	Silver, Oz.	Lead, Tons	Silver, Oz.	Lead, Tons
1910	5,196,323	94,818	7,608,336	85,035
1911	5,731,468	94,966	8,797,677	111,795
1912	5,220,538	101,811	8,293,711	97,736

The value of the output for the first nine months of 1913 shows an increase of £283,164 over the same period of 1912, and is an indication of the progress which has been made. If more skilled labor had been available the output would have been much greater.

### COPPER

The figures given contain an estimate so far as the production of the last six weeks of 1913 is concerned. It may be expected that the total produced in Australia for 1913 will be 43,500 long tons. This indicates a set-back of approximately 2000 tons compared with 1912. This decrease is accounted for by the long period of idleness forced upon some of the Queensland mines through strikes.

Generally speaking, Australia has not responded to the improved price that has ruled for the metal during the current year. Within the Commonwealth itself no new

\*Department of Mines, Sydney, N. S. W.

copper enterprises have been entered upon, but it is possible that during the next year mines in Papua, which have been undergoing moderate development during 1913, will reach a producing stage. There is ample room for fresh copper-mining enterprise in Australia if the state governments, who control all the railroads, could be persuaded to connect well known copper fields with the railway system. The only state which seems to recognize the value of her base-metal resources in Queensland, and as a result that province has jumped from a very insignificant position into the forefront of Australian copper producers.

Queensland will account for 23,000 long tons, which will be a shade less than her production for the previous year. Both the Mt. Elliott and Hampden mines in the Cloncurry district were tied up for several months through strikes, otherwise Queensland would have eclipsed her previous record. The extension of the railways by the government continues, and presently it is expected that Mt. Cuthbert will add materially to production figures. Mt. Oxide, another high-grade mine in the Cloncurry field, is perhaps too remote to be considered as an impending producer. Upward of 100 miles of railway will require to be constructed before the rich ores of Mt. Oxide will reach the market. Mt. Morgan, the famous old gold mine, will probably contribute 8500 tons to the Queensland figures. It is confidently expected that from March of next year Mt. Morgan will produce at the rate of 12,000 long tons per annum.

The New South Wales production will also show a falling off. During the past two or three years, the state production has consisted mainly of the output of the

Great Cobar property. The early promise of 1000 tons per month from this mine has never been realized, and it may be expected that Cobar will have averaged about 500 tons per month for the current year. It is improbable that the state's production for the year will exceed 8000 tons, which is a drop of approximately 1000 tons when compared with the previous year. The old Lloyds Burraga mine and the Nymagee property are now being brought into production again, but through lack of rail facilities, it cannot be said how long they will remain in operation. It will depend entirely on the price of the metal.

Apart from the Mt. Lyell operations, Tasmania can hardly be considered a copper producer. The total for the state may be put down at 5200 tons, of which Mt. Lyell will account for 5000 tons. This company has now overcome the disorganization resulting from the disastrous fire, and it may be expected that next year will produce an additional 2000 tons.

The condition in South Australia is much the same as it is in Tasmania. In this case the Wallaroo & Moonta is the principal producer, and should account for 6000 tons. The state's production for the year will be about 6500 tons.

The conditions in Western Australia have not altered materially during the year. From Whim Well and Phillips River, and sundry smaller shows combined, approximately 1500 tons of copper have been won, which is a few hundred tons in advance of the record for the preceding year.

## Mining in The Transvaal in 1913

BY H. F. MARRIOTT\*

The earlier monthly outputs of gold from the mines of the Witwatersrand indicated for the year 1913 a decided increase over the production for the previous year, which itself was a record for these fields and constituted over 39% of the world's production. The strike of white employees, however, in the middle of the year seriously affected mining operations, and as a result the whole industry suffered from adverse economic conditions during the latter part of the year, with the result that there is a reduction of total output below the amount recorded for last year.

Looking at Table I, it will be seen that, although the scale of milling increased, there is no corresponding increase in the output of gold. In fact, the yield fell to 28s. per ton, or about 1s. lower than the previous year, the 29.2s. quoted being unduly high, owing to the inclusion of the abolished gold reserves, which accounted for about 0.3s. per ton milled. This year's yield cannot be taken as the result of normal methods of working. In this connection, it is of interest to note that the portion of waste rock assorted at the surface is also lower than previous records, being about 11½% of the tonnage hoisted during the year.

### CHANGES IN OPERATING COMPANIES

There were in December, 1912, 53 producing companies on the Witwatersrand fields, having 9440 stamps and 277

tube mills at work. The only combination to be recorded is that of the Knights Deep with the Simmer & Jack East, two East-Central Rand companies. The former company absorbed the latter as from July 1, 1913, having exercised an option to do so after a period of joint working. During the present year the Cinderella Consolidated, which, with 80 stamps and three tube mills, had been milling on a restricted basis, decided in June to close down its battery pending the attainment of an improved position underground, and, later, at the close of the year, on account of the abnormal conditions prevailing, it was found advisable to suspend all work on the property. It was considered expedient also to suspend operations on the Jupiter mine in the latter part of the year owing to the inability to work its low-grade ore profitably on the existing scale of operations. This mine was, with 120 stamps and six tube mills, crushing at the rate of 30,000 to 40,000 tons per month. The year witnessed the passing of the second Treasury mine; the cessation of its operations in July was somewhat precipitated by the strike of white employees. This small outcrop mine of 29 reef claims, working in the central part of the Rand, has milled above 1,300,000 tons and distributed in dividends £542,000 since the commencement of operations.

The foregoing adverse factors in the producing capacity are counterbalanced by increases in capacity in other mines, and also by the advent of the Van Ryn Deep, a new producer situated in the Eastern Rand in the vicinity

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of the New Kleinfontein, New Modderfontein, and Brakpan mines. The plant, consisting of 80 stamps and eight tube mills with a capacity of 40,000 tons per month, was

TABLE I. TRANSVAAL GOLD PRODUCTION

Year	Witwatersrand District			Outside Mines, Value	Total Value for Transvaal
	Tons Milled	Value	Value per Ton Milled, Shillings		
1884-89.....	1,000,000	£2,440,000	48.8	£238,231	£2,678,231
1890.....	730,000	1,735,491	47.4	134,154	1,869,645
1891.....	1,154,144	2,556,328	44.2	367,977	2,924,305
1892.....	1,979,354	4,297,610	43.3	243,461	4,541,071
1893.....	2,203,704	5,187,206	47.0	293,292	5,480,498
1894.....	2,830,885	6,963,100	49.2	704,052	7,667,152
1895.....	3,456,575	7,840,770	45.2	728,776	8,569,555
1896.....	4,011,697	7,864,341	39.2	739,480	8,603,821
1897.....	5,325,355	10,583,616	39.7	1,070,109	11,653,725
1898.....	7,331,446	15,141,376	41.3	1,099,254	16,240,630
1899.....	6,872,750	15,067,473	48.8	661,220	15,728,693
1900.....	459,018	1,510,131	65.8	.....	1,510,131
1901.....	412,006	1,014,687	49.2	81,364	1,096,051
1902.....	3,416,813	7,179,074	42.0	74,591	7,253,665
1903.....	6,105,016	12,146,307	39.8	442,941	12,589,248
1904.....	8,058,295	15,539,219	38.5	515,590	16,054,809
1905.....	11,160,422	19,991,658	35.8	810,416	20,802,074
1906.....	13,571,554	23,615,400	34.8	964,587	24,579,987
1907.....	15,523,229	26,421,837	34.0	981,901	27,403,738
1908.....	18,196,589	28,810,393	31.6	1,147,217	29,957,610
1909.....	20,543,759	29,900,359	29.1	1,025,429	30,925,788
1910.....	21,432,541	30,703,912	28.5	1,297,823	32,001,735
1911.....	23,888,258	33,543,479	28.1	1,498,006	35,041,485
1912.....	25,486,361	37,182,796	29.2	1,574,765	38,757,560
1913 (est.)..	26,084,000	36,437,000	28.0	1,550,000	37,980,000

started up in August with an ore reserve in the mine standing at over 1,400,000 tons valued at 39.8s per ton. It was somewhat unfortunate that this company should have made its entrance at a time coincident with the strike of white miners, which was serious in this part of the field.

TECHNICAL PROGRESS IN TREATMENT

There are no radical changes to be recorded in the gold-extraction processes in use on these fields, and residues are now reduced to a low figure indeed, probably about 1.5s. per ton. The Butters filter process figures prominently in new designs. The Dorr continuous thickener for improving the condition of slimes before filter pressing is engaging the attention of metallurgists. Perhaps one of the most important features in recent practice is the tendency to reduce the length of tube mills. A length of 16 ft. 6 in. or under appears to give a higher efficiency than the old standard length of 22 ft. 6 in. Table II is of interest in showing the relative use of stamps and tube mills in recent years.

TABLE II. STAMPS AND TUBE MILLS

	Stamps at Work	Tube Mills at Work	Duty per Stamp per Day
1909 December.....	9250	148	6.8
1910 December.....	9150	184	7.2
1911 December.....	9565	244	7.9
1912 December.....	9440	277	8.4
1913 September.....	9330	282	8.8

DEVELOPMENT IN MINING METHODS

The advantages of the sandfilling of worked-out stopes are now fully recognized on the Rand, and considerable progress has been evinced in this direction, the Rand Mines, Ltd., having sent down about 3,000,000 tons since the inauguration of this work on some of their mines about three years ago. Among the more recent modifications in sandfilling practice may be mentioned those of the Cinderella Consolidated, Witwatersrand Deep, Robinson Deep, and Simmer & Jack. At the first-named mine, sun-dried and practically neutral sands are conveyed intermittently down the vertical shaft through a wooden box launder before being mixed with the water necessary for the subsequent conveyance to points of deposition underground. At the other mines the utilization of current sands, dewatering at the surface, lowering through boreholes, and open-launder distribution underground are

primary features of the process. The question of a suitable lining to withstand the excessive abrasion by the water-borne sands is now in a fair way to be overcome.

The continued increase in the number of machine drills at work is noticeable, having advanced from 2400 in 1908 to 5600 in December, 1912, and now to a total of 6000. The Union Government Mining Engineer's report classifies the drills in commission in December, 1912, as follows: Large reciprocating piston machines, 58.4%; small reciprocating piston machine, 23.3%; air-feed hammer machines, 15%; hand-hammer machines, 3.3%. There has been a continued increase in the proportional tonnage of rock stoped by small drills, and this increase will probably continue on account of the shortage of hammer boys. Great improvements have undoubtedly been made in drill manufacture, which is satisfactory, as it is in this direction that the effect of a deficient labor supply can best be minimized. New regulations regarding underground drill sharpening again drew attention to detachable bits, while mechanical sharpening of drills is on the increase.

As regards the handling of large quantities of ore underground by the latest methods adopted, reference can be made to the comprehensive paper by R. C. Warriner (Journ., So. African Inst. Eng., April, 1913). This paper forms a standard treatise on this highly specialized branch of Witwatersrand mining practice.

Another phase of mining practice that should be recorded is the adoption of the circular type of shaft for special purposes. The precedent recently set by the New Modderfontein in this respect has been followed during the year by two important companies, the City Deep and the Crown Mines, where shafts of dimensions similar to that of the New Modderfontein, 18 ft. diameter, were started. The Modder shaft is equipped for both hoisting and ventilating purposes; the others are being put down solely for ventilation. The City Deep shaft is to be carried to a depth of 2300 ft. at an inclusive cost of £70,000, and is estimated to have an air capacity of 300,000 cu.ft. per min. Electric blasting is used in this shaft. It should be mentioned at this point that the subject of electric blasting, in view of the insistent demands for improved health conditions underground, was one of the most discussed questions on the Witwatersrand field during the year. Electric blasting had been previously tried, and has been the usual practice in certain Transvaal collieries, but the Meyer & Charlton was the first gold mine to install a complete equipment for its whole mine this year. The results are being watched with interest, but it is doubtful whether electric blasting will prove generally suitable to Rand mining operations.

EASTERN RAND ACTIVITY

Activity continued in this important extension of the Rand mining field. The Van Ryn Deep entered the list of producers, Modderfontein B. and Geduld enlarged their reduction works, and the reef disclosures in the Modderfontein Deep Levels and Government Gold Mining Areas resulted in the decision to erect milling plants forthwith on both these mines. The New Modderfontein operations continue to be highly satisfactory. The grade of the ore developed continues to increase and is higher than that mined during the year. Brakpan experienced a set-back caused primarily by a subsidence of ground which hampered mining operations, and the difficulties

were aggravated by the recent labor disturbances. The No. 1 shaft of the Springs Mines, Ltd., cut the reef at 3432 ft., assaying 25.2s. over a width of 34.9 in., and this was followed by the intersection of the reef further south, assaying 24.7s. over a width of 53 in. The developments from these two outlying shafts will add materially to the knowledge of the district. Both the Rand Collieries gold mine and Rand Klipfontein were obliged to suspend development operations owing to exhaustion of funds.

#### LABOR

Labor in all its aspects was given predominant consideration during the year. Energetic endeavors were made to further minimize the prevalence of miners' phthisis. The miners' phthisis committee was instrumental in collecting valuable information regarding the incidence of the disease, and formulated definite proposals for its prevention. These are embodied in regulations now in force. A bacteriological institute was founded, and quite recently the Chamber of Mines arranged for an independent in-

TABLE III. LABOR EMPLOYED IN TRANSVAAL GOLD MINES

	Whites	Natives	Native Death Rate per 1000
1910	25,376	191,784	35.72
1911	25,108	194,286	31.01
1912	24,334	206,121	28.83
1913			
Jan.....	24,697	213,333	
Mar.....	25,013	226,549	
May.....	25,075	218,262	
July.....	24,174	194,789	
Sept.....	22,922	169,526	29.09 12 mo. and Sept.

vestigation of the health conditions of the field; for this purpose Colonel Gorgas, of Panama fame, is now on the Rand. Toward the close of the year an economic commission was appointed. Its duties are to deal with questions arising out of the strike and to obtain expert evidence on the local conditions as compared with those of other of the world's mining fields.

The supply of native labor showed a serious diminution after the strike. Recruiting was temporarily prohibited during the disturbances, and the position is rendered more difficult by the prohibition of the recruiting of tropical natives, thus affecting the total force by about 8%.

#### DIAMONDS, COAL AND BASE METALS

Recent Transvaal diamond outputs (chiefly from the Premier mine) are shown in Table IV.

TABLE IV. DIAMOND OUTPUT

	Carats	Gross Receipts Total	per Carat
1910	2,090,068	£1,317,715	12.6s.
1911	1,843,341	1,628,876	17.7
1912	2,131,406	2,386,979	22.4
1913	1,081,995	1,482,510	27.4

The select committee dealing with the proposed formation of a diamond-cutting industry has issued its reports but no fresh legislation has resulted.

The output of coal shows an increase over previous yearly results, as in Table V.

TABLE V. COAL OUTPUT

	Tons Sold	Gross Receipts Total	per Ton
1910	3,970,000	£986,200	5.0s.
1911	4,344,000	1,021,000	4.7
1912	4,732,000	1,045,000	4.4
1913 (estimated)	5,160,000	1,127,000	4.4

A 20-ft. seam of coal is reported at Warmbaths, north of Pretoria, but this and similar deposits only add to the already keen internal competition. The coal resources of the Transvaal have been roughly estimated at some 36,000,000,000 tons.

Tin outputs obtained from the Rustenberg and Waterberg districts increased from 2900 tons in 1912 to about 3400 tons in 1913, while slightly enhanced prices increased the sales from £368,000 to £429,000.

Practically all the copper produced in the Transvaal comes from the Messina mine, which is situated in the extreme north of the province. This mine is now using its enlarged plant, and as the railroad reached the mine at the close of the year a considerable expansion of operations is expected. Last year the price realized for the 1619 tons of 46.6% concentrate sold was £49,412, while for the nine months ending Sept. 30, 1913, there were 3395 tons of 43.9% concentrate sold for £90,400, so that the year 1913 is a record.

Endeavors have been made to establish an iron industry in the Pretoria district, whilst oil-shale areas and a carbonate of soda prospect have been the subjects of investigation, but no definite developments have yet been announced.

All these recorded outputs from the Transvaal for 1913 amount to about £42,600,000, this being practically the same figure as for the previous year.

## The Sudbury Nickel District of Ontario

BY KIRBY THOMAS\*

During 1913 the Sudbury district of Ontario continued to be the chief source of the world's nickel, furnishing about 50,000,000 lb. (estimated), or more than 80%. Notable progress was made in the Sudbury district during 1913 in mining and metallurgical efficiency, and equipment for the large expansion of the industry was installed. The proven ore reserves were greatly increased by the results of extensive explorations made during 1912 and 1913, and several important negotiations were concluded. As a result of negotiations during 1912 a strong new company has secured a foothold in the dis-

trict, and during 1913 this company indicated its intention of entering into the production of nickel in a large way.

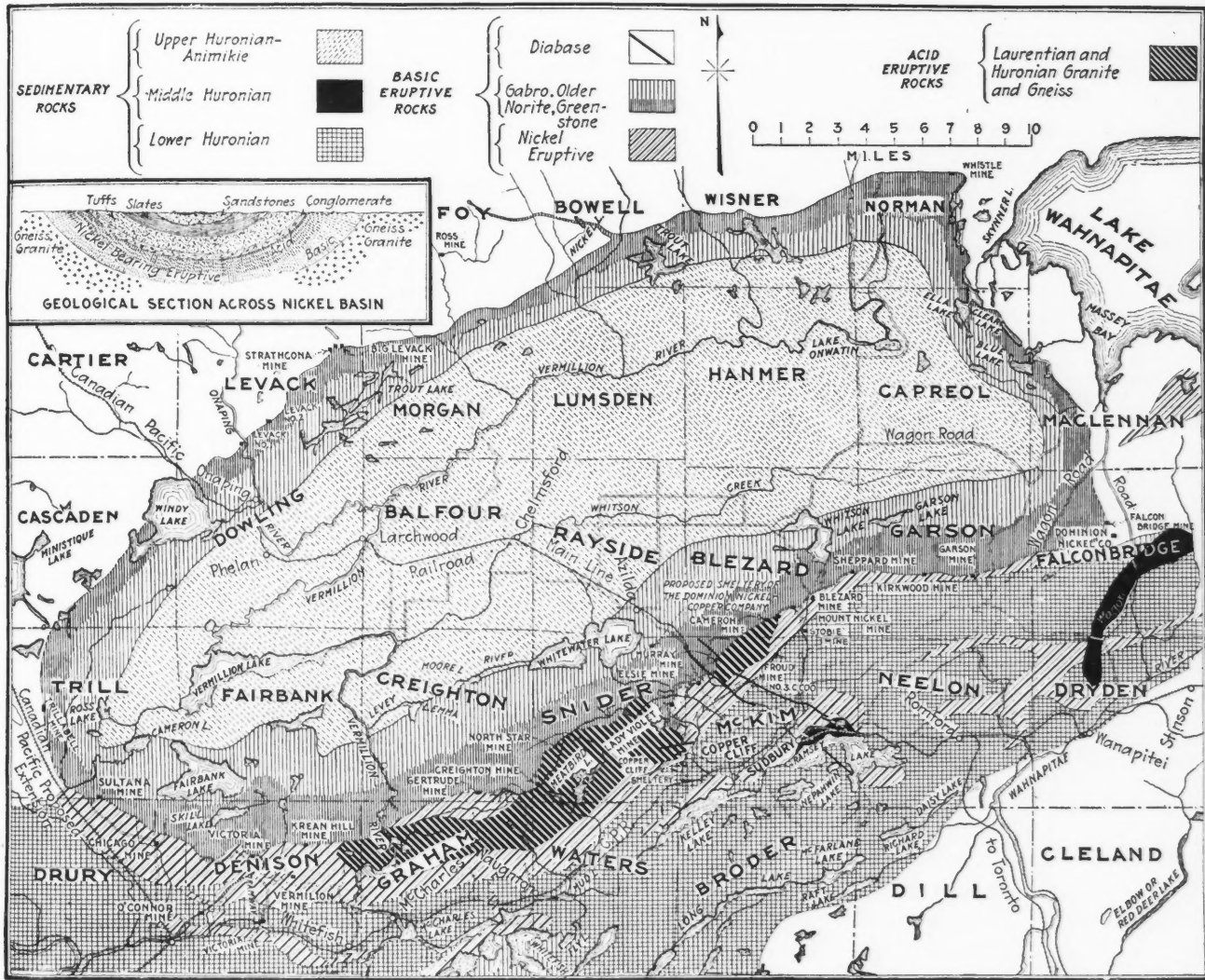
The Canadian Copper Co., the operating branch of the International Nickel Co., during 1913 improved and enlarged its smelting plant at Copper Cliff, Ontario, and began the developments of the large deposit on the Froot-Stobie "offset," known as No. 3 mine. Here several years of extensive drilling is reported to have indicated an ore-body, not formerly known, of more than 30,000,000 tons. This ore is of lower grade than the average heretofore treated in the district, but the company is planning to

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meet this condition by enlarged operations and improved equipment and methods. Working shafts to provide a daily output of 10,000 tons of ore are being sunk and an elaborate system of mining with electric underground haulage is being provided. No. 3 mine is connected with the smelting works by a railroad about three miles long, built by the company. The company has explored several other of its properties by drilling and has purchased control of the Chicago mine on the South range. Additional hydro-electric installation is being planned by the company to utilize the Spanish River southwest of Sud-

Tough-McConnel properties in Levack township on the North range. The Worthington, a high-grade ore deposit, was drilled and is being developed for mining. It is reported that the drilling of the Levack properties proved up between 3,000,000 and 4,000,000 tons of ore. The company also made a discovery of an extension of this orebody on unlocated adjacent open ground. The company also leased the Kirkwood mine on the South range and has begun operation. It also reopened its North Star mine and completed the development of the portion of the Froid-Stobie orebody, adjoining Mine No. 3, purchased



THE SUDBURY DISTRICT

bury. There has been the suggestion that this move portended the use of some method of electrical smelting, but as far as is officially known, the company has no definite plans of radically modifying its present method of treatment by heap-roasting, smelting in standard-type furnaces, and bessemerizing the matte in basic converters. The matte, containing 80% combined nickel and copper, continues to be sent to Constable Hook, N. J., for refining and separation by the "salt-cake" process. The ore supply for the year has been chiefly drawn from the Creighton and Cream Hill mines.

The Mond Nickel Co. during 1913 secured by purchase the Worthington and Blezard mines and the Stobie-

and drilled three years ago. The present ore supply of this company is from the Victoria and Garson mines. It is understood that explorations have added to the reserves in both of these properties which have been in operation for several years. During 1913, the Mond company completed its new smeltery at Coniston about eight miles east of Sudbury and the old plant at Victoria Mines was abandoned. This new plant has a capacity of 1000 tons daily, more than twice that of the old plant. It is modern and efficient in every way and follows generally the practice as indicated above for the Canadian Copper Co. The matte, slightly in excess of 80% combined metals and low in iron, is all sent to Clydach, Wales,

for separation by the carbon-monoxide process (Mond patents), producing nickel and nickel salts. The company has greatly strengthened itself, both as to ore reserves and in equipment during the year. The total ore treated during the year was about 175,000 tons, which, on the basis of other years, yielded a net profit per ton of more than \$6.

As a result of negotiations concluded during the fall of 1912, the extensive holdings of the Booth-O'Brien syndicate in the district passed to the control of interests headed by Dr. F. S. Pearson, of Montreal and New York. A company, now known as the British-American Nickel Co., was organized with capital of \$20,000,000 common stock and \$10,000,000 debenture stock. This company in its initial prospectus announced the control of 17,500 acres in the Sudbury district, including the Murray, Elsie, Gertrude, Whistle, Wildcat (Joe Lake), Victor, Falconbridge and Nickel Lake properties. It was claimed that a tonnage of 6,800,000 was blocked out, of which 4,600,000 was in the Murray-Elsie property. The company had control of the Hybinette process and planned a treatment plant of 45,000 tons monthly ore capacity. An interesting cost schedule was submitted, showing an expected earning net of \$4.96 per ton on the basis of nickel at 30c. per lb. and copper at 12c. per lb. This included \$1 per ton recovery from the precious metals in the ore (gold, platinum, palladium and silver). That the Sudbury ores contained consistently such an amount of these metals and that it could be recovered at all, at a profit, is a new idea to those familiar with the district operations. The company in the spring commenced the erection of a treatment plant near the Murray mine, but the work was suspended in June and operations since then have been confined to sinking a shaft at the Murray, and a limited amount of exploration. The announced reason for the suspension of plans was the stringency in international finances. It is now announced that the company expects

to resume its development and equipment work in the spring of 1914. There is also a rumor that the company will not introduce the Hybinette process, but that it will either resort to the standard practice in the district, or adopt some other treatment plan.

The American Smelting & Refining Co. did some drilling in the district during the early part of the year, but later withdrew, apparently, from all interest in the district. This company made an extensive examination of the district in 1912 and at one time was reported to be in negotiation for the Booth-O'Brien properties and several other properties. During the year the Crown Reserve Mining Co. of Cobalt took an option on the Shepard mine and had it examined.

The investigation of the availability of magnometric work for preliminary testing of the nickel-bearing formation has been continued during the year with reported satisfactory results.

A notable contribution to the literature on the Sudbury district was published in 1913 by the Mines Branch at Ottawa. It is entitled "The Nickel Industry," and was written by Dr. A. P. Coleman.

During 1913 the Alexo mine, near Porcupine, Ontario, continued to produce a small tonnage of high-grade nickel ore (5%), which was shipped to the Mond smeltery at Comiston.

The market price of nickel during 1913 has remained nominally unchanged. The published quotations of 40 to 45c. per lb. apply to small lots of refined nickel. The great bulk of the nickel is sold on long contracts at prices around 30c. per lb. and sometimes lower. The monel metal (nickel 70% and copper 30%) sold under restrictions for from 18 to 22c. per lb.

An important new use of nickel, as nickel salts, has developed in connection with the extension of the application of the Edison storage battery.

## Quicksilver Mining in 1913

The U. S. production of quicksilver in 1913 was about 21,000 flasks, compared with 25,147 flasks in 1912. California in 1913 produced about 17,000 flasks against about 20,500 flasks in 1912. Texas, in 1913, produced 2500 flasks. A considerable production of quicksilver is now being made in Nevada, especially at Ione, Nye County, where the Mercury Mining Co. is becoming an

### WORLD'S PRODUCTION OF QUICKSILVER

(As reported by Metallgesellschaft, Frankfort a. M., in Metric Tons)	1910	1911	1912
United States	1910	1911	1912
(a) California.....	631	578	701
(b) Texas.....	115	116	154
(c) Other states.....	17	37	
Total for United States.....	763	731	855
Spain.....	1114	1486	1490
Austria-Hungary.....	694	793	783
Italy.....	894	931	986
Russia.....	4		
Mexico.....	150	150	150
Total.....	3600	4100	4300

important producer. The Nevada Cinnabar Co., of the same place did not produce in 1912, being engaged in the construction of a 50-ton Scott furnace.

### The Quicksilver Market

The primary market for quicksilver in this country is in San Francisco, where all the California production,

which constitutes practically all that of the United States, is sold. The market during 1913 was uncertain and unsettled, and prices were generally unsatisfactory to the producers. The highest price recorded there during the year, was \$41 per flask of 75 lb. for a comparatively small order; the lowest was \$36 per flask for one carload lot. For most of the year, the price fluctuated between \$36 and \$39. Much of the California quicksilver is sold in New York, where the quotation depends largely upon that in London. The prices named are for domestic orders; purchases for export bring a lower price dependent upon the rate of duty. There are four firms engaged in the selling of quicksilver in San Francisco, but one of these is more a buyer than a seller, being a wholesale drug house, dealing chiefly in retail lots.

The Eureka Co., which was for years the general selling agency for nearly all the California producers, was dissolved in March, 1911. Previous to that, there were several reports that the company would be investigated under the provision of the Sherman law, but no such investigation was actually undertaken, and the dissolution of the company prevented anything from being done.

The New York market showed few variations during the year. It opened at \$40 per flask, dropped a little in



March, but reacted to \$40 in May, and continued between \$39 and \$40 for nearly all the rest of the year, with the exception of a few weeks in October and November, when it dropped to \$38 and \$38.50. As in San Francisco,

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

Month	San Francisco			London
	New York	Domestic Sales	For Export	
January.....	\$40.00	\$40.00	\$37.50	£7.78
February.....	40.00	40.00	37.50	7.75
March.....	39.70	40.00	37.50	7.55
April.....	39.25	39.25	36.75	7.16
May.....	39.50	38.50	36.00	7.50
June.....	40.00	39.50	37.00	7.50
July.....	39.88	39.50	37.00	7.44
August.....	40.00	39.50	37.00	7.25
September.....	39.13	39.00	36.50	7.00
October.....	38.56	38.38	36.25	7.00
November.....	38.95	38.70	36.20	7.15
December.....	39.50	39.00	36.50	7.50
Year 1913.....	\$39.54	\$39.28	\$36.81	£7.38
Year 1912.....	42.46	42.05	39.55	8.14
Year 1911.....	46.54	46.01	43.62	.....
Year 1910.....	47.06	46.51	44.54	.....

nearly all the selling of quicksilver is in the hands of three wholesale houses.

In London, there is an official market price generally known as Rothschild's price, because that firm controls the output of the Almaden and Idria mines, the principal producers in Europe. This price, at the opening of the year was £7 15s., and it remained at that figure until March, when it was reduced to £7 10s., continuing thereat until the end of July, when £7 5s. was named. There was no further change until the latter part of November, when the price was advanced to £7 10s., which continued until the close of the year. The metal is generally sold by jobbers or "second hands," as they are called, at from 2s. 6d. to 5s. per flask below the nominal official price.

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## Quicksilver in California in 1913

BY LEWIS H. EDDY\*

The production of quicksilver in California in 1913 was approximately 17,000 flasks of 75 lb., a decrease from 1912 of about 3500 flasks. The New Idria mines in San Benito County produced about 9600 flasks. The New Guadalupe and the New Almaden in Santa Clara County produced an estimated total of 5500 flasks. The remaining 1900 flasks were produced chiefly in the following named counties, in the order of importance: San Luis Obispo, Fresno, Sonoma, Lake, Napa, San Benito, Trinity. The decrease in production is generally attributed to lack of finding new orebodies and to the low price of quicksilver which for the year averaged about \$38.50 per flask. Sales were made at \$38.25, and one sale was reported at \$36.

The New Idria in San Benito County is the only mine that kept its production near normal. The New Guadalupe in Santa Clara County decreased its production about 25%, and the new Almaden produced only about 60% of normal. The decline in production by New Guadalupe was due to the low price. The decline in the New Almaden production may be wholly attributed to the interruption of active operations of the Quicksilver Mining Co. at the close of the first half of the year. In June, Charles A. Nones, general manager of the company, was retired, and W. H. Landers, initially engaged as consulting mining engineer to investigate the

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condition of affairs, has been made general manager and is proceeding with the work of reorganization. Pending the complete reorganization of the company the extraction of ore in new ground has been suspended and only the ores produced by leasers from the old mines and the dumps have been treated. Two of the old furnaces have been operated at about half their capacity. It was expected in December that the reorganization would be completed and the normal productiveness of the mines and furnaces be resumed early in the year of 1914. There is an encouraging quantity of ore in sight in new ground and in the early part of the year the furnaces were producing about 200 flasks per month. During the last half of the year the production was reduced to 50 flasks per month.

Production in the other counties probably totaled less than in 1912. There was some activity among the smaller mines in these counties, but more in the line of preparation for the future than in actively increasing production. The Pacific mine in Fresno County increased its production, and is now believed to be permanently organized for active and profitable production. A new plant, consisting of a 30-ton furnace and six Knox-Osborne condensers, was installed, and sufficient ore reported to have been disclosed to insure permanency of operation. The Helen and the Wall Street mines in Lake County, and the Cloverdale and Culver-Baer mines in Sonoma County and the Altoona in Trinity County were producers of quicksilver.

In Napa County there was notable activity in improved methods adopted for the concentration of cinnabar ores. The methods so far applied are experimental to a large degree. The Oat Hill mine, which was formerly one of the largest producers in the state, has been equipped with a V-flume, Llewellyn concentrating table and one D-retort, for working the old dumps. At the Aetna mine a concentrating plant was installed, consisting of a crusher, six Gilpin County bumpers, a Llewellyn table and two D-retorts. Both mines produced quicksilver. The Knoxville mines also made a small amount.

The principal exploration of new ground in old mines was reported from the Utopia in Lake County, Great Eastern in Sonoma County, Oceanic and Klau in San Luis Obispo County. Prospecting progressed at the El Dinero in Guadalupe district in Santa Clara County, and in the same district a new prospect was reported on the Arnerich ranch. The Mt. Boardman in Stanislaus County and the Parkfield in Monterey County were also prospected.

Several attempts were made to reopen old mines; the failures were due chiefly to a lack of economical methods for treatment of low-grade ores. There is good reason to believe that concentration will solve the problem.

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## Quicksilver Producers of California

The following is a list of the quicksilver producers of California, with some notes respecting their metallurgical equipment:

### FRESNO COUNTY

**Mercy** mine, Little Panoche district; South Dos Palos—One 20-ton Scott furnace; 2 D-retorts, 1000 lb. each.

**Archer** mine, New Idria district; Coalinga—Five pipe retorts, 150 lb. per charge.

**Pacific** mine, Little Panoche district; South Dos Palos; Pacific Quicksilver Co. One 30-ton furnace; six condensers.

#### SAN BENITO COUNTY

**Hernandez** mine, Hernandez district; Hernandez—One 4-pipe retort.

**Florence Mac** mine, Hernandez district; One single pipe retort.

**Alpine** mine, New Idria district; Idria—Twenty 12 in. by 8 ft. retorts, total capacity four tons.

**Esmeralda** mine, New Idria—One rotary furnace.

**New Idria** mine, New Idria district; New Idria; Haas Bros., San Francisco—One 60-ton fine-ore Scott furnace; two 80-ton coarse-ore Newcomb furnaces.

#### SANTA CLARA COUNTY

**New Guadalupe** mine, New Guadalupe district; Los Gatos—Two 14-ton fine-ore furnaces; two 24-ton coarse-ore furnaces.

**New Almaden** mine, New Almaden district; New Almaden—Two fine-ore and two coarse-ore furnaces; total capacity, 160 tons.

#### LAKE COUNTY

**Wall Street** mine, Mayacmas district; W. H. Parsons, Middletown—One 3½-ton concentrating plant; one D-retort, 600 lb. per day.

**Helen** mine, Mayacmas district; Andrew Rocca, Middletown—One 50-ton Scott furnace, with condensers designed by owner.

#### NAPA COUNTY

**Aetna** mine, Mayacmas district; Lidell; Bror Soderhjelm (lessee)—One 25-ton plant consisting of one crusher, six Gilpin County bumpers and one Llewellyn table; D-retorts, 600 lb. each.

**Oat Hill** mine, Mayacmas district; Middletown; R. P. Newcomb (lessee)—Three 3-ton concentrating Llewellyn tables; one D-retort, 250 lb.

**Knoxville** mine, F. E. Johnson, Napa.

#### SONOMA COUNTY

**Culver-Baer** mine, Mayacmas district, Cloverdale; F. E. Johnson, Napa. One 10-ton coarse ore furnace; one 24-ton Scott fine-ore furnace.

**Cloverdale** mine, Mayacmas district, Cloverdale; Mr. Patton, Middletown, owner—One incline tile furnace.

#### OTHER COUNTIES

**St. John's Consolidated Quicksilver Mining Co.**, Vallejo, Solano Co.; operations temporarily suspended.

**Summit** mine, Table Mountain district; (Kings County)—One 10-ton Scott furnace.

**Parkfield** mines, Parkfield, Monterey County; Kings Quicksilver Mining Co.—One 10-ton Scott furnace.

**Altoona** mine, Altoona district; Castella, Trinity County—Altoona Quicksilver Mining Co., 333 Kearney St., San Francisco.

**Oceanic** mine, Cambria, San Luis Obispo County—One Scott fine-ore furnace; two D-retorts.

**Capitola** mine, San Luis Obispo County.

## Quicksilver in Texas in 1913

BY WILLIAM B. PHILLIPS\*

During 1913 only one mine and furnace in Texas was in operation, that of the Chisos Mining Co., Terlingua, Brewster County. This company has operated continuously for 7 years with a Scott furnace. For several years prior to 1906 it operated D-retorts on ore carrying not less than 5% of metal, so that it has had an operating history of more than 10 years. This property has given some of the best ore ever mined in the district, notably the rich ore that was found in the Eagle Ford shales down to about 60 ft. This was the ore that was sent to the D-retorts. Below this level and down to the deepest point reached, something below 500 ft., the mining operations were conducted to supply a Scott fur-

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nace with ore that would carry from 1 to 2% of quicksilver. For the two years following 1906, the ore carried about 2% of metal as it was sent to the furnace. From 1908 to the present, there has been a decrease in the content of metal, so that the average for the last two years has not exceeded 1.4%.

The deeper operations are now close to, if not within, the underlying Buda limestone, but there seems to be no serious diminution in the supply of ore or the quality. The output for 1913 is estimated at 2500 flasks. This company has one of the best furnaces and one of the best camps built in the district. The supply of wood for furnace purposes keeps even pace with the demand. Some of it has been secured in Mexico. Although this camp is within 10 miles of the border, there have been no serious disturbances and it has not been necessary to close down on account of the conditions in Mexico. The camp is about 90 miles from a railroad, but has telephone connections with Alpine and mail three times a week.

The other furnaces in the district have been idle during the year. Some steps have been taken looking toward reopening some of the other properties, but there is nothing definite to report. It is beyond question that some of these would yield ore of over 2% sufficient to supply a 10- to 15-ton furnace for a number of years. Some interest has recently been shown in the quicksilver deposits southwest of the Chisos Mountains, about 35 miles southeast of Terlingua. A good deal of prospecting work was done at this place several years ago and some excellent ore uncovered, but no regular operations were carried on.

Recent reports of the discovery of cinnabar in Jeff Davis and El Paso Counties, have not been confirmed. There is also an old story of the discovery of cinnabar in the Chinati Mountains, Presidio County, but nothing definite.

For the last five or six years the importance of the Texas quicksilver industry has depended on the production of one mine, and the average production has not exceeded 3000 flasks a year. One of the best quicksilver districts in the country continues to receive but scant attention. The distance from rail deters its development; certainly not the extent or quality of the ore.

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## Pyrites in 1913

The consumption of pyrites in the United States declined in 1913, owing to the fact that about 70 of the fertilizer works in the South closed their acid-making departments for several months. The domestic pyrites mines operated at about normal capacity where their output was contracted for in advance, but the sulphuric acid of the Tennessee smelters was offered at a sufficiently low price to induce a number of fertilizer works to shut down their pyrite burners, as they found it cheaper to buy acid than to make it.

The Arminius, Sulphur Mines and St. Lawrence properties were all operated in 1913. The most important domestic transaction was the purchase of the Boyd Smith mine in Virginia by the Boyd Smith Mines, Inc., in which Harrison Bros. & Co., of Philadelphia, are interested. The present shaft will be sunk to the 400-ft. level, and the mill will be enlarged. The company expects to begin shipping in February, 1914. Besides the St. Lawrence company's output in New York, a small production was made by Homer L. Drake, of Gouverneur, from a prop-



erty at Fowler, north of Silver Lake, in St. Lawrence County; the output was used by local pulp manufacturers. The Northern Pyrites Co.'s property, in Western Ontario, was operated in 1913 by the General Chemical Co., of New York.

The importation of pyrites from Spain and Portugal declined sharply in 1913, partly due to an oversupply in 1912 and to the reduction in price of acid made by the copper smelters in Tennessee.

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### Aluminum in 1913

The general trade conditions in the United States which have affected other industries naturally have had an effect on the aluminum market, consequently 1913 was marked by an extremely heavy consumption of metal in the first nine months, and a sudden falling off during the last quarter. The Aluminum Company of America, which is the principal aluminum producer in the United States, has not increased its metal-producing plants during the year. It has confined its improvements to increasing its equipment for the manufacture of finished aluminum for the trade.

During 1913, at the New Kensington, Penn., plant of this company, several old buildings were replaced with new ones and additions were made to those already built. A stoker-fired boiler plant has been placed in commission with an ultimate capacity of 8000 boiler horsepower. In line with the company's past policy regarding its employees, a welfare building was erected and is now in use where there is ample locker capacity for all workmen.

AVERAGE MONTHLY PRICE OF INGOT ALUMINUM  
(At New York, in cents per pound).

Year	1911	1912	1913	Year	1911	1912	1913
Jan.....	20.13	19.13	26.31	July.....	20.20	23.50	23.38
Feb.....	21.25	19.44	26.04	Aug.....	20.02	24.38	22.70
Mar.....	21.15	19.58	27.05	Sept.....	19.34	25.13	21.69
April.....	20.75	20.38	27.03	Oct.....	18.75	26.25	20.13
May.....	20.55	21.69	26.44	Nov.....	18.79	26.56	19.35
June.....	20.03	22.83	24.68	Dec.....	18.85	25.75	18.88
				Year.....	20.067	22.01	23.64

The bronze-powder department of the New Kensington works, previously established on a small scale, has just finished its first complete year of production on a large scale. The product is of the highest quality and is meeting with ready sale. In line with the manufacturing developments of the Aluminum Company of America, a large aluminum-foil rolling mill is nearing completion at its Arnold, Penn., plant. This mill will provide for production of foil which will be used for many purposes, such as wrapping candy and food products, and for other purposes of a similar nature. Foil as thin as 0.00025 in. will be rolled for special purposes.

### WORLD'S PRODUCTION OF ALUMINUM

(As reported by Metallgesellschaft, Frankfurt a. M., in Metric Tons).

	1910	1911	1912
United States.....	16,100	18,000	18,000
Canada.....	3,500	2,300	8,300
Germany.....			
Austria-Hungary }.....	8,000	8,000	12,000
Switzerland.....			
France.....	9,500	10,000	13,000
England.....	5,000	5,000	7,500
Italy.....	800	800	800
Norway.....	900	900	1,500
Total.....	43,800	45,000	61,100

The use of large welded aluminum tanks has grown in the various industries, such as in fat recovery, brewing, etc. There has been an increased demand for large steam-jacketed kettles in the canning industry, and especially in hotels and institutions of various kinds. This

department of the company was, during 1913, provided with a new shop thoroughly equipped for handling tanks and other apparatus built to order.

Few important new applications in the use of aluminum have been made during the past year. The growing demand and use has been along those lines already tried, as, for example, in the case of the cooking-utensil industry, brewing industry, electrical conductors and in the automobile industry, and for use as bronze paint.

While work on the Southern Aluminum Co.'s plant, at Whitney, N. C., has progressed steadily, it is understood that the erection of the main metallurgical buildings has not yet begun.

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### The Arsenic Market in 1913

The course of the arsenic market in 1913 plainly showed that the claims of those rampant bulls in 1906 that the demand for arsenic would exceed the supply of the world were as ill founded as the bearish news of two years ago, when it was stated that the enforced output of arsenic in this country would prevent the price ever again reaching a reasonable figure. The price tended to establish itself in equilibrium between the high figure of 12c. per lb. and the low figure of 1½c. per lb. in the previous few years.

The high price of 1913 was made in January, when arsenic sold at 4c. From that time until the last of August a slow and steady decline took place, each month seeing the market down about ¼c. per lb. until 3c. was reached. After August the market was extremely dull and steady at this figure. Demand was about sufficient to take up supplies as they came forward, and sellers did not, on the other hand, attempt to force the situation.

The sources of supply have apparently been gradually restricted. Canada which, in recent years, had increased its output of this commodity, did not offer it so freely. Shipments from Mexico were interfered with by the political conditions there and arrivals during the latter half of the year were practically nil; the Cia. Minera de Peñoles, the only producer of importance, was compelled to close its plant at Mapimí. Germany, England and Spain sent only moderate quantities to this country.

The situation seems therefore to be that the American manufacturers of arsenic have now this market in hand, and probably are determined to retain their position in it. The interior consumer was naturally supplied to greater advantage from the producers in Utah, Colorado and Montana, than he could be by the importers at the Eastern seaboard. A crude-arsenic plant was constructed in 1913 at the Great Falls smelting works of the Anaconda Copper Mining Co., the product being sent to its Washoe works for refining. The high purity and satisfactory quality of the American arsenic has, moreover, firmly established its reputation among users. Hence, it seems safe to say that unless an extraordinary demand should come from quarters of which the trade is not now cognizant, the arsenic of American manufacture will be amply able to take care of the consumption in this country, and perhaps eventually, instead of being an article of import, arsenic may prove to be one for which a market must be sought outside of our own boundaries. The production of white arsenic in the United States in 1913 was 2312 tons, as against 2926 tons in 1912 and 3081 tons in the preceding year.

# New Mine and Metallurgical Construction in 1913

**Stoss-Sheffield Steel & Iron Co.**, Birmingham, Ala., started work on new coal and ore washers to cost \$500,000.

**Alaska Juneau Gold Mining Co.**, Juneau, Alaska, is building stamp mills that will have an ultimate annual capacity of 4,380,000 tons, at an estimated cost of \$4,000,000.

**Alaska Gastineau Mining Co.**, subsidiary of Alaska Gold Mines Co., Sheep Creek, Alaska, is building a gold mill of 1,400,000 tons annual capacity.

**Arizona Copper Co.**, Clifton, Ariz., has completed a smelter of 200,000 tons annual capacity at an estimated cost of \$2,500,000.

**Bagdad Copper Co.**, Bouse, Ariz., started building a railroad to connect Seligman and Bouse to facilitate transporting product of its copper mines.

**Big Eye Mining & Milling Co.**, Castle Dome, Ariz., has completed a stamp-amalgamation mill of 1460 tons annual capacity at a cost of \$5000.

**Calmnet & Arizona Mining Co.**, Douglas, Ariz., has completed a copper smelter of 750,000 tons annual capacity at an estimated cost of \$2,000,000.

**Commonwealth Mining & Milling Co.**, Pearce, Ariz., has completed a stamp mill and cyanide plant of 120,000 tons annual capacity at a cost of \$320,000.

**Consolidated Arizona Smelting Co.**, Humboldt, Ariz., has spent \$50,000 for changes in the smelting works.

**Copper Queen Consolidated Mining Co.**, Bisbee, Ariz., started work on a new cement-copper plant for precipitation of copper from mine water.

**Inspiration Consolidated Copper Co.**, Globe, Ariz., is building a mill of 2,250,000 tons annual capacity. A test mill of 600 tons daily capacity was completed late in the year.

**International Smelting & Refining Co.**, 42 Broadway, New York, broke ground for a smelting plant of 200,000 tons annual capacity in the Globe-Miami district, Arizona.

**Ray Consolidated Copper Co.**, Hayden, Ariz., completed its mill of 3,000,000 tons annual capacity.

**Relief Gold Mining Co.**, Glendale, Ariz., completed a cyanide plant of 15,000 tons annual capacity at a cost of \$3500.

**United Verde Copper Co.**, Clarkdale, Ariz., has nearly completed a copper smelter of 750,000 tons annual capacity at a cost of \$6,000,000.

**Wakota Development Co.**, Congress, Ariz., built a 5-stamp mill on the Grasshopper property.

**Y. P. Mining Co.**, Prescott, Ariz., reconstructed the old plant of 10 stamps at the Cash mine, adding five Wilfley tables and a Monell slimer for treating 20,000 tons of dump ore.

**American Potash Inc.**, Los Angeles, Calif., completed the first unit of a plant for reducing kelp to potash and other byproducts at Long Beach. Daily capacity is 500 tons of kelp per day.

**Bee Hive Mining Co.**, Humbug Creek, Eureka, Calif., built a 10-stamp mill, at a cost of \$12,000.

**Bishop Creek Milling Co.**, Bishop, Calif., built a 100-ton cyanide plant to supplement a 10-stamp mill, of an annual capacity 28,800 tons, at an estimated cost \$23,000.

**Bonanza**, Trinity Center, Calif., rebuilt the 20-stamp mill destroyed by snowslides last winter.

**Brunswick Consolidated Gold Mining Co.**, Grass Valley, Calif., built a mill of 20,000 tons annual capacity at a cost of \$100,000.

**Calaveras Copper Co.**, Copperopolis, Calif., completed a mill and smelter of 180,000 and 45,000 tons annual capacity respectively at a cost of about \$400,000.

**China Hill Mining Co.**, El Dorado, Calif., completed a 5-stamp mill.

**Field Process Smelter Fumes Co.**, Redding, Calif., built a trial plant of 7500 tons annual capacity at a cost of \$12,000.

**Gold Hill Mining Co.**, Lewiston, Calif., built a 5-stamp mill.

**Golden Center of Grass Valley Mining Co.**, Grass Valley, Calif., started building a 10-stamp mill.

**Kate Hardy Mines Co.**, Forest, Calif., built a gold mill at a cost of \$30,000.

**Madera Enterprise Mines & Land Co.**, Ahwahnee, Calif., built a 10-stamp mill, costing \$15,000.

**Midas Mine**, Harrison Gulch, Calif., started building a cyanide plant of 30,000 tons annual capacity for the treatment of tailings.

**Mountain Copper Co., Ltd.**, Keswick, Calif., planned a mill of 60,000 tons annual capacity to be started in 1914.

**North Star Mines Co.**, Grass Valley, Calif., built an experimental cyanide plant of 12,000 tons annual capacity at the Champion mine.

**Oro Water, Light & Power Co.**, Oroville, Calif., plans building electrically operated dredges for work in Humboldt and Shasta Counties.

**Osgood Mine**, Yreka, Calif., built a 5-stamp mill.

**Skidoo Mines Co.**, Skidoo, Calif., completed a 10-stamp mill replacing the 15-stamp mill destroyed by fire in June.

**Tightner Mines Co.**, Alleghany, Calif., built a ten-stamp mill of 12,000 tons annual capacity at a cost of \$25,000.

**Big Five Mining & Tunnel Co.**, Idaho Springs, Colo., built an Edison mill of 75,000 tons annual capacity at the portal of the Central tunnel.

**Colorado Gold Mining & Development Co.**, Altman, Colo., started building a mill on the Free Coinage dumps, the crushing capacity to be 100 tons per 8 hr., the agitating and concentrating capacity, 50 tons per 24 hr., to be increased later, or an annual concentrating capacity of 15,000 tons.

**El Oro Mining & Milling Co.**, Elkton, Colo., started building a mill.

**Hoosac Tunnel & Mining Co.**, Idaho Springs, Colo., started building an amalgamation and concentration mill of 15,000 tons annual capacity.

**Junta Consolidated Gold Mining Co.**, Telluride, Colo., built a cyanide plant of 100,000 tons annual capacity and tramway at a cost of \$140,000.

**Little Giant Gold Mining & Milling Co.**, Lawson, Colo., built a concentrator of a total annual capacity of 36,500 tons, at an estimated cost of \$25,000.

**London Mine**, Central City, Colo., completed a mill at Twelve Mile.

**Mt. Champion Mining Co.**, Leadville, Colo., enlarged its concentrator to 30,000 tons annual capacity.

**North American Smelter & Mines Co.**, Denver, Colo., plans to build a mill near its smelting plant at Golden, for treating ore from Clear Creek, Gilpin and Boulder County mines.

**Ohio Group of Mines**, Breckenridge, Colo., built a mill for concentrating carbonate ores.

**Otto Mears and A. R. Wilfley**, Silverton, Colo., started building a mill to treat the tailings dump of the old Silver Lake mill, of 150,000 tons annual capacity.

**Sutton, Steele & Steele**, Denver, Colo., built a concentrator of 30,000 tons annual capacity at a cost of \$100,000.

**Union Leasing Co.**, Cripple Creek, Colo., built a cyanide plant of 30,000 tons annual capacity at a cost of \$30,000.

**Lakeland Phosphate Co.**, Lakeland, Fla., built a phosphate mining plant of 100,000 tons annual capacity.

**Consolidated Interstate-Callahan Mining Co.**, Wallace, Idaho, is building a lead and zinc concentrator of 55,000 tons annual capacity at a cost of \$76,000 for mill, tramways and flumes.

**Coöperative Mining & Development Co.**, Reynolds, Idaho, started to build a mill of 30,000 tons annual capacity.

**Diamond Hitch Mine**, Orogrande, Idaho, completed plans for a stamp mill and cyanide plant.

**Flint Mines, Ltd.**, Flint, Idaho, built a 20-stamp mill.

**H. E. M.**, Wallace, Idaho, started building a mill of 30,000 tons annual capacity.

**Idaho Continental Co.**, Porthill, Idaho, is building a mill of 30,000 tons annual capacity.

**Idora Hill Mining Co.**, Wallace, Idaho, started work on a concentrator of 15,000 tons annual capacity.

**Marshall Lake Mining Co.**, Lewiston, Idaho, started work on a mill to cost \$15,000.

**National Copper Mining Co.**, Wallace, Idaho, started work on a concentrator of 30,000 tons annual capacity.

**Red Bird Smelting Co.**, Clayton, Idaho, built a smelting plant of 30,000 tons annual capacity.

**White Flr Mine**, Elk City, Idaho, started work on a mill.



**Yellow Jacket Mine**, Hailey, Idaho, completed a cyanide plant of 15,000 tons annual capacity.

**International Lead Refining Co.**, East Chicago, Ind., built a lead refinery.

**John Hall Co.**, Lawton, Kan., completed a concentrator.

**Lawton Mining Co.**, Lawton, Kan., built a concentrator.

**Onkes & Church**, Lawton, Kan., started work on a concentrator.

**Ameriann Mine**, Dierie, Mich., built a concentrator for iron ore of 150,000 tons annual capacity.

**Calumet & Hecla Mining Co.**, Calumet, Mich., completed a regrinding plant at Lake Linden, and built a new electrolytic plant at Hubbell.

**Tumrueck Mining Co.**, Calumet, Mich., remodeled its mill.

**Cleveland-Cliffs Iron Co.**, Nashwauk, Minn., is building a concentrator for sandy ores, of 200,000 tons of concentrate annual capacity.

**Minnesota Steel Co.**, Superior, Minn., continued work on its steel plant which has cost \$7,000,000 to date.

**Deil Development Co.**, Aitkin, Minn., built a new Jones-furnace plant for the treatment of manganiferous iron ore.

**Ameriann Zinc, Lead & Smelting Co.**, Webb City, Mo., built a new mill.

**Athletic Mining Co.**, Webb City, Mo., rebuilt the concentrator destroyed by fire Sept. 1.

**Bertha A. Mining Co.**, Webb City, Mo., enlarged its concentrator to treat 240,000 to 300,000 tons of ore per year, expanding about \$25,000.

**Cortland Lead & Zinc Co.**, Joplin, Mo., completed a concentrator of 120,000 tons annual capacity.

**Dexter & Co.**, Joplin, Mo., built a concentrator of 60,000 tons annual capacity.

**Dunglode & Co.**, Thoms Station, Mo., built a concentrator.

**Gerster & Ruines**, Joplin, Mo., completed a mill on the Red Lion lease of 60,000 tons annual capacity.

**Lost Trail Mining Co.**, Joplin, Mo., built a concentrator of 75,000 tons annual capacity at a cost of \$25,000.

**Lulu V.**, Spring City, Mo., completed a concentrator.

**Martha Bull Mining Co.**, Joplin, Mo., built a concentrator of 60,000 tons annual capacity on the land of the Liberty Mining Co. in the Chitwood district.

**Whirlwind Mining Co.**, Joplin, Mo., started work on a concentrator.

**Anneconda Copper Mining Co.**, Butte, Mont., started rebuilding the Washoe mill, and adding thereto a slime concentrator of 750,000 tons annual capacity at a cost of \$650,000. Work was started in rebuilding the smelting works at Great Falls, which will cost \$2,500,000.

**Harnes-King Development Co.**, Kendall, Mont., installed nine leaching tanks of 125 tons capacity each, at a cost of \$18,000.

**Boston & Corbin Copper & Silver Mining Co.**, Corbin, Mont., completed a concentrator of 75,000 tons annual capacity which together with the headframe cost about \$98,000.

**Bronzway Gold Mining Co.**, Silver Star, Mont., plans building a stamp mill and cyanide plant of 30,000 tons annual capacity.

**Bullwhacker Copper Co.**, Butte, Mont., built a copper-leaching plant of 30,000 tons annual capacity at a cost of \$100,000.

**Butte Central Copper Co.**, Butte, Mont., completed a concentrator for the treatment of silver-lead-gold ore of 45,000 tons annual capacity at the Ophir mine.

**Butte-Duluth Mining Co.**, Butte, Mont., completed a leaching plant of 60,000 tons annual capacity.

**Butte & Superior Copper Co.**, Butte, Mont., built a concentrator of 200,000 tons annual capacity.

**Eim Orin**, Butte, Mont., began work on a zinc-ore concentrator of 100,000 tons annual capacity.

**Hazel T. Mine**, Libby, Mont., started work on a concentrator of 30,000 tons annual capacity.

**Hidden Lake Mining Co.**, Cable, Mont., planned a cyanide plant of 15,000 tons annual capacity.

**King & Queen Mine**, Carter, Mont., built a mill unit for the treatment of copper ore of 12,000 tons annual capacity.

**Timber Butte Milling Co.**, Butte, Mont., started work on a zinc concentrator of 150,000 tons annual capacity.

**Halbach Smelting & Refining Co.**, Newark, N. J., began construction of a new lead refinery of 50,000 tons annual capacity.

**Aurora Consolidated Mines Co.**, Aurora, Nev., built a 40-stamp mill of 200,000 tons annual capacity at a cost of \$500,000.

**Bonita Mining Co.**, Bonita Mining District, White Pine County, Nev., built an experimental mill, which will be probably enlarged, of 2160 tons annual capacity, at a cost of \$5000.

**Buckhorn Mines Co.**, Buckhorn, Nev., built a gold mill of 100,000 tons annual capacity.

**Howard Mines Co.**, Goodsprings, Nev., completed concentrator of 15,000 tons annual capacity.

**Kinkead Milling Co.**, Virginia City, Nev., built a mill of 15,000 tons annual capacity to treat low-grade surface ore.

**Longfellow Gold Mining & Milling Co.**, Carman Heights, Nev., completed a mill of 15,000 tons annual capacity at a cost of \$15,000.

**Nevada Cinnabar Co.**, Ione, Nevada, installed mercury furnace and condensers of 15,000 tons annual capacity, at an estimated cost of \$90,000.

**Ophir**, Virginia City, Nev., built a mill and cyanide plant of 22,500 tons annual capacity.

**Pine Grove Mining Co.**, Pine Grove, Nev., built a 10-stamp mill.

**Pioneer Consolidated Mines Co.**, Pioneer, Nev., recently built a 10-stamp mill and planned a cyanide plant.

**Wicks Mine**, Hillsboro, N. M., made plans for a mill.

**Maxwell Land Grant Co.**, Elizabethtown, N. M., plans adding 10 more stamps to the 10-stamp mill.

**Ozark Smelting & Mining Co.**, Magdalena, N. M., built a zinc-ore concentrator of 45,000 tons annual capacity at an estimated cost of \$200,000.

**Howie Mine**, Waxhaw, N. C., rebuilt the mill and added cyanide equipment.

**Rich-Cog Mining Co.**, Eldorado, N. C., built stamp mill and installed concentrators of 15,000 tons annual capacity at an estimated cost of \$25,000.

**Uwarra Mining Co.**, Candor, N. C., built a stamp mill and cyanide plant of 15,000 tons annual capacity at an estimated cost of \$50,500.

**Carson-Dodson Mining Co.**, North Miami, Okla., built a concentrator of 100,000 tons annual capacity at an estimated cost of \$35,000.

**Gray Top Mining Co.**, Miami, Okla., built a mill of 150,000 tons annual capacity.

**Lost Trail Mining Co.**, Miami, Okla., built a mill.

**McConnell**, Miami, Okla., installed zinc-ore concentrators on his property, of a total annual capacity of 10,000 tons at an estimated cost of \$50,000.

**Prairie Mining Co.**, North Miami, Okla., built a concentrator of 62,400 tons annual capacity, at a cost of \$12,000. The mill was completed in 1912.

**Quapaw Mining Co.**, Miami, Okla., plans building a mill.

**Tulsa Spelter Co.**, Sand Springs, Okla., began building zinc smelter, to cost \$200,000.

**Black Eagle**, Mehama, Ore., built a small concentrator for treatment of copper ores.

**Nellie Wright**, Gold Hill, Ore., plans a new mill.

**Oriole Mining Co.**, Galice, Ore., plans building a 10-stamp mill.

**Ameriann Zinc & Chemical Co.**, 52 Broadway, New York, started work on a zinc reduction plant at Pittsburgh of 120,000 tons annual capacity.

**Aluminum Co. of America**, Kensington, Penn., started work on a new reduction plant.

**Bismarck Mining Co.**, Flatiron, S. D., completed a cyanide plant of 90,000 tons annual capacity.

**Otho Development & Power Co.**, Keystone, S. D., built an amalgamating and concentrating plant of 40,000 tons annual capacity, at an estimated cost of \$100,000.

**Rattlesnake Jack Co.**, Galena, S. D., started work on a cyanide plant of 15,000 tons annual capacity.

**Ameriann Zinc Co. of Tennessee**, Mascot, Tenn., built a zinc mill of 300,000-ton annual capacity at an estimated cost of \$100,000.

**Griggs, Castleton & Carter**, Eureka, Utah, built a cyanide plant for treating tailings, of 22,000 tons annual capacity at a cost of \$6500.

**John Tifford**, Garrison, Utah, started to build a small experimental plant for the treatment of tungsten ore at his property, 35 miles east of Osceola, Nev., in the Bonita mining district.

**May Day**, Eureka, Utah, completed a mill for the treatment of the accumulation of dump ore, of 12,000 tons annual capacity.

**Ophir Hill Mining Co.**, Ophir, Utah, enlarged its mill to 90,000 tons annual capacity.

**Aurora Copper Mining Co.**, Chewelah, Wash., built a concentrator of 30,000 tons annual capacity to cost \$100,000.

**Consolidated Gold Mines & Refining Co.**, Blewett, Wash., built a 6-stamp mill with concentrators and cyanide plant at the Golden Eagle mine.

**El Oro Mill Co.**, Republic, Wash., built a mill of 60,000 tons annual capacity at an estimated cost of \$60,000.

**Lead & Zinc Co.**, Metaline Falls, Wash., started a concentrator of 75,000 tons annual capacity, at an estimated cost of \$150,000.

**Orlolo**, Metaline, Wash., built a concentrator of 7500 tons annual capacity.

**Vinegar Hill Zinc Co.**, Benton and Elmo, Wis., built two mills of an aggregate annual capacity of 60,000 tons. The Martin plant built at Benton, Wis., cost \$32,000 and the Masbruch plant built at Elmo, Wis., cost \$25,000.

**Britannia Mining & Smelting Co.**, Britannia Beach, B. C., built a concentrator of 600,000 tons annual capacity at a cost of \$310,000.

**British Columbia Copper Co. Ltd.**, Boundary Falls, B. C., built an experimental concentrator of 18,000 tons annual capacity at an estimated cost of \$25,000.

**Granby Consolidated Mining, Smelting & Power Co.**, Anyox, B. C., nearly completed the Hidden Creek copper smelting works of 600,000 tons annual capacity.

**Dome Lake, Mining & Milling Co.**, South Porcupine, Ont., completed a 10-stamp mill.

**Dome Mines, Ltd.**, South Porcupine, Ont., completed a 40-ton stamp mill and cyanide plant.

**Hollinger Gold Mines, Ltd.**, Timmons, Ont., built a mill extension of 72,000 tons annual capacity.

**Lucky Jim Zinc Mines, Ltd.**, Kaslo, B. C., began building a concentrator of 30,000 tons annual capacity.

**McEanney**, Cobalt, Ont., completed a 5-stamp mill, and plans adding 20 more stamps and building a cyanide plant.

**McIntyre Porcupine Mines, Ltd.**, Schumacher, Ont., completed a 10-stamp mill, of 15,000 tons annual capacity.

**Nipissing Mines Co.**, Cobalt, Ont., completed its low-grade mill of 60,000 tons annual capacity.

**Northern Customs Concentrator**, Cobalt, Ont., nearly completed a mill of 60,000 tons annual capacity at a cost of \$150,000.

**Pearl Lake Gold Mines, Ltd.**, Schumacher built a 30-stamp mill.

**Pike Lake Gold Mines, Ltd.**, Swastika, Ont., started building a mill.

**Porcupine Gold Mines Co.**, Schumacher, Ont., completed a mill of 30,000 tons annual capacity.

**Swastika Mining Co.**, Swastika, Ont., completed a mill of 7500 tons annual capacity.

**Three Nations**, Porcupine, Ont., built a 10-stamp mill.

**Amajac Mines Co.**, Hostotipaquillo, Mexico, is building a cyanide plant of 15,000 tons annual capacity.

**Consolidated Mining Co.**, Hostotipaquillo, Mexico, drew up plans for a mill.

**Cinco Minas Co.**, Hostotipaquillo, Mexico, is building a stamp mill and cyanide plant of 75,000 tons annual capacity.

**Magistral-Ameca Copper Co.**, Hostotipaquillo, Mexico, is rebuilding its mill.

**Nacozari Consolidated Copper Co.**, Nacozari, Son., Mexico, built a concentrator, of 45,000 tons annual capacity, the machinery for which costing \$9000, was brought from Joplin, Mo.

**San Gregorio Mining Co.**, a subsidiary of the Dwight Furness Co., of Guanajuato, Mexico, was to have been equipped with a reduction plant of 30,000 tons annual capacity.

**Teztlitlan Copper Co.**, Aire Libre, Puebla, Mexico, started building a concentrator of 150,000 tons annual capacity.

**Mount Morgan Gold Mining Co.**, Mount Morgan, Queensland, Australia, started reconstructing the blast furnaces for pyrite smelting, and building a concentrator of 150,000 tons annual capacity.

**The Sale of a Mining Property in Mexico** last year is a noteworthy event. It is interesting to record that Chas. Butters & Co., Ltd., has sold its mine and mill at Minas Prietas, Sonora, to the Mines Co. of America.

## Important Books of 1913

Among the more important contributions in book form to mining and metallurgical literature in 1913 were the following:

Bansen, H., and Telwes, K. "Die Schachtförderung." Vol. IV of series on "Die Bergwerksmaschinen." (333 pp., 14 marks).

Bernewitz, M. W. von. "Cyanide Practice, 1910-13." (732 pp., \$3).

Beyschlag, F., Krusch, P., and Vogt, J. H. L. "Die Lagerstätten der Nutzbaren Mineralien und Gesteine nach Form, Inhalt und Entstehung." Vol. II, in two parts. (727 pp., 22.80 marks).

Blackwelder, Eliot. "Geology of the United States of North America." Vol. VIII, Part 2, of the "Handbuch der Regionalen Geologie." (258 pp., 11 marks).

Brunswig, H. "Explosives: A Synoptic and Critical Treatment of the Literature of the Subject as Gathered from Various Sources." Translated by Charles E. Munroe and Alton L. Kibler. (350 pp.).

Charlton, W. H. "American Mine Accounting." (367 pp., \$5).

Classen, Alexander. "Quantitative Analysis by Electrolysis." Translated from the Fifth German edition by William T. Hall. (308 pp., \$2.50).

Cole, Grenville, A. J. "Outlines of Mineralogy for Geological Students." (339 pp., \$1.60).

Coleman, A. P. "The Nickel Industry with Special Reference to the Sudbury Region, Ontario." Canada Department of Mines, Mines Branch. (206 pp.).

Dichmann, Carl. "The Basic Openhearth Steel Process." Translated and edited by Alleyne Reynolds. (334 pp., \$3.50).

Durham, E. B. "Mine Surveying." (391 pp., \$3.50)

Earl, T. C. "Gold Dredging." (208 pp., 20s.).

Emmons, S. F. "Ore Deposits." Compilation of papers in Transactions of American Institute of Mining Engineers. (954 pp., \$5).

Emmons, William Harvey. "The Enrichment of Sulphide Ores." Bull. 529, U. S. Geological Survey. (252 pp.).

Finlay, George Irving. "Introduction to the Study of Igneous Rocks." (228 pp., \$2).

Hatch, F. H., and Rastall, R. H. "The Petrology of the Sedimentary Rocks." Vol. II of "Textbook of Petrology." With an appendix on the Systematic Examination of Loose Detrital Sediments, by T. Crook. (425 pp., 7s. 6d.).

Hobson, J. A. "Gold, Prices and Wages." (181 pp., \$1.25)

Hofman, H. O. "General Metallurgy." (909 pp., \$6).

Hoover, Theodore J. "Concentrating Ores by Flotation." (221 pp., \$3.75).

Iddings, J. P. "Igneous Rocks. Composition, Texture and Classification, Description and Occurrence." Vol. II (685 pp., \$6).

Janin, Charles. "Mining Engineers' Examination and Report Book." (94 pp., \$2.50).

Kühn, Emil. "Die Chemischen Vorgänge bei der Cyanlaugung von Silbererzen." (198 pp., 6 marks).

Leith, C. K. "Structural Geology." (169 pp., \$1.50).

Lewis, J. Volney. "Determinative Mineralogy." (151 pp., \$1.50).

Liebig, R. G. Max. "Zink und Cadmium." (598 pp., 30 marks).

Lindgren, Waldemar. "Mineral Deposits." (883 pp., \$5).

Lord, N. W., and Demorest, D. J. "Metallurgical Analysis." (334 pp., \$2.50).

Lunge, George. "The Manufacture of Sulphuric Acid and Alkali with the Collateral Branches." Vol. I, Parts 1, 2 and 3. Fourth edition. (1658 pp., \$18).

McCulloch, George, and Futers, T. C. "Winding Engines and Winding Appliances." (452 pp., \$6).

Patchell, W. H. "Application of Electric Power to Mines and Heavy Industries." (333 pp., \$4).

Redwood, B. "Petroleum." Third edition, revised and enlarged. (Three volumes, 1214 pp., \$15).

Richards, Frank. "Compressed-Air Practice." (326 pp., \$3).

Richardson, Charles H. "Economic Geology." (320 pp., \$2.50).

Rodenhauser, W., and Schoenawa, I. "Electric Furnaces in the Iron and Steel Industry." From advance sheets of the second German edition. (419 pp.)

Singewald, Joseph T., Jr. "The Titaniferous Iron Ores in the United States: Their Composition and Economic Value." Bull. 64, U. S. Bureau of Mines. (154 pp.).

Smith, E. A. "The Sampling and Assay of the Precious Metals: Comprising Gold, Silver, Platinum, and the Platinum Group Metals in Ores, Bullion and Products." (460 pp., \$4.50).

Somermeyer, E. E. "Coal: Its Composition, Analysis, Utilization and Valuation." (175 pp., \$2).

Telwes, Karl, and Förster, E. "Die Schachtfördermaschinen." Vol. III of "Die Bergwerksmaschinen," edited by Hans Bansen. (431 pp., 16 marks).

Thorkelson, H. J. "Air Compression and Transmission." (207 pp., \$2)

Wilson, Alfred W. G. "Pyrites in Canada: Its Occurrence, Exploitation, Dressing and Uses." Canada Department of Mines, Mines Branch. (197 pp.).

"The Coal Resources of the World." An inquiry made upon the initiative of the Executive Committee of the Twelfth International Geological Congress, 1913, with the assistance of geological surveys and mining geologists of different countries. In three volumes accompanied by atlas. (1266 pp., \$25).