

THE ENGINEERING AND MINING JOURNAL
INDEX

**THE ENGINEERING AND
MINING JOURNAL**

VOLUME LXXXIII.

JANUARY TO JUNE

1907

HILL PUBLISHING COMPANY,

505 Pearl Street, NEW YORK



The Engineering and Mining Journal

VOL. LXXXIII.

NEW YORK, JANUARY 5, 1907.

NO. 1.

MINERAL AND METAL PRODUCTION IN 1906

Statistics of the Output and Commercial Movement—Market Conditions—Mining and Metallurgy

In the following table we summarize the production of minerals and metals in the United States in 1906 so far as it has been possible to collect the statistics at so early a date. The figures for copper, lead and spelter are based on reports received directly from the producers, who have communicated their actual output during

Even under these conditions, it is impossible to insure accuracy. Among other difficulties, there are always likely to be duplications or omissions in the reports of the producers, which can be corrected only by careful investigation involving considerable time. However, we are confident that the statistics which we are able

cent. of the actual, submitted six months or a year later.

It will be observed that there are differences between the statistics given by the various contributors to this number and our own statistics. This is because their contributions were necessarily written and put into type before our statistics

MINERAL AND METAL PRODUCTION OF THE UNITED STATES.

PRODUCT.	CUSTOMARY MEASURE.	1905.			1906.			CHANGES IN QUANTITY.
		QUANTITY.	VALUE.		QUANTITY.	VALUE.		
			TOTAL.	PER UNIT.		TOTAL.	PER UNIT.	
NON-METALLIC:								
Coal, bituminous	Short ton.	310,285,015	\$353,724,917	\$ 1.14	335,738,059	\$409,455,752	\$1 22	I. 25,453,044
Coal, anthracite	Short ton.	78,731,523	178,788,244	2.27	71,018,433	169,580,506	2.39	D. 7,713,090
Garnet	Short ton.	3,694	114,625	31.03	5,442	187,095	34.40	I. 1,748
Graphite, crystalline	Pound.	4,260,656	170,426	0.04	4,079,333	131,866	0.032	D. 181,323
Iron ore	Long ton.	44,578,456	94,768,122	2.13	49,670,000	103,570,000	2.08	I. 5,091,544
Limestone flux	Long ton.	14,098,000	6,739,200	0.56	14,228,500	9,390,810	0.66	I. 130,500
Petroleum	Barrel.	139,728,839	118,769,513	0.85	131,061,505	96,593,274	0.74	D. 8,667,334
Phosphate rock	Long ton.	1,933,286	9,713,296	5.02	2,102,067	10,552,376 (k)	5.02	I. 168,781
Pyrites	Long ton.	200,280	651,796	3.25	204,896	77,600	3.31	I. 4,616
MANUFACTURED:								
Alundum	Pound.	3,612,000	252,840	0.07	4,331,233	303,186	0.07	I. 719,233
Arsenic, white	Short ton.	773	50,225	64.97	831 5	83,150	100.00	I. 58.5
Bromine	Pound.	899,434	139,432	0.16	1,250,000	168,750	0.035	I. 350,566
Coke	Short ton.	28,404,112	72,284,336	2.54	32,568,926	99,960,968	3.06	I. 4,164,814
Copper sulphate	Pound.	52,278,996	2,352,555	0.045	48,534,129	3,009,106	0.062	D. 3,744,867
Copperas	Short ton.	21,103	147,721	7.00	18,546	129,822	7.00	D. 2,557
Crushed steel	Pound.	812,000	56,840	0.07	837,000	58,590	0.07	I. 25,000
Graphite, artificial	Pound.	4,595,500	313,979	0.068	4,868,000	312,764	0.064	I. 272,500
Lead, sublimed white	Short ton.	6,977	697,700	100.00	8,000	8,000,000	100.00	I. 1,023
Zinc, oxide	Short ton.	65,403	5,232,240	80.00	68,549	5,483,920	80.00	I. 3,146
Zinc-lead, white	Short ton.	7,200	540,000	75.00	5,749	488,665	85.00	D. 1,451
METALLIC:								
Aluminum	Pound.	11,350,000	3,632,000	0.32	14,350,000	5,166,000	0.36	I. 3,000,000
Copper	Pound.	871,634,245	136,837,860	0.157	915,000,000	178,699,500	0.1953	I. 43,365,755
Gold	Oz. fine.	4,265,742	88,180,700	20.67	4,702,235	97,155,201	20.67	I. 436,493
Iron, pig	Long ton.	22,702,397	377,540,862	16.63	25,521,911	490,275,910	19.21	I. 2,819,514
Lead	Short ton.	319,744	30,133,490	94.18	364,336	38,962,092	106.94	I. 44,592
Quicksilver	Flasks.	30,650	1,189,220	38.80	27,276	1,063,764	39.00	D. 3,374
Silver	Oz. fine.	56,101,600	35,373,181	0.63052	57,358,267	38,301,160	0.66791	I. 1,256,667
Zinc	Short ton.	201,748	23,733,635	112.68	225,395	27,939,964	123.96	I. 23,647

(k) Taken same as for 1905 in absence of reliable statistics.

the first 11 months of the year, together with their estimates of probable production in December; in many cases the estimates are for only the last few days of December. The other statistics are based on the reports of producers, State mine inspectors, and special correspondents.

to present at this early date are close approximations to the truth, and we believe that statistics giving the production within 5 per cent. of the actual, presented five days after the close of the year, are more valuable to the industry than statistics that are precise, or within one per

were available, and consequently the statistics of our contributors are generally estimates. This explanation will account for discrepancies, though the reason will be so obvious to our readers that an explanation is hardly required.

THE ENGINEERING AND MINING JOURNAL

Issued Weekly by the
Hill Publishing Company
505 Pearl Street, New York.

London Office: 20 Bucklersbury, London E. C., Eng.
CABLE ADDRESS "ENGINJOUR, N. Y."

Subscription, payable in advance, \$5.00 a year of 52 numbers, including postage in the United States, Canada, Mexico, Cuba, Porto Rico, Hawaii or the Philippines.

To Foreign Countries, including postage, \$8.00 or its equivalent, 33 shillings; 33 marks; or 40 francs.

Notice to discontinue should be written to the New York office in every instance.

Advertising copy should reach New York office by Thursday, a week before date of issue.

Copies are on sale at the news-stands of the following hotels:—Waldorf-Astoria, New York; Brown Palace, Denver; and the leading hotels in the principal cities.

Entered at New York Post Office as mail matter of the second class.

During 1906 THE ENGINEERING AND MINING JOURNAL printed and circulated 462,500 copies, an average of 8896 per issue. Of this issue 12,500 copies are printed. None sent regularly free. No back numbers beyond current year.

Contents	PAGE
Editorials:	
Mineral and Metal Production in 1906...	1
Graphite	2
The Precious Metals:	
Gold, Silver	3
Copper Production and Prospects.....	5
Lead and Spelter Production:	
The Southeast Missouri Lead District.	
<i>H. A. Wheeler</i> 5	5
Lead Pigments	9
The New York Lead Market in 1906...	9
Spelter Production in 1906.....	10
Zinc Mining in Wisconsin.	
<i>E. W. Moore</i> 11	11
The Joplin District in 1906.	
<i>Jesse A. Zook</i> 12	12
Zinc and Lead Mining in Virginia	
<i>J. A. Van Mater</i> ..13	13
Production of Other Metals and Minerals:	
Aluminum	14
Antimony	14
Tin	14
Zinc Oxide	15
Quicksilver	15
Sulphur	16
Magnesite	16
Phosphate Rock.....	16
Metallurgical Progress in 1906:	
Progress in Gold-ore Treatment During 1906	17
<i>Alfred James</i> 17	17
The Metallurgy of Lead in 1906	
<i>W. R. Ingalls</i> 20	20
Progress in the Metallurgy of Zinc.	
<i>W. R. Ingalls</i> 20	20
Gold Dredging in 1906.	
<i>J. P. Hutchins</i> 21	21
Progress in the Metallurgy of Copper..	23
Bismuth	23
Review of Mining in the United States....	24
Review of Mining in Foreign Countries in 1906	38
Production of Petroleum	48
Coal Mining in the United States.....	52
Pig Iron and Iron Ore.....	60
Mining Index	70

Graphite

The three grades of graphite produced in the United States are crystalline, amorphous, and artificial. The production of graphite for the past three years is as follows, in tons of 2000 pounds:

	1904.	1905.	1906.
Crystalline.....	2,179	2,130	2,040
Amorphous.....	19,115	21,953	(c)20,000
Artificial.....	1,624	2,298	2,434
(c) Estimated.			

The greatest part of the crystalline graphite comes from the Adirondack region of New York, but Pennsylvania is also a producer. Amorphous carbon occurs in Rhode Island, Michigan and Wisconsin, and to a smaller extent in Colorado, Ohio, North Carolina and Georgia. Of the last four States named, Colorado is the only one that has reported any production for 1906.

CRYSTALLINE

In New York, the Dixon Crucible Company is much the largest producer, its output being a very pure, flake, crystalline graphite, particularly suited to lubrication. Other companies operating here, with recently completed mills, are the Adirondack Graphite Company, the Champlain Graphite Company, and the Silver Leaf Graphite Company, all of Whitehall, N. Y. These last companies spent the whole, or most, of the year in development, so that their production was very small.

In Pennsylvania, the production of crystalline graphite in 1906 was merely nominal, due to the development of mines, the extension of plants, and changes of ownership. However, most of the companies now report that they are in condition to resume active productive operation.

AMORPHOUS

Rhode Island, Michigan and Wisconsin have made their usual average production and there is very little new information to report from these localities. The Hathaway mine in the upper Michigan peninsula has not been worked for over a year. The Federal Graphite Company, of Colorado, has been producing steadily. It has the only graphite factory west of Chicago, and reports a steadily increasing demand for its products. The Chicago Graphite Manufacturing Company retired from business in July, 1906.

ARTIFICIAL

The production of this form of carbon is increasing very rapidly. About 27 per cent. of the product is exported. The International Acheson Graphite Company is the only producer.

Gold Movements

As shown in a subsequent article, the great production of gold, which has marked the past decade, continued in 1906. This has been one of the reasons of the activity of general trade, the rush of new enterprise and, generally, of what we call prosperity. In all the great com-

mercial nations, business is conducted chiefly on credit of various kinds; but the basis of all credit, under our modern system, is found in the actual coin which is held, mainly as reserves in the banks and treasuries, and partly in general circulation. The greater this reserve is, the more credit is extended. The danger is that the enlargement of credit for legitimate, industrial and commercial enterprise is apt to be accompanied by a similar, or even greater, extension for purposes purely speculative, which may be carried far enough to endanger the solvency of the whole commercial system.

Twenty years ago Dr. Soetbeer estimated—and some other eminent authorities concurred with him—that not more than 25 per cent. of the world's gold production in any one year, was actually added to the available stock of money. The remainder was absorbed by use in the arts; by the amount actually destroyed in fire and wreck; by gold absorbed in private hoards, and in other minor ways; and finally by the amount needed to make up the actual destruction of values by war, fire and other public calamities. It is possible that even 20 years ago this estimate put the addition to the money stock too low. With the largely increased production of recent years, the improvements in transportation and communication and better methods in business, the proportion at the present day is certainly much higher, reaching very probably 60 per cent. The loss by public disasters is the most important in recent years. The financial derangements caused by the Boer war are hardly yet completely adjusted. The waste and loss of the Russo-Japanese war is still weighing on the world's money markets, and the destruction by earthquake and fire at San Francisco and Valparaiso were serious factors during 1906.

Reviews of the mining stock markets have been crowded out of this issue by the press of other matter. It is sufficient to remark that there was great activity in 1906 in all markets, which evinced an extraordinary public interest in mining investments. The transactions on the New York curb especially were very large. An important feature at the very end of the year was the decision of the New York Produce Exchange to list mining and industrial stocks. This is an old institution of the most respectable character, and its new departure will create a market for mining stocks where trustworthy quotations will be made and proper discretion will be exercised in the character of the stocks allowed to be traded in. This is a much needed consummation, and it is to be hoped that the new enterprise will have the coöperation of the New York Stock Exchange, the rules of which have really led to many of the evils of the curb, no organization of the curb brokers having been permitted heretofore.

THE PRECIOUS METALS

Production of Gold, Silver and Platinum—Commercial Conditions—Industrial Review

The approximate figures for the production of the precious metals show that the supply was fully maintained in 1906. If there were disappointments in some directions, there were unexpected increments in others, so that the final result is a gain over 1905; that is, the highest production ever recorded in a single year. In the following pages are given the figures of production, with comprehensive reviews of the conditions in most of the chief producing countries.

Gold and Silver in the United States

The gold production of the United States reached a total of \$88,180,700 in 1905, the largest figure ever recorded up to that date. In 1906, according to the preliminary figures received through the courtesy of George E. Roberts, director of the mint, the total output was \$97,155,201. The increase was largely due to developments in Alaska and the new mines

GOLD PRODUCTION OF THE UNITED STATES

	1905.	1906.	Changes.
Colorado	\$25,701,160	\$23,606,069	D. \$2,195,091
California	19,197,100	18,139,413	D. 1,057,687
Alaska	14,925,600	21,249,215	I. 6,323,615
South Dakota	6,815,900	6,821,100	D. 520
Montana	4,889,800	5,156,938	I. 267,138
Arizona	2,691,300	3,197,256	I. 505,956
Utah	5,140,900	5,849,652	I. 708,752
Nevada	5,559,100	9,921,600	I. 4,362,500
Idaho	1,075,600	1,041,210	D. 34,390
Oregon	1,244,900	1,368,540	I. 123,640
New Mexico	285,800	276,482	D. 9,318
Washington	370,000	374,168	I. 4,168
South'n States	367,600	227,763	D. 139,837
Other States	38,500	26,375	D. 12,125
Total	\$88,180,700	\$97,155,201	I. \$8,974,501

SILVER PRODUCTION OF THE UNITED STATES

	1905.	1906.	Changes.
Alaska	236,578	191,706	D. 44,872
Arizona	3,400,000	3,093,000	D. 307,000
California	1,106,772	1,203,557	I. 96,785
Colorado	12,831,348	13,381,575	I. 550,227
Idaho	8,326,794	8,774,000	I. 447,206
Michigan	127,800	250,000	I. 122,200
Montana	13,500,000	11,532,000	D. 1,968,000
Nevada	6,000,000	6,000,000	I. 600,000
New Mexico	250,000	362,375	I. 112,375
Oregon	81,500	100,100	I. 18,540
S. Dakota	138,409	157,539	I. 19,130
Texas	469,600	280,000	D. 189,600
Utah	12,000,000	11,385,400	D. 614,600
Washington	115,412	31,119	D. 84,293
Other States	34,666	15,896	D. 18,770
Total	58,918,839	57,358,267	D. 1,560,572

of southern Nevada. The latter are remarkable from the fact that they are in a region which was prospected and passed over many years ago, and then neglected until two or three years ago, when the finds at Tonopah sent a multitude of prospectors into the country, to search out its heretofore undiscovered riches.

Of course, their full value is still uncertain, and there may be a decrease in following years, or we should say, less production than is now anticipated; but so much is established that we may confidently expect to see some of the world's great gold mines on the Nevada desert.

The Gold and Silver Production of the World

The year 1906 records a further increase in the great production of gold which has marked the past decade. In the accompanying table we give the approximate figures for the year, compared with completed statement for 1905:

	1905.	1906.	Changes.
Australasia ..	\$85,470,779	\$82,851,561	D. \$2,619,218
British India,	11,924,308	10,655,674	D. 1,268,634
Canada	14,486,833	12,000,000	D. 2,486,833
Mexico	14,526,855	15,430,000	I. 903,145
Russia	22,197,155	21,510,000	D. 687,155
Rhodesia	7,203,865	10,201,327	I. 2,997,462
Transvaal	101,225,558	119,605,922	I. 18,380,364
United States,	88,180,700	97,155,201	I. 8,974,501
All others	34,151,823	35,250,000	I. 1,098,177
Total	\$379,867,373	\$404,649,685	I. \$24,782,312

We are able to include in this table very close approximations for all the chief producers, except Russia. For the United States we have the preliminary figures compiled by Director George E. Roberts, of the United States mint; for the Transvaal, Rhodesia and Australia, there are the definite figures for eleven months, with the month of December estimated.

The total, as was predicted a year ago, exceeds \$400,000,000, the largest amount on record. The Transvaal again leads, and moreover shows the largest gain. The United States holds the second place, with Australia third. These three producers together furnished about three-fourths of the total. For Russia, the fourth producer in rank, it has been impossible to obtain our usual estimates, owing to the troubles of the past year. From the best available information, however, we are obliged to allow a small decrease; it is small, because most of the Siberian gold mines are isolated from the centers of commercial and administrative disturbance. Canada dropped last year to the sixth place, falling below Mexico; the decrease resulted chiefly from a lower output in the Yukon territory, which is still in the transition state, but may be expected to recover within the coming year, to a large extent. British India showed a loss in the Kolar goldfield, the largest mine in that field—the Champion Reef—having entered a zone of lean ore, through which work is being pushed in the hope of recovering the main orebody at a lower depth.

The work done in all the chief producing countries is referred to at length in the special articles which follow.

The silver production of the world recorded little change in 1906. The output probably increased with that of gold, lead and copper, in connection with which most of the mining of silver is done. The

United States and Mexico remained the chief producers during the year just closed.

The Commercial Movement of Gold and Silver

BY FREDERICK HOBART

The tracing out of the disposition each year of the world's production of gold and silver is always a work requiring time and study. The great movements are clearly apparent, perhaps, but there are many obscure cross-currents which must be taken into account; all of these have their effect, and must be considered, if we wish to arrive at conclusions even approximately correct. At the present time it is only possible to give such indications from official reports as will serve to point out the general direction of the movements.

The total gold production of the world in 1905, as given by THE MINERAL INDUSTRY, was \$379,635,413; in 1906 it is estimated at \$404,649,685, an increase of over 10 per cent. That is, after making all deductions, the commercial gold reserve standing back of trade and credit was increased by some \$250,000,000, possibly a little more.

GOLD MOVEMENT IN THE UNITED STATES

The United States, which has led in commercial, industrial and speculative activity, was in 1906 the chief absorber of gold. The imports and exports of gold for the 11 months ending Nov. 30—to which December will not add largely—are reported as follows:

	1905.	1906.	Changes.
Imports	\$46,264,524	\$147,961,827	I. \$101,697,303
Exports	44,125,935	44,831,203	I. 705,268

Net imports, \$ 2,138,589 \$103,130,624 I. \$100,992,035

Adding our own production for the year there was, apparently, an increase of nearly \$300,000,000 in the gold in the country; or of over \$200,000,000, if we allow only 60 per cent. of the output to have passed into use. To a great extent, of course, this calculation is hypothetical; but it is evident that we absorbed the greater part of the new gold supplies of the world. The large imports were provided in various ways. In part they were the result of favorable trade balances; in part sales of securities; and in large part they represent actual borrowing of accumulated capital from Europe, which must be repaid at a future date. At the close of the year the situation is not altogether favorable for further imports, since the influence of the great foreign banks is against any extension of loans.

BRITISH GOLD MOVEMENT

Great Britain has been for many years a taker of gold from abroad, because of its large foreign trade and its enormous investments in foreign enterprises. In 1906 its gold balance was lower than usual, chiefly because of large shipments to the United States. The official figures for the 11 months ended Nov. 30 are as follows:

	1905.	1906.	Changes.
Imports.....	£36,376,387	£41,846,861	I. £ 5,470,474
Exports.....	27,084,930	39,428,907	I. 12,343,977
Net imports, £	9,291,457	£ 2,417,954	D. £ 6,873,503

The exports to the United States were £1,817,000 in 1905, and increased to £14,148,394 in 1906.

GOLD MOVEMENT IN FRANCE

For France, which also usually absorbs more gold than it gives out, we have the official figures for 10 months ended Oct. 31, as below:

	1905.	1906.
Imports.....	Fr. 716,809,000	Fr. 403,537,000
Exports.....	110,698,000	112,733,000
Net imports.....	Fr. 616,111,000	Fr. 290,804,000

Here we have a decrease of 325,307,000 fr. in the net imports; due to a large falling off in the receipts of gold, the exports remaining about the same.

BANK GOLD HOLDINGS

The gold reserves of the great European banks in the closing weeks of 1905 and 1906 compare as follows:

	1905.	1906.
England.....	\$ 142,451,255	\$ 145,322,390
France.....	575,971,135	541,150,235
Germany.....	166,300,000	137,940,000
Austria.....	224,325,000	233,045,000
Netherlands.....	33,019,500	27,680,000
Belgium.....	16,233,335	17,076,665
Italy.....	134,345,000	159,440,000
Spain.....	55,115,000	76,740,000
Russia.....	576,215,000	589,520,000
Sweden.....	18,900,000	19,780,000
Total.....	\$1,962,775,225	\$1,947,794,290

We find here a total decrease of \$14,980,935, notwithstanding the large increase in the total of the Bank of Russia. That bank, it must be noted, holds practically the reserves of the Russian treasury as well as its own commercial balances. It has been charged also that the bank includes foreign gold bills in its balance; this, if true, would be to that extent a duplication of gold reported by other banks.

The specie holdings of the New York banks, including both gold and silver were \$176,212,800 in the last week of 1905, and \$179,323,000 in that of 1906. The working balance of the United States Treasury for the closing week included \$136,831,505 gold in 1905, and \$162,415,554 gold in 1906. In addition to this the Treasury holds \$150,000,000 gold reserve against outstanding notes in circulation, and \$572,972,119 against gold certificates; making its total gold holdings the largest in the world.

THE SILVER MOVEMENT

The price of silver rose gradually through the year, reaching its highest point in November. From that there was

a recession, but comparatively small in amount. The average monthly prices of silver in the New York and London markets for two years past has been as follows:

AVERAGE PRICE OF SILVER

Month.	New York.		London.	
	1905.	1906.	1905.	1906.
January.....	60.690	65.288	27.930	30.113
February.....	61.023	66.108	28.047	30.464
March.....	58.046	64.597	26.794	29.884
April.....	56.600	64.765	26.108	29.984
May.....	57.532	66.976	26.664	30.968
June.....	58.428	65.394	26.910	30.185
July.....	58.915	65.108	27.168	30.113
August.....	60.259	65.949	27.822	30.529
September.....	61.695	67.927	28.528	31.453
October.....	62.034	69.523	28.637	32.148
November.....	63.849	70.813	29.493	32.671
December.....	64.850	69.060	29.977	32.003
Year.....	60.352	66.791	27.839	30.868

The New York prices are in cents per fine ounce; the London quotation is in pence per standard ounce, 0.925 fine.

The high price of silver was due chiefly to two causes, the first being the heavy demand from India, the result of three successive years of prosperity in that country; the second cause was the large demand for silver for use in the arts, incident to a period of general prosperity. Another reason for the maintenance of prices was the purchase of a considerable quantity of the metal by the United States mint.

MINT PURCHASES OF SILVER

Under authority of an act of Congress the United States Treasury Department began in August to buy silver in the market, to be used by the mint for the coinage of subsidiary coins. These purchases continued up to the early part of November, when they were temporarily discontinued, but resumed about a month later. Before inviting tenders in August, the Department, anticipating that the invitation to sell might have an effect upon the market, bought about 2,500,000 oz. in London for future delivery. These purchases were afterward exchanged for metal in this country, which was delivered at the several mints, as shown below. The total purchases made, with the deliveries, are shown below in ounces, the London silver above noted being given separately:

Mint.	American.	London.	Total.
Philadelphia.....	875,000	1,630,307	2,505,307
New Orleans.....	850,000	400,119	1,250,119
Denver.....	1,950,000	403,299	2,353,299
N. Y. Assay Office..	50,000	.....	50,000
Total.....	3,725,000	2,433,725	6,158,725

The London purchases were made at a price ranging from 65.474 to 65.772c. per ounce, and averaging about 65.60c., which was close to the current market price. The lowest price paid in the American market was 65.17c., Philadelphia delivery, on Aug. 2; the highest was 71.952, New Orleans delivery, on Nov. 9. The prices paid in America included delivery, and they ranged almost uniformly about 0.4c. per ounce for Philadelphia and Denver, and about 0.5c. for New Orleans delivery above the New York quotations of even dates.

The total silver bought by the mint

was about 10 per cent. of the production of the United States for the year.

SILVER IMPORTS AND EXPORTS

The movement of silver in the United States for the 11 months ending Nov. 30 was as follows, in value:

	1905.	1906.	Changes.
Exports.....	\$49,313,953	\$53,400,246	I. \$4,086,293
Imports.....	31,246,389	39,790,748	I. 8,544,359
Net exports..	\$18,067,564	\$13,609,498	D. \$4,458,066

The net exports showed a decrease, chiefly owing to the heavy receipts from Mexico. Detailed figures are available only for the 10 months ending Oct. 31; these show that the more important exports were as follows:

	1905.	1906.	Changes.
Great Britain..	\$35,335,408	\$42,513,893	I. \$7,178,485
Other Europe..	1,492,466	2,942,218	I. 1,449,752
China.....	4,021,419	888,447	D. 3,132,972
Japan.....	1,538,070	1,664,802	I. 26,732

It is probable that most of the silver taken by Japan is for use in Manchuria and Korea. The leading imports for the 10 months were:

	1905.	1906.	Changes.
Mexico.....	\$22,486,633	\$30,439,540	I. \$9,952,907
Canada.....	2,294,963	4,388,982	I. 2,094,019
Cent'l America,	1,474,478	1,168,007	D. 371,471

The heavy exports from Mexico were due to the currency changes in that country and the disposal of its surplus silver.

EXPORTS AND IMPORTS OF GREAT BRITAIN

London continues to be the great silver market from which the East draws its supplies. As shown above, the exports from the United States directly to China and Japan were small, most of our silver going to London. The British returns for the 11 months ended Nov. 30—the latest available—show total imports and exports of silver as below:

	1905.	1906.	Changes.
Exports.....	£13,055,800	£17,329,585	I. £4,273,785
Imports.....	11,752,396	16,292,810	I. 4,540,414
Excess, exp. £	1,303,404	£ 1,036,775	I. £ 266,629

Of the 1906 imports the United States is credited with £14,032,451, or 78.7 per cent. of the total. The exports to the East, the most important of all, were as follows:

	1905.	1906.	Changes.
India.....	£6,379,112	£14,479,027	I. £8,099,915
Ceylon.....	5	65,700	I. 65,695
Straits.....	400	1,750	I. 1,350
China.....	956,691	439,957	D. 516,734
Japan.....	70,000	.....	D. 70,000
Total.....	£7,406,208	£14,980,434	I. £7,574,226

These exports in 1906 were more than double those of the preceding year. The great increase was due solely to India, whose people still follow the ancient custom of investing their savings in the white metal. These practically disappear from general commerce, as they either pass into the form of coined rupees in circulation or are added to the accumulation of centuries.

The Straits Settlements have ceased to import silver since the currency settlement of two years ago. The reason for the decrease in shipments to China is not altogether clear. It is understood that it was, in part, compensated for by shipments from Australia, but the returns for these have not been published.

COPPER PRODUCTION AND PROSPECTS

The Statistics, Conditions, and Commercial History of Copper in 1906

The production of copper in the United States in 1906 is given in the following table. These statistics are based chiefly on reports received directly from the producers who have communicated their records for the first 11 months of the year, together with their own estimates of probable production in December. Only in two or three cases has it been necessary to include estimates; and these have been made on trustworthy data. In statistics collected within so short a time that investigation of all doubtful points is impossible, the final figures inevitably show some variations, but it is believed that the statistics now submitted, subject to revision, are a very close approximation to the actual production in 1906.

PRODUCTION OF COPPER IN THE
UNITED STATES
(In pounds)

State.	1904.	1905.	1906.
Alaska	2,043,586	4,703,600	6,250,000
Arizona	191,602,958	222,866,024	265,800,000
California	29,974,154	13,089,993	28,500,000
Colorado	9,401,913	9,854,176	9,100,000
Idaho	5,422,007	6,500,000	10,100,000
Michigan	208,329,248	218,959,753	223,800,000
Montana	298,314,894	319,179,855	293,000,000
New Mexico	5,368,664	5,634,842	5,800,000
South and East	15,211,086	14,907,982	19,500,000
Utah	47,062,889	51,950,789	56,800,000
Wyoming	3,556,229	2,393,201	250,000
Other States.....	1,418,065	1,550,000	1,600,000
Total.....	817,715,005	871,634,245	915,000,000

It appears, therefore, that the increase in the production of the United States in 1906 was about 5 per cent., making comparison with our revised statistics for 1905. The latter show a smaller total for that year than was reported by the U. S. Geological Survey, but we are confident of the accuracy of our figures. Other statisticians continue to report the Michigan production much too high, although the report of the Michigan Commissioner of Mineral Statistics, to whom the companies make sworn statements, gives the production substantially as we made it (217,762,382 lb. vs. 218,999,753 lb.).

ALASKA

The copper production of this Territory shows a small increase—much less than a year ago it was expected it would be. However, there is no question that the copper resources of Alaska, near the sea-coast and easily workable, are large, and an important increase in production from this source is to be looked for in the near future.

ARIZONA

Of the chief copper-producing States, Arizona shows the largest increase in 1906. The increase would have been larger had it not been for the shortage in labor, which was a difficulty all through the year,

and moreover a shortage in the fuel supply which became a difficulty toward the end of the year. The flood at Clifton, about the end of November, which seriously damaged the smelting works of that camp, also contributed to the restriction of the output. The smelting works at Douglas and at Globe produced considerable copper from ore received from Cananea and Nacozari, Mexico, the amount of which has been deducted from their reports.

CALIFORNIA

The increase in the production of this State is due especially to the operations of the Mammoth Copper Mining Company, which made a large output in 1906. The new smelter which is being erected by the Balaklala company to treat the ore of the Balaklala and Trinity mines will increase the copper production of California in 1907. A small increase in the production is shown by the mines outside of Shasta county, especially in Calaveras county. A new copper district, the Greenwater district, was discovered in Inyo county in 1906. It appears to contain important copper resources, but its development will be slow because of unfavorable natural conditions. A good deal of the ore and matte produced in California is shipped to Utah for smelting and at present we are unable to make an accurate separation of the California and Utah production in 1906. The suspension of smelting by the Bully Hill company, pending the completion of a railway connection, caused the increase in California production in 1906 to be less than was anticipated.

EASTERN AND SOUTHERN STATES

The increase in the production of these States was due almost entirely to the enlargement of operations by the Tennessee Copper Company. By far the largest part of the production credited to the East and South is derived from the Ducktown district, Tennessee. A small amount of copper was derived from North Carolina. Vermont re-entered the list of copper-producing States, the mine at Pike Hill having been a small producer. The attempt to treat the ore of the Elizabeth mine by magnetic separation did not prove a success. Massachusetts appears for the first time as a copper-producing State, some copper-bearing ore having been found in the Davis mine, at Rowe. A little copper ore was shipped from another mine in the same neighborhood.

IDAHO

The copper production of this State shows a large increase. The largest part of the production came from the Snow-

storm mine, in the Coeur d'Alene. The producer next in importance was the White Knob mine, at Mackay, Custer county. A small amount of copper ore was shipped from the Seven Devils district. The ore and matte of Idaho are shipped to other States for smelting to pig copper, wherefore the production credited to this State is deducted from the reports of smelters in other States.

MICHIGAN

The production of the Lake Superior district shows only a small increase. In most cases the output of the older mines showed decreases, which in some cases were large. The Atlantic mine suffered a cave-in, which caused the mine to be abandoned; the Quincy also suffered from a cave; while the Tamarack had a fire. The Calumet & Hecla made a considerable increase in output, as did also some of the new producers. These gains a little more than offset the losses of the other mines.

MONTANA

The decrease in the copper production of this State was due primarily to shortage of labor. Even if the supply had been adequate, it is doubtful if the production could have shown any increase, because the smelting capacity appears to have been utilized at the maximum in 1905. Plans are now being carried out to increase the smelting capacity, which will be consummated during 1907.

UTAH

The important increase in the copper production of this State was due to the more extensive operations of several of the smelters. Construction of the new dressing works for the Utah Copper Company and Boston Consolidated was begun. These plants should add materially to the production in the latter half of 1907. A drawback to the situation in Utah, however, is the recent injunction against the smelters of the Salt Lake valley, which probably will cause the abandonment of certain plants and the removal of some departments of others. These conditions are likely to upset to some extent the smooth running of the industry in 1907. The new Garfield smelter did not get into regular operation until late in 1906 and consequently was only a small producer. The smelters of Utah receive a great deal of ore and matte from other States, and although the major portion of such copper has been deducted from the smelters' reports and credited to the States of origin, it is probable that the statistics representing the Utah production still include some duplication.

OTHER STATES

The copper production of the other States in 1906 was small. Colorado remained at about the same figure as in the previous year. New Mexico showed an increase. Wyoming showed a decrease, the most important producer of that State having made no shipments. Oregon and Washington made small outputs.

Copper in Foreign Countries

Outside of the United States, it is impossible at this early date to present statistics of the production of copper, except for Canada and Mexico. It appears that both those countries made diminished outputs. The Canadian statistics are based on reports from the producers, checked by an estimate based on the net imports into the United States. The statistics for Mexico are based on the net imports into the United States (assuming those in November and December to have been at the average of the ten months previous), to which is added the Boleo production. The total statistics for North America are given in the following table:

PRODUCTION OF COPPER IN NORTH AMERICA
(In pounds)

Country.	1904.	1905.	1906.
U. S.	817,715,005	871,634,245	915,000,000
Mexico.....	114,117,000	144,350,962	135,400,000
Canada.....	42,970,594	47,597,502	46,500,000
Total.....	974,802,599	1,063,582,709	1,097,900,000

Outside of North America, it will doubtless appear that there was a material increase in the copper production of Japan, Australia, Peru, and possibly Chile. No figures for Spain and Portugal are available.

In Australia, the Mount Morgan mine opened its career as a producer of copper. This copper, as does also considerable other Australian copper, comes to the United States for refining. The copper production of Japan is increasing because of the high price for the metal and the more vigorous attention that it has been possible to devote to the industry now that the war with Russia is over. The output of this empire is helped materially by the great Osaka mine, which is now the largest producer.

In Peru, the Cerro de Pasco company began smelting in January, but like many other new enterprises, this has suffered from infantile troubles, wherefore the output is not so large as it was expected it would be at the beginning of the year. The Cerro de Pasco copper is to come to the United States for refining.

A noteworthy feature of 1906 has been the increased attention directed toward the copper resources of Chile. Several new British and American companies have become interested there. Doubtless this will soon result in a material increase of the Chilean production.

In Canada, the mines of the Boundary district, British Columbia, suffered from substantially the same difficulties as prevailed in the United States, namely,

shortage of labor and fuel. In the autumn, a strike in the Crows' Nest coalfield temporarily cut off that supply of coke and compelled the smelters to obtain fuel, at greatly increased cost, from the United States. The furnaces of the Granby company, the largest producer, have now been remodeled, and if there be no further difficulties of the same kind as those which appeared in 1906, the output of the Boundary district will show a large increase in 1907.

The copper production of Mexico showed a material decrease in 1906, but it is manifest that this Republic is bound to increase more and more in importance as a producer of copper. However, even in Mexico, shortage of labor is the general complaint. For this reason, and also because of the riots at Cananea late in the summer, and other troubles of the Greene company, the production of Mexico in 1906 was not so large as it ought to have been.

The leading feature of the year was the development of a great new mine by the Cananea Central company, and at the very end of the year the amalgamation of that company with the Greene Consolidated, under the name of the Greene-Cananea Copper Company, in which Messrs. Cole and Ryan, who are affiliated with the Amalgamated Copper Company, are the controlling interest. Colonel Greene is still identified with the company, but the management of the mines which he developed has passed out of his hands. The ore of the Cananea Central properties has been smelted at the works of the Greene Consolidated, while a good deal of the ore of the Greene company has been shipped to the United States for smelting. The production of the Mochtezuma Copper Company also was smelted in the United States.

Consumption of Copper in the United States

We can estimate the consumption only approximately, lacking statistics of imports and exports for the last two months. Estimating them each at the average of the first 10 months, we reckon the consumption as follows:

	1905.	1906.
Stock, Jan. 1.....	208,376,672	128,980,000
Imports.....	210,724,685	225,000,000
Production.....	871,634,245	915,000,000
Total.....	1,290,735,602	1,268,980,000
Deduct exports.....	548,772,403	472,870,000
Deduct stock, Dec. 31....	128,980,000	135,570,000
Consumption.....	612,983,199	660,540,000

The estimated stock at the end of 1906, except for the comparatively insignificant quantity which the refiners necessarily have on hand even when the market is technically bare of refined metal, represents crude copper in transit and in process of refining, the increase as compared with Dec. 31, 1905, being simply in proportion to the increased production of metal.

The New York Copper Market in 1906

The year 1905 witnessed developments which the most ardent admirers of copper would not care to have predicted at any time. The history of 1906 may be summarized in the single statement that consumption has actually overtaken production. It had been noticed for some time past that production and consumption were about even, in spite of the continued large increase in the former from year to year, mainly on the American continent, while the rest of the world followed only to a very slight degree. But consumption has pushed ahead with even more energy, and the uses of copper, especially in connection with the electrical industry, have stimulated an enormous demand, with the result as above stated. To the closer observer it was evident for some time past that the industry was in a dangerous position, inasmuch as no reserves, so to say, existed anywhere, or rather they were so small that they would hardly be sufficient in case of an emergency. We cannot call the comparatively large quantities which are in process of manufacture reserves, as it must naturally take some time for any article to be put into manufactured shape.

For some time no stocks of refined copper existed in this country, nor abroad, with the exception of the so called visible supplies, which are mostly warehoused in Liverpool, Swansea and London, and have of late been below 10,000 tons. These stocks form the basis of transactions in standard copper on the London Metal Exchange. They can thus be practically ignored. The moment therefore that production showed a temporary decline, or consumption increased, it was natural that a famine would have to be faced, with more or less serious consequences to the manufacturing industry. This is exactly what happened during the last few months of 1906, when all at once the demand became larger than the available supplies. That under such circumstances a very high level of prices was unavoidable can easily be understood, and while it must be conceded that the larger selling agencies did everything they could to prevent a material rise in prices from the already comparatively high level which existed earlier in the year, they soon found themselves unable to stem the tide.

Thus, at the close of the year, we find prices at 23 $\frac{3}{4}$ @23 $\frac{3}{4}$ c. for electrolytic, and at 24@24 $\frac{1}{4}$ c. for Lake, and with such a firm tendency that it is safe, at least, to predict that for some months to come the market is not likely to show a considerable easing off; while probably there will be a further advance. The last time when such prices as the present existed was from January to April, 1880, when copper sold between 23 and 24c. Since then

there have been fluctuations in the price for Lake copper as follows:

During	Average
1881—1890	14.60c.
1891—1900	12.35c.
1896—1905	13.88c.
1901—1905	14.11c.

The lowest prices in any year were those during 1894, when the average for the whole year was 9.56c., and for the month of June 8.94c.

During this period of 25 years two efforts were made to raise prices artificially, the first in 1887, when the French syndicate tried to corner the market, and the second during 1899-1901, when the Amalgamated Copper Company interests tried to hold the price arbitrarily between 17 and 18c. Both efforts failed, but in fairness it is only just to admit at this late date that the principle, viz: to put copper upon a higher basis, was right; only the efforts were somewhat ahead of time.

What has been a certain disappointment is the fact that, in spite of the high average value of copper in 1906, production has by far not increased as much as was anticipated 12 months ago. It is only natural that high prices should stimulate every effort for an increase, and great activity is noticeable in all directions in the development of new fields, which were hitherto either not known or were of too low grade for commercial success, or were too remote from the arteries of transportation. Unquestionably, the stimulus now given will help greatly to increase the production, but it will be some time yet before their effect is noticeable in the markets. In fact, it is not too much to say that years will elapse before that is the case. It was therefore the actually developed mines from which relief was to be expected, and that this has not been forthcoming was the result of various causes, one of which is the fact that some conservative producers thought it wise to mine lower-grade ores, the mining of which in the past did not afford sufficient remuneration, and in this way their yield was reduced. But far more important were two factors which developed more and more as the year progressed, viz: scarcity of labor and insufficient supply of fuel and transportation facilities. Although wages have been repeatedly increased during the year, there was continually a shortage of miners and smelting men. Both in the South and Northwest the smelters were very short of oil, coal and coke, and repeated shut-downs were the consequence. The railroads were utterly unable to provide the necessary cars for the transportation of fuel and partly also for the transportation of ore, and all these causes put together contributed very largely toward reducing the production from the estimated figures. It is very unlikely that there will be any immediate material change, and therefore we do not figure on any large increase during the next few months, but later in the year there ought to be a change for the better.

A feature deserving of notice happened last spring when the war between some of the largest producers in Montana, viz: the Amalgamated Copper Company on the one side, and the Heinzes on the other, was happily terminated, and the injunctions against working a great many properties were lifted. In the natural course of events this ought to result in a considerable increase in the output of Montana.

In Michigan great activity exists and prospecting is done on a larger scale than ever before in the district. Arizona is coming more and more to the front and would undoubtedly show a very much larger production had it not been hampered by events as above stated.

The main increase in the near future may be expected from Utah and afterward from Nevada, and while the former State will most probably be the more important during 1907, Nevada should follow during 1908. California will also share in the augmentation, and British Columbia and Mexico will not remain behind.

The year opened with Lake copper at 18½ to 19c.; electrolytic at 18½ to 18¾c., and casting copper at about 18¾c. During January the market was rather sluggish. The Orient was re-selling copper in Europe and here. American consumers were covered and held off, and the European speculative market declined somewhat. By the middle of February Lake copper had declined to about 18c., and electrolytic to about 17¾c.

Meanwhile, the winter in this country had been exceptionally mild, permitting much work to be done which usually must be deferred until spring. This made business very active, so that our home manufacturers who found their supplies of copper exhausted entered the market again.

At the end of February the Europeans who had been skeptical as to the maintenance of the level of prices had also to replenish their stocks. As a result, prices gradually advanced, and during March, in spite of the fact that China was still selling copper, Lake again went to 18¾c., and electrolytic to 18½c. The London market for standard then began to show signs of the shortage of supplies. In fact, toward the end of March, it was practically cornered, having advanced £7 during the month.

In April it became evident that consumption was much in excess of production and consumers bought ahead with confidence, covering their wants until about the first of September, at about 18¾c. for Lake, and 18½c. for electrolytic. The producers recognized the situation, but sold freely at these prices, which were quite satisfactory to them; and besides, they were desirous of preventing a runaway market, with its inevitable reaction and bad effect upon the trade generally.

In May copper for early delivery became very scarce, and premiums were

paid for it. Toward the end of the month consumers abroad as well as here again bought heavily for future delivery at about 18¾c. for Lake, and 18½c. for electrolytic, with casting selling at 18½c.

As expected, June and July were dull months because buyers had already covered their requirements. The political situation in Europe at this time looked very grave, and this induced the London speculators to press upon the standard market, selling it down to about £78, but by August the immense increase in the consumption again made itself felt. Manufacturers were receiving orders far ahead and they came into the market, buying heavily for delivery up to the very end of the year.

September opened with producers practically sold out for both September and October, and with large orders on their books for November and December, and prices advanced to 19c. for Lake and 18¾ for electrolytic. The orders which manufacturers were receiving extended far into 1907, and led them to buy for the first six months of 1907. Meanwhile, copper for early delivery commanded fancy prices, and the month closed with Lake at 20c. and electrolytic at 19¾c.

During October the shortage in supplies led to a squeeze in the London market, and standard copper went as high as £102 15s. Some of the largest producers who were sold out for 1906, and had refrained from booking any orders for 1907, now offered to sell for that delivery at 22½c., and were quickly cleaned out. In fact, at this time several of the important producers were already entirely sold out for the first quarter of 1907.

In November the market was somewhat more quiet, but in December the European buyers who had held off during November made heavy purchases for 1907, and prices advanced rapidly, closing at about 24¾c. for Lake, about 23½c. for electrolytic, and 23¾c. for casting copper.

The year 1906 ended with no stocks of copper on hand, and several producers sold out for the first six months of 1907. It was certainly a prosperous year in the copper trade!

AVERAGE PRICES OF COPPER

	NEW YORK.				LONDON.	
	Electrolytic.		Lake.		1905.	1906.
	1905.	1906.	1905.	1906.		
Jan....	15.008	18.310	15.128	18.419	68.262	78.869
Feb....	15.011	17.869	15.136	18.116	67.963	78.147
March..	15.125	18.361	15.250	18.641	68.174	81.111
April... 14.920	18.375	15.045	18.688	67.017	84.793	
May....	14.627	18.457	14.820	18.724	64.876	84.867
June... 14.673	18.442	14.813	18.719	65.881	83.994	
July... 14.888	18.190	15.005	18.585	66.887	81.167	
Aug.... 15.664	18.380	15.725	18.706	69.830	83.864	
Sept.... 15.965	19.083	15.978	19.328	69.667	87.831	
Oct.... 16.279	21.203	16.332	21.722	71.406	97.269	
Nov.... 16.599	21.833	16.768	22.398	74.727	100.270	
Dec.... 18.328	22.885	18.398	22.350	78.993	105.226	
Year..	15.590	19.278	15.699	19.533	69.465	87.232

New York prices are in cents per pound. Electrolytic quotations are for cakes, ingots or wire bars. The London prices are in pounds sterling, per long ton of 2240 lb., standard copper.

LEAD AND SPELTER PRODUCTION

Developments in the Lead and Zinc Industries in 1906—Statistics of Production

The production of lead in the United States in 1906 showed a further large increase, but even this was insufficient to supply the requirements for consumption, and a large amount of lead had to be imported. The statistics of production are given in the following table, which is based on reports from all the producers except one, whose output has been estimated on the basis of its known ore supply. These statistics represent the production of refined lead. The lead-smelting industry is so complex that it is impossible at this early date to make any distribution among the States, and even the separation between foreign and domestic production is only approximate.

PRODUCTION OF LEAD IN THE UNITED STATES

(In tons of 2000 lb.)

Class.	1905.	1906.
Desilverized, domestic.....	205,665	237,815
Antimonial, domestic.....	8,456	8,752
Southeast Missouri.....	81,299	99,699
Southwest Missouri.....	21,524	16,590
Miscellaneous.....	3,000	1,500
Total, domestic.....	319,744	364,336
Desilverized, foreign.....	83,504	46,045
Antimonial, foreign.....	2,730	1,701
Total, foreign.....	86,234	47,746
Grand total.....	405,978	412,082
Total, antimonial.....	11,186	10,433
Total, soft.....	102,623	116,289
Total, desilverized.....	289,169	321,391

IMPORTS AND EXPORTS OF LEAD*

(In tons of 2000 lb.)

	1905.	1906.
Imports of refined lead.....	3,503	11,256
Exports of foreign lead.....	52,112	40,088
Imports of lead in ores and base bullion.....	80,059	61,900
Lead in bond Jan. 1.....	11,481	8,148
Lead in bond Oct. 31.....	8,340	6,206

*For the first 10 months of the year.

The prominent features of the lead industry in 1906 need be only briefly mentioned. Almost all of the important lead-producing districts show gains, and the increase in the production is attributable especially to them, viz., the Cœur d'Alene, Southeastern Missouri, the Joplin district, Leadville, Colo., and Park City, Utah. However, the operation of new smelters in Idaho, New Mexico, and Arizona added to the total.

The lead content of the ore produced in Idaho in 1906 is estimated by Robert N. Bell, State mine inspector, at 125,400 tons.

The conditions of lead mining in Missouri and Idaho are described in following articles. Outside of the leading lead-producing districts, the most important event of the year was possibly the reopening of the old mines at Eureka, Nev., which are now being unwatered. In the meanwhile low-grade ore and slag from the old dumps are being shipped to Salt Lake City. If these mines, operated un-

der modern conditions, are able to approach their former record, they will add something to the much needed supply of lead.

Attention may be called to the increasing competition in the market for lead ores. The United States Smelting Company, of Salt Lake City, the Ohio & Colorado Smelting Company, of Salida, Colo., and the Pennsylvania Smelting Company, of Pittsburg, Penn., are now decidedly more than insignificant competitors of the American Smelting and Refining Company. The Bingham Consolidated Mining Company, of Utah, was planning to erect lead furnaces in connection with its copper smeltery, but although these plans may be deferred on account of the smoke injunction, it is likely that this company will eventually go into the business, inasmuch as interests identified with it have been investigating and optioning lead mines in the Cœur d'Alene. Moreover, there is an increase in the number of small lead producers in various States.

The Southeast Missouri Lead District

BY H. A. WHEELER*

The output of the southeastern Missouri lead district approximated 88,000 short tons of pig lead in 1906. Of this, St. Francois county, or the Bonne Terre and Flat river districts, contributed 90 per cent. and Madison county, or Fredericktown and Mine la Motte, produced about 9 per cent., while the small mines scattered throughout the adjoining Washington, Jefferson and Franklin counties produced much less than usual, or only about 1 per cent. This is about a 5 per cent. increase over 1905 and is the largest output in the history of the district. The prices received for the lead were also at high-water mark, as they ranged from \$5.25 to \$6 per 100 lb. in the St. Louis market. The year was prosperous in every respect and labor shared in the prosperity, as it never received such high wages as in 1906. There were no labor troubles, but labor was very scarce; however, the large companies managed to finish the year without serious curtailment. The outlying districts of Washington, Franklin and Jefferson counties were seriously affected, as the tributaries, or small leasers, who produce the lead in those districts, were attracted and drawn off by the high wages paid at the big mines, so that the output was much below normal. The latter has become such a small factor, since the

*Consulting mining engineer, St. Louis, Mo.

opening up of the deeper disseminated orebodies, that the deficiency was more than made up in the growth of the St. Francois county mines. The increased output is not due to the development of any new companies, but merely to the greater activity of the established mines that was stimulated by the high prices of lead.

The energetic prospecting for new orebodies by the large companies inaugurated in 1905 continued through 1906 and many thousands of acres were optioned and drilled, though in most cases the drilling was inadequate to demonstrate the value of the land. One of the older properties acquired by the Federal Lead Company under such an option was the land of the St. Louis Prospecting Company, for which \$500 an acre was paid.

THE CENTRAL MINE

The most important event of 1906 was the successful unwatering of the main mine of the Central Lead Company (which was drowned out three years ago by the miners' strike) and the erection of a new mill. The old Central mill was started as a 200-ton mill and later enlarged to 400 tons at a time when capital was scarce; it has done excellent work in grinding out dividends, but it is to be superseded by a fine, modern, steel-frame mill that will be of 1000 tons daily capacity. A new shaft has been put down on the 40-acre tract in Flat River of the Central company that will prove a valuable acquisition in maintaining the success of this property.

ST. JOSEPH LEAD COMPANY

The St. Joseph Lead Company materially strengthened and improved its old plant at Bonne Terre, which is still the largest producer of the district. A new shaft was completed at North Bonne Terre, No. 13 or 2 B, that will assist the old mine in maintaining its big production, although the latter is holding up its output admirably in spite of having been continuously worked for over 40 years. The new plant at Leadwood, or Owl creek, was also enlarged, 10 roasting furnaces having been added, and it is now producing almost as much lead as the Bonne Terre plant, but with a very much finer electrically operated mill. A new shaft is being sunk that will come into production this year.

DESLOGE CONSOLIDATED LEAD COMPANY

The Desloge company suffered a temporary set-back in the loss of its No. 3 shaft house (its principal producer) by fire in the autumn. The output of this

company was therefore smaller than usual, although shafts Nos. 2 and 4 were pushed more energetically to make up for the loss of No. 3. No. 3 will be rebuilt and will be producing again before spring. A new shaft is being completed on the recently acquired land adjoining Washington county that should materially increase the output of 1907.

DOE RUN LEAD COMPANY

This company had a very prosperous year and is contemplating the erection of a new, modern mill. It is sinking a new shaft on its Mitchell tract and is considering the re-opening of its old mine at the town of Doe Run, where there is not only a large deposit of low-grade ore, but recent discoveries show plenty of high-grade ore that was overlooked in the earlier and supposed thorough drilling of the original property.

NATIONAL LEAD COMPANY

This company has begun to look around for new territory by optioning several tracts that are now being prospected with the diamond drill. It sunk a new (No. 5) shaft at Esther that will open up the eastern end of its property, and is arranging to make new improvements in the mill that will add to its efficiency.

FEDERAL LEAD COMPANY

This company had a very busy year in recovering the principal mine of its new acquisition, the Central Lead Company, and in erecting the mill for it. The latter should largely increase the output of 1907 if its completion is not delayed. The company is also sinking two new shafts on the southern portion of the property that it acquired from the old Missouri Leadfields Company. Additional property has been judiciously acquired and several other tracts have been optioned that are now being prospected. By the end of 1907 this company will be the largest producer in the district with the exception of the St. Joseph Company, and if its present rate of growth continues, it will even eclipse that famous property.

OTHER COMPANIES

The Columbia Lead Company has eliminated the internal legal troubles, that put it into the hands of a receiver, by the majority interests buying out the minority holders, but beyond doing some prospecting, it has not yet started up its mines.

The Union Lead Company's property is under option to the Doe Run Company, which is drilling it, while the Penicaut lands are under option to the St. Joseph Company.

In Madison county, the North American Lead Company is going into the nickel business by utilizing the large body of mixed nickel, cobalt, copper and iron sulphurets that have hitherto been

neglected. It is now erecting a large smelting and refining plant that will cost \$250,000 and is expected to be ready by July 1, 1907. It will not only work its own ores, but also will treat similar ores that are found on the adjoining Catherine and Mine La Motte properties.

The Madison Land and Mining Company has enlarged its plant by putting in a 20-drill air compressor and erecting a new 200-ton mill. Later on it expects to enlarge the latter to 400 tons and then to abandon its first mill, which is only 150 tons capacity. It installed a Hancock jig in the old mill, replacing the Harz jigs, and is so well pleased with it that it will use Hancock jigs in the new mill.

The old Mine La Motte property is being rejuvenated under the new Pittsburgh management and is recovering from the blight inflicted on it by the Dougherty & Albers stock scheme. The old copper-mine lease to the Hudson Valley Mining Company was actively and successfully worked during 1906 and is producing from 18,000 to 20,000 lb. of concentrates daily.

The outlook for the district during the coming year is excellent, and if the scarcity of labor does not interfere, this year's output should exceed that of 1906, and thus maintain the healthy, steady growth that has characterized its recent history.

Lead Pigments

Any increase in the apparent consumption of lead pigments during 1906 was in the oxides, and it is doubtful whether white-lead did not show a slight falling off from the previous year.

This is attributable in a measure to the loss of the Canadian business through the imposition of a prohibitory tariff by the Dominion government, in its effort to assist in the development of a domestic white-lead industry. The effect thus far, however, has been to leave the Canadian consumers of lead pigments largely dependent upon foreign supplies, and to advance prices there very much above what white-lead from Europe or the United States would cost in bond at Dominion ports.

The prices on lead pigments in the United States established late in December, 1905, continued exactly twelve months, when the first change of the year was made, this being an advance of \$5 per ton on white-lead and the oxides, on Dec. 20, 1906.

In the face of the stocks, or contracts for deliveries, during the year at the prices current late in 1905, held by grinders, the possibilities of competition from graded lead and mixed paints was such as to render corrodors unwilling to advance the price on pure lead in oil, although the cost of pig lead had steadily

risen. But the last advance made by smelters in December brought the cost of pig lead to \$8 per ton above the figures ruling at the opening of the year, and this led to the advance of \$5 per ton on the products above referred to.

A strenuous effort is being made by the manufacturers of zinc, in coöperation with the makers of mixed paints and graded leads, to popularize zinc and the so called "inert pigments" such as barytes, silica and whiting, at the expense of white-lead. This is being done through magazine and other forms of advertising which appeal to the public, and the effort forces upon corrodors a problem in the solution of which is involved the margin they shall allow between dry lead, used as a base for all paints competing with pure lead in oil, and their price for the latter product. The margin in 1906 was narrower than usual, and although grinders and makers of mixed paints were pretty well supplied with dry lead at low prices, they have foreseen a changed condition in 1907, and have made strong protests to the corrodors against so close a relation between the dry pigment and lead in oil. In view of the fact that the interests which control probably 85 per cent. of the production of pig lead now control nearly a like proportion of the production of lead pigments, the relation which they will choose to assume toward the industries that have been prominent factors in the distribution of those products, becomes an interesting question.

The United Lead Company, which was owned by American Smelting and Refining Company interests, was merged with the National Lead Company during the year, and the latter also obtained control of the Davis Lead Company, of Pittsburgh, and the Carter White Lead Company, of Chicago. This leaves six corrodors works outside, with a capacity of about 30,000 tons of white lead and oxides.

The New York Lead Market in 1906

Not for 30 years has the lead market ruled at as high an average as during 1906. The high level of 1906 was due not only to the fact that a very large proportion of the output is controlled by one interest, but also to the underlying conditions, which were such as fully to warrant the high market. Consumption overtook production, and not only was a large amount of foreign lead, refined in this country, retained for domestic consumption, but also during the summer several thousand tons were actually imported from Europe. More than the normal expansion has occurred in all lines of manufacture; an unprecedented tonnage was used up by cable makers.

The increase in the production of lead, particularly in the Far West, was not commensurate with what could have been reasonably expected on account of the

market conditions. This was due, in the first place, to the non-discovery of large new lead deposits, and, secondly, to the obstacles in the way of utilizing present facilities, owing to the scarcity of labor and other causes which are hampering industrial activity throughout the country. Supplies from Missouri became more plentiful and there was a great deal of prospecting going on there as well as in the Far West, which may be expected to show results during 1907.

The year 1906 opened with lead standing at 5.60c., New York, at which price it remained until Feb. 14, when, on account of a decline in the European market, the quotation was reduced to 5.35c. No change was made until the latter half of April, when the price was advanced to 5.50c., and then in quick succession there were further advances in the early part of May to 5.60c. and 5.75c. The latter price ruled until about the middle of December, when the demands upon the sellers became so heavy that the price was raised to 6c., at which the year closed.

AVERAGE PRICE OF LEAD, NEW YORK

Month.	1905.	1906.	Month.	1905.	1906.
Jan.....	4.552	5.600	July.....	4.524	5.750
Feb.....	4.450	5.464	Aug.....	4.665	5.750
March.....	4.470	5.350	Sept.....	4.850	5.750
April.....	4.500	5.404	Oct.....	4.850	5.750
May.....	4.500	5.685	Nov.....	5.200	5.750
June.....	4.600	5.750	Dec.....	5.422	5.900
			Av. year.	4.707	5.347

Prices are in cents per pound. The London average for January, 1906, was £16.850 per long ton; February, £16.031; March, £15.922; April, £15.959; May, £16.725; June, £16.813; July, £16.525; August, £17.109; September, £18.266; October, £19.350; November, £19.281; December, £19.609; year, £17.370.

Spelter

The production of spelter in the United States in 1906 showed another large increase, considerably more, indeed than 1905 showed over 1904. The details of the production are given in the following table, which is based on reports received directly from all the producers, who reported their actual production for the first eleven months of the year, together with their own estimates of probable production in December.

PRODUCTION OF SPELTER IN UNITED STATES (In tons of 2000 lb.)

States.	1905.	1906.
Colorado.....	6,599	6,214
Illinois.....	45,357	48,048
Kansas.....	114,948	129,877
Missouri.....	11,800	11,076
South and East.....	23,044	30,180
Total.....	201,748	225,395

ZINC-ORE PRODUCTION

The Joplin district continued to be the largest producer of zinc ore, and its statistics show a material gain over 1905. This is explained by the general stimulus to mining inspired by the high prices for the ore and metal; and also to further improvements in the milling practice, which have led to a higher extraction of mineral from the ore. Whereas only a few years

ago the average extraction in the district was probably not more than 70 per cent., at present it is believed to be in the neighborhood of 75 to 80 per cent. The effect of this improvement upon production is obvious.

Outside of the Joplin district, Colorado continued to be the largest producer of zinc ore. In regard to tonnage, Colorado probably leads all of the other States, but it is to be remarked that a large part of its zinc ore undergoes milling, which greatly reduces the tonnage actually received by the smelter, while moreover the finished product is of much lower grade on the average than is that of the Joplin district. Among the zinc-producing districts of Colorado, Leadville continues to be far in the lead. Other important districts in 1906 were Creede, Rico, Breckenridge and Red Cliff.

Among the other western States, New Mexico leads, its output in 1906 having shown a large increase over 1905. However, the major part of the output of this Territory is used for the manufacture of zinc oxide, rather than for spelter. Zinc ore was also produced in Utah, Nevada, Montana and Idaho.

Among the States east of the Mississippi, Wisconsin showed an important increase, far more indeed than the statistics alone indicate, because the average percentage of zinc in the finished ore produced there has increased materially.

The production of Kentucky in 1906 was small, but arrangements are being made which will doubtless lead to a considerable increase in the output in 1907, the problem of successfully separating the ore having been solved by the introduction of a flotation method. The Sanders Separating Company used this process at Marion in 1906. Two new ore-separating companies have been organized, which will probably be operating in 1907. The results of the year in Tennessee were rather disappointing, but one or two mills will probably be built in the Holston district in 1907. In Virginia, zinc mining was temporarily at a standstill. In New Jersey, operations were continued as usual at the Franklin mine, where, however, the management was changed, which possibly may indicate a change in the method of mining.

THE SMELTING INDUSTRY

Among the smelters, the works of the Mineral Point Zinc Company at DePue, Ill., were completed, and that company entered the market for ore. The works of Hegeler Brothers at Danville, Ill., are not yet completed. Another one of the old smelters at Pittsburg, Kan., was put in operation. Otherwise there were no new producers during the year. Several new plants are now under construction, however, including one at Bartlesville, Ind. Ter., and one at Dearing, Kan., and several more plants are in contemplation for 1907. Also, another one of the old coal smelters of Kansas will probably soon be put in operation.

A feature of the year was the entrance of two more of the mining companies of the Joplin district into the smelting business, these being the American Zinc, Lead and Smelting Company, and the United Zinc Companies.

The year was one of great prosperity in the smelting business, the margin between spelter and zinc in ore being so large as to yield a very handsome profit. The only troublesome factor was the further diminution in the supply of gas at Iola, but the shortage has not yet become sufficiently acute to cause any falling off in the production of that district. Doubtless the smelters there will continue to work with a low pressure of gas for some time to come, just as was the experience in Indiana.

The smelters of Kansas obtained a large supply of ore, chiefly carbonate, from Mexico during 1906, very much more than in the previous year. The protest of the smelters against the decision of the Treasury Department, making this ore dutiable at the rate of 20 per cent. *ad valorem*, instead of classifying it as "calamine," which according to the Dingley tariff is on the free list, was argued at New York before the Board of General Appraisers. The decision of that board has not yet been rendered. Several smelters were buyers of Western and Mexican ore in 1906, who had previously limited their purchases to the Joplin market.

EUROPEAN AND AUSTRALIAN SMELTERS

The production of spelter in Europe is also likely to show an increase in 1906. In Upper Silesia, the most important single district, the output in the first nine months of the year was 101,378 metric tons, against 96,097 metric tons in the corresponding period of 1905. The European smelters have received bountiful supplies of ore from Broken Hill, Australia, whence the offering of this raw material is destined to increase greatly. Largely on this account, the smelting capacity of Europe is being greatly increased, new and large works being now under construction in Great Britain, France and Germany. Australia itself will also become a larger producer of spelter, the idea being to make as much there as is required for home consumption. The Sulphide Corporation has already a works in operation at Cackle Creek, and its capacity is to be increased materially in 1907. The Central Zinc Company, a subsidiary of the Sulphide Corporation, is building a large works in Great Britain. The Broken Hill Proprietary Company now has the plans ready for a plant to be installed at Port Pirie, Australia, the construction of which will be proceeded with in 1907. In the meanwhile, the Zinc Corporation is considering the erection of a large plant. The outlook is, therefore, for a large increase in the supply of spelter outside of the United States in the near future.

Zinc Mining in Wisconsin in 1906

BY E. W. MOORE*

It is now about five years since the first modern mill was put in active operation in the southwestern Wisconsin zinc field and those who at first were pessimistic as to the outcome have been forced to admit that they were wrong. The highly satisfactory prices, which have continued throughout 1906, have done much to spur on the local investors and also to induce outside capital to come into the field, but it is a self-evident fact that, no matter how high the prices of zinc may go, if the majority of the mines in the Wisconsin-Illinois district do not make good, nothing could induce anyone to take a chance. Another factor of great importance to which must be ascribed some of the remarkable growth of 1906 is the commercial perfection to which magnetic separation has been brought. Many producers state positively that were it not for the present type of roaster and magnetic separating plant, as generally used, the district would not amount to much. This fact metallurgically is considered one of the most important results of the year, for aside from demonstrating beyond a question of a doubt that magnetic separation pays commercially in the Wisconsin zinc fields, it has made it possible to work up a vast number of old dumps that were considered useless. Many new processes have been proposed and a few tried, but so far, for all kinds of ore, the slow-roast process of the Galena type of roaster has been the only one that has stood the test and given satisfaction.

USE OF CORLISS ENGINES

From the advent of the first mill in the district to the present day, the necessity for more economical and dependable methods of ore concentration has been continuously in evidence; but so far nothing startling has been developed. Some extravagant claims have been made along the lines of greater economy in operation of steam-driven machines, and, in many instances, machinery has been installed that has substantiated the manufacturer's claim of sustained economy. The majority of the engines that are now being installed are of the Corliss type. Along the lines of economical installation it has been found that the heavy-duty type of Corliss engine is particularly adapted to the strenuous work required in the concentrating and power plants. Early in the summer considerable interest was evinced at the installation of a gas-producer plant, but for some reason nothing much is said about it, although the plant is running. However,

*General manager, Galena Iron Works, Platteville, Wis.

the general trend is toward Corliss engines and compound steam and air compressors. About 95 per cent. of the steam installations are now of plants designed for more economical operation, and the fact that the economy of two-stage compression is recognized is shown by the number of compound air compressors in operation; in one or two instances both the steam and air ends are compounded.

Paramount among the many improvements has been the gradual education of the miners and mine operators along the lines of mechanical devices used in cleaning their ores. There was a time when all of the uses of the different machines around a mill and methods of handling them were not thoroughly understood, and a great many expensive delays were thereby occasioned.

It has been found that the small mill (of about 50 tons capacity per 10 hours) is best suited to the underground conditions of this district. If for no other reason, it enables the operator to cull down his mine run and only run through the dirt that contains pay ore, whereas with the larger mill it is necessary to run through everything to keep things going and the ground boss is often tempted to side-shoot in the deads in order to "give 'em enough dirt on top."

PRODUCTION AND PROSPECTING

Unless one is thoroughly acquainted with the existing conditions in the Wisconsin-Illinois zinc district, it will be difficult to see much of an increase in tonnage production, as against last year. It will be necessary to go behind the reported figures showing the net tonnage shipped to the smelters. If this is done it will be found that 75 per cent. of all the ore now produced in the district is now finally treated in magnetic separating plants which materially reduces the gross weight; consequently the total gross tonnage exceeded that of last year by about 85 per cent., a marvelous growth when it is remembered that it has been necessary to locate the ore by the slow and laborious method of churn-drilling; then shafts have had to be put down and buildings erected, machinery installed and all within a short period. Last winter and spring 300 or 400 drills were busily prospecting for ore; today it is estimated that there are less than 75. This is due to several reasons, chief among them being that those who were drilling are now spending their money in development work. It is not to be wondered at if many mistakes have been made in the rush to endeavor to accomplish in a twelvemonth what it has taken other zinc fields several years to attain. The prospectors and operators have been forced to accept the conditions as they were found and make the best of them. The main question has been, "Is it profitable to do thus and so, commercially?"

It is true that considerable waste has resulted in endeavoring to obtain the largest turn-ins obtainable, regardless of other results. At first it was not known whether or not the mines would last more than a year, but it now appears that in many of the present producers there is more ore in sight than has been taken out. Owing to this uncertainty a great many of the first installations, where expert help was not sought, were done hurriedly and with no thought of permanency and consequently were incorrectly designed, and some work has had to be done over again.

GENERAL SUCCESS IN MINING

A thing that must strike the observer of the conditions in this district is the comparatively small proportion of absolute failures and the comparatively small area yet developed. Although the district has been a producer for over half a century, it is only within the last few years that any great amount of money has been invested in it. During the last year it is estimated that \$1,500,000 has been invested in new enterprises. Nearly 70 per cent. of the new ventures, it is claimed, will be successful. A noticeable feature is that fully 90 per cent. of the new strikes have been made in the immediate vicinity of, or on the outskirts of, the lead diggings of the early days, and that nearly all of the strikes in new territories show the same conditions of the early days, excepting that the old water levels have been lowered.

Improved pumping methods have demonstrated the fact that the water problem is not nearly as bad as at first it was thought it would be. In the early days the inadequate pumps made it appear that the water in the mines was of unusual amount and that it took a fortune to keep the mine unwatered. It is now known that a great number of the mines do not yield anywhere near enough water to supply the concentrating plants.

NEED FOR MORE CAPITAL

The territory surrounding Platteville, Hazel Green, Benton, Cuba City, Mineral Point, and a few other camps, has seen more paying properties come to life than any of the others. Probably the main reasons for the prominence of these camps are their proximity to railways and good hotel facilities.

So far the principal activity has been confined to the camps where ore was known to be, although between Platteville and Big Patch camps there is now a string of mines widely separated, but nevertheless showing that the ore runs (as some are inclined to believe) in undulating waves from these two camps at least.

In spite of the great amount of outside money that has already come into the field, the progress of the district is being retarded for lack of capital; as in all other mining districts, new

prospects have opened up faster than the local capital has been able to take care of them. Many mining men from the copper and iron fields are coming into the Wisconsin zinc district.

The Mineral Point Zinc Company (a subsidiary of the New Jersey Zinc Company) has pursued its policy of buying up a number of zinc properties. A commendable proceeding of some connected with this company was in several instances to advance the funds to carry on operations to the producing period, securing as a remuneration a half interest in the mine. Other large companies, heavily interested in zinc elsewhere, have been quietly acquiring control of good mines and mining lands.

NEW DEVELOPMENTS

The railroads have continued their broad policy and have aided developments materially by their readiness to meet the operator half way whenever it has been found necessary to run spurs or sidings. The C. M. & St. P. is at present contemplating a new route into Platteville, which will give several of the promising mines splendid side-track facilities.

The general prosperity of the mines has made itself felt in the different local camps. In order to take care of the increased number of inhabitants, mostly people connected with the mines, it has been necessary to build new homes and hotels. The local foundries have been pushed to their utmost, but by increasing their capacity have been able to keep pace with the rapid growth. There is not a village or hamlet in the entire district but has felt the impetus due to the success of the majority of the mines.

A local paper reports the proposed erection of an oxide plant in the near future, site not yet definitely decided, but it is said the choice lies between Benton and Galena.

The proposed electric railway and power plant is still in abeyance, but it is stated on reliable authority that the work of building will in all probability begin in the early spring. There is no doubt but that the mines will be greatly benefited by this as it will mean cheaper power and lower haulage costs.

The results in the zinc industry of southwest Wisconsin have more than exceeded the most sanguine expectations of a year ago. Today there are in operation about 60 concentrating plants and a conservative estimate shows that at least 50 more mines will be ready for mills before 1907 closes. At the beginning of 1906, there was a general rush on all sides to put up mills, regardless of development work, and in the excitement several mills were erected a little prematurely, and one or two were built on properties that will probably never make good, but fortunately the majority of the prospectors learned a lesson and are benefiting thereby, as also is the district generally.

The Joplin District in 1906

BY JESSE A. ZOOK

Last year, 1906, was foremost in the tonnage of zinc and lead concentrates shipped, and in the combined value of the two minerals. It was by long odds the greatest year the Missouri-Kansas district has ever known. As 1905 excelled all preceding years in the value of the zinc and lead concentrates marketed, so 1906 eclipsed even its immediate forerunner, there having been an increase of \$1,800,000 in the value of the products shipped to the smelters. This refers to the value of the concentrates f.o.b. at the mines. The year put on record a price of \$85.50 per ton for galena concentrate, \$5.50 per ton higher than the closing price of 1905.

THE LABOR SITUATION

In writing at the close of 1905 it was noted that 1906 "should show a marked reduction in cost per ton of concentrate. * * * unless the demands of labor should absorb the saving." Additional cost for labor has prevented any marked reduction in cost, but it has been the exigencies arising from a scarcity of labor rather than the demands of labor. The prospect of trouble from organized labor, manifest at the close of 1905, was swept away by the general prosperity of the district and a higher wage scale resulted from the competition for labor.

LIGHT SUMMER DEMAND

The rainfall of the year was largely confined to the period between the latter part of April and the first of July, and was so distributed as to cause no serious obstacle to mining. Subsequent to July the year was comparatively dry and exceptionally good weather prevailed for mining, development and prospecting. The principal drawback of the year was the lightness of demand for ore throughout the spring and summer, believed locally to have occurred as a rebuke to producers for making their stand for an import duty on importations of Mexican carbonates.

CHANGES IN POINTS OF PRODUCTIONS

The mines of the Chitwood group, in Joplin, which held up the Joplin product for several years, were not such heavy producers in 1906, the points of production changing to the west and southwest, east and southeast of Joplin, the largest development of the year being on the southwest.

Oronogo, Webb City and Carterville have become merged by the development of new mines in the south part of the corporate limits of Oronogo, the output of which mines has been classed in Webb City-Carterville, taking Center creek as the natural dividing line, instead of the line of municipal incorporation, which extends nearly a mile on the Carterville side of the river.

The Porto Rico group has maintained

the equilibrium of the worked-out mines of Duenweg. Alba and Neck City show the heaviest increase of shipments on the Missouri side of the line, while the Galena-Empire mines have held up the Kansas side with a material increase.

LARGER DEMAND FOR 1907

The completion of a new smelter at DePue, Illinois; one at Bartlesville, Indian Territory; one at Dearing, Kansas, and another projected by the European stockholders of the Pueblo works, would seem to insure a steadier and perhaps stronger demand for Missouri-Kansas zinc concentrate during 1907.

PROBLEMS OF 1907

The record of the last three years has fairly demonstrated that the price for zinc concentrate cannot be held below \$45 per ton of 60 per cent. zinc to insure a permanently steady output.

The year should bring economies in labor-saving machinery in every manner practicable, to offset the scarcity of labor felt during 1906. The new year begins with several mills in operation that will change many fixed ideas regarding size, economy in operation and savings.

During 1906 many mills were equipped with various and sundry tables for handling slimes. The best is yet to be determined. The same is evident in the installation of gas engines. There are too many cheap, makeshift ones introduced.

While the idea is slowly changing to the installation of heavier and better machinery, the peculiar prospecting and development conditions of the district require only a cheap plant, and the same cheapness is too often followed in subsequent mill installation.

PRODUCERS ENGAGE IN SMELTING

At least two more companies holding the fee to a large acreage of Missouri mineral land, have become interested in smelting, that is, have a holding of stock in a smelter now in course of construction. The Granby Mining and Smelting company, the largest fee owner in the district, has been engaged in smelting several years. Report is current that still another company holding a fair-sized acreage, and producing the largest weekly tonnage, will either engage directly or be represented in a smelter in 1907.

A representative of the United States Zinc Company, owner of the smeltery at Pueblo, Colo., was in the Joplin district early in December, from whom it was learned that a smelter was being projected in the natural-gas field for smelting Missouri-Kansas zinc concentrate.

ZINC ORE PRICES

Zinc concentrate sold at \$53 per ton the first week of 1906, advancing to \$54 the following and succeeding four weeks, dropping successively to \$53, \$52, \$51, and \$50 for two weeks, then to \$49 the third week in March. March closed at \$52 and April opened at the same price, followed

by a decline to \$49, to \$47, and to \$45. All through May \$44 was the highest. June showed a fluctuation from \$45 at the first to \$50 three weeks later, declining to \$49, \$48 and \$47, up to \$48 for four weeks, then \$48.50 and \$49, returning to \$48 in the first fortnight of September, dropping to \$46 and closing the month at \$47. For three weeks of October the price was \$46, closing at \$48. The first half of November it was \$58, the third week \$49.50, closing at \$48.50.

The highest price paid for first-grade zinc concentrate was \$54 in January and February, buyers inaugurating a decline immediately upon the decision of the treasury assessing an *ad valorem* duty on importations, from which the price continuously declined to the low point of \$44 in May.

The average price for all grades of zinc concentrate, during the first eleven months of 1906 was \$43.24, against \$44.88 last year.

High zinc prices will be less a factor in the future, as all buying has been changed to an assay basis strictly, with deduction for actual moisture carried in the concentrate.

The highest assay basis price during 1906 was \$50 in January and February; the lowest \$40 the last week of April, all of May and the first week of June. An average basis of 60 per cent. zinc for the year ranged from \$42 to \$44 per ton.

LEAD PRICES

Lead concentrate began 1906 at \$80.50 per ton, advancing to \$81, declining to \$80 and closing January at \$76. The first half of February it was \$78.50 and the last half down to \$72. March recorded \$73, \$76.50, \$79, \$80, and closed at \$78. April fluctuated from \$76 to \$78.50; May from \$79 to \$83; June from \$83 to \$78; July from \$78 to \$75; August from \$78.50 to \$82; September from \$84 to \$82.50; October from \$82 to \$84.50; November from \$83 to 85.50.

The highest price for lead concentrate was \$85.50, at the close of November; the lowest price for first grade was \$72 in February; the average all grades, eleven months, was \$77.40, as against \$62.12 last year.

HIGH AND AVERAGE PRICES

The following table embraces the highest and the average price of zinc and lead concentrate for each of the last eight years:

ZINC		
	Highest	Average
1906.....	\$54.00	\$43.24
1905.....	60.00	44.88
1904.....	53.00	35.92
1903.....	42.00	33.72
1902.....	42.00	30.33
1901.....	34.00	24.21
1900.....	38.50	26.50
1899.....	55.00	36.61

LEAD		
	Highest	Average
1906.....	\$85.50	\$77.40
1905.....	80.00	62.12
1904.....	62.00	54.80
1903.....	60.50	54.12
1902.....	50.00	46.10
1901.....	47.50	45.99
1900.....	56.50	48.32
1899.....	55.00	51.34

SHIPMENTS AND VALUES

The total shipment of zinc concentrate for 1906 was 279,653 tons, valued at \$12,095,752; the total shipment of lead concentrate was 39,156 tons, valued at \$3,031,118; the total shipment of both zinc and lead concentrate was 308,890 tons, valued at \$15,126,870.

The following table embraces the shipments of zinc and lead concentrate and their combined values for 13 years:

	Zinc tons	Lead tons	Value
1906.....	279,653	39,156	\$15,126,870
1905.....	252,435	31,679	13,302,800
1904.....	267,240	34,362	11,487,350
1903.....	234,873	28,656	9,471,395
1902.....	262,545	31,625	9,430,890
1901.....	258,306	35,177	7,971,651
1900.....	248,446	29,132	7,992,105
1899.....	255,088	23,888	10,715,307
1898.....	234,455	26,687	7,119,867
1897.....	177,976	30,105	4,726,302
1896.....	155,333	27,721	3,857,355
1895.....	144,487	31,294	3,775,929
1894.....	147,310	32,190	3,535,736

Total.....2,918,147 401,672 \$108,513,557

REDUCED TO METAL

The zinc ore produced in the Missouri-Kansas district in 1906 represents approximately 140,000 tons of metallic zinc. Whatever the total United States tonnage of metallic zinc may show, the difference between the product of this district and the total will show unmistakably the product from all other sources, including Wisconsin, the Western States and importations from Mexico. The tonnage of ore from all other sources will exceed that of this district and yet it is doubtful if the metallic zinc tonnage will reach 60 per cent. of the product of the Missouri and Kansas mines.

Zinc and Lead Mining in Virginia

BY J. A. VAN MATER*

Some prospecting was carried on in 1906, but no important results were realized. The Albermarle Zinc and Lead Company continued to explore its mine at Fabers, Nelson county, by sinking the shaft 60 to 70 ft. deeper and driving a cross-cut at the bottom, since which time the property has been idle. The company has a mill equipped with Krom crushers and rolls and Krom air jigs, but it has never been run, except experimentally.

The Cedar Spring Zinc Mine and Development Company, now called the Columbus Mining Corporation, at Cedar Springs, near Rural Retreat, in Wythe county, also has a mill which has never been run, because sufficient development work has not been done to supply it. The company is now giving its attention to prospecting and developing its property.

The only zinc and lead production during 1906 was made by the Bertha Mineral Company from the old Wythe mines at Austinville, in Wythe county, and this

*General manager, Bertha Mineral Company, Pulaski, Va.

was entirely from surface workings, which are now practically exhausted. The total amount of zinc concentrate (carbonate and silicate) was about 500 tons and about 50 tons of lead concentrate (carbonate and galena). This output was considerably curtailed by the scarcity of men during the year, necessitating the closing down of all surface mining operations the early part of the summer. Development was prosecuted vigorously throughout the year on the sulphide ores, which were found about 200 ft. below the surface. The shaft was sunk 100 ft. below the tunnel level, or 335 ft. below the surface and the mineral developed on both the 235-ft. and 335-ft. levels by drifts and a winze between these two levels; in places considerable pyrite was encountered. Boilers and compressors have been erected for furnishing the mine with air, and air drills were in use throughout the year. The development, on the whole, has been encouraging, though no large area has yet been opened up. The deposit is not continuous, but the ore seems to occur wherever the rock conditions have been favorable for mineral deposition. It is a difficult property to develop, as there is apparently no connection between the deposit already located and others, if they exist. A mill of 10 tons capacity per hour was erected during the year for concentrating these sulphide ores and will be ready for operation about Feb. 1, 1907. If the separation is a success this property will be a small producer during the coming year; in the mean time the development work will be pushed as much as possible.

AVERAGE PRICE OF SPELTER

Month.	New York.		St. Louis.		London.	
	1905.	1906.	1905.	1906.	1905.	1906.
Jan....	6.190	6.487	6.032	6.337	25.062	28.225
Feb....	6.139	6.075	6.989	6.924	24.594	26.844
Mar....	6.067	6.209	6.917	6.056	23.825	24.563
April..	5.817	6.078	6.667	5.931	23.813	25.781
May....	5.434	5.997	5.284	5.848	23.594	27.000
June..	5.190	6.096	5.040	5.948	23.875	27.728
July..	5.396	6.006	5.247	5.856	23.938	26.800
Aug....	5.706	6.027	5.556	5.878	24.675	26.938
Sept....	5.887	6.216	5.737	6.056	26.375	27.663
Oct....	6.087	6.222	5.984	6.070	26.225	28.075
Nov....	6.145	6.375	5.984	6.225	28.500	27.781
Dec....	6.522	6.593	6.374	6.443	28.719	27.938
Year.	5.822	6.198	5.730	6.048	25.433	27.020

New York and St. Louis prices are in cents per pound. The London prices are in pounds sterling per long ton (2240 lb.) good ordinary brands.

It is reported that a large bed of bessemer hematite ore has been discovered near Port Arthur, Ont. The deposit lies about 20 miles east of Port Arthur, and covers an area averaging about three miles in width and six miles in length, reaching to within 1000 ft. of the shore of Thunder bay, Lake Superior. It is estimated to contain at least 200,000,000 tons of high-grade ore. The deposit ranges in thickness from 8 to 35 ft. All of it can be quarried without underground work being done.

PRODUCTION OF OTHER METALS AND MINERALS

Aluminum—Antimony—Quicksilver—Tin—Statistics and Commercial Conditions

The production of the minor metals is shown in the several articles which follow. Tin, the most important of these, reports about the same production as in 1905, but an increased consumption, leaving no surplus for future demands. Quicksilver output does not increase, as some of the old mines are partly worked out, and new ones have not yet taken their place. Aluminum gained slightly, and the others show little change.

Aluminum

The production of aluminum in the United States in 1906 is estimated at 14,350,000 pounds, valued at \$5,166,000 against 11,350,000 pounds, valued at \$3,632,000 in 1905. A further great increase in the production is to be expected in 1907, for which year the total is likely to reach between 25,000,000 and 30,000,000 pounds. The average market price of aluminum in 1906 was 35 @ 36½c. per lb. for 99 per cent. metal and 34 @ 35c. per lb. for No. 2 grade of ingots, according to size of purchase.

The production of aluminum in Canada in 1906 is estimated at 6,000,000 lb. against 3,100,000 lb. in 1905.

Antimony

The high price for this metal in 1906 redirected attention to the deposits of antimony ore which exist in the West, especially Utah, Nevada and Idaho. There was a small production in those States, as to which complete statistics are not yet available, except for Idaho, where 40 tons (metallic content) was produced. A new antimony enterprise has been organized to operate a mine in Utah, which is said reliably to possess a large quantity of high-grade stibnite.

THE ANTIMONY MARKET FOR 1906

Last year has witnessed a remarkable rise in the market value of antimony. Supplies of antimony ore were again rather inadequate and the exhaustion of the more important antimony mines in China made itself keenly felt. The consumption of the metal increased considerably, and the different European governments were large buyers of antimony for ammunition purposes.

The production of antimonial lead, which is gained as a by-product in lead smelting, did not come up to the demands, and low-grade antimonial lead had to be manufactured out of lead and antimony. This low-grade antimonial lead is used to a large extent in storage batteries and as sheet lead in acid chambers.

At the beginning of 1906, antimony was selling at about 14@15c., depending upon the brands, and remained stationary for a few months. During March, however, the demand became so large and supplies so scarce that prices were driven up at a furious rate so that at the beginning of June Cookson's and Hallett's antimony commanded a price of 25@26c., while outside brands could be secured for about ½c. cheaper. After the heavy demand had been satisfied prices settled down. There was, however, at all times a scarcity of spot supplies for the reason that the production at the French and Italian works were frequently interrupted by strikes, and shipments which were contracted for a specified period were, in most cases, not made until a few months later.

The market remained neglected until the middle of October, when large contracts were again being entered into by dealers and speculators in this market. Prices then quoted ranged between 24½c. and 25c. for ordinary, 25½c., for Hallett's and 26c. for Cookson's brands. At the end of the year the market was again dull and neglected. This condition can invariably be observed in the antimony market after a spasm of great activity.

Tin

There was a small production of pig tin in the United States in 1906, made experimentally in the Black hills. There was also a small production of tin ore in the Carolinas and elsewhere. However, tin mining in the United States continues to be insignificant.

The statistics show a further decrease in the tin production of the Straits Settlements in 1906. On the other hand, there was a considerable revival of mining in Cornwall and Australia, stimulated by the high price for the metal, and tin production in Bolivia continues to forge ahead.

The production of Tasmania will probably show a decrease, inasmuch as the Mount Bischoff mine appears to be approaching exhaustion. The unfavorable reports from this company caused a great fall in the value of its shares.

According to Vice-consul-general G. E. Chamberlin, the exports of tin, in tons (2240 lb.), from the Straits Settlements, including the ports of Singapore and Penang, during the first nine months of 1905 and 1906 were as follows:

	1906.	1905.
United States.....	10,777	13,055
England.....	26,434	23,552
Continent of Europe.....	6,051	6,524
Total.....	43,262	43,131

The output of all the tin-producing States of the Malay peninsula for the first nine months of 1905 and 1906, in tons of 2240 lb., was as follows:

	1906.	1905.
Perak.....	19,271	19,740
Selangor.....	11,975	12,889
Negri Sembilan.....	3,452	3,738
Pahang.....	1,515	1,502
Total.....	36,213	37,869

According to the market reports of shipments from the Straits Settlements for the first nine months of 1906, there was shipped 43,262 tons, or 7049 tons more than the commissioner of mines reports the output of the mines. This shows conclusively that there was a large amount of tin on hand, held back to control the market and take advantage of the higher prices which prevailed during 1906.

The production of tin is largely from countries where the mineral statistics are not kept at all, or are collected very imperfectly. It is necessary, therefore, to compile them from the trade statistics of imports and delivery. From these sources we obtain the following figures for the 12 months ended Nov. 30; they are in long tons:

Shipments:	1905.	1906.	Changes.
Straits.....	58,547	50,307	D. 240
Australia.....	5,528	6,352	I. 824
Banka and Billit.....	12,675	11,194	D. 1,481
Cornwall.....	3,857	4,100	I. 243
Bolivia.....	12,500	12,500	.....
Miscellaneous.....	800	950	I. 150
Total.....	93,907	93,403	D. 504
Deliveries:			
Europe and U. S.	89,499	91,369	I. 1,870
India and China.....	1,700	1,500	D. 200
Miscellaneous.....	960	1,050	I. 100
Total.....	92,149	93,919	I. 1,770

It is necessary to combine the deliveries to Europe and the United States, since a large part of the shipments to America go to England or Holland in transit, and are credited to those countries.

Imports of tin into the United States, estimating November and December, were 44,450 tons; showing a consumption in this country of 47.3 per cent. of the total production.

In these figures we have not included the production of China, which is altogether an uncertain quantity. Moreover, it is in large part consumed in that country, though Yunnan tin finds its way to the general market, in quantities estimated as high as 4000 tons or over in a year.

AVERAGE PRICE OF TIN AT NEW YORK

Month.	1905.	1906.	Month.	1905.	1906.
Jan.....	29.325	36.390	July.....	31.760	37.275
Feb.....	29.262	36.403	August....	32.866	40.606
March.....	29.523	36.662	Sept.....	32.095	40.516
April.....	30.525	38.900	Oct.....	32.481	42.852
May.....	30.049	43.313	Nov.....	33.443	42.906
June.....	30.329	39.260	Dec.....	35.836	42.750
			Av. year.	31.358	39.819

Prices are in cents per pound.

Zinc Oxide

The production of zinc oxide in the United States in 1906 was 68,549 tons, against 65,403 tons in 1905. The average market value of the product, at the works, was approximately the same as in 1905, viz., 4c. per lb., the advance in price, which occurred during the latter part of the year, not affecting the average to any appreciable extent. During the year, the Ozark Smelting and Mining Company completed and put into operation its new plant at Coffeyville, Kan. There were no other new producers in 1906, but it is understood that the Tri-Bullion Smelting and Development Company, of Magdalena, N. M., contemplates the erection of a plant in 1907.

The production of zinc-lead pigment by the United States Smelting Company, at Cañon City, Colo., in 1906, was 5749 tons, valued at \$85 per ton, against 7200 tons, valued at \$75 per ton in 1905.

Quicksilver

The production of quicksilver in the United States in 1906 was 27,276 flasks valued at \$1,031,667, against 30,705 flasks, worth \$1,142,884 in 1905. California is still the mainstay of the industry. The Texas quicksilver district, about which such high hopes have been entertained, has not yet become an important contributor to the output, although from no lack of enterprise. Distance from railroads, and a variety of natural drawbacks are the retarding features. The old Sacramento mine of Mercur, Utah, is making a small output of the metal in search of which the camp was first founded; development of the Blackbutte, Ore., quicksilver mines continued through 1906, but no output of metal was recorded. An excellent reduction plant has been put up here, and a few experimental furnace runs have been made. A new cinnabar deposit in Yuma county, Arizona, is being developed by the Colonial Mining Company at a point 14 miles from Ehrenberg, but no furnace has yet been installed.

The production of quicksilver in the United States during the last three years has been as follows in flasks of 75 lb.:

	1904.	1905.	1906.
California	28,876	24,655	22,500
Texas	5,386	5,000	23,500
Utah	700	1,050	1,276
Total	34,912	30,705	27,276

a Partly estimated.

CALIFORNIA

SPECIAL CORRESPONDENCE

California for over half a century was the only section of the country which produced quicksilver, until recently when the Texas mercury mines were opened. The State still, however, yields the largest proportion of the liquid metal. The industry is not in these days as remunerative as it was formerly when there was no

cyanide process and when hundreds of silver mines were worked where one is now.

California produced in 1905, a total of 24,655 flasks of mercury valued at \$886,081. In 1906, as near as can be estimated without detailed returns from the producing mines, there were 2000 flasks less output than in 1905. The domestic sales decreased in direct proportion to the decreased yield. There were in 1906 virtually no exports to China, and only a limited amount to Japan. This has been a good thing for the California producers, because the quicksilver sold in the Orient brings less price than that sold in domestic market. It is sold abroad only as a matter of necessity, to dispose of the surplus product of this country, and these foreign sales reduce the general average prices received by the California quicksilver men. Therefore the California men really did better in 1906 than they did the previous year, though the product was materially less. Mexico, one of the California markets for quicksilver, has greatly decreased its annual demand because its own native product is preferred, and the Mexico quicksilver mines are now producing at a good rate. This leaves a stock to supply the increased requirements of the Eastern States.

The average prices for mercury throughout the United States in 1906 were \$38.50 to \$39.50 per flask of 75 lb., the lowest being naturally near the points of production in California and Texas. The latter State decreased its product about 25 per cent. The principal mine there shipped considerable less than in the previous year and while some smaller mines started up their output did not make up the decrease of the largest producers.

Sales of California quicksilver might have been made in China at an offered price of \$30 per flask, but this offer was rejected. What very little was shipped to the Orient brought \$31.50 per flask. California about held its own in prices by not shipping to the Orient, though the output was smaller for the year, as stated.

If the prices of silver are maintained, certain silver mines with lower-grade ores may resume operations using the amalgamation process, which will create a demand for quicksilver. The higher-grade silver ores are now shipped to smelters so no mercury is used in their reduction. Indeed it is to the prevalent use of the cyanide process that the decreased demand for mercury is due, coupled with the present custom of shipping ores to smelters.

The New Idria mine in San Benito county, which is yielding 600 flasks per month and is supposed to be in a condition to maintain this rate of production for many years to come, is now the only California quicksilver mine paying dividends. The famous old New Almaden mine in Santa Clara county is now in-

creasing its output, as is also the Socrates at Pine Flat, Sonoma county. The Napa Consolidated is yielding less by one half than formerly. Some of the San Luis Obispo county mines have closed down but others are working. One new mine in Stanislaus county recently started up, but very few new quicksilver properties in California are being put into operation.

TEXAS

Only four of the quicksilver mines in the Terlingua district produced any quicksilver in 1906: the Marfa & Mariposa Mining Company; the Lone Star Mining Company; the Chisos Mining Company; and the Texas Almaden Mining Company, otherwise known as the Dallas Mining Company. The last is at Big Bend and all the others are at Terlingua. The Lone Star is now closed down. The Chisos did not smelt its ore in its own furnace, although extensive additions to the plant are now under erection. Two other former producers, the Terlingua Mining Company and the Big Bend Cinnabar Mining Company remained idle, while a third, the Colquitt-Tignor, it is rumored, will be reopened. The only mines active at this moment are thus the Marfa & Mariposa, and the Texas Almaden.

The Scott furnace is the favorite for reducing the ore. Wood is the only fuel employed, and this is becoming exceedingly scarce. The Upper Cretaceous shales of the district carry both oil and gas, and a fair grade of lubricating oil is not infrequently obtained with the mercury in the condensers. Coal of inferior quality is close at hand, and it has been suggested that this might be utilized for retort fuel through the medium of the gas producer.

The Texas Almaden Mining Company has recently completed a model reduction plant, containing a 20-ton Scott furnace, whose distinguishing feature is the use of extra hard and dense brick, set with special care to reduce the width and permeability of the mortar joints, for lining the condenser. By this means the soaking of quicksilver was greatly reduced, and permitted the recovery of 60 flasks of mercury in less than one month after the retorts were charged with ore; this is a noteworthy accomplishment in mercury smelting. The condensers are also housed under well ventilated roofs, whereby they are kept cool, even during the hot weather of that district. The company's mine is temporarily closed while a drainage hole is being drilled, but operations will shortly be resumed.

MARKET

The price of quicksilver in large lots at San Francisco for domestic delivery opened at \$39 per flask, but at the end of January rose to \$39.50, at which figure it remained throughout the rest of the year. As has been explained above, the price for foreign shipments ranged about \$1.50 be-

low the domestic price throughout the year until November, when it fell to \$2 below. The price at New York remained steady at \$41 throughout practically the entire year, except at its beginning and its close, when it ranged \$1 below. This lack of variation in the American market is accounted for by the pooling of the output in California. The London price opened at £7 5s., rose at once to £7 7s. 6d. and remained there until midsummer, when it fell to £7 per flask for the remainder of the year.

Sulphur

The growing importance of American sulphur was reflected in 1906 by two important events, namely, the practical taking over of the Sicilian sulphur industry by the Italian Government, under the *Consorzio Obbligatorio*, and the virtual disbandment of the Anglo-Sicilian Sulphur Company.

The *Consorzio Obbligatorio* came into being August 1, and in spite of strenuous protests, soon had full control of the Sicilian industry. The immense stocks of the Anglo-Sicilian company were disposed of to the *Consorzio* with the understanding that delivery was to be extended over a period of 12 years. The operations of the *Consorzio* led to great dissatisfaction among the producers, and to resentment among the rival shipping ports. Exports to the United States were not officially interdicted, but were largely restrained by the statute requiring the permission of the *Consorzio* to make any shipments whatever.

COMMERCIAL MOVEMENTS

Total exports of sulphur from Sicily in the 10 months ending Oct. 30 were 361,120 tons of 1030 kg. in 1906, and 391,016 tons in 1905, a decrease of about 40,000 tons. On the other hand, stocks at the end of October had increased from 416,088 tons in 1905 to 500,123 tons in 1906.

The imports of crude sulphur into the United States in the first 10 months of the year, little of which came from elsewhere than Sicily, amounted to only 65,380 long tons, as compared with 71,027 tons, and 114,838 tons during the same periods of 1905 and 1904, respectively. There is usually an additional import of about 1000 tons of refined sulphur per year.

The *Consorzio* also controls the selling price of the Sicilian product, and has firmly insisted on high prices; some few stocks of independent operators were soon absorbed, and the process by which the Anglo-Sicilian stocks are to be gradually absorbed will permit prices to remain at a high level. No reduction is to be looked for.

The Anglo-Sicilian Sulphur Company sold its stock to the *Consorzio* at a price which involved a loss of £298,105. To meet this loss the depreciation reserve fund was entirely wiped out and more

was taken from the general reserve fund. At its last annual meeting the company found itself unable to pay the 6 per cent. dividend on its preferred shares, and money was absorbed for this purpose from the capital guaranty fund. Steps are now under way to liquidate the liabilities, and dissolve the organization.

LOUISIANA

The sulphur industry of Louisiana has continued to grow, and had a prosperous year. We are unable to give statistics of the production. The Union Sulphur Company had great difficulty toward the latter part of the year in shipping its product. All deliveries along the Atlantic seaboard are made by boat from New Orleans, to which point the sulphur has to be transported by the Southern Pacific Railway; shipments in other directions are made by all-rail routes. The shortage of cars, which has been so prevalent, as well as of sea-going barges, has lately made it impossible for the company to insure prompt delivery.

FLUCTUATIONS IN PRICE

The price of first-grade Louisiana sulphur at New York, Boston and Portland fell from \$22.15, during the first seven months of the year, to \$20 for the remaining five months. The price at Philadelphia or Baltimore ranged about 50c. per long ton higher. This difference is due only to the fact that Sicilian sulphur costs more to deliver at Baltimore and Philadelphia than at the first mentioned cities, and the Louisiana company sees no object in quoting a different price. Roll sulphur or brimstone sold for \$2 per 100 lb.; flour sulphur at \$2.20; and flowers at \$2.40 per 100 lb. during the year.

No noteworthy change has occurred in the consumption of sulphur. It is still practically confined to the wood-pulp business, and has not yet been adopted for the making of sulphuric acid. It has been estimated by Frederick J. Falding that the use of suitable pyrite for wood-pulp manufacture in New England would induce an economy of 75c. to \$1 per ton of pulp, according to whether the plant is on the seaboard or inland. It is also generally stated that sulphur will not be generally utilized in the manufacture of sulphuric acid until it is reduced in price to \$12 or \$14 per ton, according to the location of the factory.

Magnesite

California is the only State in the Union thus far producing magnesite in commercial quantities, but the output does not exceed 4000 or 5000 tons per annum, that being about the limit of the local consumption. Thus far it has been found impossible to ship the mineral East to any extent on account of the high freight rates, the European material being furnished cheaper than the California product. While there are several dozen known

magnesite deposits, thus far very few of them have become productive, and these few are near railroad lines. A team haul of any distance is against mining this substance when other deposits have the advantage of being near railroads.

For these reasons the deposits near Porterville, in Tulare county, continue to furnish most of the magnesite used. Both raw and calcined magnesite are furnished from this point. The deposits on Red mountain, in Stanislaus and Santa Clara counties, are being worked, and the product is shipped to factories in Oakland harbor, where some is made into building material and magnesite brick. Carbon dioxide gas is also manufactured at this plant. In Contra Costa, the Magnesia Product Company, at Nobel, is making magnesia alba, and this is sold to the powder companies as an absorbent for high-grade explosives. Some is also made into paint.

The Napa and Sonoma county deposits continue unproductive owing to lack of demand at remunerative prices. It would seem as if this mineral, which in a well calcined state is fire-proof, would be largely utilized in San Francisco, where there is a demand for a fire-proof structural material. No attempt to furnish it on a commercial scale has been made, or at least it has not come into general use. As to make it fire-proof all the carbon dioxide must be eliminated, the process is a somewhat expensive one and cheaper materials are more commonly used. More or less work has been done within the year in new or old claims, but for some reason no new producers have come to the front. Unless some new uses are found, or there is a material reduction in east-bound freights, it is hardly probable that the magnesite industry of California will expand to any great extent.

Phosphate Rock in 1906

The production of phosphate rock in 1906 is estimated at 2,100,000 long tons as compared with 1,947,190 tons in 1905. The figure for 1906 is estimated on the basis of the coastwise shipments and exports for the 10 months ending October, 1906, and the ratio of those shipments to production in 1905.

The general condition of the phosphate business in Florida was highly satisfactory in 1906. The supplies continue to fall short of the demand, and at the end of the year there was nothing offering for sale before the last half of 1907, while recent prices are fully maintained, and in some cases considerable advances are asked for by the miners.

The *British and South African Export Gazette* reports that remarkable discoveries of diamonds near Kimberley have recently taken place. They are said to surpass in area and richness the existing mines of the De Beers company.

METALLURGICAL PROGRESS IN 1906

A Summary of the New Practice and Improvements in Gold, Silver, Lead, Copper, and Zinc

The year which has just closed has witnessed steady improvements in the metallurgy of the precious and common metals. The most important of these have been made in the metallurgy of gold, which subject is treated by Mr. James in a highly satisfactory manner. Only a little inferior in importance have been the improvements in the art of separating mixed sulphide ores, which have added greatly to the world's supply of zinc ore. In the metallurgy of lead, the most important developments have been on the lines indicated originally by Huntington and Heberlein. In the United States their process of lime roasting has been modified into a new process called "pot roasting," in which the presence of lime and galena appears to be a subordinate factor. However, there is some question as to the success of this modification. In the metallurgy of copper, the improvements have been especially on the lines of increasing the sizes of both blast and reverberatory furnaces, and in sintering the fine material, such as flue dust, instead of briquetting it as heretofore.

Progress in Gold-ore Treatment During 1906

BY ALFRED JAMES*

Fine sliming and the treatment of slime may be taken as the main directions of improvement in this branch of metallurgy during 1906. The use of tube mills has progressed by leaps and bounds, and is now rapidly becoming well-nigh universal, but with the adoption of fine sliming the question of slime treatment has forced itself into still greater prominence, and, as stated in my article last year, some of our keenest metallurgists have been attacking this problem. Their endeavors have met with a considerable measure of success.

As will be indicated later, progress has also been made in the treatment of difficult ores—including silver-gold ores, antimony-gold concentrates and cupriferous tailings—and in crushing, roasting, and conveying we are ahead of last year's practice.

It is interesting to note how gold-ore treatment methods have progressed into the metallurgy of the other metals. Fine sliming and prolonged cyanide treatment is in many cases ousting chloridizing roasting and the old patio process for the treatment of silver ores. Copper ore is now being leached in Chile in a cyanide plant—without cyanide—and the Merton

roaster (so successfully introduced in Australia for gold ores) has now taken quite a hold in the zinc industry for the roasting of blende, and mixed sulphides. Indeed, one cannot fail to be struck by the way in which some famed names in gold-ore treatment have temporarily been withdrawn from gold-ore treatment in favor of zinc-lead undertakings.

It is difficult to put one's finger on any one part of the world as having made the most striking progress of the year. Australia probably still has the pre-eminence. Quick-witted inventions, which may have originated in other countries, appear to be more quickly put into practice with useful results there than elsewhere; and just as Australia has taken the lead and been pre-eminent in fine sliming and in circulating cyanide solutions through the mill, so now it seems to lead in slime treatment. Probably the emulation arising from the keen up-to-date methods of the leading firm of mining engineers on the one hand, and independent managers on the other hand, has tended to place Australia in the front in the matter of up-to-date methods, high extractions and low costs. Certainly such men as Hamilton, Moss, Nicholson and Klug, and the gentlemen associated with Bewick, Moreing & Co., have cause for congratulation on the results they have achieved, and are achieving, and the adoption of their methods in other fields shows that the industry generally, and not merely locally, is under an obligation to them as well as to the alert and progressive West Australian Chamber of Mines, which has published an excellent series of articles by Mr. Allen on ore treatment as carried out at the various local installations.

American practice has chiefly busied itself with tube mills and slimes treatment. Argall, Bosqui, Butters and Merrill have all been contributing to our advancement by devising improved methods. In Africa the publication of Messrs. Denny's results at the Meyer & Charlton and New Goch has caused much interest, and generally extraction and output have been increased and cost lowered, mainly by the use of tube mills; indeed, once more record gold outputs are being produced from this territory, which has more than recovered the set-back occasioned by the war.

CRUSHING

The tendency to stage-crushing is in still greater evidence. Coarse crushers, fine crushers, heavy stamps, pans, tube mills, are not an uncommon sequence. With reference to crushing (or breaking), however, it has not yet been proved that crushing for stamps to finer than $2\frac{1}{2}$ -in.

cube is advantageous. Experiments seem to indicate that finer crushing is more expensive than the gain arising from any increase in stamp duty resulting from such finer crushing.

As for crushers, the Gates type still mainly holds the field for big work, but the Bigelow crusher (of the Black type, but with the pitman working in compression and having its weight assisting the crushing stroke) appears to be replacing the other types at Kalgoorlie, and to show a lower running cost than the gyratory or older reciprocating patterns.

Stamps of 1500 lb. weight are now in use on the Rand, and it looks as if the weight limit has not yet been reached. One has heard but little this year of anvil blocks for mortars, but at the Waihi Grand Junction they seem to have made for a considerable increase in output beyond that originally expected. Judging by output per horse-power, ball mills would appear to be the most efficient machine, the best types giving an output of over two tons per horse-power per day, crushing all the ore through screening of 700 meshes per square inch, but the cost of dry crushing (milling) at the South Kalgurli (August) appears to be about 3s. per ton as against roughly 1s. 9d. per ton (wet crushing) at the Oroya Brownhill, Lake View and Ivanhoe. On the other hand, the latter crush through very much coarser screening (100-, 300- and 225-mesh respectively), reducing the over-size product by their pans and tube mills.

FINE GRINDING

The tendency has been to use stamps for coarser crushing only—i.e., to substitute coarser screens for those formerly in use—and from the pulp to separate the coarse product and to grind it in tube mills or pans. There have been no notable contributions to our knowledge this year as to which is the best appliance for this purpose. Tube mills seem to be generally employed, except at Kalgoorlie, where the roasted ore can be efficiently ground to the required fineness in pans. Not that pans are not effective on raw ore. On the contrary, the Ivanhoe results show very good work, indeed, and it is to be much regretted that the comparative tests of pans and tube mills made at that mine were carried out in such a way as to cause the results to be worse than useless. But it is a matter for serious thought that the Ivanhoe costs for regrinding sands should be only $8\frac{1}{2}$ d. per ton treated, when those of the Oroya-Brownhill, Lake View and other companies are double that figure. It cannot well be a matter of pans only, or one

*Consulting mining engineer, 2 Broad street place, London.

would have heard of similar low results from the other companies exclusively employing pans (at the Oroya and Lake View pans are used in conjunction with tube mills). Is it that the Ivanhoe ore is softer, or that the final product is not slimed so fine? The management has recently been very keen on reducing its residues—and has succeeded very materially in doing so—and one would therefore expect that it would not overlook the gain from crushing as fine as its neighbors. One therefore assumes that the crushing is as fine; but anyhow the fact remains that the Ivanhoe sands-grinding cost is less than half that of neighboring wet-crushing companies of the same group. We still need that careful comparative test of pans and tube mills which has so often been asked and which we have hoped would be undertaken by Messrs. Klug or Denny (Johannesburg). Indeed, I have understood that the latter was making such tests, but nothing seems to have come of them.

Meanwhile, I am informed that such a test has been made at Broken Hill with a pan, a wet-grinding ball mill, a disk grinder, and a tube mill, and that the tube mill has proved itself the best of the lot, but in the absence of details I can only take this statement as the expression of individual opinion. Even if we assume tube mills to be the best slimers, there is still the question of stage-grinding, and it is by no means certain that the preliminary crushing of the coarser particles could not be effected more economically in pans.

The best pan figures have been given above. The following tube-mill figures will probably prove of interest. African costs have been reduced from 8½d. per ton ground down to 5½d., of which 1.89d. is for power, 0.7d. for pebbles and 0.93d. for liners. Mr. Leupold states that silex linings cost only half as much and last two and a half times as long as iron liners. The Consolidated Gold Fields made tests on manganese-steel liners as against silex, with the result that the former was shown to be more expensive and the grinding nothing like as good, owing to the slipping of the pebbles caused by the polished surface of the manganese steel. At El Oro a 20-ft. mill with 7½ tons of pebbles grinds 125 tons of sands per day, using 60 h.p., to such a fineness that 90 per cent. will pass a 100-mesh and 50 per cent. a 200-mesh screen. At Waihi an 18-ft. mill grinds 77 tons of 20-mesh sand a day so that 93 per cent. will pass 150-mesh, using 37½ h.p. The Waihi is notorious for the hardness of its material, which ball mills fail to grind satisfactorily. Its tube mills do not appear to be run to their utmost capacity, but the figures are interesting as an example in practice of direct tube-mill work—i.e., without returns. The above figures of over two tons slimed per horse-power at first sight show a less duty than that mentioned in

my article last year, viz., four tons per horse-power in Africa, but it must be remembered that the African crushing was much coarser, they having at that time adopted a standard of under 2 per cent. retained on 60-mesh.

But apart from the question of comparative cost of work done, tube mills have very fully shown their economical advantage as well as their capacity as regrinders. Reference was made last year to the huge additional net profit of £65,000 a year accruing to the El Oro company from this source. At Waihi three 18-ft. tube mills and 90 stamps have increased the output from 2.89 tons per stamp per day to four tons, and have reduced the assay of the residues by 50 per cent. They have improved the amalgamation returns by from 5 to 7 per cent., and have effected a 75 per cent. saving in screening. It is found also that since the adoption of tube mills the slimes are more permeable and the filter-press charges take less time for treatment, so that the same presses can now deal with 30 per cent. more slime than before. The new Barry tube-mill linings made on the spot seem to be most effective, and to result in a great saving of cost over the imported silex. One set of linings is stated to last six months; a new set is always kept ready at hand and can be replaced in two days. Mr. Barry makes a great point of having his linings as rough as possible, so as to give a grip to the pebbles, and has modified his doors also to effect this.

At Johannesburg, Mr. Dowling emphasizes the necessity for the complete separation of the sands to be re-ground from the slimes in the mill pulp, and for keeping the proportion of water to sand at as low a figure as possible. He shows at the Robinson Deep a 0.48 dwt. lower residue (formerly 1.26 dwt., now after tube-mill treatment 0.78 dwt.) and an increased tonnage of 2300 tons per month. The Eckstein mines show in addition to the increased output resulting from the tube mills an additional profit of from 1s. to 1s. 6d. per ton, 1s. at the Robinson, 1s. 4d. at the Ferreira) resulting from the increased extractions, which have reduced the assay of the residues by about 0.5 dwt. There are now 58 tube mills at work on the Rand—and more on order—at 24 different mines, and these 58 tube mills, working in the 24 mines only, have increased the amalgamation returns of the whole of the Rand by 3 per cent. At present the Knight's Deep appears to have the highest monthly output per stamp—for complete battery—this being 7.68 tons per stamp, since reduced by the substitution of different screening to 6.68 tons. In West Australia the Oroya Brownhill outputs 7¼ tons per stamp through 10-mesh screening, and the Great Fingall (1150-lb. stamps) has an average duty of seven tons per 24 hours through 12-mesh screening, and the Sons of Gwalia at Leonora

(1000-lb. stamps) crushes 6.68 tons per head per day through 20-mesh screening.

It is estimated that in addition to the above gains resulting in Africa from the use of tube mills there is a saving of 30 per cent. in equipment, arising from the adoption of tube mills in place of obtaining the same output by the addition of the increased number of stamps necessary (see *South African Mines*, Oct. 27, 1906).

AMALGAMATION

The increased amalgamation returns resulting from the use of tube mills have been referred to above. At Waihi amalgamation is carried out on plates set in a large building right away from the mill, sands and slimes being treated separately. There is much to be said for this arrangement. Companies circulating cyanide solutions through the mill find a scouring of the copper plates by the cyanide solutions. Denney, at the Meyer & Charlton, proposed to minimize this action by adopting shorter plates, but probably the better method would be to exclude copper plates from the amalgamation arrangements. At Lake View (Kalgoorlie), for instance, plates are discarded and amalgamation takes place in pans. Fifty-one per cent. of the value of the concentrates is there recovered by amalgamation and 46 per cent. by subsequent cyanidation.

ROASTING

Edwards has increased the capacity of his recent furnaces by a parallel system of rabbles, which is stated to promote inter-rabbling. Klug has adopted this for the Holthoff-Wethey furnaces at the Perseverance, and claims high results. Merton has also modified his furnace by making it a 5-hearth and also of greater hearth area; but except by the Great Boulder Proprietary Company, with its roasting cost of 2s. 3d. per ton (with its Merton furnaces) for roasting ore going 4 to 5 per cent. sulphur down to 0.07 per cent. sulphur as sulphide, the record of the South Kalgurli type of Merton furnaces does not yet appear to have been improved on, either for cost (2s. 6d. per ton roasted), output (32 tons per diem for small sized furnace, requiring 1½ h.p.) or efficiency (3.1 per cent. of sulphur down to 0.01 per cent. of sulphur as sulphide; one ton of green wood roasting 11 tons of ore). With regard to the tip, referred to in my article of a year ago, of adding say 2 lb. of lead acetate per agitator charge (40 to 60 tons) of roasted ore, Mr. Hamilton of the Great Boulder finds that the use of lead salts appears to result in an increased consumption of zinc in the precipitation boxes, as against which he benefits by a saving of roasting fuel, an increased tonnage through the mill for the same labor, a reduction in the assay of the residues, and a general feeling of confidence in ability quickly to set foul roasts all right in spite of fluctuations in natural draft.

CONCENTRATION

There appears to have been no great advance made in 1906 in the concentration of gold ores. We are still faced with the difficulty that an attempt to concentrate out refractory particles from an ore usually leaves tailings practically as refractory as the original ore.

It was hoped that fine sliming and the Wilfley slimer might overcome this difficulty, but the latter machine is by no means perfect and maintenance is a most formidable item. So far the old canvas tables or frames appear to give the best results, but the cost of washing down is very heavy indeed—amounting in certain cases to 30 or 40s. per ton of concentrates produced. A continuous rough-rubber or canvas-belt table, somewhat on the Lührig or Buss system, might solve the difficulty, though the capacity per unit would necessarily be small; or the old treatment table could have a traveling system of washing pipes worked by a water balance, and thus avoid the expense of so much boy-labor.

The flotation processes are being mainly applied to zinc-lead concentrates at Broken Hill, rather than to gold ores. De Bay and Simpson appear to have made an interesting discovery as to the principles involved in the various flotation processes, which they claim depend on the surface tension of sulphides as contrasted with ore gangue, the greasy sulphides retaining an envelope of air when wetted which is expanded by heat, or by vacuum, or aided by the air entangled in oil, or gelatinous silica, or by flowing the mineral pulp in very thin layers—practically all surface—over inclined tables.

TREATMENT OF DIFFICULT ORES

Cupriferous tailings, with not exceeding 0.5 per cent. copper, are mainly successfully treated by leaching out the copper with dilute sulphuric acid and precipitating on scrap iron as described by W. S. Brown in his paper in the *Transactions of the Institution of Mining and Metallurgy*. With ores containing more copper—but not rich enough to smelt—a preliminary roasting of the ore has been found to improve matters. The addition of ammonia to the cyanide solution has been previously suggested and carried out in practice.

Auriferous antimonial concentrates, containing say 20 per cent. of antimony and arsenic, have been successfully treated by an ordinary careful roast of the ore previously mixed with from 2 to 5 per cent. of charcoal or coal, followed by a hot acid wash of dilute hydrochloric acid (obtainable by exposing old chlorine solutions to direct sunlight), and then lixiviating with cyanide solution or chlorine water.

A variation successfully employed is to roast as above, add salt at the end of the roast and chlorinate. Both methods have yielded 90 per cent. extractions, but have

the drawback of requiring very careful roasting.

SLIMES TREATMENT

The Messrs. Denny have made a considerable sensation at Johannesburg by the running of their new plants at that center. In these they adopted the West Australian method of circulating dilute cyanide solutions through the mill, and filter-pressing the slimes in Dehne hydraulic-closed filter-presses. They claim a recovery of over 94 per cent. at a treatment cost, including cyanide, filter-pressing, and disposal of residues (5d.) of 1s. 10d. per ton. As this carrying into practice of their proposed treatment scheme was not effected without many prophecies of failure, and as the cost of the installation necessary appears to be less than half that of the method of treatment locally in vogue, it is natural that their work should have received much attention; and as their figures do not seem to be seriously contested the Messrs. Denny certainly look like scoring heavily again as the result of their enterprise and foresight—just as they did previously by the introduction of tube mills on the Rand.

But perhaps the two greatest successes in slimes treatment—as being a real advance on established filter-press practice—are the respective methods evolved by Ridgway at the Boulder and by Barry at Waihi. Anyone reading R. Gilman Brown's article in the *Mining and Scientific Press* of Sept. 8, 1906, on the Moore filter must have noticed the very sloppy, badly arranged frames shown in the illustration. One can understand, perhaps, from these illustrations one of the reasons for the small success attending the Moore filter in America. At Waihi, Barry has a frame (see the *London Mining Journal*, Sept. 30, 1905) which is much more effective than that shown in the illustration referred to above, and he has successfully treated many thousands of tons by his method of open-framed atmospheric filtration; but the drawback to this—as to the Moore basket filter—is the necessity of having men constantly in attendance to clean the frames.

Butters seems to have been alive to the defects of the Moore frame and has got out one which he appears to be working with considerable success at Virginia City, as does also Bosqui, at Tonopah. Butters has apparently, however, allied himself to the Cassel inclosed type of press, which looks similar to that referred to in a previous paper as being experimented with at Johannesburg, apparently unsuccessfully.

The Ridgway machine has now been in use for a year at the Great Boulder, and appears to have treated some thousands of tons of slime quite automatically and without any continuous supervision, and Mr. Hamilton, who has been testing it alongside his filter-press installation, is so satisfied with the results that he is lay-

ing down a plant to treat 500 tons a day, the largest slimes plant in the southern hemisphere. The principle of the machine is a number of horizontal plates revolving around a central vertical post, which is really a tube, and to which pipes communicating with each plate are attached. Each plate has an under filtering surface, and dips through a portion of its revolution into the slimes pulp. A cake is formed by the application of a vacuum, and the plate in the course of its journey around its axis finds itself next in a water bath, where it remains sufficiently long for thorough washing. The cake is then automatically dislodged into the residues deposit system. This machine is certainly cheaper than filter-presses, both in first cost and in operation, and a plant to do the duty of an African decantation plant should not only yield higher recoveries at a lower working cost, but also should be installed for less than half of the expense of the existing system.

Of the other methods referred to in last year's article but little has been heard. Merrill appears to be still at work on his hydraulic emptying filter-press, but details of successful work have not yet been communicated.

Argall has a fixed frame and movable tank, which probably he will install in his new plant at Colorado City for the treatment of Cripple Creek ore.

In West Australia one of the groups had a method of upward percolation of the solutions through the slime pulp during agitation, but this method does not appear to have been attended with any great success. Generally speaking it looks as if some direct method of automatic atmospheric filtration would displace both decantation and Dehne filter-pressing, although at the outset it will probably require a higher degree of intelligence for its effective and successful working.

TAILINGS RE-TREATMENT

We have heard but little of the Stark process during 1906. It seems to have been most profitably applied at the Crown Reef dump. Is it that there is any special characteristic feature of this dump which makes it exceptionally suitable for the Stark process?

MERCURIC CYANIDE

A reference to a test by Butters, on El Oro ore, of mercury salt added to cyanide solution recalls the investigation made by the Cassel company (the owner of the cyanide patents) in 1895 into the use of this salt. It obtained on some ores 3½ per cent. greater extraction of the gold and 3 per cent. greater extraction of the silver, with a lower consumption of cyanide, but the tests were not continued as the improved extractions seemed insufficiently encouraging in view of the additional expense of the added salt, but Butters' tests have renewed interest in the subject, and we hope for fuller data.

COSTS

Tube milling, fine grinding, milling and roasting costs have been given above. The following statement of West Australian costs will show the progress still being made on this field by comparison with those in preceding papers, as well as with those obtaining elsewhere.

Rock-Breaking—Lake View, 1.71d.; Ivanhoe, 1.87d.; South Kalgurli (dry), 3.39d.

Milling—Lake View, 1s. 9d.; Ivanhoe, 1s. 9d.; South Kalgurli (dry), 2s. 11d.

Concentrating—Lake View, 6s. 7d. per ton concentrated, 9d. per ton milled; Ivanhoe, 8s. per ton concentrated, 10d. per ton milled.

Roasting—Lake View, 3s. 10d. per ton roasted (concentrates only); Ivanhoe, 5s. 5d. per ton roasted (concentrates only); South Kalgurli, 2s. 6d. per ton roasted (all the ore); Great Boulder Proprietary, 2s. 4d. per ton roasted (all the ore).

Fine-Grinding Sands—Lake View, 1s. 10d. per ton ground; Ivanhoe, 8d. per ton ground; South Kalgurli, 1s. 3d. per ton ground.

Cyaniding by Agitation—Lake View, 3s. 1d. (includes 1s. 4d. for KCy and 1s. 2d. for BrCy); Ivanhoe, 4s. 1d. (includes 11d. KCy, 2s. 6d. BrCy, and royalty 2d.); South Kalgurli, 1s. 4d. (includes 7d. KCy.)

From the above it appears that the agitation treatment, less cyanide and bromo-cyanide, but including power, lime, labor and supplies, costs roughly 7d. per ton. (Ivanhoe 6d.).

Cyaniding by Percolation—Ivanhoe, 2s. 2d. (including 9d. for KCy and lime); Great Fingall, 11¼d. (including 6d. for KCy and lime).

Filter-Pressing—Lake View, 1s. 7d.; Ivanhoe, 1s. 6d.; South Kalgurli, 1s. 6d. per ton filter-pressed. (The cost of filter-cloths at the Lake View consols was under ½d. per ton pressed for every month in 1906, save one, when it was under ¾d.)

Total Treatment Costs—Ivanhoe, 9s. 0d.; South Kalgurli, 11s. 3d.; Great Boulder Proprietary, 11s. 6d.; Great Fingall, 6s. 11d.; Sons of Gwalia, 5s. 2d. per ton treated.

GENERAL

The battle of the processes in Kalgoorlie is now over. It is admitted that the all-roasting process gives the most profitable extractions, but the good fight made by the wet-crushing bromo-cyanide section, and especially by the Ivanhoe, has been of the greatest service to the industry, and the Ivanhoe's costs are such as to reflect very great credit on the management and the staff; but the fine showing made by the South Kalgurli, the Great Boulder, the Kalgurli, and other companies, appears now to have convinced even the former bromo-cyanide advocates.

In the first nine months of 1906, Prussia produced 95,953,110 tons of stone coal and 34,671,252 tons of brown coal.

The Metallurgy of Lead in 1906

BY W. R. INGALLS

The chief feature in the metallurgy of lead in the United States in 1906 was the further introduction of the lime roasting process, which has been modified, however, by the metallurgists connected with the American Smelting and Refining Company, so that as used by them it is rather a process of "pot" roasting than "lime" roasting, the distinction hanging upon the point as to whether lime does or does not play a chemical part in the process, i.e., any part other than merely serving as the diluent of the charge, which function may be fulfilled by ferric oxide or other material. A third alternative is that lime or other material may possibly act as catalyzers. The nature of the reactions which occur in these processes of desulphurizing galena is still a disputed point. Pot roasting, as practiced by the American Smelting and Refining Company is performed on charges low in lead, and free or nearly free from limestone. However, this modification does not appear to be an unqualified success, the time required for the working of a charge being rather long and the proportion of fines produced, which must be re-treated, being rather large. Certainly the results reported are much inferior to those obtained with the Huntington-Heberlein process on high-grade galenas in Australia, Europe, and elsewhere.

In the construction of dust chambers, there appears to be a general reversal of fashion, the flues of reinforced concrete construction, which were so much in vogue a few years ago, being now out of favor. It has been found impossible to prevent them from cracking, which of course is highly undesirable. In new constructions, the flues are built of brick in the form of an inverted catenary.

Another new feature has been the restoration to fashion of the bag-house which has been before the attention of silver-lead smelters since 1880 and found its leading exponent in Doctor Iles. However, it never came into general use. An installation was made at the East Helena works, but a few years ago was abandoned. In 1906, however, the bag-house at East Helena was put into commission again, and the United States Smelting Company at Salt Lake, began the installation of a similar fume-saving device.

A prominent feature of 1906 was the extension of interest in the Betts process of electrolytic lead refining. The installation of the Consolidated Mining and Smelting Company at Trail, B. C. was materially increased in size, and a new refinery was erected and put in operation by Locke, Blackitt & Co., at Newcastle-on-Tyne, England. Most important of all was the erection of a plant of 2500 tons per month capacity, near Chicago, by the United States Metals Refining Company.

This plant went into operation early in December, and at the end of the month was in smooth running order. There seems to be no question as to the success of this process of lead refining in so far as the electrolytic work is concerned, but the problem of handling the anode slime does not seem yet to have been satisfactorily solved. Mr. Betts has patented a new process for this purpose, but both at Trail and at Chicago the slimes are being worked up by independent processes. Anyway, the treatment of this material is only an ordinary metallurgical problem from which an economical method will doubtless be developed by a little experimentation.

Progress in the Metallurgy of Zinc

BY W. R. INGALLS

The chief feature of last year was the further attention devoted to the mechanical separation of mixed sulphide ores and the improvement in processes already introduced for that purpose, which have put it beyond all question that an immense increase in the supply of zinc is now available from this class of ore, formerly of little or no value. It is now quite well established that there are few varieties of this sort of ore which cannot be raised to a grade of 40 per cent. zinc by magnetic separation, while in many cases much better can be done. Moreover, there are some ores which can be even more efficiently worked by electrostatic separation or flotation. Electrostatic separation does not appear to have made much further headway, but in the flotation processes great strides have been made. At Broken Hill the flotation processes have clearly beaten magnetic separation at all points, including extraction of minerals, degree of concentration, and economy both in operating expense and in first cost of plant.

It is another example of the backwardness of American metallurgists in adopting new inventions of foreign origin that these processes, which have become of so great importance in Australia, are still but little known in the United States. However, it is satisfactory to report that during 1906 an installation of this kind was made at Marion, Ky., for the separation of the blende-galena-fluorspar ore of that district (which previously had been a difficult problem) and the results have been all that was hoped for. The samples of the concentrates that I have seen have certainly been of excellent quality. It is interesting, moreover, to remark that the zinc of this ore occurs distinctly as resin blende, which character of mineral, it had been previously stated, was incapable of flotation. The fact is that at the present time no one knows what is the real theory of flotation, and the adaptability of the process to any particular ore can only be determined by experiment.

In zinc smelting there have not been any particularly noteworthy innovations. The new plants that have been erected in Illinois, all of which are planned with a view to the manufacture of sulphuric acid, have been equipped with the Hegeler roasting furnace. The advantages of the McDougall type of furnace for this purpose continue to be overlooked. In Kansas, where sulphuric-acid manufacture is not generally considered, all the new plants have adopted the Zellweger furnace, which does good work, but like other furnaces of its type is wasteful of fuel. The use of the Ropp, Cappeau and Brown furnaces is limited by patent rights, wherefore outside companies are obliged to adopt some other form of furnace. At the present time, of course, no one would think of using the old hand-raked kilns. At the Argentine works of the United Zinc and Chemical Company, furnaces of the McDougall type have been used for the roasting of Western ores, but Hegeler furnaces are being substituted because of the desire to have larger units. The ore is roasted at Argentine for the manufacture of sulphuric acid, and the cinder is shipped to Iola for reduction to spelter.

Various new types of distillation furnaces have been tried experimentally, but no remarkable improvement appears to have been effected. Smelters generally stick close to the lines of their previous experience and are timid about venturing far from them. The character of the new installations at DePue, Palmerton and elsewhere was referred to in my article in the last volume of THE MINERAL INDUSTRY.

Experiments have been made, with successful results, with the Queneau composite retort and the Queneau charging machine. A similar form of charging machine has been tried at Ougrée, Belgium, which was described in the JOURNAL of Oct. 6, 1906. The idea of charging the retorts mechanically has long been hopefully looked forward to, but after all it is questionable as to how much advantage will be gained and whether the machines that have now been invented, which certainly are workable, will come into general use.

Among the new processes, experiments have been made with the Imbert process in France, with the Ganelin process at Overpelt, Belgium, and with the Schmiuder process in Silesia. Further experiments were to have been made with the Lungwitz process at Warren, N. H., but it has not yet been reported how much was accomplished. Electric furnaces have received considerable attention, but so far they are in use only in Scandinavia (de Laval furnace) and they do not yet present any promise of displacing the standard form of furnace.

It is reported that a large deposit of remarkably pure stibnite is located in southern Utah, and is shortly to be worked.

Gold Dredging in 1906

BY J. P. HUTCHINS*

The year 1906, one of remarkable general prosperity, was unusually favorable to most metallurgical operations, but those having for their object the recovery of gold were in some ways seriously handicapped. While the producer of gold received no more for his product, he was compelled to pay more for machinery, labor, and for all supplies needed in the installation and operation of machinery. He had to wait tedious periods for machinery or renewals, all manufacturers being swamped with orders; he paid higher prices for his necessities than ever before. That gold dredging should flourish in such circumstances vouches for its prosperous condition. That operating cost has been reduced when there were many features conducive to increased expenditure bears testimony to the improvements in design, construction and operation of gold-dredging machinery.

SEARCH FOR NEW AREAS

The great success of dredging, notably in California, stimulated the search for workable areas. Engineers have been scouring remote parts of the world and the dredging horizon was widened somewhat. The results, however, were hardly commensurate with the energy and capital expended, and there was considerable disappointment. Many countries credited with large total productions of placer gold, practically all of which has been won from dry deposits, have been thought to contain rich under-water alluvion and have been investigated, rather casually to be sure, with disappointing results by operators whose experience has been confined to California, where conditions are remarkably favorable; their unfamiliarity with tropic and Arctic environments has resulted in areas condemned hastily and probably unjustly. The characteristics of the Oroville field are said to be ideal. It must be remembered, however, that there has been some remarkably lucrative placer mining elsewhere in the world. The California dredgeman is prone to look for ideal conditions and to condemn areas not possessing similar features. It is extremely probable that, like the success achieved in the Klondike dredging fields, which were turned down by the California operators, similar success will follow in the tropics. Dredging cost is extremely sensitive; it is affected particularly by environment, and any hostile conditions raise cost in a surprising manner.

MISDIRECTED EXPLOITATION

As a result of the prosperity of dredging and of the recent strong general

*Consulting mining engineer, 52 Broadway, New York.

tendency of mining shares, a number of dredging corporations have been formed to exploit areas of dubious value. Some of these are entirely dishonest but have succeeded in disposing of their shares. Other companies have been promoted by ignorant but enthusiastic persons who have supposed that certain areas could be profitably worked. While they are honest in their belief, they are still reprehensible in not ascertaining accurately the gold content and the characteristics of their holdings.

Following the great success of one dredging operation in Klondike, there is a condition approximating a boom in that territory and its influence is likely to boom other northern districts. Large purchases of mining ground in the Klondike by powerful interests have made for this same result, opening great opportunities for illegitimate promotion.

During the past year there were several failures, all due to lack of sufficient preliminary investigation. Thus, attempts were made either to work undredgable ground or to work dredgeable ground with unsuitable machinery. The choice of dredging machinery of design and construction proper for the area it is to work is a matter of prime importance. The press of business is so great that some of the dredge manufacturers are prone to urge the purchase of "standard" dredges. While these dredges have been successful in circumstances similar to those in which they were evolved, there have been failures where they have been worked under different conditions. It is easy for the manufacturer to build machinery like other that he has made, since there is no need of changing drawings, patterns, etc. This feature has been to a degree responsible for the installation of unsuitable machinery.

TESTING DREDGING GROUND

The past year served to emphasize the advantages of test pits of large diameter over holes of small diameter. When shafts are sunk, it permits not only a more accurate determination of the gold contents, but it allows, as well, a thorough inspection of the gravel section and an accurate investigation of all the characteristics which have such a potent influence upon the working of dredging machinery. Drilling machines, in areas whose characteristics are already known (by exploitation with dredging machinery), are entirely satisfactory. When an investigation is conducted in a new district, however, the characteristics of which are not known, it is much better to sink enough shafts to determine them, even though drilling machines are used in conjunction.

Prospecting cost did not vary materially during 1906. Shaft sinking cost, in general, from \$1 to \$8 per ft. Drilling cost about \$1 to \$2.50 per ft., though

the more general use of larger and more powerful drilling machines resulted in a generally lower average cost. It is interesting to note that, under exceptionally favorable conditions, considerable drilling was done in California for less than \$1 per ft., some of it for less than \$0.50 per ft.

EXPANSION OF DREDGING

Although new dredges were constructed in 1906, the total number of dredges operating in the world remains about the same, namely, 500. This was due principally to the working out of holdings in New Zealand. Investigation proved the existence of new areas, and enlarged the boundaries of old districts. A considerable area was drilled in Klondike and considerable ground, said to contain from \$0.40 to over \$2 per cu.yd., was proved. Dredges in Klondike achieved the largest extraction per cu.yd.; more than \$1 per cu.yd. was saved, out of considerable volumes. The lowering of cost widened the dredging horizon, and ground formerly thought unprofitable is now included.

South America is attracting much attention and this will have beneficial results. It is almost certain that such countries as Colombia, Brazil and Bolivia contain dredging ground. Russia and Siberia are known to contain large areas of auriferous gravel and some of it is now being dredged profitably, although in one instance it is costing about \$0.16 per cu.yd. British Guiana has an inefficient dredge which is said to have produced 20,000 oz. of gold in about nine months.

Northern South America, already credited with about 14 dredging failures, added another during 1906. A dredge installed on an affluent of the Magdalena river seems to be a complete failure. It is not certain whether mechanical features were entirely responsible, but a continuous series of breakdowns, such as would have meant disaster even in California, occurred when operation began. Thus Colombia unjustly got more bad repute, even though there are probably areas of rich gravel suitable for dredging on the Magdalena, Atrato and other rivers.

A dredge is in course of construction for working auriferous and diamondiferous material in the bed of the Jequitinhonha river in Brazil. It is expected to be operating in 1907, when its unusual features will be watched with great interest. Its essential difference from the ordinary dredge is a large dredging pump to take the material of a diameter between 1-16 and 1 in., after its passage over gold-saving devices, through a pipeline, sustained as in hydraulic harbor dredging, to a diamond-saving plant on shore, where jigs and other devices will save the diamonds.

Investigation of ground in Ecuador pro-

gresses actively and a dredge having a producer-gas engine was installed. No data as to its working are available.

The island of San Domingo is known to contain auriferous gravel and it is being investigated with the idea of installing gold dredges. Some of the Central American countries are being examined similarly. Some Mexican placers near Chihuahua, which were unsuccessfully worked with a steam shovel some years ago, are now being considered as possibly suitable for exploitation with floating dredges.

There is a class of deposits in the United States which have been worked unsuccessfully with floating dredges of old and inefficient types. They have been investigated during 1906 and are now considered as well suited for profitable exploitation with modern dredges of large capacity. There are such areas near Breckenridge, Col., and Idaho City, Idaho.

VARIED DREDGING PROCEDURE

The variations in practice and design were almost as wide as before. This was noticeable, particularly, in the gold-saving phase of dredging, and the remarkable difference between the practice of New Zealand and of California remains as great as ever. It is difficult to account for this fact when it is remembered that the characteristics of the gold in the two countries are practically identical. Part of the variation in dredging practice arises from the circumstance, not generally understood, that it is a difficult matter *not* to save a large percentage of the gold in most placers—almost impossible to lose it, in other words—while, on the other hand, it is almost impossible to save the gold in some deposits, like those of Snake river, Idaho, when operation is conducted on a large scale. So some dredge operators strive for large capacity, working their machines at top speed, and save only that gold which is easily saved. Fortunately this is a very large percentage—often over 90 per cent. of the total—though this is not generally acknowledged.

The conflict of practice in gold saving is due largely to ignorance of the gold contents of dredge tailings. Any investigation in this connection is sure to have valuable results, as valuable as is the sampling of tailings in lode mining.

RECENT DREDGE DESIGN

There were no remarkable novelties in design and construction during 1906; there were some general improvements and dredging machinery is heavier and more powerful than ever. The 5-cu.ft. bucket of 1900, weighing about 600 lb., now weighs about 1500 lb. Comparisons of other parts indicate similar increase. Hull construction received more attention; the rotting and distortion of some of the older dredge hulls made it seem

more likely that steel hulls will be used to prevent these difficulties. Steel hulls have not been used in the United States for gold dredges, and for no good reason, although more structural steel now enters into a gold dredge than ever. The tendency is to strengthen hulls in this way, for which there is a crying need, for some hulls have been greatly distorted. One of them, formerly with a 6-in. crown to the deck, now has a 6-in. cup, and the well is over 12 in. wider at the bow than originally built.

The large dredge was well tried in 1906. A 13-cu.ft., continuous-bucket dredge was at work near Folsom, Cal., in shallow free alluvion; this material is said to be excavated at the rate of 200,000 cu.yd. per month at a cost of 2.25c. per cu.yd. Other large dredges working in coarse, indurated gravel, demonstrated, better than before, that the concomitant weight of the large dredge is a great advantage in digging. There was a distinct retrogression at Oroville several years ago when a number of 3-cu.ft. dredges were installed; at present there is one 3-ft. dredge at work near a 5-ft. dredge in indurated material. Comparison of the operation of the two machines indicates most strongly the advantage of the larger and heavier dredge.

A dredge with 12½-cu.ft., open-connected buckets was installed in Montana in 1906. This dredge is electrically operated and is owned by a company which also works a 7-cu.ft. dredge and one with 10-cu.ft. buckets, both of which are steam driven. All three dredges work in gravel of great tenacity, and the results indicate that the larger dredge is the cheaper to run per cu.yd., and that electricity is more satisfactory than steam, particularly for driving dredge buckets.

The centrifugal tailing elevator has held its own in the Antipodes, but no dredges have used it in the United States. Considerable experimenting has been conducted by one of the large dredge factories with a similar device and it is possible that it will be used here in the future.

CLAY-BEARING GRAVEL

The problem of handling alluvion containing clay, or lying on a clay bottom, received greater attention. It has been generally held that the proper way to treat such material is to macerate and disintegrate it as far as possible in revolving screens having spirals or projections to effect this result. Considerable effort has been expended in this direction with dubious success toward disintegrating really tenacious clay. Investigation will prove that really it is exceptional to find gold either in clay strata or on a clay bottom. It often occurs in contact with them but seldom in them, since the conditions that made

for the deposition of clay and tufaceous material are not those that favor the contemporaneous deposition of gold. It is often found in sticky gravel, and it is fortunate that such gravel usually yields to treatment in a revolving screen with water jets. It is also fortunate that the really tough clays, almost without exception, contain no gold.

Much effort is being wasted in attempting to disintegrate tough clay, and, in fact, harm is often done in treating this material in such a way as to bring it in contact with gold, which may then be lost by adhesion to clay balls. Thus the revolving screen, where tough, barren clay occurs, is not so suitable as the shaking screen which does not roll the auriferous material around with the adhesive clay.

Some loss is occasioned through the picking up of gold by clay balls when clean-ups are so infrequent as to permit gold and amalgam to accumulate near the top of the riffles.

WINTER DREDGING

During the past winter, operations at Ruby, Mont., demonstrated that work can be carried on even when temperatures less than -25 deg. F. are noted for a time. This means that dredging can be carried on all the year in any part of the United States, by using modified design and manipulation as at Ruby or in Klondike, where housing the belt stackers and having a boiler for heating the dredge permitted work after all other out-door mining had been stopped.

STEAM-SHOVEL DREDGING

Within the last year a steam-shovel plant was installed at Atlin, British Columbia, for exploiting placer ground, and preparations were made for similar work in Klondike in the future. The Atlin plant has not been in operation long enough to form a positive conclusion. The outcome of such installations will be watched with considerable interest, for such plants can be successful only under exceptional conditions. Lack of mobility and the difficulties of tailing disposal are the more important of a number of obstacles to large capacity and consequent low cost.

DREDGING COST

The cost of dredging did not vary materially during 1906. The cheapest work was done in California (said to be 2.25c. per cu.yd.; the cost in Montana was more than 10c. per cu.yd. In Klondike, in unfrozen ground, the cost was about 15c. per cu.yd. with a large modern dredge, and about 75c. per cu.yd. with a small, obsolete dredge in partially frozen ground, which required considerable thawing. Cost was lowered in some instances by merging several operations under one management; dredging is naturally susceptible to such procedure.

Progress in the Metallurgy of Copper

The leading features in the present metallurgy of copper are the tendency toward increasing the size of both blast furnaces and reverberatory furnaces. This has indeed been the tendency for many years, but the recent great leaps in dimensions, which are far beyond what anyone dreamed of only a few years ago, are due to the boldness of Mr. Mathewson, of the Washoe works. The great economy obtained from these large furnaces has been thoroughly discussed and explained in recent papers by Prof. L. S. Austin in the *Transactions of the American Institute of Mining Engineers* and by Dr. E. D. Peters in *Metallurgie*.

Another striking feature of modern practice is the increasing use of the reverberatory furnace for the smelting of fine ores, the proportion of which is all the time increasing as we undertake the working of low-grade ores in greater quantity and consequently produce the mineral in larger proportion in the form of fine concentrates. For the smelting of such material the combination of roasting furnaces of the McDougall type with reverberatory furnaces of large dimension is hard to beat.

In this connection, attention may be called to the large reverberatory furnaces that were installed at the works of the Arizona Smelting Company at Humboldt, Ariz., in 1906, these being equipped with oil burners. The results have been extremely satisfactory and establish a reliable precedent for the use of that fuel wherever it be available at a lower relative cost than coal. Oil firing had previously been used in connection with reverberatory furnaces, especially at Kedabeg in Russia, but nowhere has it been applied on so large a scale as at Humboldt, Arizona.

The most recent feature in the metallurgy of copper is the increased attention that is being devoted to the proper treatment of flue dust and other excessively fine material. The desire appears to be to get away from the clumsy and costly process of briquetting. Curiously the attention of several metallurgists seems to have been directed toward this question at about the same time. The line of effort is toward the sintering of the material in a cheap and efficient manner. This has already been very ingeniously and satisfactorily accomplished by Messrs. Dwight and Lloyd at Cananea. It is probable that their process will find extensive application.

The Minister of Finance stated recently in the Chilean Senate that deposits of nitrate had been found at Antofagasta and Tocopilla, as rich as those of Tarapaca when first discovered.

Bismuth

The chief bismuth smelters and refiners of the world are Johnson, Matthey & Co., of London, the royal smelteries of Freiberg and Oberschlema, Saxony, and the Deutsche Gold- und Silberscheideanstalt, of Frankfurt am Main. These three concerns form the convention, or trust, which until recently held the monopoly in treating bismuth ores, by-products and crude metal, and which still determines the market price of the metal.

The sources of supply of ores have been Queensland, Bolivia, Mexico, the United States, the Erzgebirge (Saxony) and Spain. The bismuth ore obtained from the United States has come from Leadville, Colo., and has been of comparatively small amount. Formerly only high-grade and pure ores were bought, and even for such only low prices were given. With increasing competition, however, ores of a mixed character began to fetch fair prices, and for the purer kinds reasonable terms can now be expected. Frequent parcels of mixed bismuth and copper ores, generally in the form of oxides, with about 10 per cent. Bi and 10 to 20 per cent. Cu, have appeared on the market, and in these the bismuth has been paid for at the rate of about 10c. per lb.; when the metal was worth \$2.50 per lb., the bismuth in these ores realized 25c. per lb. The higher grades of ore, containing 30 per cent. Bi and upward, were sold at \$1 per lb. of bismuth when the metal was at \$2.25 to \$2.50 per lb., but now that the metal is worth only about half that amount, prices for ore are proportionately lower.

It is possible that if the market were not artificially contracted, and the metal were mined and smelted without restriction, new uses would be found for it, and manufacturing on a large scale might become a commercial success. Most of the metal now produced is made into pharmaceutical preparations, like the subnitrate, tannate, iodide and bromide. Some is used in the alloy business for making fusible *cliché* metal, and similar readily fusible alloys.

An important discovery of ore containing bismuth was reported in the Washington basin, Custer county, Ida., during 1906. At this place, the old Empire group of mines was taken over by the Idaho-Montgomery Mining Company, Ltd., the main office of which is at Hailey, Ida. The property is traversed by five large veins, which dip to the southeast about 40 deg. Bismuth, both in the form of maldonite and tetradyomite, is said to occur in large quantities throughout all the veins, in connection with galena of high grade in silver and gold. The bismuth ore itself is said to be high in silver and gold and to assay 55 to 58 per cent. bismuth.

REVIEW OF MINING IN THE UNITED STATES

Virginia—New Mexico—Montana—Utah—Colorado—California—Nevada—S. Dakota and Other States

Mining in the United States in 1906 was generally prosperous, as is manifest from the following reviews. The production of the precious metals and the base metals in the States west of the Rocky mountains will be found, in almost all cases, to show increases when the final statistics are collected, except in the case of copper. Such decreases as there may be, and the failure to show increases as large as was expected at the beginning of the year, are due to the insufficient supply of labor, a difficulty which is remarked in many of the following reports.

New Mexico

BY CHARLES R. KEYES*

In the main the advancement made in the mining industry of New Mexico during the year 1906 has been notable. Everywhere throughout the commonwealth there has been unusual activity in all branches of mining; and the coming year promises an even greater rate of expansion.

The remarkable immigration to the Southwest during the past year, the great increase in transportation facilities, the consummation of plans for the erection of additional smelters, the introduction of many new methods of hauling and treating ores, and a very material lowering of freight rates on certain grades of ores, have all been important factors contributing to advancement in the mining industry. Mines already operating are being worked on a much larger scale than before; many old mines are again producing; and new mines are being rapidly developed. In all of this the noteworthy consideration is that the progress is of a lasting character, as is evidenced by the greater care which is being taken in the erection of mills and plants. Moreover, when it is recalled that during the year just passed over one-fourth of the railway construction of the entire United States was in the Southwest, the effect of this development upon mining activity may be readily surmised.

The investigations of the past few years have clearly shown New Mexico to be far richer in minerals than had been generally supposed. There are none of the many mountain ranges which are not promising mineral districts. With the recent discovery that ample water is easily accessible, instead of being totally absent, as was long believed, mining will hence-

forward develop much more rapidly than in the past.

Nowhere in the world are the phenomena of ore deposition displayed in greater variety than in New Mexico, nearly every known type of deposit being known to exist here. The intimate relationships of ore deposits to geological formations have now been clearly made out; the geographic distribution of deposits with regard to the grander geotectonic features has been traced with a wonderful degree of accuracy; and the time when the great ore deposits were formed has been determined. All of these factors must have a most important bearing on the vast expansion of the entire mining industry in the near future.

Especially noteworthy is the fact that in New Mexico most of the great ore deposits now being worked, and the tracts where the most extensive mines are likely to be opened in the future, lie on the south and east slopes of the great dome of the high plateau region. Of great interest also is the further fact that, without a known exception, the ores being worked by all of the important operating mines were deposited very recently, chiefly in mid-Tertiary times. In prospecting, in development, and in the working-of mines in the New Mexican region the economic value of these generalizations can be hardly overestimated.

ZINC

The mining of zinc ores is of special interest by reason of its being an entirely new industry, and also because of the extensive deposits which are continually being brought to light. At present the largest producing camp is in the Magdalena mountains, in Socorro county. Since the opening of these mines two years ago other camps have been found to contain large amounts of zinc ore. The principal shipping points are Magdalena, Hanover, Tres Hermanas, Pinos Altos, Las Cruces, Cooks Peak, Granite Gap and Hachita; and a number of other locations will soon have adequate transportation facilities.

The chief feature to be noted in regard to the New Mexican zinc ores is their large percentage in the carbonate form—the form most sought for in the manufacture of zinc pigments. In the case of the Magdalena mines, which during the last 30 years have been worked for lead only, the limestone walls of the lead slopes have been found to consist entirely of replacements of zinc carbonate.

Besides the carbonate ores there are large deposits of blende; also complex ores containing copper, lead, gold and

silver. Zinc mining promises to be one of the most important of the mineral industries. The production for the year exceeds 30,000 tons.

LEAD

Much of the lead produced in New Mexico is derived from complex ores. In statistics the tonnages of lead ores alone do not appear so large as they should. Many of the zinc ores and copper ores contain large percentages of lead. The largest production of lead ores alone is from Las Cruces, in Doña Ana county, the chief mines being in the Organ mountains about 15 miles distant. The deposits are in contact zones of limestone and intrusive granite. New and important developments have taken place during the past year at Cooks Peak, Granite Gap, Magdalena, and a number of other places. In the Caballos mountains, west of Engle, some large deposits have been opened up during the year, the ore being a very pure galena in a fluorite gangue.

Taking into consideration the numerous new developments in complex deposits in which there is also a considerable lead content, it may be expected that during the next few years the lead production will greatly increase.

COPPER

The annual output of copper continues to increase slowly; but, with the full operation of new mines which have been opened, a rapid increase may be expected. The bulk of the copper ores comes from the mines of Grant and Socorro counties. In these districts extensive new operations have been going on during the past year. The Mogollon district will be especially worthy of attention as soon as better transportation facilities shall have been provided. Doña Ana county mines have become more active than for some years past. Provision has been made for handling the low-grade copper ores of San Miguel county. Some promising prospects have been opened up in the archæozoic schists of Santa Fé county. Considerable attention has been paid to the very low-grade copper deposits of the Red Beds, extending over large areas in the Southwest, and methods of leaching these ores have been proposed.

The Santa Rita mines are taking out native copper chiefly. This occurs in large plates in brecciated zones in porphyry.

The new copper developments in the Magdalena mountains continue to be of exceptional interest on account of the relationships which the ores bear to those

*President New Mexico State School of Mines, Socorro, N. M.

of zinc and lead. Important new developments have taken place in the Burro mountains, in Grant county, and some interesting deposits have also recently been opened up in the Caballos mountains in Sierra county.

It is difficult to estimate the exact total output of copper from New Mexico for the reason that many ores other than copper yield considerable copper percentages, and these do not show in the copper-ore returns, but for the past year it cannot be far from 6,000,000 lb.

IRON AND SILVER

The principal iron deposits now being worked on a large scale are those of Fierro, in Grant county. Other important ones occur in eastern Socorro county; some hematitic ores occur at Magdalena, and magnetic ores in Santa Fé county. The total output for the year exceeds 200,000 tons.

The output of silver shows an increase over the previous year; but, considering the former records of New Mexico, there is not nearly the activity that there should be. Western Socorro county continues to be far in the lead, with Grant county second. Doña Ana, Luna and Sierra counties are also among the principal producers.

Most of the mines which a dozen years ago produced high-grade ores still remain closed. Large augmentations of the silver output may, however, be expected from the complex ores of the baser metals now being so largely developed, as ores of this class almost invariably carry enough silver and gold to warrant recovery. The output of the year is about 300,000 oz.

GOLD

There have been notable developments in the mining of placer gold; but the output of the lodes has remained about the same as in former years. It may be expected that the great increase of production of the complex ores of the baser metals will add largely to the gold production also.

Rich placers have been demonstrated, and a number of large prospects for their exploitation have been begun. The most important new developments have been in the Rocky mountains, near Elizabethtown, in the Tuertos mountains, near Golden, in the Caballos mountains, at Apache cañon, and in the foothills of the Mimbres range, east of Hillsboro. Many other points of minor note might be mentioned. About one-half of the total gold product is now taken from placers.

West central New Mexico continues to be the chief lode-mining district. Mogollon and Rosedale are the principal gold-mining districts in Socorro county. At Hillsboro much new work has been done recently. In Grant county most of the gold comes from the vicinity of Silver City. Near Jarilla, in Otero county, some good quartz veins are yielding gold.

Operations have been lately instituted to

explore more extensively than ever before the deep mines of Lincoln county, particularly the Old Abe, now down 1500 ft., and the deepest mine in New Mexico.

Recent investigations appear to show conclusively that in nearly all of the many mountain ranges of New Mexico gold occurs in workable grade. In many of the districts good placers are also to be found, and the problem of a sufficient water supply for exploiting these placers has now been solved. Another noteworthy circumstance, and one which should greatly stimulate mining, is that the geology of New Mexican gold has been carefully worked out, so that most of the uncertainties as to occurrence and probable extent of deposits have been removed.

The production for the year may be valued at \$500,000.

COAL

Activity in coal developments has been very marked. The output has already increased, but progress in the construction of railroads to new fields will in the course of another year or two result in an immense advance in production.

In the northeast the Raton range coal-field has received much attention, and a number of large mines have been opened. Three lines of railroad are now under construction, which will afford access to markets not now reached by the Atchison, Topeka & Santa Fé Railroad, which has long controlled this territory. The coal rights on the Maxwell land grant, embracing over 300,000 acres, have been recently sold to a syndicate which is also building a railroad eastward into Kansas, and whose present expenditures involve upward of \$15,000,000. The Phelps-Dodge are also surveying a new line, about 200 miles long, to tap their Dawson fields already reached by their road from Tucumcari.

In the northwest, in the San Juan valley, great activity has been manifested during the past year. At present the region is greatly hampered by inadequate transportation facilities, but these conditions will not long continue, as the Southern Pacific, Denver & Rio Grande, and other railroads, are pushing into this territory. The San Juan field is in many respects the most remarkable in the country.

At the present time the Gallup field continues to be one of the principal producers, and new developments here have been in progress.

A feature of special note has been the reopening, on a large scale, of the Carthage coalfield, near the Rio Grande in central Socorro county. The railroad from San Antonio has been entirely rebuilt, and the output is shipped directly over the Santa Fé.

Still further south, and near the site of the Elephant Butte dam, on the Rio Grande, some good coal has been opened up in the Mescal cañon. The seam is about 4 ft. thick, and the field is probably

one of considerable extent. This is the most southerly of the known coal deposits of New Mexico. A large power-plant has been erected over the seam, and power transmitted over wires will supply a number of mines and mills within a radius of ten miles. In this locality are six other seams in the coal-bearing section. One bed of bituminous shale is 400 ft. in thickness.

The total tonnages mined during the year amount to over 2,000,000 tons.

Virginia

BY THOMAS L. WATSON*†

The mining industry in Virginia, during the year 1906, showed noticeable advancement. In general, those mines producing in 1905 continued to produce during 1906, with, in many cases, a substantial increase in output. At some of these, developments both above and below ground were made, increasing thereby the efficiency of the plants, and, in turn, the production. In many places new mines were opened and extensive areas under development.

Virginia is entering upon a new era of railroad building, which in the future, will greatly stimulate and increase mining operations over extensive areas of largely undeveloped mineral resources.

IRON

The year 1906 was one of considerable activity in iron-making in Virginia. Most of the old mines produced their full quota of ore, while new mines were opened and extensive areas were and are now being actively developed.

The most important type of ore is limonite. In the Cambrian sandstone of the Blue Ridge there is one important fault deposit being mined. In the upper Cambrian shales, along the western base of the Blue Ridge, there are three relatively large operations, and a number of minor ones. In the clays of the Valley limestone, in the New River-Cripple Creek region, there are some 25 operations producing a total of about 20,000 tons of ore annually. Of the so-called Oriskany ore, which is mined chiefly in the vicinity of Clifton Forge, there are seven operations each producing from 50 to 400 tons of ore per day.

Red hematite is second in importance to limonite. Of this ore there are two kinds, both bedded deposits, one of the Cambrian, the other of the Clinton age. The Cambrian hematite is mined in four operations in the Blue Ridge. The Clinton is mined in seven operations in the two extreme southwestern counties of the State, and in one operation near Clifton Forge.

*Geologist in charge, Geological Survey of Virginia; professor of geology, Virginia Polytechnic Institute, Blacksburg, Va.

†I am indebted to R. J. Holden, assistant geologist on the Virginia Survey, for the information bearing on the iron-mining developments for 1906 contained in this review.

Magnetite and specular hematite are mined, in a small way, in the southern part of the State, east of the Blue Ridge.

Developments, during the year, were largely connected with the extension of railways to new areas. The extension of the Norfolk & Western Railway, from Cripple Creek to Speedwell, has added three producing mines. A railway has been built 13 miles from Philpot to some promising magnetic ore in Patrick county. In Pott's valley vigorous developments are now being prosecuted. Twenty miles of railway are being graded from Covington, and the survey of 35 miles more is completed. This is a new area which heretofore has been inaccessible. If its production proves proportionate to the funds which are now being expended in its development, this region will be the most important that has been opened in recent years, and should add very materially to the amount of the State's production of iron ore.

At Buena Vista the most substantial iron-ore dressing establishment in the State has recently been put into operation, which indicates the faith of the operators in one of the oldest mines in the State. At the Oriskany mine one of the most complete iron-ore dressing establishments in the South is now being erected. Two furnaces, each with tributary ore properties, have changed owners during the year and are now in blast.

MANGANESE

During 1906 special activity was manifested in the exploitation and development of manganese properties in both the Valley and Piedmont regions. The principal developments were confined to Augusta county, in the Valley, and to Campbell county, in the Piedmont region. The work was directed more particularly to the reopening and developing of old properties rather than to the opening of new mines.

In Augusta county, the Crimora Manganese Company suspended work in October, pending a change of management, and will probably not resume systematic work before February, 1907. A drainage tunnel 5800 ft. long, connecting with a central shaft, has recently been completed, and hereafter the ore will be broken down by hydraulic washing. In the vicinity of Vesuvius, near the Augusta county line, the Manganese Corporation of Virginia has been developing some old mines, which, in the past have produced small tonnages of ore. An extensive body of good ore has been blocked out ready for stoping, and arrangements are rapidly being completed to place the plant and the working in shape for extensive operation. The shipping of ore will shortly begin at the rate of 25 to 30 tons per day.

Vigorous prospecting at the Saunders manganese mines, located one mile east of Evington, in Campbell county, was in progress during the spring

and summer of 1906, and good bodies of ore have since been found. In the extreme northeast corner of Campbell county, about two miles east of Mt. Athos, the old manganese mines, worked some years ago by the Lernel Mining and Manufacturing Company, have recently been acquired by the Piedmont Manganese Company, incorporated; and developments on an extensive scale for large shipments of ore are in progress. At each of the mines enumerated above, the ores are of excellent quality and they command good prices on the market, for uses to which the better grades of manganese ores are put.

GOLD

Gold mining in Virginia was less active in 1906 than during certain past years, although plans were being matured at several of the principal properties, in the main gold belt, preparatory to the beginning of mining on a permanent basis in the early future. In Buckingham county, the Anaconda Gold Mining Company, located about three-quarters of a mile southwest of Johnson station, commenced development work in March on an old gold-mine property. In the Virgilina belt of Halifax county, the Red Bank gold mine of the Virgilina Mining Company, located about four miles northeast of Virgilina, has been and is operating a 10-stamp mill, and is milling about 10 tons of ore per day. The underground work at this mine comprises a 160-ft. shaft and 400 ft. of drifts at the bottom of the shaft.

COPPER

The Virginia portion of the Virgilina copper belt was inactive, as regards copper, during the past year. In the Blue Ridge copper district of northern Virginia, some development work was continued. About six miles south of Front Royal, in Harmony Hollow, Warren county, a 30-ft. shaft was sunk on the Beatty property. On the southwest end of the "Gossan Lead" at the Great Outburst, near Chestnut Yard, in Grayson county, the Pulaski Mining Company continued to mine the copper-lean pyrrhotite for trial tests in acid and ironmaking, with occasional shipments made of the black secondary copper ore concentrated beneath the gossan.

COAL

Owing to the rapid developments in the principal coal areas of southwest Virginia during the past year, and the length of the present account of mining in Virginia in 1906, a review of the developments during the past year in the principal coal areas will be reserved for separate treatment in an early number of the JOURNAL.

No shipments of coal were made from the mines of the Richmond coal basin during 1906. Actual developments in this basin were in progress at only one operation, namely, the mines of the James River Coal Corporation, at Midlothian, in Chesterfield county. The developments

made by this company comprise the completion of an inclined slope at an angle of 33 deg. to a depth of 1022 ft., to coal 8 ft. thick. The coal in this shaft has been actually proved for considerable distances, so that the future of the company seems especially good. The building of 1¼ miles of trackage, and the erection of a tippie, are under way, and on their completion, about the first of the new year, the shipping of coal will begin.

Rapid advances were made during 1906 in developing the Montgomery-Pulaski counties anthracite coal area. In the Montgomery portion of the field, the Merrimac mines of the Virginia Anthracite Coal Company, the largest operation in the district, produced steadily throughout the year with an output of 100 tons per day. Two smaller operations on the same ridge, Price mountain, and three on the nearby north ridge, known as Brush mountain, in the vicinity of Blacksburg, were producers, supplying strictly a local market.

In the Pulaski portion of the field, the developments were more extensive than in Montgomery county. The Parrot mine, formerly known as the Kimball, of the American Coal Company, produced on an average about 75 tons of coal per day. Extensive improvements were made during the year in the tippie of this mine. At the mines of the Belle Hampton Coal Company extensive development work, largely in the nature of deepening the mine slopes and extending the entries, was carried on. During the latter part of the year the shipments from this mine were estimated at an average of about 25 tons of coal per day, taken out principally to meet the cost of the development work. About three miles northeast of the Altoona coal mines of the Bertha Mineral Company a slope was put down during the year to a depth of about 600 feet, with an excellent showing of coal.

BARITE

In addition to the output of mines operating in the vicinity of Honaker, Gardner and Richlands, in Russell and Tazewell counties, which continue to be the principal barite producers in the state, and the Bennett mine near Toshes, in Pittsylvania county, small shipments of ore were made from mines reopened in Smyth, Bedford and Nelson counties. Barite mining on a small scale was recently resumed to the west of Marion in Smyth county. Work in connection with the opening of a barite property in Bedford county, about three miles west of Thaxton station, has been in progress for several months past. In Louisa county, barite mining was again begun about three miles east of Lindsay, a station on the Chesapeake & Ohio Railway.

PYRITE

The famous pyrite mines near Mineral, in Louisa county, and near Dumfries, in

Prince William county, continued operations on a very extensive scale during 1906, with a large total production of ore, which is consumed entirely in acid-making. The production of pyrite from these mines could have been considerably increased had the demand for labor been met. The mines operating in 1906 were the Arminious and the Sulphur mines, north of Mineral, in Louisa county, and the Cabin Branch mine, near Dumfries, in Prince William county.

TALC AND STEATITE (SOAPSTONE)

Within recent years the soapstone industry in Virginia has assumed large proportions. During 1906 the quarrying of steatite (soapstone) and talc was carried on in four counties in the State, the principal operations being confined to the Albemarle-Nelson counties belt. Beginning with the most southwesterly operation in Nelson county, the following companies were operating during 1906: The Piedmont Soapstone Company; the Phoenix Soapstone Company; the American Soapstone Company; the National Soapstone Company; the Plumbers Soapstone Company of America; the Virginia Soapstone Company; the Old Dominion Soapstone Corporation; and the Albemarle Soapstone Company.

In Amelia county, about four miles north of Jetersville, a station on the Southern Railway, extensive developments were in progress by a Philadelphia corporation during the summer, for the quarrying and dressing of soapstone. In the vicinity of Herndon station, on the Southern Railway, in Fairfax county, a good grade of talc was mined during the year.

GYPSUM

Considerable activity was shown during the past year in the gypsum industry, in Washington and Smyth counties, in southwest Virginia. The Buena Vista Mining and Plaster Company, with its well known established mines and mill located at Plasterco, has been engaged, in addition to its regular mining and production, in developing other deposits of gypsum on its property. From six to seven miles northeast of Plasterco extensive and thorough drilling by a Western company of a gypsum property, located immediately on the north fork of the Holston river, was in progress during the year.

ASBESTOS

The mining of asbestos in Virginia during the year was confined to the mines of the American Asbestos Company, located at Chestnutfork postoffice, in Bedford county, and about 12 miles from Bedford City on the Norfolk & Western Railway. The variety of asbestos mined at this locality is entirely of the amphibole type. Other very promising deposits of amphibole asbestos are found in a number of counties in the crystalline area of the State; but as yet they are largely unde-

veloped and little or no work has been done.

MICA

Although numerous deposits of excellent merchantable mica are known in a number of counties in Virginia, some of which have been rather extensively worked in the past, very little activity was manifested in mica mining during the year.

The Pinchback mines, located about two miles northeast of Amelia courthouse, in Amelia county, were the only ones operating in Virginia in 1906. New openings were made during the year on the Pinchback property with very encouraging results. All the products from these mines are marketed; they comprise mica, feldspar, and kaolin, the latter of which results from the alteration of the feldspar of the pegmatite dike down to some depth below the surface.

GRAPHITE

Developments near the base of the Blue Ridge foot-hills and along the Albemarle-Orange county line, on the Naylor-Bruce property, by the Naylor-Bruce Graphite Company, was continued during a part of the year just ended. A plant for refining the product is planned to be built in the near future, when the systematic mining and preparation of the mineral for shipment is expected to begin.

OTHER MATERIALS

Lack of space forbids, at this time, a review of the clay, lime, cement, and quarry industries of Virginia, all of which are extensive and are among the most important mining industries in the State.

Montana

BY R. E. ST. CHARLES

All of the large companies operating in Montana made good records last year, especially those mining copper and silver in Butte, and those mining gold ore in Fergus county. Butte was, of course, the center of activity; and, while its production was not much greater than in 1905, it promises an increase this year by reason of the opening of known bodies of rich ore that had been tied up for years by litigation between United Copper and Amalgamated interests. The year just ended brought forth a settlement of the controversies by the sale of all United Copper interests, save the property of the La France Copper Company, and an adjustment of interests between the purchaser and Amalgamated. Since then harmony has prevailed among all of the large operating companies, and the peace which characterized operations prior to the advent of F. A. Heinze as a mine-worker has been fully restored. Much development work was begun after the sale and adjustment of rights, and much more planned for future execution. The deep-

ening of several of the old shafts was begun toward the close of the summer, and is still progressing. New shafts were started, and are going down rapidly. One of these is on the Badger State, through which this claim and the Auraria will be developed by the Boston & Montana company; another is on the Tramway, and will be used as an outlet for the ores of this mine, the Snohomish, and Minnie Healey. The expense of this work will be borne jointly by the Butte & Boston company, and Butte Coalition company, both of which are owners in the Tramway and Snohomish, while the Minnie Healey is exclusively a Coalition mine.

OPERATIONS OF NEW COMPANIES

Many new companies were organized last year for work in the Butte district, and 90 per cent. of them began operations which are still under way. Their work has progressed so far that in all likelihood ore-bodies outside of the developed zone may be found by some of them. A few had ore to begin with, and maintained a steady output in a small way up to the close of the year. The advance in the price of silver toward the latter part of the year stimulated the mining of this class of ore, and numerous properties, in Butte and other sections of the State, that had been idle for years, were placed in commission. Up to the close of December, however, none had become phenomenal producers of the metal.

Mining in Montana is practically confined to a few counties—Silver Bow, Madison, Jefferson, Fergus, Missoula, Flathead, Beaverhead, Lewis and Clarke, Granite, Powell, Deer Lodge, Park, Broadwater and Carbon. In copper and silver production Silver Bow leads all in 1906; but Fergus produced the most gold. The output of zinc was small, due principally to the burning of the plant of the Montana Zinc Company, near Butte early in June. In the latter part of November the zinc company formulated plans for a new mill, and it will probably be in the productive class in 1907. The output of lead in the State was not great, for this class of mineral is found only as a by-product of other ores. The upper levels of the Lexington mines of Butte contain ore in which the percentage of lead is considerable.

GOLD DREDGING

Dredging became more prominent in the State last year than ever before. Five new boats were put in operation, one by the Conrey Placer Mining Company, operating at the mouth of Alder gulch, Madison county; one by the Supreme Gold Dredge No. 1, on Hughes creek, in the western part of the State; one by the Trustees Gold Company, on Basin creek, Jefferson county; one by a Kansas City syndicate on Cottonwood creek, Deer Lodge county, and the other by the Gold Creek Company, Ltd., on Gold creek,

Granite county. Another was built for work on the Jefferson river, 45 miles southeast of Butte, but faulty construction prevented its use. The Conrey company is operating three large boats within half a mile of each other and extracted a large amount of gold last year. Three companies suspended work as soon as the cold weather set in, but will resume in the spring. The boat on Cottonwood was designed for saving gold and sapphires, both of which the gravel contains.

COPPER OUTPUT

Little copper is produced in Montana outside of Butte. During the first six months of 1906 the ores treated in the Washoe smelter yielded 94,360,915 lb. of copper; and it is estimated that the last six yielded a greater quantity on account of the fact that the ores of Red Metal and La France Copper were added to the shipments during that period. Prior to July 1 they had gone to the plant of United Copper. With Red Metal and La France ores the plant yielded about 112,360,915 lb. from July 1 to January 1, or a total of 206,721,830 lb. during the year. From this must be deducted 40,000,000 lb. for North Butte, 15,000,000 lb. for Red Metal for the last half of the year, and about 3,000,000 lb. for La France Copper for the same period; also the metal derived from the many smaller companies and individual operators that shipped ore to the plant during the entire year. The ores of Anaconda, Washoe, Butte & Boston, Parrot and Trenton therefore yielded about 150,000,000 lb. of copper, and the Boston & Montana about 90,000,000 lb., a total of 240,000,000 lb. for the Amalgamated companies. To this can be added North Butte, 40,000,000 lb.; Red Metal, 30,000,000 lb.; La France Copper, 6,000,000 lb.; Clark mines, 15,000,000 lb.; miscellaneous, such as Pittsburg & Montana and individual operators, 10,000,000 lb.; making a total of 341,000,000 lb. for the entire district. This copper was produced from an ore tonnage averaging about 12,500 tons a day for the year, of which about 8000 tons a day was treated in the Washoe and 3500 tons in the Great Falls plant; the remainder passed through the Clark plant and the smelter of the American Smelting and Refining Company in Helena. The average daily shipments from Amalgamated mines, exclusive of Boston & Montana, was a little more than 6000 tons. The production of North Butte and Red Metal mines in the early part of the year was much less than that of the latter part, but a good average was shown at the close of the year. Extensive development work was carried on in all of the large mines between July 1 and Jan. 1, nearly all of the main shafts having been sunk from 100 to 400 ft. each. Great bodies of ore were opened in the Cora, North Butte, Anaconda and Red Metal mines; and many mines that had not been operated for years on account of litigation

were placed in commission and their development was begun. Among these properties are the Tramway, Snohomish, Nipper and Berkley. A deep shaft was started on the Badger State late in the fall; another on the Greenleaf at an earlier period, and another on the Poser, by which this claim and the Elm Orlu, Clark mines, will be opened.

ANACONDA

About the middle of the year the Anaconda company bought the Belmont from the Coalition company for the purpose of using it later as an outlet for the ore of the Anaconda mines and as an avenue for timbers. The company resumed operations in the veins of the Buffalo and Pacific mines, sunk the shaft on the High Ore from the 2200- to the 2550-ft. mark, and is sinking to the 2600; added 300 ft. to the Neversweat shaft, crosscut the vein of the Anaconda at the 2400-ft. and connected the 2000- and 2200-ft. with a raise in the vein. Late in the fall it began equipping the Diamond with electrical apparatus for operating all of the compressors of the Amalgamated system, deciding to retain its steam machinery for emergency.

BOSTON & MONTANA

Boston & Montana had a fairly good year. It retimbered the shafts of the Mountain View and West Colusa mines; finished the installation of a new hoisting engine and skips at the former; and placed the Leonard in shape for greater ore production. It ordered two large hoisting engines for the Pennsylvania and Badger State, and in November decided to install an electric-haulage system underground in its principal mines. It also began enlarging its smelter with a view of treating 1000 tons more per day.

NORTH BUTTE

North Butte began extensive development. In the early fall it started two crosscuts north from the 1200- and 1600-ft. of the Jessie for the purpose of cutting supposed veins in the Berlin group and sank its main shaft 200 ft. It opened the Edith May and Miners' Union vein, one of the largest and best in the district, and exposed 100,000 tons of ore in the old Speculator vein. It equipped its main shaft with an engine having capacity for 3500 or 4000 ft. erected a steel gallows frame, and added a large air compressor to its machinery. It also substituted skips for cages in the shaft and equipped the levels with skip pockets. Its possessions were greatly increased, several undeveloped claims having been bought by it. Toward the latter part of the year it resumed sinking in the old shaft on the Berlin.

LA FRANCE

La France Copper operated the Lexington property continuously, but did not make much of a showing on account of the fact that its work was confined to the upper levels. In November it finished

unwatering the lower levels. Its daily average output was between 100 and 150 tons of ore carrying copper, silver, gold, zinc and lead. The destruction of the Montana Zinc Company's plant by fire in June prevented La France from realizing on its zinc, for it had no market for this class of ore after the fire. It made many improvements at the mine, one of which consisted in the building of a tramway from the shaft to the top of the hill east of the shaft, to facilitate the handling of ore by rail.

PITTSBURG & MONTANA

Pittsburg & Montana made a better record than it did in 1905. It closed its smelter in April and began shipping ore to the Washoe. It sunk two winzes, one 200 ft. and the other less, from the crosscut leading from the main crosscut between shafts 2 and 3, and developed a strong vein west of the 200-ft. winze. Its shipments during the latter part of the year averaged more than 150 tons of ore a day. Deeper work through the main openings was planned, and, if nothing happens, will be carried out this year.

CLARK'S MINES

Improvements begun at the Clark plant in 1905 were finished about the middle of last year. They included the erection of a 352-ft. steel and concrete stack, with dust-chamber and connecting flues, and the substitution of converters for blister-copper furnaces. The mines were productive up to Oct. 1, but from about that date up to the close of the year the output averaged 100 tons a day less and the concentrator was idle part of the time. Custom ores were bought to make up the deficiency, and with their assistance the furnaces were kept in operation continuously.

SILVER OUTPUT

Silver production in Montana in 1906 was large, considering that mining for this metal exclusively was conducted on a small scale up to the time the price began to ascend. Amalgamated was the greatest producer, its ores and those treated in its Washoe plant during the first six months yielding 3,811,735 oz. The amount for the year would thus be 7,623,470 oz., making a total of 29,710,285 oz. since the new smelter was blown in, 56 months ago. Red Metal mines, La France Copper, and smaller companies and individual operators in the Butte district alone turned out approximately 2,000,000 oz., Boston & Montana 2,000,000 oz., and the Clark interests 800,000 oz. North Butte and Pittsburg are figured in the Washoe yield. The total output of silver in Butte last year was about 12,423,470 oz. Granite, Powell, Jefferson, Beaverhead, Lewis and Clarke, and Madison counties added considerable to this, possibly 4,000,000 oz.

ZINC

The destruction of the plant of the Montana Zinc Company by fire last June

gave the zinc industry in Montana a setback; for after the fire no zinkiferous ores were treated in the State, except at Corbin, where an experimental plant was placed in commission in October. This plant was used principally for making chlorine gas to be used later in the treatment of zinkiferous ores, of which there is an abundance in that district, some of it running as high as 67 per cent. zinc. The original capacity of the plant will be doubled this year.

GOLD PRODUCTION

The output of gold in 1906 was not small, every county in which mining was done contributing to the aggregate. From Jan. 1 to July 1 the Washoe plant yielded 22,567 oz. or a total of 45,134 for the year. Boston & Montana, Red Metal, La France Copper, and other Butte mines added largely to this output, bringing the total to about 70,000 oz. Lewis and Clarke, Granite, Madison, and Deer Lodge counties contributed largely to the total production, the Cable Lease and Southern Cross companies being the banner producers. Both of the latter companies operated almost continuously; the former treating the output of its mines in its own mill, and the latter shipping to the Washoe part of the time, and using its own plant the remainder. The estimated output of the Pioneer district in Granite county was \$200,000, and that of the Garnet district, in the same county, \$100,000. Fergus county was the most productive, the Barnes-King, Gilt Edge, and other mines in that county in which there are immense bodies of average grade ore, yielding continuously. The Barnes-King property was sold in November at a figure said to have been \$1,250,000, Butte and Eastern men taking it and organizing the Barnes-King Development Company, to operate it and double the capacity of the mill. To April 30, 1906, Barnes-King had yielded \$1,527,126.37 gross, of which sum \$547,800 was paid out in dividends at the rate of about \$144,000 a year on 210 tons daily treatment. The average yield per ton is \$5.95, and the cost of mining, etc., \$2.80 per ton. Total extraction for 1906 was 49,384 tons. The quantity of ore in sight on April 30 was 400,281 tons. The company's surface equipment is valued at \$121,495. It has 23 claims for mining purposes, and a ranch containing 1,000,000 ft. of lumber and a sawmill.

The Green Campbell Consolidated Gold Mining Company started its new mill about Oct. 1, and operated it almost continuously up to the last of the year. This mill and the company's mines are located in the Silver Star district, 55 miles southeast of Butte. During the three months' operation it crushed about 3600 tons of ore that averaged \$10.50 a ton, but much of that crushed was second class. It began systematic development of its ore-bodies and expects to open immense reserves this year.

Colorado

BY GEORGE E. COLLINS*

The year 1906 was for Colorado, on the whole, uneventful and prosperous. No new bonanza of the first rank has been opened up, and the long-expected new camp still remains undiscovered. The undoubtedly improved condition is due to two causes: viz., the absence of labor troubles, and the higher prices of metals, and especially of silver. At the time this is written, it does not appear probable that this will be found to have materially increased the output, but it makes a most welcome addition to the profit margin. New enterprises have been relatively few in number. The only seriously disconcerting features in the outlook for the future are, first, the decadence of prospecting, due largely to the more alluring attractions of Nevada, and secondly, the scarcity of skilled labor.

CRIPPLE CREEK DISTRICT

The production of this district will probably be about the same as for 1905. The Portland is still by far the largest shipper, followed by the Elkton, Vindicator, Granite, El Paso, Stratton's Independence, and Golden Cycle. Several good orebodies have been opened up by lessees, of which the Little Clara lease, on the Work property, is the most important. The remaining properties of the Woods Investment Company, including the Gold-Coin, have been absorbed by the Granite Company. The Findley has been shut down, pending completion of the Golden Cycle mill; it is generally expected that this mine and the Golden Cycle will commence a large output as soon as the mill is ready, in the spring of 1907.

As to ore treatment, the proposed mill to handle the Independence dump by raw cyaniding is still in abeyance, and little progress has been made with the treatment of the large low-grade bodies of semi-oxidized ore, and the dumps, by this process. The old Telluride mill was purchased by the Golden Cycle interests, and is being remodeled as a roasting-cyanide mill. The Dorcas mill was destroyed by fire, and is not being rebuilt.

The projected co-operative drainage tunnel has not yet been commenced, owing to disagreement among many of the principal interests involved as to the basis on which the expense should be apportioned; nor has it yet been decided which of the schemes proposed will be finally adopted, although opinion is veering round again in favor of the deepest or Window Rock project. It is greatly to be hoped that this enterprise will be commenced as soon as possible; as un-

*Consulting mining engineer, Boston building, Denver, Colorado.

less the productive area is drained and deeper sinking rendered practicable the present rate of output cannot possibly be maintained for many years longer.

LEADVILLE DISTRICT

There was a very great output from Leadville, as to tonnage; and it is probable that, owing to the improved prices for silver, lead, and zinc, the profits realized were greater than in previous years. The properties of the Western Mining Company produced the largest tonnage, followed by the Moyer mine of the Iron Silver Company, the various mines included under the administration of the Yak Tunnel Company, the Ibox (still operated mainly by lessees), and the Reindeer. Developments on the Owers property in Iowa Gulch are reported to have been unfavorable, the shaft sunk through the wash having struck granite without encountering the ore-bearing limestone series. Toward the end of the year shipments from the camp were greatly hindered by shortage of cars.

Perhaps the most salient single feature was the striking success of the Yak tunnel, which partly by supplying power and transportation of ores, but principally by leasing and working the properties opened up along its course, has become a very remunerative enterprise. Its success affords an excellent object lesson to the many other tunnel schemes throughout the State.

SAN JUAN DISTRICT

The list of misfortunes in this region of rugged mountains and heavy snowfall was again added to. In the spring the Camp Bird mill was destroyed by snowslide and fire; while about the same time a snowslide carried away the buildings of the Shenandoah mine, near Silverton, with a heavy loss of life. Several other mills, near Silverton, were damaged by the same agency. The Silver Lake mill, also near Silverton, was totally destroyed by fire. All of this damage, however, is being, or has already been, repaired; other properties are beginning to produce largely, and there is every reason to hope for a period of steady prosperity.

The Telluride district has been more prosperous than for many years past. The leases on the Smuggler-Union are producing largely and profitably; the advance in the price of silver is especially welcome to this property. The Tomboy Company's Argentine mine continues to make a large output, and the grade of the ore has considerably improved, so that the proportion of profit has been higher than at any time since 1902. The Liberty Bell has settled down to steady production, after the interruptions due to remodeling the mill. The vicinity of Ophir, on the other hand, has been less active.

At Silverton, owing to the loss of the Silver Lake mill, the Gold King and the

Sunnyside have been the leading mines. The most prominent newcomer is the Gold Prince, which is erecting at Animas Forks, and has virtually completed, a huge mill of 500 tons daily capacity, in the construction of which no expense was spared. With the aid of cheaper shipping costs, by the extension of the Silverton Northern railroad to the same point, and a solidly built tramway from mine to mill, it is expected that the extensive low-grade orebodies opened up in the Sunnyside Extension ground last year can be profitably worked. It is certain that this district contains many other veins of almost or quite equal size, which will be successfully operated some day, whenever working costs have been reduced to a sufficiently low level; and it may be that the enterprise of the Gold Prince and Grand Mogul companies will prove this time to have arrived already. Prominent among the new producers near Silverton are the Old Hundred and Green Mountain in Cunningham Gulch.

At Ouray, the enforced suspension for seven or eight months of the Camp Bird, and the continued inactivity of the American-Nettie, have been severely felt. On the other hand, the reopening of the old Red mountain mines by the agency of the Joker tunnel, and the reworking of the Saratoga, have led to a feeling of hopefulness for the coming year. At the Revenue tunnel good discoveries in the lower workings have resulted in a profitable summer's work. The Bachelor is idle, excepting for the work of a few lessees.

NORTHERN COUNTIES

The situation in Gilpin county remains unchanged; except in the Russell Gulch district a large proportion of the best mines are idle. The Old Town is still the largest and most profitably producing mine; but the Pewabic is also handling a large tonnage. Nothing has yet been done toward carrying out the extensive program of development projected for the Gregory-Bobtail consolidation, with a view to proving the famous old Gregory, Bobtail and Fisk veins at considerably greater depth. The Gunnell has changed hands, and the new proprietors have re-erected the shaft-house (which was destroyed by fire), and are retimbering the upper portion of the shaft, which was ruined at the same time, preparatory to re-opening the mine. On Quartz hill all the principal mines are idle; the future of this district is bound up with that of the Newhouse tunnel, which is now believed to be within less than 2000 ft. from many of the principal veins, and is advancing at the rate of over 250 ft. monthly.

The neighboring Idaho Springs district continues to pin its faith to its deep cross-cut tunnels, planned to unwater and develop the old producing veins to

the north and southwest of the town. Among the most important of these are the Newhouse, Central and Lucania, the ulterior objectives of which are various parts of Quartz hill, and the McClelland tunnel, aiming to strike the old Free-land property in depth. The Gem and Lamartine are at present being worked only by lessees, and the Stanley is carrying out only development work.

At Georgetown there is to-day no bonanza mine, such as the Dives-Pelican, Colorado Central, or Terrible of former years. Several mills are at work on the dumps and stope fillings left by former workers, and others are being built. Pending the discovery of new bonanza orebodies, the milling of low-grade silver and zinc ores gives employment to a considerable number of men, so that the camp is by no means inactive. Considerably increased interest is shown in the veins of the Argentine district, which has been opened up during the year by a narrow-gauge railroad (the Argentine Central).

In Boulder county there has been no increase of production, as compared with the last two years; but much is promised for the future. The new mill under construction for the Wano mine, at Jamestown, is nearly finished; and as the preliminary testing was thorough and satisfactory, it is safe to predict that a success will be scored, if the orebodies in the mine prove of the size and grade expected. A much larger mill is being erected to cyanide *en masse* a huge rhyolitic dike near the South Boulder, which is claimed to run on the average a couple of dollars or more. It has been known for years that some of the remarkable systems of dikes in this county contained gold, but the gold has hitherto been found too erratic in occurrence for economic work.

MINOR DISTRICTS

The vicinity of Breckinridge has been benefited by the advent of a market for zinc, and several mills are in operation on zinc-lead ores. It is currently reported that the Revett dredge on French Gulch has had a very successful season; and further developments in dredging are anticipated. Creede continues to ship a considerable tonnage, principally of low-grade silicious ores. Lake City and Kokomo are still awaiting a revival. The large zinc orebodies of Red Cliff and Rico are shipping a considerable tonnage, which is likely to be increased in the near future. At Aspen the principal production is made by the Percy La Salle and Smuggler mines; there has been little, if any, increase in activity as yet, following the better prices for silver.

PLACER MINING

Some work has been done by the dredges built a couple of years ago in

the Clear creek valley near Golden; with what success is not known. The successful operation of the new dredge on French Gulch near Breckinridge is referred to above. Hydraulic mining is carried on at the Twin Lakes placer, near Leadville, and the Keystone placer, below Telluride; but in the latter case extensive caves of surface soil, resulting from the heavy snowfall in the spring, caused the suspension of operations.

MINING OF RARER METALS

As is well known, Colorado is relatively liberally endowed with ores of the rarer metals; but hitherto the small demand, and smaller knowledge of the subject, has confined production to the extraction of pockets of ore, so that it has been intermittent. Tungsten mining, however, has now become a staple industry in Boulder county, where the value of the production keeps pace with that of gold. Owing to the rather pockety occurrence of the ore in the veins, the actual mining is done principally by tributers. The price having been low during the early part of 1906, production was naturally checked; and the present high price is bound to increase it. The occurrences of huebnerite so far developed in the San Juan are more scattered and perhaps more pockety, and have not yet led to systematic operation.

There is a little mining of pitchblende in Gilpin county, this mineral occurring together with auriferous sulphide ores in the Kirk and Wood mines.

The numerous deposits containing finely disseminated molybdenite, in the central parts of the State, are as yet unworked. It seems probable that they are capable of a considerable production.

In San Miguel county the Vanadium Alloys Company has erected a mill for the treatment by roasting and leaching of the vanadiferous sandstone of the district, producing vanadate of iron for shipment. The process is said to be entirely satisfactory; but the mill is at present shut down, pending the addition of a mechanical roaster.

LABOR CONDITIONS

There was no strike or difference of opinion between employers and employees in 1906, a condition of affairs which can only be attributed to the comparative decadence of the Western Federation of Miners in every camp throughout the State, excepting Silverton and Ouray, where there is still a leaven of old-time independence and common-sense in the local unions. As a whole, it cannot be denied that wages and conditions of labor are satisfactory throughout Colorado. The demand for miners everywhere far exceeds the supply, and the opportunities for advancement open to steady and sensible men, in contracting, leasing or by promotion to positions of

responsibility, are excellent. There has as yet been no formal advance in the wage scale, excepting at Aspen, where the operators, in accordance with a pledge made years ago, raised the minimum daily pay from \$2.50 to \$2.75, in consequence of the improved profit margin resulting from the advance in silver. This (\$2.75) is now the lowest wage paid to miners anywhere in the State. Any general advance would perhaps be a grave mistake, as the majority of mines find it difficult to make both ends meet even now. But indirectly, in the case of obtaining employment, and in the increased wage paid to the more competent men, labor is getting its full share in the present condition of relative prosperity, as compared with two or three years ago. At Cripple Creek and elsewhere, business men (storekeepers and saloonkeepers) complain of slack business; but business men are apt to forget that the mines in a camp should be run for the benefit of the mine-owners, rather than that of the town.

At Leadville the card system has been abolished, and some are of opinion that its abolition at Cripple Creek and Telluride will follow. Undoubtedly the system has been abused in some cases, and its essential object of protecting and providing constant employment for the steady and competent men has been lost sight of, but in my opinion it would be a great mistake to do away with the system, because a few errors have been made in its administration.

Utah

BY L. H. BEASON.

Mining was never in so prosperous a condition in Utah as at the close of 1906. The mills, smelters and other agencies produced in that year (December estimated) gold, silver, copper, lead, zinc and quicksilver to the value of \$38,042,384, as computed from the average market prices of the several metals for the first 11 months; the output was as follows:¹

Gold, fine oz.....	470,976	\$9,735,084
Silver, fine oz....	15,981,315	10,629,547
Copper, lb.....	67,303,367	12,744,988
Lead, lb.....	115,018,811	4,480,310
Zinc, lb.....	6,472,734	398,267
Quicksilver, flasks.	1,276	54,188

Utah is not entitled to all this production. Salt Lake being the smelting center of a vast mining territory, it is difficult to segregate the ores coming from outside States. Large amounts of gold-silver ores came from Nevada, while Idaho sent considerable lead from the Cœur d'Alenes. Southern Nevada also produced some zinc, which passed through Utah channels. However, the copper was nearly all of Utah produc-

¹These figures are as communicated by the contributor and will be found, in some instances, to differ from those reported elsewhere in this issue.

tion. If \$5,000,000 were deducted from the foregoing total, the result would not be far from the actual production of Utah mines during 1906. This exceeded the value of the 1905 output by about \$10,000,000.

The high prevailing metal prices, of course, stimulated mining, while the smelting and transportation companies also, in a number of cases, fostered the industry by granting concessions in treatment charges and freight rates with the result that a very large tonnage of low-grade ores were profitably marketed. In dividends, a total of \$5,148,044 was paid by the mines in the following list:

Beck Tunnel Consol. (Tintic).....	\$307,000
Bingham-New Haven (Bingham).....	22,600
Bullion Beck & Champion (Tintic).....	40,000
Carisa (Tintic).....	30,000
Consolidated Mercur (Mercur).....	100,000
Daly-West (Park City).....	432,000
Gemini (Tintic).....	200,000
Grand Central (Tintic).....	172,000
Horn Silver (Frisco).....	80,000
Mammoth (Tintic).....	140,000
Mountain View (Tintic).....	12,554
Petro (Bingham).....	32,000
Sacramento (Mercur).....	40,000
Silver King (Park City).....	800,000
Swansea (Tintic).....	18,000
Utah (Fish Springs).....	34,000
Utah Consolidated (Bingham).....	1,350,000
Uncle Sam Consolidated (Tintic).....	50,000
United States (Bingham-Tintic).....	1,099,907
Victoria (Tintic).....	125,000
West Mountain Placer (Bingham).....	2,483
Yankee Consolidated (Tintic).....	42,500

Two new dividend payers will appear in January, 1907, when the Daly-Judge of Park City will make its initial quarterly distribution of 37½c. a share, or \$112,500. Columbus Consolidated will be the other. Utah Consolidated will also pay a regular dividend of \$2.50 and an extra of 50c. a share, or \$900,000 within this month.

BINGHAM

Bingham made greater strides than any other camp in the State and, while the production from that source was not materially increased, a tremendous amount of development was done preparatory to ore extraction upon a much larger scale than heretofore. This is particularly the case with the Boston Consolidated, Utah Copper, Utah Apex and Ohio Copper Companies. The former has now under construction at Garfield, 13 miles west of Salt Lake City, a concentrating mill, which is planned to treat 3000 tons daily of the low-grade monzonite copper ores of the Boston Consolidated and Utah Copper mines. This plant will probably be ready for operation about June, 1907. The Utah Copper Company is building a concentrating plant in the same vicinity. This plant is being put up in two units, each of 3000 tons capacity per day. The first unit will go into commission about next March and the second in the autumn of 1907. Both the Boston Consolidated and the Utah Copper companies are using steam shovels to strip the overburden from the ore deposits, which carry average values of a little under 2 per cent. copper. The ores will be delivered to the respective milling plants by the Rio

Grande Western Railway, which is building a second track into the camp to meet the demands of rapidly increasing traffic.

The Utah Apex Company conducted an energetic campaign of development, installed some heavy power equipment, and is driving what is known as the Parvenue Tunnel through which the main operations of the mine will be conducted. This adit will also tap the ore deposits about 1000 ft. under the surface. At present the company operates an aerial tramway, of new construction, between the mouth of the Andy Tunnel and Carr Fork Gulch and is producing a little over 1000 tons of ore per day. The most important mining deal in which Bingham figured was the purchase of a control of the Bingham Consolidated Mining and Smelting and of the Ohio Copper Company by F. A. Heinze, of Montana. Plans are now being made for the construction of a large concentrating mill for the Ohio mine, the initial capacity of which will be at least 2000 tons. The Utah Development Company, owner of the New Red Wing and Butler Liberal mines, has developed a large, low-grade deposit, which makes a concentrated product worth \$10 to \$12 per ton.

The principal mines now producing in Bingham are: The Utah Consolidated, Boston Consolidated, Utah Copper, Utah Apex, Phoenix, New England, Fortuna, Ohio, Utah Development and Montezuma; the Dalton & Lark and Commercial mines of the Bingham Consolidated; the Old Jordan, Galena and other properties of the United States Smelting, Refining and Mining Company; and the Bingham-New Haven. It is estimated that the present daily output of the camp is between 3000 and 4000 tons; but a year from now it will probably be anywhere from 15,000 to 20,000 tons.

While the mining of copper ore represents the principal resource of Bingham, the production of lead ore is by no means unimportant. The United States Company finds it profitable to extract lead ore from its Galena mine, and the Bingham Consolidated from its Lark and Lead-mine veins. Lead ore is a factor in the shipments from the Phoenix, Utah Apex, Utah Development, New England and the Bingham-New Haven mines. The lead ores shipped range from 15 to 35 per cent. lead and from 5 to 15 oz. silver.

The copper ores are of two general types: Sulphide ores occurring in the limestone as replacement deposits, and the silicious ores. The replacement ores are characterized by a heavy excess of iron and carry from 2 to 18 per cent. copper, averaging in most cases from 1.5 to 3.5 per cent. copper as mined. The copper ores also carry from \$1 to \$4 in gold and some silver.

TINTIC

Next to Bingham, the Tintic mining district sent the largest tonnage to the smelters. Tintic has the deepest mines in the State and several of the older companies, the Mammoth, Centennial Eureka, Eagle and Blue Bell, and Gemini, have sought lower levels with most gratifying results in increased values. The leasing system, inaugurated in the Bullion Beck & Champion mine a little over a year ago, has been conducted successfully in other mines and has contributed largely to the increased activity in that camp. The only milling was conducted by the Uncle Sam Consolidated and the Godiva Mining Companies; the other mines shipped direct to the Salt Lake smelters.

Announcement was made recently of the formation of the Tintic Smelting Company, backed by some of the strongest financial interests in Utah. It is the intention of this concern to begin the construction of a lead smelter at a convenient point within the Tintic district. The initial capacity will be about 400 tons of ore per day and will, no doubt, afford a market for the low-grade silicious ores which are abundant. This new smelting concern is closely allied to the Utah Smelting Company, operating a small copper smelter near Ogden.

MERCUR

The principal gold mining in the State in 1906 was conducted by the Consolidated Mercur Gold Mines Company at Mercur and by the Annie Laurie and Sevier Consolidated Mining Companies, in the Gold Mountain district of Sevier county. The former is still the leading gold producer and the management has succeeded in working out some interesting metallurgical problems in the treatment of low-grade gold ores. The Consolidated Mercur handled, up to Dec. 1, 1906, an average of a little better than 800 tons of ore daily through its mill, and has come very near capturing the world's record in economy of operation.

There are mines with open cuts and "glory holes" and nothing but oxidized ore, which can show a lower cost per ton. The Consolidated Mercur, however, gets practically all its ore underground; all of the ore has to be trammed a long distance and all of it has to be hoisted to the mill. About half of it comes in the form of sulphides and has to be roasted before it can be treated by the cyanide process, thereby entailing an extra cost of \$1 per ton.

The company is also put to considerable expense for power and water; but in spite of these drawbacks, the management kept the expenses during the past fiscal year down to \$2.48 per ton, including not only the ordinary expenses of mining, but taxes, insurance and all other costs. In November the directors

authorized the management to proceed with the installation of a new slimes plant at an expense of about \$25,000 and this decision was reached only after a series of experiments by Manager G. H. Dern and the company's metallurgists. The residue values in the ore after treatment have in the past averaged close to \$1 a ton, sometimes slightly higher and sometimes lower; the average during 1906 was 95c. By the new process, the management expects to bring the tailings down to as low as 50c. per ton. The condition of the mine is excellent; much better than it was a year ago. The December production was light on account of the scarcity of fuel.

The only other mines operated in the Mercur district during the year were the Sacramento, which produced about 6000 oz. of gold and over 1200 flasks of quicksilver. This is the only quicksilver producer in the State. It is reported, that the high-grade cinnabar ores are pretty well worked out and, while the mine still contains large bodies of low-grade ores, there will be a falling off in the revenues from this source in 1907 unless other bodies are developed. The Overland mine, which is equipped with a good mill, has been closed, some say permanently, owing to the refractory character of the ore.

PARK CITY

This noted silver-lead camp of Summit county has not yet recovered from the Ontario Tunnel disaster of almost two years ago, when the avenue through which practically the whole camp is drained was obstructed by caving. The Ontario Company, however, has been heroically endeavoring to clear the way and its efforts are about to be crowned with success. The tunnel stoppage prevented the resumption of development and of ore extraction on the lower levels of some of the older mines, but a number of newer exploitations have responded so as more than to offset the bad results of the tunnel difficulty. The more important developments were made in the Daly-Judge mine, which is now a dividend payer. In February, 1906, this company had an indebtedness of \$232,000, which has since been cleared up, and it begins the new year with \$300,000 in its treasury. Other important developments occurred in the Thayne's cañon section of the camp. There were no important sales of mining property within the year. Three mills are being operated in the camp at present—by the Daly-Judge, Daly West and Keith-Kearns companies. The Daly-Judge has realized considerable revenue from the shipment of zinc ore. This mine, the Scranton in the Tintic district and the Horn Silver mines in Beaver county, are the only mines in the State producing zinc ore of commercial value.

ALTA

Alta, in the Big Cottonwood district, 25 miles from Salt Lake City, forged ahead and promises to be a large contributor of gold, silver, copper and lead ores from now on. The Columbus Consolidated is the best developed property in the camp, but large bodies of mill ore have been proved in the Albion and City Rocks mines. The Albion will, no doubt, provide facilities for treatment during the coming year. Both the City Rocks and Albion, however, contain considerable high-grade ore and shipments are being made. Several important deals were consummated within the year. The old Flagstaff and Emma mines were sold to Salt Lake and Eastern syndicates, resulting in the formation of the Consolidated Flagstaff and the Emma Copper companies. A consolidation of the South Columbus and Alta Quincy mines, under the title of the South Columbus Consolidated, was effected and the new company has mapped out a broad campaign of development.

OTHER MINING DISTRICTS

In Beaver county, the most sensational developments were made in the Cactus copper mine of the Newhouse Mines and Smelters Company, which is now looked upon as being one of the great copper mines in Utah. The Newhouse company is doubling the capacity of its mill, which has been treating from 600 to 800 tons of ore daily for some time. The Cactus ores concentrate on the basis of from 8 to 10 tons into one, and of late, the mill has been turning out a concentrate product of the value of about \$60 per ton. Mining activity in other parts of the county was also pronounced and a number of new shippers came to the front, among them the Cedar and Talisman, near Milford, and the Lulu, at Frisco. The Frisco Contact, also at Frisco, developed a body of low-grade copper ore and a drift is being run to cut the extension of the Horn Silver vein. The Horn Silver Company added materially to its ore reserves. The Newhouse Company is using steam shovels for mining, and was the first to introduce them in this portion of the West; the two Bingham companies followed closely.

Although little has been heard of the Ophir district in Tooele County, some extensive shipments of lead-silver ore were made. The Ophir Hill mine, owned by Senator W. A. Clark, is the largest producer. The Ophir Hill Company operates a mill of 100 tons daily capacity. The Cliff Mining Company, controlled by Michigan people, is about to complete the installation of an aerial tramway and will possibly build a mill next year. At Stockton, the Honerine Mining Company resumed mill operations in the autumn, and has since been marketing from 20 to 40 tons of concentrates daily. The

New Stockton Company developed some extensive bodies of low-grade lead-silver-copper ore at a depth of 1000 ft. and has run a small mill intermittently. The Black Diamond Company more than paid expenses from ore shipments, and has kept up energetic development. The Southport, a new company, but solidly financed, encountered some good ore-bodies and promises to become a shipper in the near future.

In the Sierra Madre mining district, in Boxelder county, recent development indicates some good copper mines. The Eldorado, Napoleon and Santa Maria are the principal mines; the latter expended \$50,000 in development and improvements during the past year. Little has been done in the Park Valley mining district except by the Century Gold Mining and the Ione Mining companies. The Century company is operating a mill and making good profit. A new gold camp, known as Gold Springs, has been established in the western part of Iron county. It is less than a half-year old and contains about 100 population.

In the Gold Mountain district, Sevier county, the Annie Laurie Company has carried on a vigorous campaign of development and has kept its cyanide mill in operation about all the year. The Sevier Consolidated placed its new 125-ton mill in operation several months ago and is said to be working very successfully. The Sevier Consolidated ores average \$10 per ton.

THE SMELTING INDUSTRY

The smelting situation in Salt Lake valley is rather unsettled, owing to the outcome of the "smelter smoke" litigation instituted by residents in the surrounding agricultural districts. The farmers won the case in a decision by Judge Marshall, followed by an injunction, which, if it becomes operative, will end sulphide smelting at Murray and Bingham Junction in the southern part of Salt Lake county. The case has been appealed to the United States Circuit Court of Appeals at Minneapolis, and, pending a settlement by that tribunal, the companies will continue smelting as usual, under bonds of \$100,000 each. It is evident that the smelters do not expect any relief from the higher tribunal, for already the Utah Consolidated Mining Company is preparing to build a new \$1,000,000 plant elsewhere and to go into custom smelting. It is practically certain that the Bingham Consolidated and United States companies will move also. In his decision, Judge Marshall prohibits the defendants, the American Smelting and Refining, the United States, the Bingham Consolidated and the Utah Consolidated companies from treating any ore or combination of ores carrying any more than 10 per cent. sulphur, and from casting off any ar-

senic in fumes. The Yampa smelter in lower Bingham, and the new Garfield plant of the American Smelting and Refining Company are not affected by the injunction.

Placer mining has been carried on in a limited way in Grand and San Juan counties.

South Dakota

BY JOHN V. N. DORR*

The expectations of a year ago of an increased production of gold in South Dakota in 1906 were not fulfilled, as, according to the State Mine Inspector's report, the production fell off slightly. This is due, among other things, to the fact that the "Limestone district" has dropped out as a producer; the one mill operating there in the fall of the year, that of the Spearfish Gold Mining Company, shut down in the spring and the two 200-ton mills of the Eleventh Hour and Victoria companies, which were just being completed a year ago, shut down after a short campaign.

The chief event of the year just closed was the change of the Homestake Mining Company to an eight-hour basis. The whole force of more than 2000 men, including miners, mill men, teamsters and wood choppers, have been given an eight-hour day with the same wages previously paid them for 10 and 12 hours. It is understood that the management does not expect that the change will increase the cost of operating materially, as most of the miners actually worked little more than eight hours and with the shorter hours for mill men the number of men per shift can be decreased.

The output of the Homestake company for 1906 shows an increase for the year, although the slime plant which was expected to start in the fall has been delayed on account of the impossibility of getting material. It is thought now that it will not be in full operation until spring.

The Maitland, Imperial, Dakota, Wasp No. 2, and the Lundberg, Dorr & Wilson mills treating silicious ore, were operated during the year and the Golden Reward until fall, when they shut down to change from dry to wet crushing and they will probably start again early in the spring. The Gilt-Edge Maid mill was changed from fine wet crushing to coarse dry crushing and is reported to be making some profit on the low-grade ore. The Kildonan mill of the Mogul Mining Company, which has been changed to a wet crushing mill, has just started up, using four 6-ft. Monadnock Chilean mills to do the grinding, with one 5x18-ft. Abbé tubemill to re-grind the sands from the highest-grade ore treated. The Reliance company, holding property in the Portland district, has just completed a 150-ton mill in which Huntington mills are

used. As the Golden Reward is putting in both Chilean and Huntington mills, the comparative value of these two grinders on the hard silicious ores will probably soon be determined.

No new discoveries of great importance were made during the year, although several companies did considerable development and were able to block out large quantities of low-grade ore. There was considerable prospecting in the southern hills during the year, but no heavy production was made from there.

The smelter at Rapid City has been operating since spring and affords a nearer market for the blue ores produced in the district, but cannot compete with the cyanide mills on oxidized ore unless it runs over \$20 in value.

It is impossible to foretell the effect of the anticipated change to eight hours on the mines outside the Homestake, and what its influence will be on the production in the hills for the ensuing year. If no trouble ensues, the additional mills now in commission and the operation of the Homestake slimes plant should cause a material increase in the production in 1907.

It is true in this district, as in many others, that the increase in production for the past few years has been due almost entirely to the advance in metallurgical knowledge and the consequent reduction in the cost of operation, for, leaving out the Homestake, four-fifths of the ore now being treated could not have been handled at a profit with the milling costs of five years ago.

California

BY CHARLES G. YALE

The immediate effect of the disaster of last April was to stop the work of development at many hundred of mines in California, also in Nevada, Arizona, Mexico and other places where San Francisco capital was employed in opening properties. Those properties, however, which were on a producing basis were not in the least affected by the disaster. No caves resulted from the earthquake nor were any plants or buildings injured in any way. It was only those mines in process of development which were closed down, and there are hundreds more of these than there are of productive ones. Most of these closed because no further funds were forthcoming for the time, and others because it was impossible for some months to obtain machinery or have extensive repairs made. The latter feature inconvenienced even the productive mines to a certain extent. Some mines are still idle, but many more have resumed work in the usual way, the effect on the mining industry having been, therefore, mainly temporary.

Numbers of California mines are now being opened and developed, and others

*Metallurgical engineer, Lead, S. D.

are being equipped with the necessary plants. This work, however, is not so active as it was before the fire, and normal conditions are not to be expected for some months to come. This is due not only to the disaster, but also to the fact that miners are turning their attention to the newer districts of Nevada. There are so many opportunities for investment in these young camps, and such mines as have been opened have shown such good results that they would have overshadowed California mining investments in any case. The success of these mines of southwestern Nevada is virtually of as much importance to San Francisco as if the mines were in California itself, most of them being just over the border. Their stocks have largely displaced those of the old Comstock in stock speculation, but the money still changes hands in San Francisco.

GOLD DREDGING

There are few matters to note regarding mining in California during 1906, aside from the usual progress. The bulk of the gold continues to come from quartz mines, although the greatest increase of output occurred in dredging, which is the most progressive of all the forms of gold mining. There are upward of 50 dredges now at work in the State, the largest number being in Butte county, in the Oroville field. The increase from this source is some \$750,000 per annum and this will be enlarged next year as the new machines lately put in operation have so much greater capacity than the old ones. Some have been started in the Yuba river field, in that county, which are digging to a depth of 100 ft., the ground in that vicinity being very favorable. The only other important field is near Folsom in Sacramento county, where several of the largest machines are now at work. Dredges are also operating in Calaveras, Siskiyou and Trinity counties, but the fields at these places are not so extensive as in Butte, Yuba and Sacramento counties, where they work the bottom lands near the mouths of the Feather, Yuba and American rivers.

The hydraulic, drift and surface placer mines do not evince any increase of output, and in fact are turning out less gold each year, though the deficiency is more than made up by the dredgers. The dredges now turn out more gold each year than the hydraulic, drift and surface placers of the State put together. The greatest gravel-mining counties for the old-style work are Siskiyou and Trinity, which yield half the output of the State from the hydraulic and placer mines. They have no restrictions in that section to hamper hydraulic mining, the tailings going into the Klamath river and tributary non-navigable streams. There are more active mines in Siskiyou

than in any other county of California, but most of them are small ones. The most productive county in gold is Nevada, where quartz mines predominate, followed second by Butte, where auriferous gravels and sands are worked by the dredges.

COPPER

While the copper mines of Shasta county were not so productive as in past years, owing to the closing down of the largest plant because its flumes caused damage, yet new smelters were put up by other companies and some of the old ones were enlarged. The Fresno copper mines made some product and will make more. Nevada county is attracting attention to its copper mines, and some deposits long known, but never worked, are being opened. Calaveras is also doing more in copper than formerly. The new Greenwater field in Inyo county has not yet begun to produce, though it is very promising. Large investments have been made there by leading copper men. It is all prospective as yet. The railroads have not yet reached the camp and adjacent copper territory.

PETROLEUM

In petroleum, California still leads in output the other States of the Union, and this output is on the increase as new markets are found. Santa Barbara is the coming county in this mineral product, being near the sea, and some of its fields very productive. In the valleys, the Kern and Fresno fields are productive, but prices are unsatisfactory owing to transportation difficulties.

CALIFORNIA'S MINERAL WEALTH

The steady growth in values of mineral output in California for the last 10 years is shown in the following table:

1896...	\$24,291,398	1901...	\$34,355,981
1897...	25,142,441	1902...	35,069,105
1898...	27,289,079	1903...	37,759,040
1899...	29,313,460	1904...	43,778,348
1900...	32,622,945	1905...	43,069,227

To show the wide distribution of mineral substances in California, an analysis of the statistical table for 1905, recently published by the State Mining Bureau (Bulletin No. 42), proves that all of the 57 counties of the State, except three, made some mineral product in that year. Gold was mined in 35 counties, and is known to exist in several others; silver in 27 counties. Some 40 mineral substances are now being mined or quarried in California, with an annual value of from \$43,000,000 to \$45,000,000. The gold alone is worth \$19,000,000 or \$20,000,000 and is increasing about half a million a year. The silver will increase as the copper does, but the latter will increase materially in the next few years. In the structural materials, limestone, lime, macadam and rubble, marble, granite, sandstone, slate, soapstone, brick and pottery clays and cements, there is a marked advance in output, many of these

things being in great demand in the rebuilding of San Francisco.

The excitement in the development of new camps in Nevada has brought much capital to San Francisco, and there is now more interest in mining than there has been for many years. All this is of advantage to California mines as well as those of the neighboring State. There are some thousands of known mines in California needing capital for development, and attention is gradually being turned toward them.

Idaho

BY ROBERT N. BELL*

In common with other Western States, Idaho, during 1906 enjoyed another prosperous year of mining, development and production, and was largely free from exaggerated fictitious operations, and when complete returns are available the year will prove to have been another record-breaker in metal production and in dividends.¹

LEAD

The lead-silver mines of the State continue to progress, and Idaho's production is destined to increase at a rapid pace, if the market can absorb it and the prospects seem bright in that respect. The most noteworthy development during 1906 was the performance of the Bunker Hill & Sullivan lead-silver mine, at Wardner; in spite of a nasty fire in one of its principal stopes during the early months of the year, which greatly retarded production, the dividends paid by this property during the year probably stamp it as the most profitable metal mine in the United States. The other great mines of the district all continue to show remarkable strength or improvement in their lower levels.

Several new lead-silver producers entered the shipping list during the year, and, when more fully equipped, are likely to make paying mines. Notable among these are the Tamarack & Chesapeake, Callahan, the Success, Rex, Bear Top, and the Pittsburg.

The Hunter mine at Mullan also made an important production; it is being developed at depth by a long drain tunnel which will greatly facilitate its output, and is likely to open higher-grade ore. There are fully 4000 men at work in the district. Many new companies have been incorporated, and new orebodies of both lead and copper will unquestionably be disclosed in the near future. Some extensive preliminary work has already been done in the Park copper belt, south of Mullan, which had been lying dormant until the recent disclosures of the Snow-storm revived interest in that section of the district.

*State inspector of mines, Boise, Idaho.

¹The statistics in this article are as given by the author and may differ from those reported elsewhere in this issue.

Among the other lead-producing districts of Idaho the output for 1906 was not much improved. The principal producer of the Wood River district, in Blaine county, the Minnie Moore, suspended its output early in the year. This mine has yielded high-grade ore both in lead and silver, and has a record of over \$8,000,000 produced. Development was cut off by a fault last year, and the ore has not been found beyond it, although a large amount of work has been done for that purpose. The total shipments from the Wood River district, during 1906, amounted to 200 cars, and ranged in value from 10 to 60 per cent. lead, and from 20 to 130 oz. silver per ton. There are several hundred men at work on development in the district. None of the old mines has been completely bottomed, and it is likely that deep work on its more important fissures will disclose new ore-bodies.

In Lemhi county, the Gilmore mine shipped over 1500 tons of high-grade lead-carbonate ore and concentrates during 1906, containing an average of 60 per cent. lead and 30 oz. of silver per ton, and had 500 tons of similar grade on hand at the close of November, which it was unable to get hauled to the railroad. This property has been worked conservatively with little capital investment. The mine carries a pronounced fissure in blue limestone, which has been developed to a depth of 300 ft. by a vertical shaft. It has yielded in the neighborhood of \$300,000 gross, and its ore now exposed principally between the 200- and 300-ft. levels is estimated at a like value.

On the opposite side of the valley from the Gilmore the Viola mine produced ore to the value of \$5,000,000 in the early eighties when lead was selling around \$3 per hundred.

One of the most extensive and promising silver-lead prospects in Idaho has recently been taken over by Wayne Darlington, former state engineer, on a working option for an Eastern syndicate. These are the South Mountain mines, situated near the extreme southwest corner of Idaho, in Owyhee county, 25 miles southwest of Silver City. The property consists of 15 patented claims owned by George A. Sonnemann, of Spokane, Wash., and is being developed by a force of 20 men. The Sonnemann property covers the choicest mineralized section of the limestone lode for two miles of its course, and comprises the best old claims that formed the basis of an excitement in 1873, when South Mountain had a population, for a short period, of 1000. A small 30-ton smelter was built and \$250,000 worth of bullion run out; a like amount of crude ore was shipped to the railroad at Winnemucca, Nev., which was the nearest shipping point at that day.

COPPER

The most important progress in Idaho's copper development during 1906 was at

the Snowstorm mine, three miles above Mullan, in the Coeur d'Alene district. This property developed bonanza proportions during the year, and with a light prospecting equipment produced shipping ore and concentrates to a total gross value of \$1,200,000 in copper and silver, and paid nearly half of that amount in net profit. There are a number of good copper prospects, both east and west of the Snowstorm, actively developed at present, and on the opposite side of the Coeur d'Alene river, in the Parke or Stevens Peak copper belt. It is eminently probable that rich copper sulphide ore will be disclosed by the numerous operations now in progress on that side.

Unlike most other portions of the Coeur d'Alenes, the Parke copper belt has some remarkable surface showings of rich, brown, spongy gossan sprinkled with pebbles and kidneys of chalcopyrite. One of the main veins of this belt is traceable by such croppings for 15 miles, and is accompanied throughout its entire length by pronounced dikes of hornblende diorite, another rare accompaniment of ore in the Coeur d'Alenes. The Monitor mine on this belt has already made several shipments of high-grade sulphide ore containing about 16 per cent. copper and \$5 or \$6 in gold, and other mines may be expected among the shipping list at an early date.

The next most important yield of copper in Idaho during 1906 came from the White Knob mine, at Mackay, in Custer county. It was successfully handled during the past year by a company of western leasers who mined and smelted 50,000 tons of ore which ranged something over 4 per cent. copper.

The Lost Packer mine, at Loon Creek, Custer county, with rich copper-gold ore, was equipped with a 100-ton matting furnace, which was started in the summer, but owing to an accident to the plant the first day of its operation, the run did not realize success. This property contains a shoot of 30 per cent. copper-sulphide ore carrying 3 or 4 oz. per ton of gold, together with 12 or 14 oz. silver. Development has increased its resources during recent months, and it is the intention of the company to readjust the smelter and get it into commission early next spring, when an important yield of high-grade gold and silver matte may be anticipated.

From the Seven Devils district, in Washington county, 2792 tons of copper ore, mined by leasers, was shipped to the Sumpter Valley smelter; it contained 636,000 lb. of copper, 7942 oz. silver, and 162 oz. of gold. The Copper Queen, in Lemhi county, made several shipments of high-grade bornite from a fissure in a schist and slate formation on Agency creek in the Lemhi pass. This ore runs better than \$10 per ton in gold, and over 30 per cent. copper. The deposit is being actively developed.

The total gross contents of copper ore

and matte shipped from Idaho during 1906 was 11,720,000 lb., and the future prospects for copper mining in this State are bright indeed.

SILVER

The total output of silver in Idaho for 1906 was 9,675,000 oz. derived chiefly as by-product by treatment of the Coeur d'Alene lead ores and concentrates, but comprising 500,000 oz. from the Snowstorm copper ores, and 750,000 oz. from the silver-gold milling ores of the Trade Dollar mine at Silver City.

The old Ramshorn mine, at Bayhorse, in Custer county, carries a rich deposit of dry silver ore with resources equivalent to 2,000,000 oz. blocked out. The ore of this mine is a siderite gangue carrying gray copper, and yields on an average 100 oz. silver per ton. This property, with a number of important lead-ore deposits in the same neighborhood, was carefully studied during the autumn, with a view to forming a combination and building a smelter, for which the district presents a fine opportunity. It was formerly a big producer of silver and lead, but has remained practically idle excepting for small leasing operations since the slump in silver in 1893.

GOLD

The gold output of Idaho during the past year did not show a material increase and probably did not exceed \$1,108,000. One of the main producers of the State, the old Delamar mine, was practically out of commission, owing to the installation of a new method of treatment which was not completed early enough to make much of a show in production this year. The mine has been developed right along, however, and shows bigger resources of developed ore (but probably not of as high grade as formerly) than any time during its career. The most important part of Idaho's gold production will still have to be credited to extended placer operations and a continued increase may be anticipated from this source, involving extensive mechanical equipment.

A remarkable revival of interest occurred in the old Atlantic gold camp in Elmore county, which produced ore to the value of \$5,000,000 from its secondary enriched surface horizons, 40 years ago. The ore, on development, showed a slight mixture of antimony, and proved difficult to treat, and the camp has been quiet for a number of years. The Monarch mine, at this camp, is installing a hydro-electric power plant, an extensive aerial tram and a new mill of 200 tons daily capacity adapted for amalgamation, concentration and cyaniding; the ore is said to be suited to this treatment, and will make a good yield, even though one-fourth of its value is in silver. Most of this machinery is on the ground, and the management intends to have it in full operation early next summer; the mine has 1,000,000 tons of developed ore worth \$5 a ton and up-

ward. The Minerva mine, in the same district, has developed and operated a 10-stamp mill throughout the year, producing from \$7000 to \$10,000 per month, by plate amalgamation, while the tailings, which are being saved for further treatment, are said to run from \$5 to \$7 per ton. The Pettit mine, in the same district, has \$1,000,000 worth of developed ore in sight with average gold values of \$10 per ton, and the owners are installing a 50-ton mill.

The Golden Sunbeam mine, near Bonanza, Custer county, developed an ore-body 10 ft. wide and something over 150 ft. long, that yields free-milling values of \$30 to \$50 per ton. It will shortly be equipped with a new mill, and should become an important producer of gold.

COAL

The deposits of steam coal discovered in Fremont county have been developed to a limited extent during the year by the original claimants. One of the veins, 5 ft. wide and 93 per cent. fixed and volatile carbon, is operated and produces 20 tons of coal a day for local consumption. The property carries to distinct seams, varying from 2 to 10 ft. wide, and exposed in shallow shafts, cuts and tunnels. The series is somewhat faulted, but indicates an extensive resource of high-grade steam coal. Private capital has been attracted to the discovery and evinced an inclination to develop it extensively, but, unfortunately, it is located on unsurveyed land, and the President's withdrawal of Western coal land from entry, involving the uncertainty of obtaining title, has deterred progress.

PHOSPHATES

Some important discoveries of phosphate rock have recently been made in Bear Lake county, in the extreme southeastern corner of Idaho. The deposits occur in thin-bedded limestone, and flagstones, like flat-dipping seams of coal, and are being opened in a similar manner. The beds are from 1 to 5 ft. thick and carry a fine grade of phosphate rock of a dark color. Five large groups of claims have been located in Idaho, and others extending into Utah and Wyoming. 3,020,000 lb. of the mineral have been shipped and it is believed the deposits will develop into an important industry. The formation in which they occur are believed to be Tertiary immediately overlying the Cretaceous coal-bearing formations of western Wyoming.

SAPPHIRES

An important discovery of corundum crystals was made in 1906 on the bedrock of an old placer mine, near Meadows post office, in Washington county. The general formation of the district is gneiss and the crystals, which include some of excellent gem quality, seem to be derived from a wide dike of decomposed basalt. The dike is 100 ft. wide, with a spheroidal structure, and the gem stones were found

associated with a great array of pyrope garnets and opaque corundum in the clean-up boxes of the placers below this dike, which was uncovered in washing the gravel for gold. Some beautiful gems have been found, in a variety of colors, the oriental amethyst shades predominating. Most of them have a silky opalescent luster, and would cut into cats-eyes. Some small stones have been cut into sets weighing ½ carat that have a beautiful clear cornflower blue color, others of a larger size make brilliant light-pink stones. The crystals also include large segments of bronze color, with distinct structure and cleavage that would make star sapphires and tiger-eye sets. Some pieces of a poor red color have also been found, but nothing approaching a true ruby as yet. However, the colors are so varied and the crystals so plentiful that valuable gems are likely to be found with the further development of the deposits. This development is now in progress. The corundum of these placer fields is invariably associated with other heavy concentrates, often in appreciable amounts; these include monazite, zircon, chromite, ilmenite, magnetite and traces of platinum.

Nevada

SPECIAL CORRESPONDENCE

There has been more stock gambling during the past year than at any other time in the history of the State. Much of the money has been furnished by Easterners who have found that Nevada mining shares offer as good a chance of profit as horse races or other sports. The great fortunes made by some of the speculators this year will attract capital for a long time to come. There is but little conservative mining in the State; the principal business of nearly all the mine managers is in hunting up new mines for their special group of capitalists, and in floating new companies. Everybody is in the game; clergymen are found on the directorates, and the governor of the State has lent his name to some very shady companies; one, the Bullfrog Rush, is now in the receiver's hands.

HIGH PRICES FOR CLAIMS

Prices for prospects are still out of all reason and one must be provided with a great vein of romance to do any business at all. I have heard of but one mine, out of all the hundreds that have been launched, that has paid dividends within a year of its discovery; this is the Nevada Hills, of Fairview.

This asking of high prices is nothing new; I was told by George Grayson that he paid \$85,000 for the Grand Prize mine of Tuscarora when there was only a 10-ft. hole on it. This must have been in the late 70's; in the Raymond reports of that period are complaints of the unreasonable prices given for undeveloped claims;

however, the prices obtained now are probably records as regards mere prospects; probably Greenwater holds the palm for that bad eminence.

MOHAWK MINE

The great feature of the year has been the rich strike in the Mohawk mine in Goldfield. Ore was discovered here by Hayes and Monette on their lease at a depth of about 250 ft. in April; this strike caused a rush for other leases and now the whole hillside is covered with hoists and looks like an active oil field with its forest of gallows-frames. These leases will nearly all end on Jan. 1. Work is now being pushed as fast as possible, in some cases with six-hour shifts paying miners \$5 per diem; nearly all the shafts have a separate engine for each compartment. Exact production figures are not attainable, but it is thought the output since April will be some \$10,000,000. Hayes and Monette, in addition to the ore already shipped to the amount of \$2,600,000 to Nov. 20, will make a special shipment of 100 tons of ore, carrying about \$1,500,000.

The claims adjoining the Mohawk have been merged into the Goldfield Consolidated by Senator Nixon and George Wingfield. This company has 156 acres and a capital of \$50,000,000 in 5,000,000 \$10 shares. Messrs. Wingfield charged the modest commission of 250,000 shares for making the combination. The shares are selling now for about \$7, or \$35,000,000 for the property.

GOLDFIELD

Goldfield is one of the most active places on earth, but much of the activity is misdirected to saloons and gambling. These evils are supposed to be necessary by the average Nevadan; however, I read that Cobalt, where there is a fairly active boom, does without these plagues. Goldfield has increased greatly in population; the present estimate is 15,000. There has been much suffering because of lack of fuel; wood has sold for \$90 per cord. Owing to lack of rooms many of the poorer men slept in the saloons or in unfinished buildings. The death rate was high, as many as 20 deaths were reported in a day, but there is much difficulty in learning the true state of affairs. Conditions are a little better at the close of the year. A curious phenomenon is the employment of prize fights as a booming factor. Goldfield has had one fight, and a large arena is building for a fight in Tonopah, on the first of January, and arrangements are being made for a fight at Rhyolite soon.

Goldfield is the scene of the operations of the L. M. Sullivan Company, whose personnel and methods would make a startling history. They are reported to have received \$80,000 a day from the sale of their widely advertised stocks and their advertising bills have been enormous. They seem to have obtained several good properties which will perhaps make a profit

for some of their investors. This sort of mining is the twin brother of the Louisiana Lottery and most of the purchasers of the stocks realize that they are buying a lottery ticket. Stealing of rich ore, or "high grading" has become a leading business of Goldfield, and 50 assay offices have sprung up to handle this business.

No important discoveries seem to have been made in Goldfield except in the immediate vicinity of the Mohawk. There have been some small strikes in the Great Bend, Daisy and other Diamondfield mines.

BULLFROG AND OTHER CAMPS

The Bullfrog district has been rather quiet during the year and nothing phenomenal is reported. The Gold Bar mine is said to have a very wide ledge of rather low-grade ore. The banner mine is still the Montgomery-Shoshone where work has been pushed. Men are now grading for a 100-stamp mill, which is expected to be running in March. Several other companies are talking of putting in mills, and the Bonny Claire mill will soon be running. Up to date the Tramp Consolidated seems not to have decided about its mill.

A few miles north of Beatty was the camp of Transvaal, where there was a lively excitement for a few weeks in April and May. Town lots were sold for \$100 to \$400 and for a time there was a population of several hundred. The camp is now almost deserted.

A little work is being done in many camps south of Tonopah. A rush was made for the Saline valley copper deposits in September, but they have heard nothing since. The silver camp of Klondyke seems to be coming to the front; a number of claims are being opened here. This camp antedates Tonopah; rich bunches of silver ore are found here in strong quartz ledges.

TONOPAH

Tonopah has gone on steadily; a threatened strike of the miners was avoided by wise management in the summer, and wages are now settled for three years on an eight-hour, \$4 basis.

The 100-stamp mill of the Tonopah Mining Company, at Millers, is now running, and the 40-stamp mill of the Montana Tonopah will soon be in operation. The camp has been free from litigation for a long time, but an apex suit has just been started by the West End Consolidated against the MacNamara.

MANHATTAN

Manhattan was started in December, 1905, and by April was a town of 3000. The mines here were largely financed from San Francisco, and the earthquake caused great depression; lately things have picked up a little on the report of the coming of a strong company bringing in water and building a large custom mill. There are some very promising properties in Manhattan, but they are cursed by liti-

gation; the richest part of the camp is called Litigation hill, and is well named, as all of the mines are tied up with from one to seven suits.

INADEQUATE LAWS

Nevada laws and custom particularly favor litigation; 90 days is allowed for doing location work, and the claims are usually marked only by the center monument. This gives a chance of swinging the claim should any neighbor make a good strike; then the prospectors have a pleasing way of destroying monuments and location notices. Great hardships are caused by the loose system of taking up ground. It would seem best to have all the claims officially surveyed within thirty days of location; this would be hard on the poorer prospectors in some cases, but it would give certainty to titles, which is greatly needed. Some system of this sort and the abolishing of the apex law are greatly wanted reforms, although William M. Stewart, who knows as much mining law as anyone, says that the laws are good enough as they are and only need enforcement. But little ore has been shipped from Manhattan; the average ore is too low grade to stand the long haul to the railway.

OTHER NEW CAMPS

Twenty miles or so north of Manhattan is Round Mountain, where there have been some rich gold discoveries; the Antelope claim showed a sheet of gold 10 by 14 inches, on a face of rock at the mouth of a badger's hole. Great things are promised for this camp.

On Oct. 29, there was a lively scene at Walker Lake. The Indian reservation was thrown open on that day and some 4000 people took part in the rush; most of them found men already in possession of the best claims. Much litigation will result should any good discoveries be made; so far, copper prospects are giving best promise. It is said that 2000 claims located on Oct. 29 will be abandoned.

The Blair mines at Silver Peak, have been sold during the year. A 20-mile railway connecting with the Tonopah & Goldfield Railroad, at Blair Junction, has been built, and the town of Blair started. This should be a genuine good camp for the Blair mines have been long and favorably known, the ore exists in large amount, the average is said to be a little below \$10 gold, and with the wide ledges the costs should not be over \$4 per ton, leaving a good margin of profit. The Valcald mines, near the Blair mines, are said to have \$2,000,000 in sight, whether prospectively, or problematically in sight, is not known, since there is very little to be learned in the shape of accurate figures. I predict a great development for this section.

Northeast of Walker Lake there is much activity in copper mines and prospects; the Ludwig mine is shipping steadily, and said to be making a profit of \$30,-

000 per month; some of their ore is used for ornamentation, selling to New York jewelers for 50c. per pound.

Thirty-five miles northeast of Luning are the camps of Goldyke and Atwood; a ten-stamp mill is being erected at Goldyke on a wide low-grade ledge about which all sorts of optimistic predictions are made.

Fairview has some good mines, the Nevada Hills being a specially good property. The town of Wonder, near Fairview, is young, but has some very rich silver mines and all speak well of this camp.

Seven Troughs and Rosebud are among the newest camps; both are near Humboldt. Rosebud shows white porphyry with specks of ruby and stephanite; assays of croppings give up to \$4000. Rosebud is said to be more promising than was Tonopah at the same age. Phonolite is also very new, the mines having been found in August; this is 12 miles north of Ione, an old camp. The Silent Friend mine averages \$35 for a 4-ft. ledge, with streaks giving higher assays.

NEW PROSPECTS

Many old camps are being reopened and prospectors are everywhere. Antimony is found in many places in Nevada; the Japanese are working mines in Lander county.

Tungsten and molybdenum ores are found in Nye county, and a little prospecting has been done during the year, but nothing of much value has been opened thus far. Lack of all sorts of material has greatly hampered mine operators during the last months of the year, and the coal shortage has been a curse.

Many railways are projected for Nevada; the San Pedro, Salt Lake & Los Angeles Railroad is already at Rhyolite and the Tonopah & Tidewater Railroad will soon reach the same place. This is Borax Smith's road, and will be continued to join the Nevada Central at Austin, probably touching Manhattan and Tonopah en route.

The year 1907 should be a banner year for Nevada. The army of prospectors in the mountains are sure to make good discoveries; most of the prominently rich deposits have probably been found, but ores are now looked for that were not thought of a few years ago, and in formations that were passed by as barren.

The biennial report of the Colorado State School of Mines has just been made public. In consequence of the number of students from outside the State having increased, the tuition charge for these will next year be increased to \$150. It is to be hoped that at the coming session of the legislature ample provision will be made for the institution, which is becoming more important from year to year. The attendance is 294 at present, 43 per cent. coming from outside of Colorado, which shows the reputation the school is getting abroad.

REVIEW OF MINING IN FOREIGN COUNTRIES IN 1906

The Transvaal—Rhodesia—Mexico—Ontario—Eastern States of Australia

The mining industries of foreign countries in 1906 generally showed the same prosperity that prevailed in the United States. The production of gold in South Africa was the largest on record, but nevertheless the year concludes with an unhappy feeling on the Witwatersrand, especially because of the unsatisfactory conditions arising from the labor question. In the mining industries of Canada and Mexico there have been great advances. In Australia there has been a boom, resulting from the successful utilization of the great resources of zinc ore at Broken Hill. An especially remarkable feature of 1906 is the great attention which is being directed toward the mineral resources of South America, which will doubtless result in an important development of that continent in the near future.

The Transvaal

BY W. FISCHER WILKINSON*

The value of the gold won in the Transvaal in 1906 was, in round figures, twenty-five million pounds sterling, which represents about 30 per cent. of the total production of the world. There has been a considerable increase over last and previous years, and the Transvaal will no doubt easily maintain its place at the top of the list of gold-producing countries.

The Transvaal production is mainly derived from the Witwatersrand area, the outside districts contributing only about 4 per cent. of the grand total. It is also interesting to note that 68 per cent. of the Witwatersrand output comes from the section between the Langlaagte estate on the west and the Witwatersrand mine, on the east, containing a continuous line of mines covering a distance of 12 miles. The following table compiled from the September returns shows the relative importance of different sections of the Witwatersrand goldfield.

	No. of producing mines.	No. of stamps.	Percentage of value of production.
Randfontein to Champ d'Or.....	11	840	10
Princess to Langlaagte Central..	9	720	7
Langlaagte Estate to City and Suburban	15	2110	31
Meyer and Charlton to Witwatersrand	22	3080	37
East Rand Mines..	7	1145	15
Totals.....	64	7895	100

The large increase in the production over 1905 is due more to the increased scale of operations on the mines working in 1906 than to the accession of new mines.

*Consulting mining engineer, London, England.

STATISTICS OF PRODUCTION

In January, 1906, there were 63 producing companies in the Witwatersrand district, and in September, 65, the two new companies being the Cason of the East Rand, and the Luipaardsvlei of the West Rand. The number of stamps dropping in January was 6920, while in September the number was 7915. The use of tube mills now largely increases the milling capacity of the stamps, which are no longer the best standard of measurement. The tonnage treated forms a more trustworthy basis for comparison.

During the month of January, 1906, 1,039,500 tons were milled, and in September 1,235,055 tons, these figures including the outside mines. The value of the gold produced for the 10 months, January to October, was Witwatersrand, £19,177,737; outside mines, £799,664; or a total of £19,977,401. The total production for the year may therefore approach £25,000,000.

The September figures included the gold reserves to the value of £63,580 of the Goerz and Albu groups, the managements of which decided to stop the practice of keeping gold reserves for the purpose of equalizing the monthly returns. Several of the other groups now publish what their gold reserves are, but the amounts have not yet appeared in the output returns. From the figures published it appears that on Oct. 31 the value of gold held in reserve by the Eckstein, Rand Mines, Goldfields and Barnato groups, was about £354,598, which gold might now well be included in the returns.

The following table gives the figures of production and tonnage of the Transvaal from the commencement of gold mining:

TRANSCVAAL GOLD PRODUCTION

(Chamber of Mines Returns.)

Year.	Witwatersrand District.		Outside Mines Value.	Transvaal Total.
	Tons milled.	Value.		
1884-9	1,000,000	2,440,000	48.8	238,231
1890	730,350	1,735,491	47.4	134,154
1891	1,154,144	2,556,328	44.2	367,977
1892	1,979,354	4,297,610	43.4	243,461
1893	2,203,704	5,187,206	47.0	236,292
1894	2,890,885	6,963,100	49.2	704,052
1895	3,456,575	7,840,770	45.2	728,776
1896	4,011,697	7,864,341	39.2	739,480
1897	5,325,355	10,583,616	39.74	1,070,109
1898	7,331,446	15,141,376	41.3	1,099,254
1899 a	6,639,355	14,046,686	41.14	661,220
1899 b	233,395	1,020,787	.....	15,728,693
1900	459,018	1,510,131	65.82	1,510,131
1901	412,006	1,014,687	49.25	81,364
1902	3,416,813	7,179,074	42.00	74,591
1903	6,106,016	12,146,307	39.79	442,941
1904	8,058,295	15,539,219	38.46	515,590
1905	11,160,422	19,991,658	35.82	810,416
1906 c	13,510,000	23,677,000	35.00	962,000

(a). Jan. to Oct. (b). Nov. to Dec., supplementary (incomplete). (c). Estimated.

GRADE OF THE ORE

The average yield of the Witwatersrand mines, in 1906, amounting to about 35s. per ton milled, again shows a decrease. The average reduction in grade is due, as was pointed out in a previous review, to the increased scale of operations, which (by reducing the cost of working) allows of the profitable working of lower-grade ores than formerly.

Classified according to the value of recovery the September returns show the following figures:

No. of companies.	Yield per ton milled.
3	20 to 25s.
21	25 to 30s.
20	30 to 35s.
8	30 to 40s.
9	40 to 45s.
4	45s. and over

PRACTICE IN CHARGING UP DEVELOPMENT WORK

The cost of development, which figures in the costs as development redemption, becomes proportionally reduced as the tonnage is increased. It may be well to explain that it is customary on the Rand to charge all development work, except main shafts, to capital account, and to write off to working costs a round figure per ton milled calculated on the available ore reserves. These figures have in the past been estimated on a conservative basis, and it will be evident that by including ore, which was formerly considered unpayable, the average cost of the ore reserves may be considerably reduced.

As to how development expenditure should be treated in the accounts has been the subject of discussion—some arguing that when a mine reaches the milling stage the development account up to that date should be closed, and that only the current development, which should of course be kept up to the scale of milling, should be charged to working expenses; others maintain that the development account should be gradually liquidated by charging an amount to working costs equivalent to what the ore reserves stand at in the books. As the development costs of a mine are usually highest in its early years, this system makes the working costs higher than they really are when milling commences, and is, on this account, misleading.

In examining the working costs of a mine it is important to note whether the tonnage developed is equal to the tonnage milled, and that the amount charged to working costs is not less than that actually expended.

In charging to working costs a higher figure for development than what it actu-

ally costs when the producing stage is reached, a sinking fund for the redemption of capital expenditure is being formed. If this policy is considered right, the redemption of all capital expenditure should logically be provided for and not only of the money spent on development. But sinking funds for the redemption of capital, except on development account, are not provided for and investors must take this into consideration.

AMALGAMATION OF MINES

During 1906 several amalgamation schemes were carried through with the object of increasing the working area, and of obtaining the advantages of large plants, and of reducing management expenses. Some of the smaller outcrop mines are now approaching exhaustion, and the ground remaining can, in certain cases, be worked with advantage by the neighboring deep level. Among such amalgamations may be mentioned those of the Wemmer and the Village Main Reef; the Henry Nourse and the Nourse Deep; the Geduld Group; the Klip Deep and South Wolhuter, and the South Geldenhuis Deep, South Rose Deep, Rand Victoria and Rand Victoria East, which four companies will in future become the Simmer Deep.

These amalgamations have on technical grounds much to recommend them. In the early days of the Rand the parceling out of the ground was done on too small a scale, and the boundaries were in many cases irregular and unsuited for economical working. But exception has been taken to some of the amalgamations on the ground that the shareholders in the different mines have little say as regards the terms, which are practically arranged for them by one or other of the big financial houses. Take, for instance, the case of the Henry Nourse and Nourse Deep amalgamation. The former mine was one of the old-established outcrop mines, which had for years paid regular dividends and had an assured future before it of about 17 years. Judging by its past results and by the favorable statements of the directors as regards the future, the mine appeared a particularly sound mining investment. The controlling house, however, suddenly proposed and carried out a scheme for amalgamating the company with another neighboring mine also under its control. Although in theory the property of the Henry Nourse shareholders has been improved by the fusion with another mine, due to possible advantages of longer life and cheaper working costs, the practical result to them has been that, instead of their customary dividend of over £100,000 a year, their share in the profits of the combined concern in 1906 was only £56,250. In the face of these figures it seems that the objections raised to this amalgamation were not without weight.

In some cases economy of working has

been sought by erecting a joint plant for two mines, each having its own stamps, tubes, and cyanide plant, but sharing in the power station. The Knights Deep and Simmer East have a joint plant of 400 stamps and three tube mills, this being the largest reduction plant on the field. The Crown Deep and Robinson Central also have a joint mill, and the East Rand companies are also laid out on the coöperative principle.

IMPROVEMENTS IN MINING AND METALLURGY

The use of tube mills is being rapidly extended. In August, 1906, there were, according to *South African Mines*, 58 tube mills on the Rand. Their use has enabled higher extractions to be obtained, and an increased tonnage to be put through the battery as coarser screening can be used. The Knights Deep, for instance, put through, in September, 7.24 tons per stamp per 24 hours, while the Luipaardsvlei mill deals with about 8 tons, using 400-mesh screening. Both mines have stamps weighing 1550 lb., and maintain an extraction of over 90 per cent.

As regards fineness of ore reduction, W. A. Caldecott, the consulting metallurgist to the Goldfields group, informs me that now 97 per cent. of the total ore passes a 60-mesh screen (0.010 in. aperture), and that the stamp battery's economic limit appears to be 92 per cent., the rest being done by tube mills.

There is not much variety in the methods of milling and cyaniding. Denny Brothers, however, have introduced at the George Goch and Meyer & Charlton mills a new method in which the use of cyanide solution in the battery and filter presses in the extractor house are the chief features. A detailed account of these plants was given in a lengthy paper read before the South African Association of Engineers.

It is too early yet to say whether the new process is more economical than that in common use. The inventors may, however, be congratulated in having struck out a new line, and in having erected a plant which as regards first cost is said to compare favorably with the standard plant of the field.

Among metallurgical improvements may be recorded the use of zinc fume for precipitating gold dissolved in acid washes from the clean-up of zinc gold slimes, a process which is to be tried on working solutions.

A new departure as regards management which is being tried at one of the Goldfields mines is in placing the whole of the reduction plant under one manager instead of having separate managers for the mill and cyanide works. This change has been successful, and it is probable that the system will be extended.

Belt conveyors for ore and sand have come largely into use.

COST OF MINING AND MILLING

As an example of the present-day costs of mining and milling on the Rand I may give the costs of the Simmer & Jack Mine for the year ending June 30, 1906:

Data: Tons milled, 624,507; sorting, 16.83 per cent.; No. of stamps, 320; no tube mills. Yield of fine gold per ton, 7,572 dwt. Value, 31s. 10.453d.

Items.	Cost per ton milled.	
	s.	d.
Mine expenses.....	10.	4.513
Hauling expenses.....	1.	5.838
Pumping expenses.....		5.796
Transport of quartz.....		2.717
Crushing and sorting.....		7.322
Mill expenses.....	1.	8.328
Cyanide expenses.....	1.	5.373
Slimes expenses.....		6.691
Development redemption.....	2.	6.000
Maintenance of buildings.....		0.937
Roads and surface improvements.....	0.	1.156
General charges.....	0.	9.891
Total.....	20.	4.762

Of the ore mined 47 per cent. was broken by hand and 53 per cent. by machines.

The report of the Rand mines group of nine mines for 1905 gave the following figures based on 2,023,239 tons milled:

	Highest.		Lowest.		Average.	
	s.	d.	s.	d.	s.	d.
Revenue per ton.....	53.	10.534	28.	2.061	35.	3.732
Expenditure per ton.....	29.	1.680	19.	3.407	22.	9.824
Working profit.....	32.	2.822	1.	0.335	12.	5.908

The report of the Consolidated Goldfields gives some interesting figures as regards the amount paid in wages on the Transvaal gold mines during the year ending June 30, 1906. They are: White men, £6,341,706; Chinese, £2,742,239; Kafirs, £1,079,908.

Gold to the value of £22,100,707 was recovered during the same period, and was distributed as follows:

	£	Per cent.
To Working costs.....	£14,637,043	66.23
Dividends.....	5,234,750	23.69
Profits tax.....	475,000	2.15
Reserve fund, debenture redemption and interest, machinery, renewals, etc.....	1,753,914	7.93
Total.....	£22,100,707	100.00

The working expenses of the producing mines of the Goldfields companies were approximately in the following proportion: White wages, 34.5; colored wages, 19; stores, 39.5; sundries, 7; total, 100 per cent.

PROFITS IN MINING

The profits earned by the mines show a general increase over 1905. For the first half-year 29 companies on the Witwatersrand paid out £2,535,706 and three outside companies, £110,623, or a total of £2,425,083. As increased dividends for the second half-year may be expected, the total for the year will probably be between five and six million pounds sterling.

DIVIDEND LIST OF GOLD MINES OF THE TRANSVAAL

Year.	£	Year.	£
1887.....	12,976	1897.....	2,707,181
1888.....	112,802	1898.....	4,848,238
1889.....	432,541	1899.....	2,946,358
1890.....	254,551	1900.....	
1891.....	334,698	1901.....	415,813
1892.....	879,320	1902.....	2,121,126
1893.....	955,358	1903.....	3,345,502
1894.....	1,527,284	1904.....	3,911,093
1895.....	2,046,852	1905.....	4,857,539
1896.....	1,513,682		

Of the 65 producing companies, 29 paid dividends during the first half-year of 1906.

The mines of the Central Rand are the largest profit earners, seven mines distributing 46 per cent. of the total dividends of the Witwatersrand. The Robinson mine heads the list with a half-yearly dividend of £247,500.

The finance companies have not done so well as the mines, owing to the heavy fall in the value of South African mining shares, necessitating the writing off of large sums for depreciation of securities. According to the *Investors' Chronicle*, the market value of 44 leading companies, which was £154,509,000 on Dec. 12, 1904, had fallen on Nov. 26, 1906, to £70,308,489. Goertz & Co. for the year ending Dec. 31, 1905, wrote off £331,851. The General Mining and Finance Company for the same period £230,164, and the Consolidated Goldfields of South Africa, for the financial year ending June 30, 1906, wrote off £700,000. All these companies passed their dividend, as did also the East Rand Mines. The latter company appears to have been unfortunately financed, the dividends of the profit-earning subsidiaries being passed to meet expenditures for new plant.

THE LABOR SITUATION

The mining industry continues to suffer from an insufficient supply of unskilled labor. The following table gives statistics of the labor supply during 1906 and previous years:

LABOR STATISTICS (MINES DEPARTMENT). PERSONS EMPLOYED IN GOLD MINES AT END OF MONTH

	White.	Colored.	Chinese.
1902—July	8,162	32,616	.....
December	10,292	45,698	.....
1903—June	11,825	60,221	.....
December	12,695	73,558	.....
1904—June	13,413	74,632	1,004
December	15,023	83,639	20,885
1905—June	16,939	104,902	41,340
December	18,159	93,831	47,267
1906—June	17,959	90,882	52,352

In June, 1906, the labor employed on all mines, including gold, coal and diamonds, was: Whites, 19,329; colored, 108,980, and Chinese, 52,352.

The present labor force is concentrated on the best producing properties, while the less promising properties, and those which are some distance from the productive stage, have to remain comparatively idle. Owing to the uncertainty as regards labor and in some cases to the difficulty of raising fresh capital, work on the unproductive mines has been reduced since the beginning of 1906. In January there were 57 developing companies, using 173 machine drills; while in September there were 48 companies, using 146 drills.

The Chinese supply has ceased, and by the end of next year about 20,000 will be free to return home on the expiration of their three years' engagement. Re-enlistment may take place, but in any case it seems that this labor will be a decreasing quantity. The Chinese now represent about a third of the unskilled labor supply,

and their repatriation must necessarily mean a considerable contraction of mining work and of gold production, and the dismissal of a large number of whites.

From an economic point of view, as remarked in my last year's review, the experiment has proved a success. If, on other grounds, the policy is now to be reversed, it is to be hoped that it will be done gradually, so as to prevent, as far as possible, any sudden dislocation of business, which would bring ruin or distress to thousands in South Africa.

FUTURE PROSPECTS

There is some hope that an important economy of labor may be brought about by the introduction of small machine drills, which can be put into the hands of Kafirs. But the solution of this problem has not yet been obtained, although the experiments made in this direction appear to be meeting with success. The mining correspondent of the *African World* (Nov. 17, 1906) says that experiments at the Robinson mine with the Gordon stope drill have shown that a Kafir can put in eight 3-ft. holes with this machine against one by hand. I have not yet seen any official figures, and no doubt an extended trial will be given before responsible engineers will make a statement, but it seems probable that a reliable stope drill will before long become an accomplished fact. Its adoption must bring about a great economy of labor, and will go a long way toward solving the labor problem.

Further, a reduction in the cost of living, which time will no doubt bring, will also tend to alleviate the position by making it economically possible to employ more Europeans. But a reorganization of the methods of working on these new lines cannot be done in a moment, and it does not seem that there is much hope for any rapid expansion in the industry, while if the Chinese are repatriated, a serious setback will certainly take place.

Spanish Mineral Trade

Exports of metals from Spain for the 10 months ending Oct. 31 are reported by the *Revista Minera* as follows, in metric tons:

	1905.	1906.	Changes
Pig iron	45,413	28,430	D. 16,983
Manf. iron	4,434	22,303	I. 17,869
Copper	8,656	8,902	I. 246
Copper precipitate	14,423	18,596	I. 4,173
Zinc	1,198	1,022	D. 176
Lead	142,973	147,458	I. 4,485

Exports of minerals for the 10 months were as follows:

	1905.	1906.	Changes
Iron ore	6,818,362	7,895,399	I. 1,077,037
Copper ore	861,994	923,119	I. 61,125
Zinc ore	110,973	116,028	I. 5,055
Lead ore	5,050	3,798	D. 1,252
Manganese ore	38,417	85,197	I. 46,780
Pyrites	604,024	864,228	I. 260,204
Sulphur	904	651	I. 253
Salt	303,120	387,125	I. 84,106

Imports of chemicals for the 10 months were 11,627 tons alkaline borates and silicates; 11,837 tons caustic soda and potash; 2266 tons sulphate of soda; 151,726 tons mineral fertilizers; 76,049 tons phosphates and basic slags.

Rhodesia

BY W. FISCHER WILKINSON*

The gold production for 1906 may be expected to reach 555,000 oz. of a value of £2,053,000. Rhodesian returns are not made in fine ounces except in the case of the Panhalonga and Rezende mines, which are up to date in this respect. The official figures for the 10 months ending Oct. 30 were 457,153 oz. of an approximate value of £1,681,215. Besides gold there is a production, not indeed of much importance, of silver, lead, coal, wolfram, chrome-iron ore, and diamonds. The following table shows the gold production from the commencement, in ounces:

GOLD PRODUCTION OF RHODESIA

Prior to Sept. 1, 1898	6,470
Sept. 1 to Dec. 31, 1898	18,085
1899	65,303
1900	91,940
1901	172,061
1902	194,169
1903	231,872
1904	267,737
1905	409,836
1906 estimated	555,000

Total 2,012,473

According to the statistics of the Chamber of Mines the gold production from 1898 to March 31, 1906, was as follows:

	Tons of 2,000 lb.	Oz.	Value.
Matabeleland	2,557,799	1,221,586	£4,427,598
Mashonaland	744,265	341,609	1,238,494
Tati Concessions	39,161	20,926	63,986

Total 3,341,225 1,584,121 £5,730,078

The most noticeable feature in the returns for 1906 is the large number of small producers having batteries of five stamps or under. Whether this source of gold will be permanent seems doubtful. As pointed out in the president's address to the Chamber of Mines in reviewing the work of the financial year ending March 31, 1906, many of the small workers and tributors are working on properties partially developed by companies that have exhausted their working capital. Quartz mining is not generally profitable for the man of small means, and a time must come when development is necessary in order to obtain grist for the mill. The president does not anticipate that the production of gold by the small producer will be maintained at its present figure.

The official figures for the first 10 months are as follows:

RHODESIA CHAMBER OF MINES				
Month	Tons milled	Stamps	Oz.	Value £
1906.				
January	106,032	892	43,353	159,597
February	95,033	882	38,375	141,707
March	112,531	899	44,915	165,343
April	107,129	920	43,024	161,433
May	116,568	999	47,135	175,658
June	112,631	991	47,664	174,022
July	120,420	1,024	48,485	175,708
August	123,773	1,065	50,127	182,577
September	118,088	1,012	48,410	176,170
October	.....	.....	45,664	*169,000

Total 457,153 1,681,215
*Estimated.

DIVIDEND-PAYING MINES

An unfavorable feature of the gold-mining industry of Rhodesia is the lack of

*Consulting engineer, London, England.

dividends. During 1906 only two companies, viz., the Globe & Phoenix and the Giant, declared dividends. The latter is a new company, which commenced crushing in December, 1905, added materially to the output. It has a mill of 15 stamps and two tube mills. The value of the output is about £9000 per month, of which about £5000 is profit. This company paid its first dividend of 7.5 per cent. in July. The capital is £250,000. A wide reef is worked and the filling in of stopes is practised. The Globe & Phoenix mine, which has a 40-stamp mill, continues to make good returns and to pay dividends.

NON-DIVIDEND-PAYING MINES

The Killarney, Hibernia mine has a 20-stamp mill and a tube mill. The monthly value of its output is about £5000, but the company has not yet paid a dividend, and the development of the mine in depth has been disappointing. The Selukwe mine with 40 stamps is one of the principal producing mines, but it has not paid a dividend since 1903. The Wanderer, which is more of a quarry than a mine, crushes the largest number of tons per month of any Rhodesian mine. It has a dry-crushing mill equivalent to 100 ordinary stamps. The value of its monthly output is in the neighborhood of £9000. For the year ending March 31, 1906, it crushed and treated 174,975 tons at a cost of (exclusive of development redemption) 6s. 9.38d. per ton. Nine other Rhodesian mines operating 195 stamps crushed 360,018 tons during the same period at a cost, exclusive of development redemption, of 21s. 5d. per ton. Other mines treating over 4000 tons of ore a month are the East Gwanda with 60 stamps, the Sabiwa with 40 stamps, the Ayrshire with 60 stamps, and the Penhalonga with 50 stamps. Attention is now being paid to the mining of low-grade iron stone and schistose ores as distinct from ordinary quartz reefs.

DISCOVERY OF DIAMONDS

A discovery of diamonds which may turn out to be of some importance has been made at Somabula in the Gwelo district, a place situated on the Buluwayo-Salisbury railway. The diamonds, with which are associated other gem stones, of no great commercial value, however, are found in a gravel deposit resting on a decomposed surface of granite. The occurrence is, therefore, an alluvial digging and not a pipe, and is probably similar to the diamond fields of India and Brazil. Stones of good quality have been found. Up to March, 1906, the production was 1161 carats valued at £4028. A plant capable of treating 500 loads a day is in course of erection.

It is estimated that the copper output at Mount Molloy, Queensland, during 1907 will be 2000 tons of blister copper. This is assuming that necessary additions are made to the reduction plant.

Mexico

BY C. A. BOHN*

In a review of the year's mining and metallurgy in Mexico, naturally the first thought is of silver. Mexico is still the leading nation in the production of this metal. Yet it is not alone to silver that her greatness is now due, for as the government has adopted the gold standard, the output of the gold mines of the country has increased until production more than meets the demand of the country, and Mexico easily stands fourth among the world's gold producers, being preceded only by the United States, Africa and Australia. Likewise in copper, the production continues at such a pace as to keep it second only to that of the United States. In the output of lead, Mexico is surpassed only by the United States, Germany and Spain. Among other mineral products are iron, coal, oil and asphalt, zinc, sulphur, tin and mercury; the salt beds and salt lakes; the building stones, the onyx of Puebla, and precious stones, of which the most important are opals and turquoise.

The greater attention, however, is paid to the production of silver and gold, and in the production and extraction of these two metals has the greatest progress been made. As will be seen, much of this progress has been due to the application of cyanide process to the copper-free silicious ores, very few of which are not amenable to this treatment. In the introduction of this process great credit is due the Mexican Gold and Silver Recovery Company, which for 12 years has held the rights in Mexico to the McArthur-Forrest cyanide patents. This company's experts have demonstrated the process in Sonora, Sinaloa, Chihuahua, Durango, Zacatecas, Guanajuato, Michoacan, and all over the Republic. What promised to be a long and expensive litigation over the right to hold a patent on this process was instituted early in February by the manager of the Recovery company, against the Guanajuato Reduction and Mines Company, for use of the cyanide process without paying royalties, but the controversy was amicably adjusted by the payment of a nominal sum for the perpetual right to use the process.

SILVER AND GOLD

Guanajuato—Of the silver-producing districts, Guanajuato is in the lead. Only a few properties were working in a small way at the time the Guanajuato Consolidated Mining and Milling Company entered the district and took hold of the Sirena mine seven years ago. After heavy expenditures in development and equipment, Jan. 1, 1905, saw this company with 90 stamps dropping and practically satisfied with the success of cyanide, after concentrating, for the treatment of its ores. Including that done in the patios, 300 tons

were being treated daily in Guanajuato, which would have given a total valuation of \$2,000,000 for the year's product. The opening of 1906 saw this output doubled; the pay rolls had increased from \$80,000 to \$200,000 per month, 200 stamps were dropping, treating 600 tons daily and giving a production at the rate of \$4,000,000 Mexican per year. The advantages of electric power have been proved; the cyaniding of low-grade ores and the old dumps is no longer an experiment; the profits on \$30 ore have been raised to about \$22, where formerly they were less than \$3, and it has needed only capital to make Guanajuato one of the leading silver-producing camps of the world. This has been done principally with American capital.

The history of one company is the history of all, and I can do no better than to record here the year's work of the Guanajuato Reduction and Mines Company, operating all the old producing mines of the mother vein of Guanajuato, except the Sirena. Work was started upon an 80-stamp mill and cyanide plant in March, 1905, and was completed in March, 1906, since which time the mill has run in its entirety something over 98 per cent. of its possible stamp hours, and upon ores about one-half of which have been old waste and one-half mine ore. An extensive compressor plant was at the same time installed on the Cata mine, which is the central one of the group, and most energetic development work was prosecuted throughout the entire year with very favorable results. For the unwatering of the huge Rayas and Mellado workings, occupying the southern one of the two miles owned by the Guanajuato company, two 300-gal. pumps were installed in the Cata, upon the 1000-ft. level, and were connected by piping to an aperture in a dam separating the Rayas and Mellado mines from the Cata, on a deep level, the pumps thereby receiving their water under pressure of approximately 400 lb. per sq.in. and performing the labor only of lifting this pressure to 425 lb. Unwatering is proceeding at the rate of 600 gal. per minute, day and night. The Tepeyac mine, lying to the north, has, in this same manner, been unwatered to the bottom and the unwatering of the Valenciana will shortly follow.

The ores, while containing a fraction of their values in gold, are silver ores and many doubts were expressed as to the ability to treat them by the cyanide process. This has been so successfully accomplished, however, that extraction of better than 86 per cent. has been steadily obtained. The company owns dumps aggregating 2,000,000 tons, all easily accessible to the mill site, and the original design of the mill involved the installation of a 1000-ton plant, of which the present 80 stamps constitute one unit. The working of these dumps has been so much more profitable than the original estimates

*Mining engineer, City of Mexico, Mexico.

that contracts have been let for all machinery and excavations, while foundations are now practically complete for an additional 80 stamps; it is probable that before these are installed the third unit will likewise be under way. It is expected that the second 80 stamps will be in operation by August, 1907, making this the largest mill under a single roof in the Republic. The stamp mill and concentrating units are located immediately at the mines, the tailings of the concentrators being conveyed a distance of more than a mile through an 8-in., cast-iron pipe, laid on a $2\frac{1}{4}$ per cent. grade, to the Flores hacienda, an old patio hacienda in the city of Guanajuato, where they are cyanided, and the waste discharged into the main stream of the district.

In addition to the mine development satisfactory progress has been made in opening up the immense masses of stope fillings in the old mines, which exist in widths up to 50 ft., the average grade of which is about \$10 (U. S. gold) per ton. On the least calculation the company's mines on the mother vein have 1,500,000 tons of this grade.

The company also owns a mile along the main La Luz vein, north of Guanajuato, the mines held there embracing the Purisima, San Pedro, Rosario and Pili, all very important producers in the past, but now flooded. One of the shafts of this group has been put in excellent condition, with electric hoists, and unwatering is proceeding. At the same time a fair amount of development has been done upon virgin ground between these old producers with such results that it is contemplated, before long, to install a 250-ton unit upon this group in addition to the installations upon the mother vein.

With the companies: Guanajuato Consolidated, Peregrinas, Guanajuato Amalgamated, Central, Nayal, El Cubo, Carmen, Pinguico and others, practically all is new work, but the metallurgical problem is the same, and all are cyaniding, so that combined there are 650 stamps now dropping in Guanajuato, treating 2000 tons a day, or at the rate of \$14,000,000 (Mexican) a year, an increase of more than 50 per cent. over that of the most flourishing bonanza days of the past centuries. Nor is the end yet in view; for example, in the workings of the Pinguico mine of the Guanajuato Development Company, where marvelous bodies of ore have been encountered, it is said that once as much as \$1,000,000 worth of ore was opened up in a week's development work.

The future of the camp is to be greatly aided by the extension of the Mexican Central Railroad from Marfil into Guanajuato, and the building of a line from Guanajuato, via Marfil and San Gregorio (this much of which has been in operation for some years), to Salamanca to connect with the Mexican National Railroad,

both of which lines Guanajuato should have had years ago.

Pachuca—Next to Guanajuato, of the old camps, comes Pachuca, but unlike Guanajuato it had not particularly declined, one of its old plants alone, the Hacienda de Guadalupe, of the Santa Gertrudis & Guadalupe Mining Company, treating 150 tons a day by the old process of Bartolomé de Medina. In February, 1906, the United States Smelting, Refining and Mining Company, of New York, purchased through the MacDonald Brothers, of Guanajuato, the famous old Real del Monte mines, and since that time the property has been practically closed down while a full electrical equipment is being installed, and a 250-ton cyanide plant is being erected. It is understood also that the Blanca y Anexas, another of Pachuca's largest properties, has just been sold for \$10,000,000 (Mexican).

Zacatecas—This famous old silver camp where the patio prevailed, which had fallen off much more in its production than the two just mentioned, seems to stand a fair chance of being revived. The old San Rafael group was taken up by El Grande Mining Company, of A. E. Stillwell and associates, and active mining operations were resumed about the middle of the year. The property is being slowly unwatered, and results so far, especially from the work in virgin ground, have been most encouraging. El Bote, also famous during the last century, has been under examination for some months by an American company. The old Tajos de Panuco, which gave the silver for the coins minted in Zacatecas as early as 1560, is being unwatered by New York capital, as is also the San Roberto, adjoining the Mala Noche, while it is probable the Veta Grande will also be unwatered to admit of examination. As yet little has been done here with the cyanide process, but unquestionably the coming year will see its introduction in this old camp.

San Luis Potosi—The success of the cyanide process has been proved for some years in the treatment of the old dumps in the San Pedro district near San Luis Potosi, though the greater part of the ores still go to the smelter of the Mexican Metallurgical Company, at the latter point. This company has opened up this year large bodies of silver-bearing lead and iron ores in the properties it holds under lease from the Victoria company in the San Pedro district.

Chihuahua—In Ocampo, or Jesus Maria, the seat of the Rayon district in western Chihuahua, beyond Miñaca, where stamps and amalgamation, with and without concentration, have been in use for years, the success of the Concheño Mining and Milling Company, with its 60 stamps and cyanide plant, has convinced the skeptical, and the past year saw the extension of cyanide practice to the other companies, led perhaps by the Greene interests. At the famous Dolores mine, May, 1906, saw

the successful institution of cyanide after amalgamation. In Parral, too, the initiative has been taken by the Veta Colorado in the starting of a 250-ton cyanide plant, which will be the first in the district, and if a success will be followed by others and possibly by a 1000-ton custom plant.

Jalisco—In the Etzatlan district of this State the greatest activity was shown during 1906, and the Amparo Mining Company, of Philadelphia, owning the old Santo Domingo mine among others south of Etzatlan, has gradually brought up its production to 100 tons a day, and with a 20-stamp experimental mill has proved the practicability of the cyanide process for its ores, so that orders have been given for a 200-ton plant for the treatment of the low-grade ores that will not stand shipment, and possibly eventually for the treatment of all its ores. In the old properties of Mololoa and Tamara in Hostotipaquilla, a district north of Etzatlan, remarkably rich bodies of ore have been disclosed, and the last months of the year saw a large combination effected between these properties and those of Amajac, which will mean much for that section. As yet the patio is in use in this district for the ores that are not shipped. At El Favor mines, owned by a company of the same name, and controlled by Makeever Bros., of Boston, what is believed to be the Mololoa vein was encountered in October, and a large body of ore is being blocked out, only that produced in development work being shipped, while the rest is left in the mine for treatment in the immense mill for which experiments on the ore are now being carried on.

El Oro—The mining camp of El Oro extends from the town of El Oro, in the State of Mexico, over into the State of Michoacan, and includes Tlalpujahu. Into this district electric power was introduced by the Mexico Light and Power Company, from its power plant at Necaxa over a distance of 200 miles, and with El Oro Mining and Railway Company the replacement of steam by electricity was begun in February and applied throughout the property. The operation of the electric plants has been most satisfactory since the installation, and has resulted in a reduction in the cost of power from \$150 or \$200 per horse-power-year down to about \$50, and a consequent lowering of the milling cost from about \$7 to \$5. This company reported in June, 1906, for the preceding 12 months' work, a total production of 234,079 tons, from which were realized \$2,225,000 gold at a total cost of \$1,257,000, and of the resultant profits \$675,000 gold was distributed in dividends, or something over \$100,000, Mexican, per month, while the Dos Estrellas Company has kept up its regular monthly dividend of \$40, Mexican, per share, or a total of \$120,000 per month; this should be materially increased after the completion of the new mill, with 120 stamps and three 24-ft. tube-mills, capable of treating 600

tons daily. The Esperanzas Mining Company, said by many to be the most productive gold-mining company in the world, has continued paying its dividends of \$400,000, gold, per month. This company has resorted to the novel expedient of further leaching with water the old dumps that have been acted on by weather, and this water passed over zinc.

The combined production of these three El Oro properties, amounting to a little over \$12,000,000, Mexican, per year, of which 80 per cent. is gold, makes it the second most productive gold-mining center on the American continent; the reduced cost of extraction, owing to the introduction of electricity, and the development of the smaller properties will greatly increase this enormous output in the present year. At the properties of the Mexican Mines of El Oro, Ltd., several thousand tons have been opened up, and a plant of 20 stamps, with tube-mills and cyanide tanks for 100 tons daily capacity, is under erection. The Chihuahua, Aldebaran, Victoria and a number of smaller properties are actively engaged in development.

Miscellaneous—In Sonora the great copper camps so overshadow all else that little is heard of other work, but rich silver-lead ore has been opened by the Cubana Consolidated Copper Company, at Arizpe, 40 miles south of Cananea; at the Pichaco mines, southeast of Cananea, bought from Phelps-Dodge Company by Clancy Bros., of Detroit, bodies of silver and gold ores are being developed and are treated at the 200-ton mill just completed on the Oro Maximo Mining Company property, under the same ownership. Chas. Butters has started the cyaniding of his low-grade ores at the Grand Central, while the Boss process, followed by cyanide, is used at the Creston Colorado, both of which are at La Colorado, Sonora. At the Llanos de Oro placers, Epes Randolph is putting in a 100-stamp mill, while the Greene Gold Company is installing dredges of 2000 tons daily capacity for operation on La Brisca placers. In Chihuahua the Lluvia de Oro is putting in a 100-ton plant with cyanide after amalgamation, while the Palmarejo and Mexican Gold Fields, Ltd., has been put on a profitable basis by increasing to 100 tons a day and cyaniding after concentration.

Metal Refinery—In connection with the country's gold and silver production the most important new work of the year was the putting in operation of the electrolytic refinery of the National Metal Company, in Mexico City, from which the first shipments of fine silver and fine gold were made in January, 1906. The melting department of this plant consists of three Doré furnaces, one reverberatory furnace and three tipping-retort furnaces; the parting and refining departments are made up of 10 sections of four cells each for the electrolytic refining of silver by the Moe-

bins process, and one section of six cells for the electrolytic refining of gold.

The refinery is receiving base bullion and cyanide and sulphide precipitates from almost every State in the Republic, and among these receipts is practically the entire output of the Guanajuato, El Oro and Pachuca districts, with many others. The business has grown from a necessarily small beginning up to where now the monthly production amounts to 500,000 oz. of fine silver and 25,000 oz. of fine gold, which is about two-thirds of the actual capacity of the plant, and as the output is continually increasing there is no doubt that additions will have to be made to the plant during 1907. Of the product, which, in both silver and gold, is 999.8 fine, all the gold is sold to the Monetary and Exchange Commission of the Federal Government, while the silver, with the exception of a small proportion disposed of locally, goes to London.

COPPER

Cananea—The great increase in the production of copper, which has put Mexico among the chief producers of this metal, is due to the properties in the State of Sonora, and particularly in the district of Cananea. The greatest at this camp is the Greene Consolidated Copper Company. In eight years this company has grown from nothing to be one of the greatest works of its kind in existence, and it is now adding to the world's wealth of copper at the rate of \$10,000,000 (gold) per annum. This is notwithstanding the fact that three-fourths of its ore is of second grade and has to be concentrated. Development has been carried on beyond the ability of the surface equipment to handle the tonnage, but this is being rapidly brought up to meet the requirements; the caving system is being introduced in the mines; an elaborate system of underground and surface roads and ways, with electric traction, between the mines and mills has been installed; the concentrators have been increased by 1000 tons, and brought up to a daily capacity of 3500 tons; an extensive system of Robins belt conveyors, for bedding the ores and feeding the furnaces from the beds, is about ready to be put into operation; the fines and flue dust are being sintered by a patent process to relieve the work of the blast furnaces, and the eight blast furnaces now in commission are being replaced by larger furnaces, 56x180 in., at the tuyeres, and with automatic feed; so that 1907 should see the present production of 6,000,000 lb. per month greatly increased. It is said that the company will be able profitably to handle ore running as low as 1 per cent. copper by the new and enlarged plant, with the practically automatic equipment which cuts down labor and cost of handling.

What promised to be another immense company was organized in July by T. F. Cole and associates, among them W. C. Greene; it was known as the Cananea

Central Mining Company, with a capital of \$10,000,000 gold, and owned, among others, the American mine (which previously had been under bond to the Lewisohn Bros., of New York, and a year before could have been purchased for \$100,000), for which \$2,500,000 gold was paid, and the Cananea-Duluth, which was obtained for \$500,000 gold and certain interest in the new company. Development was at once started, the old shafts were deepened, new shafts were projected, so that by the middle of September the company was shipping 100 tons of ore per day. More recently, through Messrs. Ryan, Cole and Greene, the Amalgamated Copper Company obtained an interest in the Cananea companies, and a merger was effected between the Cananea Central and the Greene Consolidated, and for the combination a new holding company, the Greene-Cananea, was formed, with a capital of \$15,000,000 gold. There can be no doubt that Cananea will soon be the largest copper camp on earth, for in addition to the companies interested in the merger, there are the Sierra de Cobre Mines, of the Queen Consolidated Copper Company, now producing 200 tons a day of 5 per cent. ore and continually increasing; the Southwestern Copper Company, the Cananea Eastern, the Rouquillo Copper Company, and the South Cananea, all producing, together with a number of other properties which have not yet got onto the shipping list.

Miscellaneous—Among other more important copper properties are La Dicha mines, of the Mitchell Mining Company, in Guerrero, producing 15 tons of copper per day; the Jimulco Mining Company, with its railway and mines at Jimulco and Panuco, whose work on the building of its own smelter at the latter point was checked by an exceptionally favorable contract with the American Smelting and Refining Company, the Mazapil Copper Company, with its mines, smelters and railroads in the States of Zacatecas and Coahuila, whose new smelting plant in Saltillo has just been completed; the Rio Tinto, with its 250-ton smelter at Terrazas; Chihuahua, which has just been blown in; the Tezuitlan Copper Company, with its large smelting plant in the State of Puebla, which company has added largely to its holdings during the year and greatly increased its ore reserves; and a number of smaller properties in the southern part of the State of Jalisco, and in the States of Michoacan and Guerrero.

COAL AND IRON

With iron little has been done, notwithstanding the immense deposits at Durango, at Las Truchas, in Michoacan, and at Alvarez, in Colima. But in the coal fields several large companies have been formed, the principal of which are the Mexican Coal and Coke Company, at Esperanzas, Coahuila, producing 50,000 tons of bituminous coal and 8000 tons of coke; and the Sabinas Coal Mining Com-

pany, at San Juan de Sabinas, just north of Esperanzas, organized the early part of the year, which is developing and opening up its 30,000 acres of coal lands. It is awaiting the completion of the railroad from Barrteran before placing its bituminous coal on the market. For the opening of the semi-anthracite beds in Puebla, between Tulancingo and Guachinango, the National Railroad has ordered a survey to be made, but another year will have passed before much can be done there. On the other deposits known to exist in the States of Sonora, Vera Cruz, Oaxaca, Michoacan and Guerrero, little or nothing has been done because of the lack of transportation.

ZINC

In zinc little new was done because of the check given it by the imposing of a 20 per cent. *ad valorem* duty by the United States on zinc ores shipped into that country. The chief new work of interest is the magnetic separator at the American Smelters Securities Company's mines in Velardeña, Durango, and its Tecolotes mines in Santa Barbara, Chihuahua; and the Sutton-Steele dry table and the dielectric separator at the Tiro General mine in Charcos, San Luis Potosi. All of these are still in the experimental stage, and results are not yet assured.

SMELTING

The prediction that lead must soon give way to copper as a base for collecting the gold and silver values in the ores in smelting, though looked upon as a fact for the future, does not seem as yet to be proved in the work of the past year. The existing smelting plants that have been using lead continue to do so; and of the new and independent plants, in the build-up of which there seems to have been somewhat of a contagion during the year just past, the tonnage is perhaps equally divided between copper and lead. Among these the more important custom plants are the Magdalena lead smelter in Oaxaca, of 100 tons, blown in in July; the Oaxaca Smelting and Refining, of Oaxaca, with a lead plant of 250 tons capacity, which was blown in by the end of December; the Mexican Smelting and Refining, Taxco, Guerrero, with a 40-ton lead furnace, blown in in September; the Michoacan Metallurgical Company, at Augaugueo, with a 250-ton copper plant blown in last July; the Guaymas, Sonora, 500-ton lead and copper plant; and the 500-ton lead plant of the American Smelting and Refining Company in course of construction in Chihuahua. The largest new plant to go into commission in 1906 was that of the American Smelters Security Company, at Velardeña, Durango, intended for 600 tons of lead ores and 900 tons of copper ores, though as yet only two copper stacks, of 600 tons daily capacity, have been installed and blown in. At this plant all is automatic from the time the ore leaves the railroad

cars, belt conveyors taking the ore to the mill, thence to the beds, and from the beds to the 5-ton, electrically driven charge cars, which dump directly into the furnaces, and by electric traction the slag pots are taken from the furnaces and dumped. As yet no converters have been erected, the matte being shipped to the American Smelting and Refining Company plant at Aguascalientes.

RAILROADS

Railroad building has been carried on at a pace as never before since the original completion of the Mexican Central and National systems from the United States border to the City of Mexico. The Cananea, Yaqui River & Pacific is running its extension to the port of Guaymas, Sonora; the Kansas City, Mexico & Orient is driving across Chihuahua and Sinaloa to Topolobampo, the first desirable port south of Guaymas on the west coast; the Mexican Central is completing its branch from Guadalajara to the Pacific coast port of Mazanillo; and the Southern Pacific is stretching out its gigantic arms almost across the continent, from Guaymas, Sonora, through that State, and Sinaloa, Tepic and Jalisco, to Guadalajara, the second city of the Mexican Republic, as fast as surveys and construction work will permit of its being done. But most important to all business interests in Mexico, of whatever nature, is the control just obtained by the Federal government over the Mexican Central, which, taken with the Mexican National, of which the Government secured control in 1903, will form a gigantic combination with a mileage, including branches under construction, of 10,000 miles, and for the operation of which a new \$225,000,000 (gold) company will be formed, the Government holding \$113,000,000 of said company. What this means in the building of much needed lines and connections can only be surmised. Mexico may possibly be considered now as in a transition stage, but the change is so healthful and the development so certain that its success is assured.

Ontario

BY THOMAS W. GIBSON *

In the Province of Ontario the chief interest centered in the silver ores of the Cobalt camp, the discovery of which in the autumn of 1903 ranks as one of the most notable finds of mineral within the last decade. The early promise of these narrow, but wonderfully rich, veins has so far been more than realized.

Nothing was shipped from Cobalt in 1903; in 1904 the output was 206,875 oz. of silver; in 1905 it rose to 2,451,356; in 1906 the product up to the end of

*Deputy Minister of Mines, Toronto, Ontario.

September was 2,542,827 oz., and as the shipments during the last quarter of the year were in excess of those for the first nine months the yield will hardly be less than 5,500,000 oz. of silver for the year. The prospects for 1907 are that the production will be still greater. The development of Cobalt has given Ontario easily the first place among the Provinces of the Dominion in the production of silver. British Columbia led for many years, but in 1905 its yield was only 3,439,417 oz., so that unless it has greatly increased during 1906, the leading position must be conceded to Ontario.

GRADE OF ORE

A glance at the tonnage of ore shipped from the mines shows its quality. The first shipments in 1904 were native silver nuggets and plates found in the upper zones of the deposits; the 158 tons sent out averaged 1309 oz. per ton; in 1905 the consignments were 2144 tons and the average contents 1143 oz., while in 1906, although the exact figures cannot yet be given, the shipments will amount to about 5000 tons, containing an average of say 1100 oz. of silver to the ton. Some of the consignments have been of phenomenal richness; one carload from the O'Brien mine in 1905 brought about \$65,000, while one from the La Rose, or, as it is sometimes called, the Timmins mine, in 1906, yielded a return of \$110,000. Ores, carrying up to 200 or 300 oz. of silver per ton, which in other camps would be reckoned of high quality, are in Cobalt spoken of as "low grade." The mine owners feel that in comparison with the more valuable ores they do not pay to handle and ship; hence they are piled on the dump until the time arrives when concentration methods will be employed.

PRODUCING MINES

The producing mines are as follows: Nipissing, La Rose, Coniagas, Jacobs, Trethewey, Drummond, Foster, University, McKinley-Darragh-Savage, Buffalo, Cobalt Silver Queen, O'Brien, Violet, Right-of-Way, Lawson, Hargrave, Watts and Allen, and Green-Meehan. In addition to these, several other properties are just about to enter the productive stage. The rich territory is fairly well distributed. Most of the mining companies hold one, two or not more than three 40-acre claims, so that there is no great likelihood of any one concern's owning absolute control. One or two of the companies which were early on the ground are, however, an exception to this rule, the principal one being the Nipissing Mining Company, whose holdings aggregate 846 acres. This company is the successor of E. P. Earle, who, in 1904 before the field became famous, bought out a number of the original locators, and secured a large area in the center of the camp. O'Brien

& O'Brian have also a considerable tract, procured in the same way, consisting of 277 acres. The Hudson Bay and Timiskaming Mining Company has several 40-acre claims, but its producing property, now known as the Cobalt Silver Queen, has been sold to the company of that name.

Cobalt has been the scene of much litigation. The titles of the Nipissing Mining Company and of M. J. O'Brien & J. B. O'Brian were called in question by the government of the Providence on the ground of misrepresentation as to discovery, but both suits have been settled, that against the Nipissing Company having been abandoned, and the one involving the O'Brien mine, having been settled by the agreement of the proprietors to pay the government a royalty of 25 per cent. on the output. A similar suit against Messrs. Hargrave and White concerning three 40-acre claims was decided in favor of the government by Chancellor Boyd, but proceedings have not yet been concluded.

DISTRIBUTION OF ORE

The labors of the prospectors seem to have pretty well defined the boundaries of the productive area of Cobalt, and have shown it to be limited to certain portions of the eastern half of Coleman township and portions of the adjoining townships of Bucke and Lorrain. Outside of this territory, comprising perhaps 10 or 12 square miles, cobalt bloom and smaltite are found at many widely separated points, but silver values are low or absent altogether. What special influences were at work to deposit silver so profusely in the veins which characterize the conglomerate and diabase of eastern Coleman, while denying it to veins occurring in the same or similar rocks occurring elsewhere in the region, has not yet been elucidated by geologists. During the closing days of the prospecting season of 1906, two prospectors, the White brothers, returned from near Lady Evelyn lake, in the Temagami forest reserve, with fine samples of native silver in diabase, as well as smaltite and cobalt bloom, and it is not impossible that another argentiferous area may be opened up in that region.

DISPOSITION OF ORE

The Cobalt orebodies carry considerable cobalt, nickel and arsenic. The last two constituents are at present valueless to the mine owner, and he gets nothing for cobalt unless it is in excess of 6 per cent. Ore buyers settle on the basis of 93 per cent. of the value of the silver, if in excess of 2000 ounces per ton. A sliding scale governs payments for ore of lower grade. Up to the present, most of the ore has been shipped to Newark and Perth Amboy for treatment, but several reduction plants are in course of construction in Ontario, some of which

will shortly be ready to begin operations. The Copper Cliff refinery has already treated considerable ore.

An interesting development in the Cobalt district has been the direct participation of the Ontario government in the mining field. A portion of the mineralized area known as the Gillies limit was withheld from the market because of its value for pine timber. This timber having been removed, the government, authorized by the legislature, embarked upon the business of mining. Operations were placed in charge of Prof. W. G. Miller, the Provincial geologist, whose prospectors during the past summer located several promising veins. One of these, carrying cobalt and native silver, is 7 in. wide on the surface and a shaft, which has been sunk to a depth of 70 ft., showed the vein to be strong and rich at that point. The mines are to be worked for the benefit of the Provincial treasury. On Dec. 20, the government disposed of the bed of Cobalt lake, containing some 43 acres, to the highest bidders, an Ottawa-Toronto syndicate, for the sum of \$1,085,000, a reasonably good price for an undeveloped claim.

SUDBURY DISTRICT

The nickel mines of the Sudbury district were more active in 1906 than during any previous year. High-water mark in the yield of nickel was reached in 1905, when the production was 9503 tons; for 1906 the output was 8037 tons for the first nine months, and for the full year it was about 10,750 tons. The chief producers are the Canadian Copper Company and the Mond Nickel Company. The production of copper, which comes mainly from the nickel-copper ores of Sudbury, was about 5200 tons in 1906, as against 4525 tons in 1905.

IRON ORE

The iron ore raised in Ontario comes almost wholly from the Helen mine in Michipicoten, and the shipments totaled somewhat less than in 1905 when they amounted to 211,597 tons. New sources of production are likely soon to come into play, as an extension of the Canadian Northern Railway is now under construction into the Hulton iron range north of Sudbury. The Farnum mines in Mayo township, Hastings county, are now also equipped with railway facilities. The pig-iron produced during 1906 was in the neighborhood of 280,000 tons as compared with 208,094 tons in 1905. The output of steel was about 160,000 tons in 1906, a considerable advance over that of 1905.

The other metallic products of Ontario are not important, a small quantity of gold being obtained from the quartz veins of Lake of the Woods and Sturgeon lake mines, and a little zinc and lead in Hastings county.

NON-METALLIC MINERALS

The yield of the petroleum fields in the southwestern part of Ontario showed a decided increase in 1905, when the production was 22,131,658 gal., and the returns are likely to prove that this increase has been maintained, or even improved upon, in 1906. Several new pools were opened up during the year. In natural gas, the outlook is very promising. The Dunnville field is now producing largely, and late in the year a large well was struck in Raleigh township, which had a flow of about 7,000,000 cu.ft. per day. Salt continues to be raised from the brine wells west of lakes Huron and St. Clair in quantities sufficient for domestic consumption. The principal point of production is now Windsor. Corundum, mica, iron pyrites, feldspar, gypsum, graphite and other useful substances are mined in considerable quantities and form the basis of important local industries. The manufacture of portland cement is rapidly advancing, and the output of 1,254,360 bbl. in 1905 was surpassed during 1906. Building materials of all kinds, such as brick, lime, stone, etc., are being turned out year by year in increasing quantities, the distribution of clay, limestone and the other necessary raw materials being widespread throughout the Province.

In short, the record of the mining industry of Ontario for 1906 was very satisfactory, showing marked advance in almost every department.

The Eastern States of Australia

BY F. S. MANCE

The year 1906 has proved one of the most prosperous in the annals of mining in the eastern states of Australia. From the returns for the first nine months it is clear that the year will close with an increase of over £1,000,000 in value on that of the total mineral output for 1905, which was as follows:

State.	1905.
New South Wales.....	£ 7,085,898
Queensland.....	3,726,275
Victoria.....	3,361,455
Tasmania.....	1,729,129
South Australia & Northern Territory.....	652,552
Total.....	£16,555,304

The gold yield falls below that of previous years, but as against this the production of silver, lead, copper, tin, antimony, etc., has been on a greatly extended scale, and the results achieved furnish evidence, not only of the activity displayed and the success which has attended mining operations, but also of the variety, extent, and richness of the mineral resources of these states. It is expected that the returns for the states of New South Wales and Queensland, where the mining for minerals other than gold is more actively followed, will far outstrip all previous records.

GOLD

As mentioned already the gold yield for

1906 does not come up to that for the previous year, the estimated decrease amounting to 147,894 oz. Particulars are given in the following table of the gold production of Australasia in ounces fine for the years 1905 and 1906; the figures for the latter year are estimated on the basis of the returns for the first ten months thereof:

State.	1905.	1906.
Western Australia.....	1,955,316	1,802,000
Eastern States:		
Victoria.....	747,166	790,000
Queensland.....	592,620	535,600
New South Wales.....	274,267	285,900
Tasmania.....	73,541	61,500
South Australia.....	20,390	18,300
Total Commonwealth.....	3,663,240	3,493,300
New Zealand.....	492,954	515,000
Total Australasia.....	4,156,194	4,008,300

Referring now only to the eastern states it will be seen that Victoria ranks as the chief contributor. The Bendigo field is the staple support of the industry, and has maintained an output averaging some 19,800 oz. per month. The principal dividend-paying mines were the New Argus, South New Moon, and New Moon. The disclosure of a massive gold-bearing formation in the Victoria quartz mine, at a depth of 4154 ft., has given unmistakable proof of the permanence of the reefs on this field, and has come as a fitting reward to those who have so consistently prosecuted operations to such deep levels. The output from the Ballarat field continues to show a falling off, but the quartz mines at the other centers have yielded well. In connection with alluvial mining, the dredges at Castlemaine, Fryer's creek, Buckland and Bright have contributed largely toward the total yield, as have also the mines working the deep levels at Chiltern and Rutherglen. The work of draining the Moolort deep lead has been unremittingly carried on, and it is anticipated that it will shortly be possible to rise into the gutter at the Loddon valley mine, at which mine the pumping operations have been concentrated for some time past.

The lessened output of the state of Queensland may be accounted for in a great measure by the closer attention which has been given to the mining for the baser metals. The Charters Towers field is the chief center of gold-mining operations in this state, but the results compare unfavorably with those secured in previous years, and a further drop in the average grade of the quartz won is noticeable. Calls have been readily paid by investors, and thus a considerable amount of development work has been carried out during the year. Altogether the outlook seems to warrant the assumption that the output for 1907 is not likely to recede below the present level. The Mount Morgan mine, which has paid dividends aggregating £6,680,000 as a gold mine, entered on a new era during the last half-year as essentially a large copper producer.

New South Wales is again fortunate in being able to record an increased produc-

tion. The Mount Boppy stands out pre-eminently as the gold mine of the state, and the developments underground during the year have been of such a satisfactory nature as to indicate that the output during the year 1907 will be still further augmented. On the Wyalong field rich sulphide ore is being obtained at a depth of 1000 ft., and the prospects are favorable to the maintenance of a large output. The yield from the Hillgrove field has come well up to the average, although the operations of the New Hillgrove Company have been considerably hampered owing to explosions of rock carrying away the shaft in the lower levels. The various dredges throughout the state have again won a considerable quantity of gold, and remunerative returns have been secured by most of the plants, but the yields as a whole are not as satisfactory as in preceding years.

Tasmania has unhappily to record an output below that of 1905. This is due to the fact that just as the principal gold mine, the Tasmania, was on the eve of reaping the benefit of the expensive plant which had been installed, the underground workings were flooded by an inrush of storm waters, which caused the suspension of mining operations for some months. To the end of June, 1906, the quartz crushed from this mine totaled 613,924 tons and yielded 655,408 oz. gold.

The gold yield of South Australia is now an inconsiderable item, the only producing mine of any importance being the Tarcoola Blocks, which won 4922 oz. during the year ended June last.

The export of gold from Australia during the year has been very heavy, and the shipments for the first eleven months of 1906 are £6,400,000 in excess of those for the same period in 1905. The following statement shows the value of the gold shipments from the respective ports:

	1905.	1906.
	£	£
Melbourne.....	770,258	3,122,995
Sydney.....	1,784,112	5,329,302
Brisbane.....	1,800	.....
Adelaide.....	16,250	180,000
Fremantle.....	5,320,081	5,660,938
Total.....	7,892,451	14,293,235

SILVER

The dominant feature of the mining industry has been the exceptional interest evinced in the Broken Hill field, and toward the closing months of the year the market value of the shares of this group of mines had reached over £11,000,000. The confidence shown by investors appears to be fully justified, as it has been estimated that, with the complete plants now installed at the principal mines, operations could be remuneratively carried on with lead at £11 10s. a ton, and it is at once apparent that, with the sustained price of this metal, the way has been laid for the reaping of enormous profits. In the first half of the year production was curtailed by several causes, notably the fires in the Proprietary and Junction mines, and creeps at the Central and

Block 10 mines. The total output is on this account below that of the previous year, but the value is considerably greater. In the last quarter of the year all the disabilities mentioned had been overcome, and the field was the scene of the greatest activity. Work underground has further added to the ore reserves, and, as bearing on this point, it may be mentioned that the lode in the Broken Hill South mine was opened up at the 975-ft. level during the year, and was proved to be over 316 ft. wide, with an average assay value over the whole width of 18 per cent. lead, 32 per cent. zinc, and 17 oz. silver per ton.

In the matter of the production of spelter from the enormous heaps of tailing, progress has not been as rapid as expected. The Zinc Corporation, which was formed to treat these heaps of tailing, has given very close attention to the subject during the year. Preliminary experiments were disappointing, but it is now announced that, with a remodeled plant using the Potter process, a concentrate has been produced which is in every way satisfactory, an extraction of 85 per cent. zinc and 60 per cent. lead being guaranteed. The first unit of the plant on the improved lines, which is to be capable of treating 500 tons of tailing per diem, is being erected on the British mine, and is expected to be in operation early in 1907. The Proprietary Company, in accordance with contracts extending over several years, has exported a large quantity of zinc concentrate produced by the Delprat process, and has also entered on the work of zinc distillation at Port Pirie, a furnace holding 120 retorts having been brought into commission during the closing months of the year. The Sulphide Corporation, finding it impracticable to deal with the quantity of zinc concentrate produced, has formed a subsidiary company to treat the output, the site of operations being near Middlesborough, England. The tailing at the North mine is being treated by the De Bavay process, but work can hardly be said to be yet established on commercial lines.

At Howell, N. S. W., the company which took over the Conrad and King Conrad mines, in the year 1905, has obtained most gratifying returns. The Yerranderie field, N. S. W., has contributed large supplies of silver-lead ores, as has also the C. S. A. mine, Cobar.

As already indicated, it is known that the actual production of metal from the silver-lead mines of New South Wales during the year 1906 is somewhat less than in 1905, but that the value is much greater. The figures for the year 1906 are not available at this date, but the following statement, showing the metal produced during the years 1903-1905, gives a good index of the extent of operations:

	1903.	1904.	1905.
Silver, oz. fine....	6,489,689	7,751,667	6,804,934
Lead, tons.....	92,293	106,038	93,182
Zinc, tons.....	286	299	544
Value of metals..	£1,790,929	£2,088,784	£2,131,317

In addition concentrates were exported to Europe as follows:

	1903.	1904.	1905.
Quantity, tons....	76,824	140,464	270,474
Contents by average assay:			
Silver, oz. fine....	1,736,512	2,945,058	3,480,561
Lead, tons.....	29,706	59,507	69,044
Zinc, tons.....	14,625	22,318	30,637
Value.....	£ 308,714	£ 642,125	£1,181,720
Total value of output.....	£2,009,643	£3,730,909	£3,313,037

The zinc contents have only been calculated where that metal is paid for, and the increase in the exports of zinc concentrate is thus very apparent.

The value of the production of silver-lead in Tasmania for the first nine months of 1906 is £342,557. The mines in the Zeehan and Dundas districts, on the West Coast, are in a thriving condition, and the indications are favorable to a sustained output.

In Queensland the bulk of the output has been contributed by the mines at Mungana. The permanence and extent of the sulphide lodes are regarded as so assuring that a complete Huntington-Heberlein plant, crushing appliances, roasters, etc., were installed during the year, and have given gratifying results.

COPPER

As was only to be expected, the mining for copper has received a marked degree of attention. The copper produced in the eastern states during 1905 was valued at £2,258,000, and the fact that these figures were exceeded by the output for the first nine months of the year 1906 may be accepted as proof of the flourishing condition of affairs.

In the state of Tasmania the Mount Lyell Company has taken full advantage of the favorable market, and for the twelve months ended Sept. 30, 1906, produced blister copper containing 9009 tons of copper, 703,945 oz. silver, and 23,088 oz. gold, the profits earned during this term amounting to £495,000. The manager has furnished an estimate of the ore reserves which assures a continuance of successful operations under present conditions for a lengthy period.

In New South Wales the results achieved have been altogether of a satisfactory nature. The production for the first nine months of 1906 is valued at £534,000, which is £7000 in excess of the total value of the output for 1905, which previously stood as a record. The Great Cobar mine was taken over by a new company, and arrangements are now in progress which, in the near future, will permit of the present output of 600 tons of ore per diem being increased to 1500 tons, a quantity which the orebodies seem well capable of contributing. The other established mines in the Cobar district have furnished substantial outputs, while several new and promising lodes were opened up during the year. Nothing has yet been done in the way of providing for the treatment of the large bodies of auriferous copper ore on this field, and the combin-

ing of interests to this end is much to be desired. The Lloyd Copper Company, Burruga, was fortunate in re-locating the lode which had been faulted, and has thus received a fresh and vigorous lease of life.

The Wallaroo & Moonta Mining and Smelting Company, in South Australia, was able to resume the payment of regular dividends, despite the heavy outlay incurred during the past two years in repairing the damage occasioned by the fire in the underground workings of the Wallaroo mine, and also in the installation of new plant. On the basis of the production for the first nine months the output for the year 1906, including that from purchased ores, should reach 7250 tons of fine copper. It is expected that the beginning of the year 1907 will see the work of restoration completed, and that the company will then be in a position to considerably augment the production. At the Moonta mines, the new workings at Truers, and the old North Yelta property, are being vigorously developed, and there is every prospect of large supplies of ore being made available.

Of all the states, Queensland has shown the greatest advance as a producer of copper, a yield valued at £600,844 being contributed during the first nine months of 1906, which is £97,297 more than the value of the output for the whole of the year 1905. The Chillagoe Company has benefited greatly by the rise in price, and has been enabled to earn substantial profits. Some promising developments are reported, the best being that of the Queensland lode at Morrison's. The O. K. and Mount Molloy mines have come prominently into notice as large copper producers. Some doubt was expressed as to the quantity and value of the ore reserves in the O. K. mine, but a recent report by Dr. R. L. Jack shows that no anxiety on this score need be felt, as the ore in sight is sufficient to maintain the present output for some 17½ months. Work on the Cloncurry field has been active, operations being stimulated by the proposal to connect the field with the existing railway system. The Mount Morgan Company, as previously mentioned under the heading of gold, is now engaged extensively in the treatment of the cupriferous orebodies, and for the September quarter the output totaled 1027 tons blister copper.

TIN

Operations on all the tinfields have been characterized by incessant activity, and a largely augmented production has to be recorded. The mines of Tasmania furnished an output of 3189 tons of ore, valued at £384,069, during the first nine months of the year, which exceeds that for the same period in 1905 by 468 tons, and £139,023 in value, and is greater by some £21,000 than the value of the output for the whole of 1905. The Briseis and New Brothers Home No. 1 mines have been favored with a plentiful supply of water, and have been thus enabled to deal with

large quantities of drift, the output of tin ore averaging 110 tons a month. The high price ruling for tin permitted the Mt. Bischoff company to conduct operations profitably on ore of very low grade, but during the month of September the value of the ore decreased to such an extent that the output of concentrates fell from 100 to 70 tons per month. Attention has accordingly been directed toward effecting further economies in working, and in securing improved recoveries by the tin-dressing plant. It is thus hoped that a monthly output of 60 tons of concentrate can be still maintained. Consideration is also to be given to the question of treatment of the available pyritic ores. During the past 30 years this mine has distributed £2,079,000 to shareholders, or at the rate of £173 5s. per share.

New South Wales also shows decidedly improved returns. The feature of the industry is the success which has attended the operations of the dredges in the Inverell-Tingha district, which were installed to treat the stanniferous gravels, mostly worked over by ordinary methods in past years. During the September quarter of 1906 fifteen plants won 269 tons of ore, valued at £30,000. The yield obtained in the month of September by the three principal dredges averaged 2.5 lb. of tin ore per cu.yd. of material treated, valued at 32.2d., which, after deducting all expenses, gave a profit of 22.6d. per cu.yd. Other plants are being erected on similar areas in the state, and there are indications that many years of profitable work are ahead.

The mines within the confines of what is known as the Walsh & Tinaroo field in the state of Queensland have yielded most satisfactorily, and the developments at the lower levels have been especially encouraging. The principal contributing mines are the Vulcan, Stannary Hills, and Arbouin. At the 900-ft. level in the Vulcan mine, a lode body was exposed which gave a value of 10 per cent. The dredges operating at Stanthorpe, on the New South Wales border, have also secured very good returns.

OTHER MINERALS

The favorable price ruling for antimony has stimulated the mining for this mineral. The chief contributing center is Hillgrove, N. S. W., the value of the output for the September quarter being estimated at £16,000. From Woodville and Northcote within the Hodgkinson field, Queensland, fair supplies of ore have also been drawn. The production of wolfram shows a considerable falling off, as compared with the previous year. The bulk of the yield is still contributed by the mines of Queensland, principally in the Herberton and Hodgkinson districts. The estimated output for the state of Queensland for the year 1906 is 715 tons, valued at £56,300, as compared with 1449 tons, valued at £99,873, for the previous year.

PRODUCTION OF PETROLEUM

California—Texas—Louisiana—Ohio—Indiana—Mid-Continent—Appalachian Field

The production of petroleum in the various fields is treated in the following articles. The total production in 1906 is tabulated below and shows a decrease from the previous year. It will be noted that while there was a large increase in the production of the mid-continent field it was not sufficient to offset the big falling off in Texas.

PRODUCTION OF CRUDE PETROLEUM IN THE UNITED STATES.
(In barrels of 42 gal.)

FIELD.	1905.	1906.
California (a).....	35,671,000	34,500,000
Colorado.....	(b) 376,238	(e) 400,000
Gulf { Texas.....	30,354,263	13,000,000
{ Louisiana.....	9,672,015	7,000,000
Lima { Indiana.....	22,102,108	25,680,000
{ Ohio.....	12,000,000	21,924,905
Mid-Continent (c).....	12,000,000	21,924,905
Ken.-Tennessee.....	(b) 1,217,337	(e) 1,240,000
Appalachian (d).....	28,324,324	27,345,600
Wyoming.....	(b) 8,454	(e) 8,000
Others.....	(b) 3,100	(e) 3,000
Total.....	139,728,839	131,061,565

(a) Reported by the California Producers' Association.

(b) Statistics of the U. S. Geological Survey.

(c) Kansas, Indian Territory and Oklahoma.

(d) Pennsylvania, New York, West Virginia and Eastern Ohio.

(e) Estimated.

Petroleum Developments in Louisiana and Texas

SPECIAL CORRESPONDENCE

The predominant feature of the petroleum situation in Texas and Louisiana during 1906 was the large decrease in production as compared with that of 1905. This decrease was practically confined to what is known as the Gulf coastal field. The Powell and Corsicana fields in north Texas (which produced about 450,000 bbl. in 1905) will probably not show any great variation in output, although drilling was active in the Powell field. The output of petroleum in 1905 in Texas was 28,136,000 bbl., and in Louisiana 8,910,000, a total of 37,046,000 bbl. of which all but about half a million barrels was derived from the coastal fields. The 1906 production (assuming that the December output will be equal to or slightly less than that for November—and there is little doubt but this will be a fact) will be about 13,000,000 bbl. in Texas and 7,000,000 bbl. in Louisiana, a total of 20,000,000 bbl. These figures indicate a decline in output of over 13,000,000 bbl. in Texas and 1,900,000 bbl. in Louisiana, a total decline of nearly 15,000,000 bbl.

The Gulf coast field will thus not

lead the van in petroleum production as it did in 1905, but will almost certainly be exceeded in output by the California, Appalachian, Lima (Indiana), and Mid-continent fields. To appreciate the situation and causes for such a marked decrease in 12 months, it is well to state the fact that the great porosity of the reservoir rocks in the coastal region makes the initial flow of the wells very large and the life of the wells proportionately short. The oil pools are also usually small in area, the gas pressure being very strong, and the fields overdrilled, so that each pool, when discovered, has been developed to its maximum output in a very short period.

No new productive gusher fields were opened up in 1906 and for the reasons above stated the fields that were so productive in 1905 did not yield as they did in 1906.

The Humble field in Harris county shows the largest decline, as from a production of 60,000 to over 100,000 bbl. per day it has fallen off to 7000 bbl. per day in December, 1906.

COMMERCIAL CONDITIONS

The average price of crude petroleum in 1905 was slightly less than 27c. per bbl., while the price steadily advanced during 1906 until it is now between 65 and 75c. in the various fields. The average price for 1906 will likely be in excess of 50c., so that while the decline in production is large, the money value of the output will probably exceed that of 1905 and perhaps that of California for 1906, although the output of the latter State for 1905 will be double that of the Texas-Louisiana fields. During 1906 the consumption of crude has greatly exceeded the production and in face of rising prices, that tend to restrict the consumption for fuel, the surplus petroleum in tanks has been reduced from 20,000,000 bbl. to about 11,000,000 bbl., of which two-thirds is held by refining interests.

From the standpoint of the well owners, 1906 was probably more profitable than any previous year. For while the production was vastly less, facilities for handling the product and prices were much better. In spite of the phenomenal production of the fields in gusher times very few operators made any money, the refineries and the fuel users reaping most of the benefit of the drillers' enterprise. but in 1906 even the owners of small wells producing 40 to 100 bbl. daily made money.

LOUISIANA FIELDS

While many wild-cat wells were drilled in Louisiana in 1906 the only commercially successful operations were confined to the old fields of Jennings, Welch and Anse Le Butte; the last two have been small producers, probably less than 75,000 bbl. for the entire year. The most promising new field is at Caddo, near Shreveport, where, after much delay and loss occasioned by the heavy gas pressure, some wells have been developed sufficiently to give promise of being substantial producers in 1907. The Jennings field is by all odds the best in the coastal region, although the crude is practically available only for fuel. Many new wells were drilled and old ones deepened, and production held up better than in any other southern field, as is demonstrated by the November output of 535,000 bbl., compared with 661,000 bbl. in November, 1905. This showing is attributed to the fact that it has been developed by strong companies and not overdrilled like nearly all the other coastal fields.

TEXAS FIELDS

In many Texas counties prospecting was active and many wild-cat wells were drilled. This prospecting covered a large area of territory, though naturally more wells were drilled in the Gulf coast counties, where the topography and geological formation are similar to those of the present producing fields. Most of these wells were abandoned as dry holes or salt-water producers, and none developed sufficient petroleum to indicate a new gusher field or to create any boom.

The fields located in 1905 and previous years were actively worked by drilling new wells and cleaning out, deepening or pulling the pipe up to the upper sands in old wells. Operators in gusher times did not care for small wells pumping 25 to 100 bbl. daily, but improved prices and economical arrangements for pumping made them profitable in 1906.

The largest producing field of Texas in 1906 was Humble, followed by Batson, Sour Lake, Saratoga, Spindletop and Dayton. All show a decline as compared in 1905 except Saratoga, which was producing more oil than any other Texas field at the end of 1906, and will likely show an increased output. This field produced 235,000 bbl. in November, 1906, as against 159,000 bbl. in the same month in 1905 and is the most promising of the old fields for the same reasons referred to in discussing the Jennings field in

Louisiana. The sensational field of Spindletop, near Beaumont, which started the boom in Texas petroleum, produced only about 80,000 bbl. in December of 1906 as against 143,000 in December, 1905, and all the wells are pumpers. In fact none of the coastal-field wells can now be termed gushers, although when first brought in some of them had an initial flow of a few thousand barrels. Many, however, especially at Jennings, are caused to flow by air pressure and have still a daily output of from 500 to 1,500 bbls.

PRESENT CONDITIONS

The former conditions and supposed course of development of the coastal field and its actual standing at the end of 1906 are aptly and briefly set forth in a circular issued recently to stockholders of the J. M. Guffey Petroleum Company. A portion of the circular is as follows:

"The J. M. Guffey Petroleum Company was organized in May, 1901, shortly after the discovery of oil at Spindletop, which was the first oil field discovered in Texas. At that time it was supposed that the supply was practically inexhaustible and the company at its organization acquired a very large territory, upward of 1,000,000 acres, of what was supposed to be undoubtedly and practically invaluable oil territory; and for this it issued \$15,000,000 of capital stock. It was very soon discovered, however, that the Spindletop field was of exceedingly limited area, the fact being that 90 per cent. of the entire production of that field has come from about 100 acres. It was also found that the life of the field, contrary to all expectations, was exceedingly short, the wells very soon ceasing to flow, and within a few years it practically disappeared as a producing field. A little more than five years have elapsed since the discovery of the Spindletop field, and in that time five additional fields have been found. The total productive area of all these fields probably does not exceed 1000 acres, and at the same time they have been found widely scattered, the fields or pools so developed being as much as 190 miles apart, which has entailed not only a large expenditure in the discovery of the fields, but also very great outlays of capital for pipe lines and storage facilities. These fields also have all of them had but a short life. At the present time the total production of oil in the State of Texas is about 30,000 bbl. per day, and of this only about 12,000 bbl. is of such quality as to be available for refining. The Louisiana fields are producing about 15,000 or 20,000 bbl. per day, but there are no pipe lines connecting this field with the properties of the Guffey and Gulf companies, and the oil is not generally of such quality as to be refinable."

While the above quotation is not optimistic, it must be borne in mind that

Texas refineries and tankage represent a large investment of capital and that they have exceptional shipping facilities by land and water and they will use Indian Territory oil. The center of the Southern petroleum industry will remain in Beaumont and Port Arthur and active prospecting will continue during 1907, because the lack of suitable coal within a reasonable distance will keep fuel oil at a price that will make even small producing wells remunerative and any large gusher output would still be handled by the refineries at prices commensurate with quality. Moreover, while actual conditions during 1906 have been unfavorable, it cannot be assumed that the coastal field is destined to a steadily declining production, for it requires only a few months to develop the maximum production of its gusher fields, one of which may be located any day. Past experience shows, however, that to maintain its production one or two new pools must be discovered each year.

Petroleum Production in the Appalachian and Lima Fields

BY HAROLD C. GEORGE*

Neither the increased demand for high-grade petroleum nor the advance in price over 1905 seems to have been a sufficient stimulus to maintain production in the Appalachian fields during 1906 at the level of the previous year. A similar decline is noticed in the Lima field also, although the latter does not produce high-grade petroleum.

The Appalachian oil-fields, which produce the high-grade petroleum of the United States, include the oil-field of western New York, all the fields of Pennsylvania in the various sands, the field in southeastern Ohio in the Berea grit, and the fields of West Virginia, Tennessee and Kentucky. The Lima field includes the oil-pools in northwestern Ohio and northeastern Indiana in the Trenton formation.

The gradual decrease in the production of the fields producing high-grade petroleum is attributed not so much to the natural decline in the production of the old wells as to the failure of West Virginia and southeastern Ohio to produce wells of the gusher type. Very few large wells have been struck. The oil territory of western New York and northern Pennsylvania seems to produce each year fewer wells and fewer attractions in the petroleum industry.

WESTERN NEW YORK AND PENNSYLVANIA FIELDS

The old wells in the Allegheny field in New York, and the Bradford and Warren counties fields in Pennsylvania, average

*Instructor, Western University of Pennsylvania, Allegheny, Penn.

about $\frac{1}{4}$ bbl. per day, while the new wells in the same fields average only about 3 bbl. daily. This indicates that practically these fields are things of the past. Very little new, undrilled territory is left, and operations are confined mostly to improvement in methods of operation. Many of the old wells are being abandoned and the material secured from them is being used to equip new wells drilled between the locations of the old ones. By this method of procedure many prospects which were about to be abandoned have been put on a paying basis.

In the Venango-Clarion county pools of Pennsylvania, which include the new developments in Jefferson and Mercer counties, there is still much territory to be tested.

Mercer county has afforded some good wells regularly; and the activity in Jefferson county, which has not been very thoroughly developed, may produce some new pools in the near future.

In Venango county, Pennsylvania, in the old Bullion district, made famous by the "Big Injun" strike of thirty years ago, one of the largest gushers the State has seen in years was struck in October. This well started off at 1500 bbl. per day.

The pool in Butler county, which created so much excitement in the fall of 1905, has experienced a decline as rapid as its growth. No more large wells have been struck, and the gushers of last year have almost ceased to be producers. The new wells in the Butler-Armstrong county field average about 5 bbl. per day.

The Burgettstown field in Washington county, Pennsylvania, produced some excellent wells in 1906. Six were completed in March which averaged 45 bbl. apiece, and twenty were completed in April which averaged 30 bbl.

The Beaver-Allegheny county field of Pennsylvania has produced nothing but small wells and dusters during the year. It has been thoroughly tested and its limits defined, and the territory offers nothing to encourage renewed activity.

The one field which, in its producing status, is the exception in Pennsylvania oil territory is the new one in East Finley township, Washington county. All the other fields of the state show a steady decline without any promise of renewed activities. Nearly one-quarter of the wells completed in Pennsylvania in 1906 were dusters, and the average production of the remainder was very low.

SOUTHEASTERN OHIO AND WEST VIRGINIA

The oil-field of southeastern Ohio embraces Washington, Harrison, Monroe, Morgan, Mercer, Belmont, Jefferson, and Noble counties. Some very good wells have been drilled in Washington county. Several of the largest wells have been found in the Maxon sand. In this region the "Big Injun" sand has previously been regarded as the principal producing formation; and the tendency is to regard the recent large wells in the

Maxon sand as "freaks" and of local occurrence only. Operations have been active in Harrison and Jefferson counties; and both have furnished some new producing territory during the past year. The greatest activity has been exhibited in the Berea grit. The Woodfield district in Monroe county has been the most active in southeastern Ohio. In addition to operations under way and being begun inside of defined limits, there is much work in advance of the old developments. In southeastern Ohio the old districts have been fully developed, and, except in a few localities, there is no longer room for additional wells.

The wells in West Virginia produce 45 per cent. of the total production of the fields producing high-grade petroleum. This gusher territory has been gradually declining. With the single exception of a new pool in the Green district in Wetzel county, no territory in West Virginia has furnished inducements for renewed activities during the winter of 1906-1907.

When operations are resumed in the spring of 1907, they will probably be a repetition of the work of 1906. Drilling in old territory and an occasional test, looking for extensions in some of the old fields, will then, as now, be the rule. The wells completed during the latter part of 1906 have, as a rule, been light producers, located within definite limits. During the past year several good strikes were made in the Point Pleasant district in Tyler county. There has been considerable interest aroused in the new developments on State Road Run in Wetzel county. There is room for a pool of some dimensions in this locality; and the territory has not been condemned by any previous tests.

In Roane county the extension of the Rowell's Run district in Calhoun county has attracted some notice, as most of the wells drilled are test wells of more or less importance. In Ritchie county the salt-sand district received much attention. The developments extend over a large area; and a large percentage of the work is of the experimental kind. In the extreme lower southeast, in Cabell, Lincoln, Putnam, and Kanawa counties, West Virginia, some new work was started during the fall of 1906; but in all, save Cabell county, it was purely experimental. In general it can be said of operations in West Virginia that there has been a general decline, especially in the deep-sand district. Except for the new work projected by the various gas companies and the test wells drilled, things have been very quiet. The territory that awaits development is not good for anything better than light pumpers; and the expense of drilling and equipping small wells is too great to induce investment. The work under way consists of drilling odd wells in the old fields, which, if they prove remunerative, can be operated in connection with the old producers.

TENNESSEE AND KENTUCKY

There have been practically no petroleum developments in Tennessee during 1906. Kentucky operators continue to manifest interest in the theory of a connecting link between their developments and the new field in southern Illinois, but nothing has yet been furnished to support it. Operations in Kentucky are confined mostly to Wayne and Wolfe counties; and the new wells completed from month to month help to sustain a total production of about 3000 bbl. per day.

THE LIMA FIELD

The Lima oil-field shows a general decline in the number of wells completed, in new production, and in field operations during the year. This is due not so much to market conditions as to lack of territory. The Illinois oil-field has also had a great effect in checking operations, by attracting many operators from the Indiana and the Buckeye districts. The decline in the Lima fields has been very marked. Large numbers of wells have been pulled out, and the junk secured from these has found a ready market in the southern Illinois field.

In brief, the report on the Appalachian and Lima oil-fields for 1906 may be expressed in one word—"decline."

The total production of the Appalachian field in 1906 was 27,345,600 bbl., as compared with 28,324,324 bbl. in 1905. The output of the Lima field in 1906 was 25,680,000 bbl., as compared with 22,102,108 bbl. in 1905.

The following table gives the average value of petroleum in the Appalachian field per barrel at the wells by months throughout 1906:

January.....	\$1.58	July.....	\$1.63 1/2
February.....	1.58	August.....	1.58 2/3
March.....	1.58	September.....	1.58
April.....	1.60 1/10	October.....	1.58
May.....	1.64	November.....	1.58
June.....	1.64	December.....	1.58

In the Lima fields the average value at the wells ranged round 90c. per barrel.

The above figures are the prices paid by the Standard Oil Company. Nearly all other oil companies pay from 5 to 10c. per barrel more for crude petroleum. Some districts, too, received more than the average market price—as, for example, Warren county, Penn., whose oil is worth 10c. per barrel more than that in any other Appalachian district.

California

The output of petroleum in California in 1906 has been estimated by the secretary of the Petroleum Miners' Association at 34,500,000 bbl., with a value of something over \$7,000,000, as compared with 35,671,000 bbl. in 1905. California has thus been the largest single producer of oil in the United States for four years, although in point of value of the product the State ranks below Ohio, West Virginia, Pennsylvania and Indiana.

Oil and Gas in the Mid-continental Field

BY ERASMUS HAWORTH*

The production of oil and gas in the mid-continental field was much greater in 1906 than in any previous year. The oil was bought principally by the Prairie Oil and Gas Company, the Standard Oil Company in Kansas. At present there are nine independent refineries in Kansas and one in Indian Territory, but their consumption was small, due in part to their small size and in part to the fact that a number of them did not begin operation until late in the year. A considerable amount of oil was used for fuel and was shipped to many places here and there over the State. One producer, Hon. C. A. Stannard, operated a system of tank cars and supplied customers in western and central Kansas with a comparatively large amount of crude oil.

The following table gives a monthly statement of the oil purchased by the Prairie Oil and Gas Company, to which is added an estimated amount for all other consumption:

PRODUCTION OF CRUDE OIL IN THE MID-CONTINENTAL FIELD, 1906.

Month.	Total Run.	Daily Average.	Dellveries.	Stored.
	Bbl.	Bbl.	Bbl.	Bbl.
January....	1,472,214	47,491	539,009	933,205
February....	1,352,531	48,305	527,996	824,536
March.....	1,693,182	54,619	719,320	973,862
April.....	1,779,261	59,308	752,625	1,026,636
May.....	1,741,941	56,192	802,838	939,103
June.....	1,688,433	56,281	642,128	1,046,304
July.....	2,092,215	65,233	668,439	1,353,776
August.....	1,779,262	57,396	900,755	878,508
September....	1,546,719	51,537	846,128	700,591
October.....	2,009,650	64,827	1,559,520	450,130
November....	1,945,195	64,839	1,680,928	264,267
December....	1,920,662	64,019	1,528,524	392,138
Total.....	20,951,155	690,067	11,168,209	9,782,946
Other sales..	973,750			
Grand total	21,924,905	690,067	11,168,209	9,782,946

No available method is at hand at present to determine definitely what portion of the above grand total given came from Kansas and what portion from Oklahoma. It is probable, however, that about one-fourth of the entire amount came from Kansas and three-fourths from Oklahoma.

DEVELOPMENTS

During 1906 the only new development of any considerable note was in the Glenn pool area, a few miles southeast of Red Fork. Here a wonderful pool of oil was discovered, which already furnishes many wells producing more than 1000 bbl. a day. Apparently the boundary of the pool has not yet been located, as new wells occasionally are found almost on all sides of it.

The next most remarkable discovery

*State geologist, Lawrence, Kansas.

was in Section 27, east and a little south of Dewey, four miles northeast of Bartlesville. Here is an area nearly one mile across which was wonderfully productive in which also a few 1000-bbl. wells were brought in. Drilling was so active, however, that they soon had the boundaries of the pool located and the wells have now run down to 200 to 300 bbl. daily capacity.

A large amount of development was carried on during the entire year with an aggregate of close to 2000 wells drilled. During the first half of the year development was very active in the shallow pool around Alluwe and a very large production was obtained, some wells reaching 400 to 500 bbl. capacity. The next greatest production was in the Osage near the eastern boundary, south of Bartlesville. Next to the Glenn pool this area remains the most remarkable in the mid-continental field. It seems that we have here a long, slender, north and south pool lying parallel with the ninety-sixth meridian, which is the boundary between the Cherokee and the Osage lands, lying principally in the Osage, with a few good wells east of the boundary line and a few from five to ten miles to the west. In a north and south direction the pool extends nearly to Tulsa, with only occasional dry wells interspersed. A number of these wells started at 1000 bbl. per day and they held up their capacity as well, or better, than any other wells in the area. Farther west in the Osage, drilling has been done irregularly with quite indifferent success. Some wells are good oil wells, others good gas wells, and quite a number of them are dry.

But little drilling has been done in Kansas during the year. Early in the year there was some development in the vicinity of Paola, Osawatomie and Rantoul, also a small amount in the Huffman field, Chautauqua county, five miles west of Peru, and an occasional well elsewhere here and there over the entire Kansas territory. But in general all the drilling done in Kansas was in searching for gas, as will be explained later.

MARKETS

The Prairie Oil and Gas Company is the principal purchaser of oil, and, therefore, fixes the price. The lesser concerns consume but little, and, although occasionally they bid a little above the market price, they have little, if any, influence on the market. In fact, some of them can hardly obtain as large a quantity as they desire. There is a sentiment abroad that if a producer once sells to an independent concern the Prairie Oil and Gas Company will not take his supply or any fraction of it. It is probable this has not been put to a test, but the wide-spread belief that such would be the case has kept a number of people selling to the Prairie and declining bids from others.

At the beginning of the year the price paid was 52c. per bbl. for oil with a specific gravity of 32 deg. B. or lighter.

During the summer this price gradually dropped until the low mark of 39c. was reached in August, at which point it has remained. For oils heavier than 32 deg. B., in most cases a reduction of 5c. was made for each half degree.

GAS

The mid-continental field has witnessed the most activity in developing and marketing gas. The Kansas Natural Gas Company got its pipe line laid to Kansas City, Kan., Topeka, Lawrence and Leavenworth before the close of 1905, and by February the pipes were in Atchison and St. Joseph, Mo. Certain difficulties regarding a franchise kept them out of Kansas City, Mo., until the autumn of 1906. By the close of 1905 also a pipe line had extended eastward from the gas fields to Joplin and Carthage in Missouri with laterals ramifying the entire Joplin mining region. During the summer of 1906 a pipe line was carried westward from the gasfields toward Wichita and Hutchinson and has just now reached the former city. All of these mains have laterals from which they supply the various towns and villages along their lines.

To supply such large quantities of natural gas for domestic consumption it is necessary to have a large amount developed in the gas fields. On this account drilling has been fairly active in many different parts of the gas fields of Kansas. The pipe line reaching northward to Kansas City, etc., is supplied principally from the vicinities of Iola, Humboldt, Chanute and Neodesha and intervening locations; that eastward to the Joplin area is supplied from the Montgomery county fields in the vicinity of Independence and Coffeyville, and the supply for the western pipe line will come principally from western Montgomery, Chautauqua and other counties in Kansas, and probably from the Cherokee and Osage country, although that matter is not definitely settled. It is reported that a prominent gas producer applied to the Secretary of the Interior for permission to pipe gas out of Indian Territory and was denied the privilege. There seems to be no law, however, to prevent such an undertaking.

During the year the most extensive developments of gas were in Montgomery county, Kan., south of Independence and in the Cherokee Nation throughout a strip from five to ten miles wide, reaching from the south side of Kansas southward almost to the Arkansas river. In fact gas has been developed in Indian Territory to such an enormous extent in connection with oil development that the Cherokee and Osage territories probably could supply two or three times as much gas as is developed in Kansas. A great deal of this Territory gas is shut in awaiting a market, while other portions are piped to various towns and villages and retailed for domestic consumption. Practically no large manufacturing concerns are established south of the State line. This is due

principally to the chaotic condition of land titles in Indian Territory. Different laws of Congress and different rulings of the Interior Department have matters in such a shape that to the ordinary mind they are very confusing, and, as a result, capitalists prefer to remain away rather than jeopardize their holdings by insecure titles.

In Kansas, however, factories are on the increase so rapidly that the best judges are becoming alarmed lest the gas should become entirely exhausted. A number of zinc smelters in the State have enlarged their capacity and portland cement plants have increased in number and in size. Five such plants are now in operation, consuming from 40,000,000, to 50,000,000 cu.ft. of gas per day, and two or three others are in contemplation.

Gas wells near the southern end of Kansas and those in the Cherokee Nation generally are very large. A well from 10,000,000 to 15,000,000 cu.ft. per day is nothing unusual, and some of them run up to 30,000,000 or 40,000,000. The somewhat famous well in the Cherokee Nation, which caught fire in the spring of 1906 and burned for several weeks, was estimated at 30,000,000 cu.ft. before the gas was ignited, and before it was completely closed it was estimated at 60,000,000 cu.ft. capacity, although no accurate measurements were made. In the outlying borders, however, wells average much less and some of them are even less than 1,000,000 cu.ft.

GAS MARKETS

The price of gas for domestic consumption along all of the long pipe lines is 25c. per 1000 cu.ft., meter rates. The Kansas Natural Gas Company is offering gas to large factories at 10c. a thousand, but this is generally considered higher than coal and as a result but little coal has been driven out of the factories. In the gas fields a number of the towns and cities still pay the same flat rates they did years ago, that is, from 10 to 15c. each for lights per month and from \$1 to \$2 each for stoves. Also, a number of the factories, such as the glass factory at Coffeyville, the brick kilns at Coffeyville, Independence, Sycamore, etc., get gas at the old rates of 3c. per thousand. But no new contracts on this basis are sought for by the gas companies. Occasionally parties owning gas will make such contracts for factories or for large consumers. It must be said, however, that all indications are that the day of cheap gas for large factories in this territory is almost past.

Rakes are much used by incompetent firemen to remove clinkers. The result of using this tool is to mix up the ashes and the coal, and makes the combustion take place under uneconomical conditions. The only occasion upon which the rake should be used is in drawing the fires, to replace the coal from one side to another.

COAL MINING IN THE UNITED STATES

The Technology, Markets and History of the Industry in 1906

The suspension of mining that occurred in many of the bituminous districts during 1906, pending a settlement of labor difficulties, did not materially affect the coal output for the year. The differences that occurred were anticipated, so that a heavier tonnage preceded and followed the tie-up.

The great business prosperity of the year was visibly reflected in all our coal districts, and although many new mines have been opened and numerous virgin fields developed, the production is no further ahead of consumption than it was 10 years ago. In fact, the destructive competition that took place three years ago is now generally suppressed. This is not only due to the many large consolidations and better understanding between independent operators, but the revised contracts with labor, especially in Indiana and Illinois, has resulted in establishing a fair and fixed tonnage price for the product.

Indications point to a continuation of the present great activity in steel manufacture, which, as a criterion, is a favorable indication that the coming year will, if anything, surpass in activity the 12 months just gone.

Pennsylvania and West Virginia will continue to furnish a large part of the total output. However, it is expected that southern Illinois and eastern Kentucky will show, perhaps, the greatest new development, with Colorado as a close second.

For many years the fear of over-production has worried many coal managers and deterred capitalists, but the same feeling prevailed 20 years ago, and is as far from realization now as then.

Progress in Coal Mining in 1906

BY F. W. PARSONS

It can be truthfully stated that methods and ideas concerning the mining of coal materially advanced during 1906. The companies which manufacture mining machinery have actively kept pace with the more modern requirements, and as a consequence, the mining machines, motors, drills, ventilating fans and coal washeries have been considerably modified and many improvements effected. The greatest advance, however, is in the greater enlightenment that has been thrown upon some of the more difficult problems whose nature and solution have heretofore been obscure. Along with this increase of intelligence has come a sense of greater precaution, and more humane action on the part of mine managers, which condition

has resulted in a widespread agitation for safer methods of operation, and a simultaneous desire by miners and officials for a stricter observance of the rules and laws necessary to afford greater security and comfort.

Of all the tasks to which men are assigned, there is, perhaps, none more disagreeable than that of the miner who spends his time underground; and of these workers, none endures greater hardship than the producer of coal.

The problem of greatest importance that has presented itself to managers and engineers during the past few years is the prevention of coal-mine explosions. The last 12 months has been a period of great effort toward the solution of this problem. Whether the increased loss of lives during 1906 has caused this sudden awakening and made us seriously face the conditions as they actually exist, I do not know. The fact remains that the general mining public, if not also our State and Federal governments, are evincing unusual interest in this vital problem.

A few years ago the engineers who believed that an explosion could occur with coal dust as the sole factor were in the minority, while at the present time such an opinion is general. We are now, considering whether an explosion of dust can take place without the presence of any flame, and many competent authorities agree that such is the case. We are all ready to acknowledge, that where a quantity of gas is present in a mine, the temperature of the gas-containing atmosphere may be so increased by sudden compression, due to a fall of roof or other like cause, that the temperature of ignition may be realized, and the gas exploded. We will also agree that such a pressure may react to a distant part of the workings, and there ignite an entirely separate body of gas. Without any gas present in a mine, there is no doubt that various dust explosions have been started by a blown-out shot, but whether a dust explosion can originate from such compression of the mine air as may be caused by a fall of roof without the presence of some gas, is a theory that we believe has yet to be proved. Dynamite or powder might be so exploded, but coal dust would not answer so quickly to such action.

PREVENTION OF EXPLOSIONS

In providing a remedy for dust explosions, several unique plans are being considered, and some of these arrangements have already been successfully installed. At some mines a reservoir has been placed at an elevation above the workings so as to give a considerable head to water that

flows through pipes, which are extended along the main entries and into all partings where dust is likely to accumulate. This plan of sprinkling the mines and wetting the intake air has met with only partial success. It is well known that when a layer of coal-dust is sprinkled with water, the latter collects on top, while the dust underneath remains perfectly dry.

A second method is to haul a large part of the dust to the surface, where it is dumped, and to have parts of the mine absolutely free from dust. This is accomplished by arching certain sections with brick, or by frequently wetting a stretch of entry. By this method, a dust explosion will generally be confined to some one locality, and will not extend through the workings. Other plans are to have each car of coal pass under an automatic shower before it starts on the main haulway, while still another scheme is to have the fine coal loaded into separate cars which are covered before being moved.

Those managers who have overcome the dust problem by sprinkling salt or the chloride of calcium along the different haulways have been subjected to considerable initial expense, but the result desired has been attained. One ton of calcium chloride, costing \$12, will treat 1500 ft. of entry. Salt, however, costing \$3.50 per ton, will cover almost as great an area.

VENTILATION

In ventilating our mines, no radical improvements have been introduced; the tendency, however, is to increase the number of intake and return airways. Not long ago the general system was to have one main intake and a parallel return airway; but present practice favors at least two intake and two return airways, and in some instances five or six have been driven and are being successfully used.

Modern practice now requires that stone or heavy brick brattices be built to close the crosscuts and separate main airways. Overcasts cost about \$48, and are much preferred to doors. Furthermore, when the cost of a trapper-boy is considered, the overcast is certainly cheaper and much safer. Modern managers also prefer to split the current into all cross-entries, and are specifying that their ventilating fans shall be readily reversible. In slope or drift mines the fan is generally run as an exhaust; while in shaft mines the blower system is preferred on account of hoisting during the winter, when, if the hoisting shaft is used for an intake, the collection of ice on the guide-rods and sides of the shaft during the

cold months often causes serious trouble.

One other point in our ventilating system has attracted some attention. This consists in the use of booster fans in remote parts of large workings, where from leaky brattices and friction, the air current has lost some of its efficiency.

METHODS OF WORKING

Great progress was shown during 1906 in the methods of mining that are used by some of the larger companies. It is no longer the practice to try to reduce the first cost of mining by sacrificing all regularity. Instead of driving entries water level to prevent any expense from cutting or filling, the scheme is to now drive all headings and rooms on carefully placed centers, with certain limits as to the distance of driving and the width of the room or entry.

Some bituminous mines are now procuring from 85 to 95 per cent. of all the coal contained in each acre of land. This is being accomplished by working the seam on what is known as the panel system with 15 to 25 rooms to each panel, and by then systematically robbing all the pillars that have been left.

In the anthracite coalfield the problems of mining are more numerous, and since the various companies are now turning their attention to mining thin seams of inferior coal, a greater number of difficulties are encountered. Anthracite mining will not admit of such a regular system of working as can be inaugurated in most bituminous districts; however, the development is made to conform as nearly as possible to the general plans laid out. Last year, in the anthracite field, for every ton of coal produced, 8.5c. was spent for timber and mine props. This immense drain on the available timber supply has caused the operators in this field to turn their attention to methods of preserving the timber that is used. The coming year will probably witness many successful experiments that will lead to modifications, and consequently better results in present methods of preserving mine timbers.

Since much success has attended the practice of washing and selling the culm that was formerly considered nothing more than waste coal, the operators are now turning their attention to the fine dust that results from this culm washing. The practice of flushing this fine dust into the mine is likely to be entirely discontinued, especially if it is found that this fine coal can be utilized profitably in making briquets. One other practice that is meeting with general disapproval is that of connecting the underground workings of adjacent mines. Not only is this action dangerous, but on closer study it is said to be unattended by the increased economy which was thought to result from the sinking of fewer shafts. It is to be hoped that legislative action will prevent this evil practice from being further extended.

In fighting the mine fire at the Warrior Run colliery, the anthracite managers

have for the first time made an effort to analyze carefully all the gases besides taking daily temperatures and other data that may throw light on the action of such fires, and furnish information that will be useful in future efforts along this line.

The last year has witnessed a continuation of the struggle for supremacy between electricity and compressed air for driving coal-mining machines. The advocates of both of these systems are ready to prove the advantages of their favorite apparatus.

For hauling coal, electric motors seem to be meeting with the greater favor. Many of the new installations have been of the third-rail type, while the greatest advancement along this line has taken place in what are known as gathering motors, which carry their cable on a self-coiling reel, and since they are compact, often standing no higher than 30 in. above the rail, they are particularly useful in collecting cars from the face of rooms. Where the haulways in a mine are on a grade of from 8 to 14 per cent., rack-rail haulage has proved wonderfully successful, and the future will probably witness the installation of many such haulage systems.

One of the newer innovations is the steel mine car. The manufacturers of these cars are very optimistic, and stand ready to prove to operators that the day of the wooden mine car is past. One point in this connection is worthy of mention, and that is the bad practice of spragging mine cars; progressive managers now prefer to have all such vehicles supplied with a steel brake.

In European coal mines, a number of operators have installed electric hoists which seem to be meeting with much success; in this country, however, the hoisting power still continues to be furnished by steam. Successful winding drums are now built so as to combine the advantages of both the spiral and the cylindrical forms. By having the first four or five revolutions on a gradually increasing diameter, the engine is enabled to get under speed quickly, and the retardation at the end of the hoist is considerably lessened. The objection to drums that are entirely of the conical shape is that the increased width requires more inertia for driving. In connection with mine cars and other machinery, it is indeed well that superintendents are giving more attention to proper lubrication. Only recently when visiting a large and supposedly modern mine, I watched the men drop the loaded cars, that had just been hauled out of the mine, upon the tippie. The approach to the tippie was 200 ft. long and was built on a 1.75 per cent. grade which had in previous years been sufficiently steep to cause the loaded cars to run by gravity upon the tippie. The fact that a man now had to push each car almost all the way to the dumping point attracted my attention, and subsequent investigation proved that

the whole trouble was caused by the cars not being properly lubricated. It would be interesting to know what amount of power is being needlessly expended in hauling these rickety, poorly oiled cars through that mine every day.

SURFACE ARRANGEMENTS

The improvements that have taken place in our colliery surface plants are too numerous to be dealt with at length. The tendency has been to do away with all outside labor, by substituting mechanical devices, and to concentrate the outside plants as much as possible, thus preventing the loss that results from having to carry steam or other power long distances. Much attention has been directed toward having the intake at a sufficient distance from the tippie or dumping point, so that whatever dust is raised in handling and loading the output will not be distributed and drawn back into the mine. At one operation, an expenditure of less than \$5000 enabled the company to do away with four men who had been employed on the tippie and received from \$1.75 to \$2.50 per day. This result was accomplished by the installation of self-dumping cages, and by having a heavy pan-conveyor carry the coal that was hoisted, from the top of the shaft to the head of the gravity screen. In coal washeries and other places where water is to be lifted to a height less than 100 ft., practice is now favoring the installation of turbine pumps instead of the old-fashioned steam pump.

FORMATION OF COAL

A great many theories have been evolved dealing with the methods and forces that have operated in forming our coal deposits. Of the many ideas recently presented, the one most favorably commented upon ignores the conclusion that our coal beds are the remains of great primeval forests. More careful thought and examination leads us to believe that all of our coal seams have been formed from minute vegetable matter that has probably lived and flourished at the bottom of inland lakes, being deposited year after year for a long period, and then covered with layers of sand and other materials, while later ages have furnished the pressure and heat necessary to complete the transformation. The principal argument in favor of this theory of fine vegetable matter forming our coal is that the parting between our known coal seams and the underlying and overlying strata is perfectly uniform and even. The strata forming the floor for our beds of coal do not show any traces of the roots or stumps of large trees, nor indeed any evidences of large vegetable growth.

COKE MANUFACTURE

We are on the eve of a great awakening to the immense losses that have resulted from making coke in bee-hive ovens and allowing all gases and by-products to be wasted. If the power that has already been lost in the Connellsville region,

through the waste of gases in the manufacture of coke, could be made available at the present time, it is fair to say that the factories of our country would not have to purchase coal to produce power for many years to come. This great and inexcusable waste has been one of the most shocking things in our industrial history.

By-product ovens are coming into greater use, and where operators persist in retaining the principles of bee-hive ovens, they are in many cases modifying the style by building their ovens 25 to 30 ft. long and 6 ft. wide. The by-product oven does not produce a coke with a silvery luster like the products that come from the bee-hive ovens; however, the structure and quality of the by-product coke is not far inferior to that of the old-fashioned product. In a number of instances where ovens have recently been constructed, the arrangements have included a long main flue running behind the ovens and connected to each one by smaller flues, thus catching the gases that have heretofore been lost. These gases are carried to the power house and there burned in gas engines, and used to manufacture steam. A considerable saving with little extra expense is thus effected.

CO-OPERATIVE MINING

A brief review of the work accomplished during the past year would be incomplete without a reference to co-operative mining. Two conditions are absolutely necessary in creating efficient workmen: the first is encouragement; the second is enthusiasm. The latter will not be present if the first is not exercised, and encouragement is the cheapest gift in the bestowal of a mine manager. One other fact may be mentioned as a basis for enthusiasm, and that is a thorough and intelligent understanding of the work in hand. A man who can read nothing but English will not be likely to grow enthusiastic over an article in a German paper; neither will a miner who is unfamiliar with the principles of ventilation or the effect of mine gases be sufficiently interested in building his brattices or hanging a curtain. The foregoing statements may be advanced as the fundamental principles on which successful co-operative mining is based. This leads us to a consideration of the plan which is successfully carried on at several different localities in America. One operation of such a character is at Saginaw, Mich. This mine is owned entirely by the workmen who operate it. They establish prices, make contracts, and go underground to dig out the product. There are no strikes here, for every man is personally interested in the welfare of the operation.

The company was first organized with 100 men, and a capital stock of \$50,000. After a year of success, however, it has been decided to increase the capital to \$250,000, and the company to 500 miners.

Some of the men had no money, and arranged to pay their part in labor.

When trouble was expected in Ohio this year the Caledonia Company, as this co-operative mine is called, was flooded with orders, due to the fact that consumers knew there would be no shut-down at this property.

The men at the Caledonia mine choose their own superintendent, who is responsible to a board of managers elected by the miners. Other men, noting the success of this new venture, have formed companies along these lines, and as every employee is interested in seeing that the product turned out is of the best, the mines have succeeded in establishing a reputation for themselves, as well as surviving the fiercest kind of competition. There have been many instances where co-operative work of this sort has utterly failed, while, on the other hand, the advocates of the system can point to a number of examples where success has attended the efforts of the men thus engaged.

LEGISLATIVE ACTION

The mine inspectors of the larger coal States are urging their respective legislatures to revise the present laws, so that coal-mine development will hereafter be governed by more stringent rules, which will insure greater safety to the men, and as a final result, less worry and expense to the operator. At no place is military discipline so necessary as in the operation of a mine. It would not be bad policy to have our mines policed, and see that all workmen are arrested for such infractions of rules as smoking, or having matches in a gassy mine; or for carrying powder, entering a place marked "danger," neglecting to report the strength of brattices, etc.

The organization of rescue teams is no longer an idle dream, as is proved by the recent meeting held in Scranton, Penn. All the mines of one large company were represented in this event, and the work done by the different teams showed the result of conscientious training, and promises well for the future of this important work.

Recent investigation has gone to prove that barometric pressure has a probable effect upon gases in a mine, and consequently exerts considerable influence on mine explosions. The humidity of the air, which is also closely allied to barometric pressure, has an undoubted effect upon the conditions that govern and make mine explosions possible. In this connection it is likely that the Government, both Federal and State, will investigate this hypothesis during the coming year, and be of much service to the mining industry. There is no doubt, that if through our weather bureau, mine managers could know of the movements of areas of high and low barometric pressure, certain precautions might be taken that would result

in a reduction of accidents and a material saving of life.

I remember during the summer of 1902, when the whole country was agitated because of the terrible coal strike that was taking place, causing the price of coal to be raised until its purchase by the common people was almost impossible, a coal operator (whose mines were working because he employed unorganized labor) rubbed his hands and smilingly told me that there was no doubt but that coal was king. So long as things run smoothly the general public does not realize this fact, but let the wheels that govern the production of coal, whether the time be winter or summer, stop for a short period, and see what alarm prevails and suffering ensues.

As to the efficiency of our men and methods, we have only to remember that every miner now employed in our coal mines produces on an average nearly twice as much coal per year as the miner of any other country. We as a people are also consuming more than twice as much coal for making steam than the United Kingdom, our nearest competitor. Coal mining during 1906 has not followed the great wave of prosperity that has swept over our country, but instead has led the whole procession, and present prospects seem to indicate that it will continue in this exalted position.

The Chicago Coal Market

BY E. MORRISON

In general, the year 1906 was similar to previous years in the history of the Chicago coal trade. There was the same over-supply of coal from Illinois and Indiana mines, prices continued low and the last four months of the year saw the same difficulty in getting supplies because of car shortage on the railroads. The year, however, contained one notable variation from the normal in its record for the months of April and May, when mining in the western fields was almost wholly suspended because of labor troubles. It was shown in these two months that stores of bituminous coal could be provided for at least two months, without serious losses from slacking or inconvenience to the users of coal.

During the two months in question, prices of western bituminous coal rose 20 to 80 per cent, but nearly all the large consumers had laid in stores sufficient for two or three months' needs, and the amount of coal sold at the speculative prices was small. In the other months of the year prices were about the same as in 1905 for the leading grades of bituminous. Anthracite, after the end of labor troubles at the mines, sold at the same prices as the year before.

Beyond question too many bituminous mines have been worked in Illinois and Indiana, for fair profits, in the last two or

three years. The annual car-shortage troubles of the autumn are in one respect helpful to the coal trade of Chicago—they keep back from the city shipments that under normal conditions flood the market with coal that must be quickly disposed of to avoid demurrage charges. Chicago is the natural market-place for coal not sold when it leaves the mines of the two States in question, and some arrangement that would regulate shipments would greatly benefit both operators and wholesale dealers.

Approximately 11,000,000 tons of bituminous and anthracite coal are received by the Chicago market yearly, of which amount about 3,000,000 tons are reshipped to points outside the city. A large amount of coal that never reaches the city is, of course, handled by local dealers. About 15 per cent. of the total received in the city is anthracite coal and 60 to 65 per cent. is bituminous from the Illinois and Indiana fields, the rest being from West Virginia, Pennsylvania and Ohio. Receipts of anthracite by lake were 208,420 tons less than in the previous year, and should the winter prove severe, the deficiency must be made up by the all-rail traffic in the next three months.

The range of average car prices of Illinois and Indiana bituminous, for the year, is shown in the following table:

Month	Lump and Egg	Run-of-Mine
January	\$2.00@2.75	\$1.30@1.75
February	2.10@2.85	1.30@1.75
March	2.20@3.00	2.00@2.50
April	2.75@3.00	2.50@3.00
May	2.50@3.00	2.25@3.00
June	2.00@2.30	1.70@2.25
July	1.75@2.50	1.50@2.15
August	1.60@2.40	1.30@1.85
September	2.00@2.50	1.50@1.90
October	2.00@2.85	1.50@2.25
November	2.20@3.00	1.75@2.25
December	2.20@3.25	1.75@2.25

Smokeless coal has ranged \$3.25@3.50 for run-of-mine, with the standard quotations for the last half of the year \$3.40 for run-of-mine and \$4.30 for lump and egg, these prices applying to Pocahontas and New River. Hocking valley coal has ranged \$3.15@3.40 for run-of-mine, with lump running as high as \$3.75 toward the close of the year. Coals from east of Indiana have in general been scarce in the last half of the year, because of the car shortage.

Anthracite has sold at the standard prices of \$6.25 for grate and \$6.50 for egg, stove and chestnut, subject to discounts of 30c. for June, 20c. for July and 10c. for August. The customary discounts of 40c. for May and 50c. for April were not announced, owing to the labor troubles at the mines.

The Cleveland Coal Trade

BY G. W. CUSHING

The coal trade in the Lake region for 1906 presents a study of the development of forces which have lain dormant, but apparent, for several years. For one thing the year has been conspicuous for the de-

velopment of the coal trade almost out of proportion with the demand and surely beyond the capacity of the railroads to take care of it. For another thing it has brought into stronger relief the possibility of new fields entering the market to compete with Ohio, West Virginia and Pennsylvania, in the markets these States have dominated for a good many years. The crux of the situation naturally rested upon the strike of the bituminous coal miners in April.

When the year opened there were already strong premonitions that a coal strike was ahead. This brought about buying on the part of consumers to collect a stock which would last for several weeks, or the normal period for the duration of a strike of some violence. This made a good market for coal, which was fully up to the expectations of the operators and to the ability of the railroads to furnish cars. At first there was talk that the anthracite and bituminous miners would join forces in a general strike in Pennsylvania, Ohio, Indiana and Illinois. West Virginia and Kentucky were considered out of this combination, being largely non-union. The Mine Workers' officials evidently arrived at the conclusion that public sentiment would not support a strike of such general nature as would completely tie up commerce, and in consequence the struggle was confined to the bituminous mines. The men wanted 10c. a ton advance. West Virginia and Kentucky hoped this would be granted, since the differential on coal rates is only that amount in favor of the Ohio and Pennsylvania field and this addition to the cost of production would put these two States on an equal footing with Ohio and Pennsylvania in the market theretofore controlled by those States. But the Pittsburgh Coal Company had contracts for the delivery of a specified amount of coal per week to the Steel Corporation and had to yield to the demands of the miners, forcing the smaller mines in Pennsylvania to the same position. Part of the Ohio mines held out until June and some until the middle of July. When an agreement was reached to resume operations it was found that half of the season of navigation was gone and yet there were contracts, in the closed districts, to ship an aggregate of nearly 4,000,000 tons to the head of the Lakes, to say nothing of supplying the strictly local demand. The shippers by Lake immediately went into the market to tie up vessel capacity in quantity for the last half of the season and succeeded in getting about all the boats they needed. Within six weeks, however, there set in a shortage of railroad cars which increased as the regular fall trade opened, and the business in iron and steel kept enlarging. By October the car shortage was serious and by the middle of November it was admitted that shippers by Lake would not be able to fill their contracts. This was made finally impossible when winter set in

about Nov. 15 and brought the season of navigation to a close, practically, before hull insurance had expired on the big steel steamers. The car shortage crippled West Virginia and Kentucky as well as Ohio and Pennsylvania, and held in abeyance the forces of competition.

As for influence on prices, the early demand of the consumers to provide a supply against a strike kept values steady until the strike was declared. Then there was a very rapid rise which lasted only long enough to determine that most consumers had a supply which would last for at least six weeks and in most cases three months or more. Then values dropped rapidly and the market was quiet.

When the car shortage set in in September prices began to move up again and by the middle of October mine-run steam coal was selling at \$1.50 at the mines and slack at \$1. This was due to the fact the supply of cars at no time permitted mines to run more than one-third their capacity while in some instances production was between 20 and 25 per cent. of normal. Prices were also influenced at one time—principally in midsummer—by the fact that many consumers showed no discrimination between the various grades of coal, having improved their furnaces to use either fine, or lump coal, whatever came to hand. This change promises to have even a greater influence on values in the future.

The Hepburn law had its effects also. In Ohio it brought about a ruling by the State Railroad Commission that the old practice of reserving certain points, local to certain railroads, as markets for mines located along those railroads, was illegal, thereby broadening the market for the product of all mines. In Kentucky it had the effect of bringing the railroads to terms. In that State the railroads have had a peculiar grasp of the coal situation, refusing to put switches in operation when those led to mines that competed with the railroad-controlled mines. The new law gave the operator redress for such grievances, and brought about the opening of some new mines. The Kentucky fields are extensive, and the absence of unionism there, gives the Kentucky operator a chance in the markets north of the Ohio which he is almost sure to develop, if the car situation will ever permit.

In the Lake region many shippers have filled their contracts, while others have failed. The shipments have been equal to those of former years, but not up to the demand this year, largely because the market has broadened, owing to developments in northwestern Canada.

Alabama Coal

BY L. W. FRIEDMAN

A serious railroad-car shortage during the last four months of the year interrupted the production of coal in Alabama. While it will be several weeks into 1907

before the statistics will be completed in regard to the output for 1906, it is known that there is an increase of several hundred thousand tons over the output during 1905, and that the aggregate coal mined in 1906 is close to 13,000,000 tons. The car shortage at a number of the larger mines, especially where the coal was not used in iron making, caused often more than two-thirds time to be lost.

Much development took place during the year. The Louisville & Nashville Railroad built several miles of track on its North Alabama railroad, to coal properties in the western part of Jefferson county and in Walker county. The Central of Georgia railroad built an extension in Jefferson and St. Clair counties. The Southern Railway built a branch line for the Sloss-Sheffield Steel and Iron Company, while the Frisco put down a branch line in Walker county to reach coal properties. There was a demand for every ton of coal that could be mined. The strike of the union coal miners, which began two years ago, was called off in June of this year, and many of the idle men had no trouble in getting employment at old and new mines. The effect was that, with the new men brought into the district, and the strikers returning to work, more men today are employed in coal mines in Alabama than ever before.

State Mine Inspector J. M. Gray admits that had the transportation facilities been what was expected by the coal producers the production would have been several hundred thousand tons better than it will total when all figures have been received. In 1905 Alabama produced 11,900,153 tons of coal, a year previous 11,273,151 tons, and in 1903, there were 11,700,753 tons of coal produced by this State. Basing the output for 1906 at 13,000,000 tons, it can readily be seen that there has been active work at the mines.

But one serious accident happened during the year, that at Piper, where an explosion killed 12 men. Nearly 100 men lost their lives in coal mines in Alabama during 1906, as compared with 185 the year previous. The loss of life in 1905 was brought about mostly by the explosion in the Virginia City mines, in which 112 men were killed.

During the year State Mine Inspector J. M. Gray gave notice that the mining laws of the State would be enforced to the letter, and a number of reforms were introduced by him. He forbade the use of dynamite, and excessively heavy explosives in the mining of coal, and demanded that superintendents and mine bosses caution the miners.

The Sloss-Sheffield Steel and Iron Company during the year began the opening of their Bessie mines in the western part of Jefferson county and it is expected the daily production will run something like 1500 tons.

The coke production was steady. The

demand was met sparingly. Several new and large washers were erected by the Tennessee Coal, Iron and Railroad company and others, looking to an increase in the production and a better grade of coke.

Coal in New Mexico

BY J. E. SHERIDAN*

The production of coal in New Mexico for the calendar year 1906, estimating the December output, reached a gross production of 1,973,650 short tons. The amount used in operating the mines was 77,250 tons; the net product shipped from the mines being 1,896,400 short tons, an increase of 295,400 tons over the preceding fiscal year, or 18.46 per cent. increase of net product shipped. The production of coke was 118,000 short tons. The average value of the coal at the mines was \$1.50 per ton, and of coke \$3.30 per short ton.

The number of men employed in mining, taking the average for the year, was 1753 men and 40 boys underground; 765 men and 31 boys outside, a total of 2518 persons. The number of persons killed in the mines was 17, an average of 6.70 per 1000 persons employed. This exceedingly high percentage of fatalities was due to a disastrous explosion which occurred in the Dutchman mine, near Raton, N. M., on Oct. 5, 1906, by which 10 men lost their lives. In addition to the foregoing number of persons directly employed in and about the mines fully 2500 men were employed in building railroads to transport coal from the mines, and construction of increased equipment at the mines.

The prediction of a year ago, that "the production of coal and coke from New Mexico coal mines would probably be increased by 100 per cent. during the calendar year 1906, has not been fulfilled. The failure of fulfillment of anticipated production was not in any manner due to either lack of producing capacity of the mines, nor to shortage of orders for the product. While consumers have begged for delivery of coal and coke, the production has been restricted, first by lack of transportation facilities; second, by a dearth of miners, it being impossible to secure full shifts of men, and lastly by delay in manufacture and delivery of machinery and other equipment to facilitate the increased production at the mines.

The Colfax county coalfields take precedence for production and extensive equipment. At Dawson, N. M., where the most extensive development of the mines and increase of equipment is being carried into effect, the promised increase of tonnage of coal was delayed by the difficulties above mentioned, and the production of coke was farther delayed by an unforeseen obstacle arising in the building

*Territorial inspector of mines, Silver City, New Mexico.

of the 440 new underflue coke ovens; the intense heat, generated by the combustion of the confined volatiles, fused the mortar, or cement, in which the bricks were laid, the fused material running down into the underflues and clogging them, thus necessitating the rebuilding of the entire string of 440 ovens. A more refractory and infusible sand has been found which will be used in rebuilding the ovens.

The extensive developments of the St. Louis, Rocky Mountain & Pacific Company, while having achieved comparatively good progress, have been retarded by the influences mentioned in the earlier paragraphs of this article. The Yankee coal fields, on Johnson and Barela mesas, is attracting merited attention. This field has for years been neglected except for development by a few country coal banks operated for local demand in home towns, where the coal obtains exceptional favor for domestic purposes. Development and tests have proven these coals to have exceptional coking properties, as shown by the following analysis:

ANALYSIS OF COAL AND COKE FROM YANKEE, NEW MEXICO

	Coal	Coke
	Per cent.	Per cent.
Moisture .....	.39	.60
Volatile matter.....	41.30	.40
Fixed carbon.....	50.55	86.65
Sulphur .....	.00	.00
Phosphorus .....	.00	.00
Ash	7.85	12.35
Total	100.00	100.00

Coke made in keg in beehive oven.

STRENGTH OF YANKEE COKE	
Weight in grams	Compressive strength
per cu.in.	
13.9	2000 lb.
12.9	2150 lb.

The foregoing makes a favorable comparison with Connellsville, Penn., coke, and the quality assures a good demand for this coke.

The Santa Fé, Raton & Eastern Railroad now gives these coalfields connection with the main line of the Atchison, Topeka & Santa Fé Railroad, and another new line, the Santa Fé, Liberal & Englewood Railroad, is now under construction and will give the Yankee field direct connection with new markets in Kansas, Texas and Oklahoma, adding another prominent factor to the coal and coke production of New Mexico.

The American Fuel Company, in the Gallup district, has ample development and equipment on its mines for a production of 5000 tons per day, but operation of the mines is handicapped by lack of sufficient transportation facilities. There is a constant demand for the coal from these mines for both domestic and steaming uses.

In Socorro county, the New Mexico Midland Railroad has been completed from the Carthage mines to the Atchison, Topeka & Santa Fé Railroad, at San Antonio, New Mexico, and the production from these mines will be largely increased during the ensuing year.

The several new mines being opened at

Dawson, Koehler and Yankee, in Colfax county, together with new railroads furnishing a great increase in transportation facilities, warrant the anticipation of a very large increase in the production of coal from the mines of that district. The production of coke will be increased fully 200 per cent. upon the completion of the new coke ovens at Dawson, New Mexico. To this increase there will be added the production from 200 new coke ovens under construction by the St. Louis, Rocky Mountain & Pacific Company, at Koehler, New Mexico, and from 200 new coke ovens to be built at Yankee, New Mexico, in the very near future.

The prospects of the coal-mining industry in New Mexico are exceedingly bright; it is simply a question of sufficient supply of labor, increased equipment, which is being installed as fast as manufacturers can supply it, and ample transportation facilities, which will be provided by the completion of railroads now under construction.

Coal in West Virginia

BY F. W. PARSONS

In the larger fields of West Virginia, there was practically no suspension of the wonderful activity in coal mining that occurred in 1906, and as a consequence the production shows a substantial increase over previous years. There are some who will claim that West Virginia is no longer a state full of opportunities, but rather has become like Pennsylvania and some of the older districts where most of the valuable coal lands have already been accumulated. This is true only in part, for although some of the fields are closely held, there are still thousands of acres of good coal land back from the railroads that is for sale at a reasonable price. There are also large land companies which are ready and willing to lease valuable tracts to competent men who can prove that they have the ability to open and successfully operate a mine.

So far as the industry as a whole is concerned, the most important happenings of 1906 were the completion and the successful operation of the Coal and Coke Railroad, and also the rapid development of the Deep Water road, which will carry coal to tidewater. Both of these railways are projected into new territories, and will consequently be the means of opening new fields.

For many years coal mining in West Virginia was unprofitable because of the destructive competition. This condition has been remedied by the consolidation of many mines in the several districts. There are still many independent operators, but they market their coal through one of the larger selling agencies. In northern West Virginia the largest operator is the Fairmont Coal Company, which controls nearly all of the mines in what is known

as the Fairmont and Clarksburg fields. This company, by virtue of its wonderfully organized selling department, can dispose of all the coal its mines will produce; last year was one of unprecedented prosperity in this district. Although the Fairmont company is opening and equipping a large mine near Clarksburg, W. Va., the policy of this corporation has been to perfect and increase the output at the mines already opened, rather than to develop new properties.

Many new mines have been opened along the Coal and Coke Railroad, and the field opened by it will undoubtedly become a large producer in the near future. The coal in this region is not as good for steam purposes as the New river and Pocahontas product, but it is a first-class smithing coal, for which reason it has become famous.

The largest operators in the New river field are the New River Company which was recently organized with Sam Dixon (one of the veteran operators of the field) as president, and the New River Smokeless Coal Company. The New River company is perhaps carrying on new development work more aggressively than any other West Virginia corporation. The coal produced by it is unsurpassed for steam purposes, and because of its low volatile matter is considered almost smokeless. None of the coal is washed and a large part of the production is shipped directly as run-of-mine.

Operations in the Kanawha and Pocahontas fields were vigorously carried on. The largest operations in the Pocahontas field are controlled by the Pocahontas Collieries Company and the United States Coal and Coke Company. The main offices of the former concern are at Pocahontas, Va., while the United States Coal and Coke Company has its headquarters at Gary, W. Va. Both of these companies have large plants and convert a considerable part of their output into coke. The Pocahontas company is opening up a new mine at Boissevain, which, after completion, will be followed by other new development work.

The great problem throughout West Virginia and especially in the southern part is that of a deficient supply of labor. The scarcity of men has caused the operators considerable trouble and great efforts have been made to import miners into this field. Wages are above the average and the climate is particularly healthy. However, the region is somewhat removed from large towns and legitimate amusement is scarce. It is probable that West Virginia will continue to hold her place as the second largest producer of coke, and that before many years it will have a soft-coal output rivaling that of Pennsylvania.

Excitement prevails in the Island of Trinidad over the possibility of developing petroleum. Drilling is being conducted.

Coal in Australia

An important step was taken during 1906 by the northern colliery owners in New South Wales, when a "vend" was formed to regulate the output and selling price of coal. All but one colliery is bound by this agreement, and it is believed that the industry will largely benefit now that internal competition has been ended.

The work at all the collieries in New South Wales was very active, the increased traffic on the railways, consequent on the exceptionally favorable season, being one of the chief factors affecting the local trade. The exports were on a large scale, 2,142,000 tons having been exported during the first nine months of the year, or 488,000 tons more than for the same period in 1905.

The company formed to work the coal seams beneath the Sydney harbors completed the sinking of the two shafts to a depth of 3000 ft., and has now a face of 4 ft. of clean coal in the heading, which shows signs of increasing thickness as the entries are extended.

In Queensland, a decided improvement was noticeable in the trade of the West Moreton district, which is attributable to the concession made by the Government in the shape of a rebate of harbor dues to vessels shipping over 500 tons of bunker coal. The Newnes Oil and Shale Company is exploiting the oil-shale seams in the Capertee and Wolgan valleys, New South Wales, on an extensive scale. The preliminary work embraces the driving of a tunnel several miles in length on the shale horizon, and its connection with the State railway system.

The German Coal Industry

The coal production of Germany materially increased in 1906, and great activity was evinced in all branches of the industry. For the 10 months ending Oct. 31, the output was reported in metric tons as follows:

	1905.	1906.	Change.
Coal.....	99,951,160	114,273,413	I. 14,322,253
Brown coal	42,438,507	46,098,425	I. 3,659,918
Total mined..	142,389,667	160,371,838	I. 17,982,171
Coke made.	12,366,680	16,720,631	I. 4,353,951
Briquets made, 10,589,951	12,066,867	I. 1,476,906	

The briquets are made largely out of the brown coal, or lignite. The total increase in coal mined this year was about 13 per cent.

During the first 10 months of 1906 Germany exported 16,330,426 tons of coal, which shows an increase of more than 1½ million over 1905. More than 2¼ million tons of coke and 600,000 tons of briquets were also exported. The import of coal into Germany during the same period was nearly 14,443,723 tons, which was an increase of 62,567 tons over the import of 1905.

Pittsburg District Coal

BY S. F. LUTY

The production of coal in the Pittsburg district in 1906 was the greatest in its history, but the returns to stockholders of the large companies and to independent interests were not entirely satisfactory. This was due to the fact that many large annual contracts were taken in January and February at low prices, as it was expected the mining rate would be reduced. Instead, the United Mine Workers of America forced an advance of about 6 per cent., dating from April 1, and the cost of production showed a decided increase over previous years.

A general strike of miners was threatened early in the year unless a substantial advance was conceded, but operators did not seem to regard the matter seriously and continued to quote low rates for deliveries extending through the year, the minimum price being 90c. for mine-run coal, and many contracts were made at \$1 a ton in January, after the national convention of the United Mine Workers at Indianapolis had made a demand for an advance of 12 per cent. Iron and steel manufacturers, fearing a suspension, began to store coal and all the mines in the district were unusually active in the first three months.

When a general tie-up of the mines of the country appeared certain President Roosevelt intervened by writing to Francis L. Robbins, chairman of the Interstate Coal Operators' Association, and John Mitchell, president of the United Mine Workers, urging them to endeavor to reach an agreement. It was due to the efforts of these men that a compromise was made at a reconvened conference held on March 19 at Indianapolis. The miners withdrew the demand for an increase of 12 per cent. for the year and agreed to accept a raise of 6 per cent. and make a contract for a period of two years, dating from April 1, 1906.

Western operators objected, but Chairman Robbins of the Pittsburg Coal Company signed the agreement for his company and its subsidiary interests, including the Monongahela River Consolidated Coal and Coke Company, and all the mines of these concerns and a number of independents who signed continued in operation. On April 6 the other independents who had vigorously opposed an increase gave up the fight and before April 10 every mine in the Pittsburg district was in full operation. The suspension in other parts of the country continued for a few weeks longer, when it was seen that Pittsburg operators were getting the business and there was a general resumption.

A shortage of railroad cars prevented the full operation of the mines throughout the year, but despite this handicap the production for 1906 was between 46,000,

000 and 47,000,000 tons, compared with 42,000,000 tons for 1905, 31,000,000 for 1904, and 18,000,000 tons in 1897. The Pittsburg Coal Company, the leading interest, produced 16,000,000 tons, and the Monongahela River Consolidated Coal and Coke Company, the large river interest, 6,000,000 tons.

Shipments to the Northwestern and Southern markets from this district were greater than in any previous year. The shipments to the lake ports during the season amounted to 9,200,000 tons. In 1905, 7,460,000 tons were shipped and in 1904, 6,058,000 tons. The shipments to Southern ports aggregated about 3,500,000 tons, of which 2,500,000 tons were sent out by the Monongahela River Consolidated Coal and Coke Company. The rest of the tonnage of this big company went to the mills along the Monongahela and Allegheny rivers and to other consumers in the Pittsburg district.

John H. Jones, president of the Pittsburg-Buffalo Company, the large independent interest in this district, has compiled some interesting figures on coal tonnages. He declares that if the railroads had been able to furnish necessary transportation facilities the production in the Pittsburg district would have been fully 3,000,000 tons greater in 1906. Mr. Jones estimates that the production of coal in the United States this year will reach 425,000,000 tons, and possibly 430,000,000 tons, and that the world's production will be between 1,200,000,000 and 1,300,000,000 tons.

An unusually large number of big contracts were entered into early in the year for extended deliveries. One by the Pittsburg Coal Company with the Pittsburg Steel Company called for 1000 tons daily for a period of six years. The Monongahela River Company received a contract from the Midland Steel Company for 250,000 tons annually for five years. All contracts made by the big river interest for the year with consumers at Southern ports were at low prices, as an advance in the mining rate had not been taken into consideration. In December the company gave notice that all annual contracts to be made in January would be at an advance which will range from 10 to 20 per cent. All annual contracts are to be made at higher prices than prevailed the first of this year and 1907 is expected to be the most profitable one in the history of the coal industry.

Many improvements were made during the year and there are now but few mines operated by old methods. The Pittsburg Coal Company has installed modern machinery and equipment at nearly all of its mines. The Pittsburg-Buffalo Company in May began sinking two large shafts on a 14,000-acre tract in Washington county, which is included in the Pittsburg district. These shafts are to be the finest in the world, when completed in the spring of 1907. Each shaft will have an actual working capacity of 1250 tons an hour.

The coal will be used exclusively for coking and a number of ovens are to be built.

The Pittsburg Coal Company greatly increased its coke production in 1906, and is still at work on extensions. In February the company disposed of some of its properties at a handsome profit. It sold 262 acres of coal land to the W. J. Rainey Company at \$1222 an acre, having paid \$280 an acre for the property a few years ago. The company also disposed of its interest in the Western Coal and Dock Company and the Whitnall Coal Company.

Preparations are being made by producers for a large output in 1907 at profitable prices. There will be no labor troubles, as the present scale will continue in force for another year, dating from April 1. It is the same scale as was in force in 1903 when the pick-mining rate was 90c. a ton. A reduction to 85c., or 5.5 per cent. was made for a period of two years dating from April 1, 1904, but the rate of 1903 was restored by the new agreement.

Coal in Pennsylvania

BY F. W. PARSONS

Coal mining in the anthracite and bituminous districts of Pennsylvania was carried on with much activity during 1906 and in many ways promises to eclipse the results obtained in any previous year. The labor troubles that occurred were of short duration and, if anything, were a blessing to the industry. It is probable that had no suspension of work occurred, the operators would have been compelled to have had occasional temporary shut-downs to prevent the supply from exceeding the demand. The resumption of work on the terms accepted resulted in no particular victory for either side and tended to show that neither operators nor men have forgotten the awful experiences of the last great strike.

VALUE OF PRODUCT

It is probable that the coal output of Pennsylvania in 1906 will represent a value of nearly \$400,000,000 on the railroad cars at the mines; and that this same output will show a value of from \$650,000,000 to \$750,000,000 at the points of distribution. Pennsylvania as a whole will produce upward of 50 per cent. of the total coal output of the United States.

SHORTAGE OF CARS

The shortage of cars was a trouble much heralded in the papers, and it may as well be realized at once that this difficulty is not without its redeeming features. If all of our mines were constantly to have plenty of cars for shipping their product it would not be long before many of them would not be working full time. This condition is an old trick that the operators often take advantage of, and many times such car trouble is to the mine manager a welcome misfortune.

EMPLOYMENT OF BOYS

Much has been said concerning the employment of boys under the minimum age in our mines and on the breakers. The responsibility for this serious fault does not rest particularly with the operators or mine inspectors, but rather may be laid at the door of the parents who secure certificates for their children by swearing to a false age. Only by strict investigation and a careful enforcement of the laws will this trouble be eliminated.

PROPORTION OF MACHINE-MINED COAL

Exact figures as to the amount of coal produced by compressed air and electric power are not yet available. Preliminary estimates seem to indicate that about half of the coal produced is from the use of compressed air, while the production by electric power amounts to nearly one-quarter of the total output. This is not due to any decrease in efficiency derived from electric machines, but rather to the fact that the law prohibits electric wires and the conduction of electric current in all mines or parts of mines that are considered gassy and are worked with safety lamps. The use of electricity for driving all of the jigs, screens and rolls in the newer anthracite breakers is an innovation that is meeting with much success.

The Anthracite Market

The total production of anthracite coal in Pennsylvania was as follows, in long tons; the December shipments are estimated, and comparison is made with the figures of the Pennsylvania Bureau of Mines for 1905:

	1906.	1906.	Changes.
Shipments.....	62,441,134	56,162,567	D. 6,278,567
Consumed and sold at mines.....	7,779,420	7,169,727	D. 618,693
Total.....	70,220,554	63,332,294	D. 6,897,260
Total, short tons,	78,647,020	70,922,090	D. 7,724,930

The decrease shown by this table does not involve any loss in consumption. The shipments of 1905 were swollen by large quantities of coal which was sent away from the mines in November and December and stored at various points along the lines of the coal-carrying roads, in anticipation of a possible strike. The suspension after April 1, pending negotiations between operators, brought the shipments to market down to 488,439 tons in April, and 3,276,310 tons in May; but at no time was there any shortage in supplies at consuming points, the stored coal being sufficient to meet all demands until full production was resumed. The movement of the miners failed, the settlement finally effected being a continuation of the terms arranged by the Anthracite Coal Commission three years before, with a very few minor modifications.

If exact figures of consumption could be compiled, it would probably be found that the consumption of domestic coal was slightly less than in 1905, owing to the mild winter. The demand for steam sizes

was remarkably steady during the year, with an increasing demand at its close. Of these steam sizes pea coal is finding an increasing use for domestic purposes. In November the Philadelphia Coal Exchange decided that pea coal should hereafter be considered a domestic size, selling at 25c. below chestnut. This action has not been followed in New York or other cities.

The tidewater prices of anthracite continued unchanged through the year at the list figures of \$4.75 for lump, \$5 for egg, stove and chestnut. The usual discounts of 50c. in April and 40c. in May were not given, owing to the suspension. The discounts of 30c., 20c. and 10c., for June, July and August, respectively, were given. The tidewater prices of steam sizes were fairly uniform, closing at \$2.80@3 for pea; \$2.25@2.50 for buckwheat; \$1.45@1.50 for rice, and \$1.30@1.35 for barley.

THE SEABOARD BITUMINOUS TRADE

Like the anthracite trade, the seaboard bituminous trade was fairly uniform through the year. The usual summer dullness prevailed somewhat longer than usual, consumers in the East being apparently unwilling to lay in stocks early, as all possibility of strikes had passed over, and they felt sure of getting coal when they needed it. This was followed in the fall by a rush to buy, and the closing two months of the year was an active period.

The strike in central and western Pennsylvania did not seriously affect the trade, having been settled so quickly that consumers did not have time to use up the stocks that had been accumulated by them and by dealers. In the last quarter of the year there was a good deal of trouble from shortage of cars and delays in transportation. This did not affect the trade in the East to the same extent as in the West, however, though it was sufficiently annoying.

COASTWISE TRADE

The coastwise traffic, which supplies a large part of eastern New York and most of New England, showed few changes. Vessels were in good supply nearly all the year, and the fall season was measurably free from severe storms, while ice did not make until very late in the shoal-water ports of the far East. The sailing vessels and barges, in which this traffic is mainly carried, had generally a good year.

Coastwise shipments of coal from the principal Atlantic ports for the 10 months ending Oct. 31 were, in tons:

	Anthracite.	Bituminous.	Total.
New York.....	11,240,103	8,525,321	19,765,424
Philadelphia...	1,436,044	3,228,140	4,664,184
Baltimore.....	184,772	2,664,746	2,849,518
Newport News..	.....	2,388,267	2,388,267
Norfolk.....	.....	1,849,780	1,849,780
Total.....	12,860,919	18,656,254	31,517,173
Total, 1905....	14,156,006	17,182,550	31,338,556

The total increase this year was 0.6 per cent. New York includes all the New York harbor shipping ports.

Coal Production in the United States.

The following table has been made up from carefully collected data, and is as nearly correct as present available statistics will permit. The total output for most of the States has been obtained from the various district and State inspectors, and will be found to differ but little from the finally corrected figures.

The greatest demand for fuel throughout the year has been for industrial purposes, while the unprecedented activity in steel manufacture and the metal industry has taxed the maximum capacity of our coking plants. Domestic demand would have been greater were it not for the mild winter we have so far experienced.

PRODUCTION OF COAL IN THE UNITED STATES

States.	1905.		1906	
	Short Tons.	Short Tons.	Short Tons.	Short Tons.
Bituminous:				
Alabama.....	11,900,153		12,500,000	
Arkansas.....	2,000,000		2,200,000	
California.....	48,568		48,000	
Colorado.....	8,844,711		11,240,078	
Georgia and N. Carolina.	385,600		390,000	
Illinois.....	37,183,374		38,000,000	
Indiana.....	9,772,404		9,725,300	
Indian Territory (f).....	2,970,961		2,966,812	
Iowa.....	6,728,000		6,400,000	
Kansas.....	6,780,225		7,100,000	
Kentucky.....	8,038,646		8,750,000	
Maryland.....	4,856,928		4,950,000	
Michigan.....	1,380,307		1,350,000	
Missouri.....	4,733,164		4,800,000	
Montana.....	1,743,771		2,000,000	
New Mexico.....	1,676,000		1,973,650	
North Dakota.....	900 0 0		325,000	
Ohio.....	25,894,637		27,250,000	
Oregon.....	310,000		115,000	
Pennsylvania.....	119,361,514		129,500,000	
Tennessee.....	5,195,200		5,275,000	
Texas.....	1,200,000		1,200,000	
Utah.....	1,594,943		1,859,219	
Virginia.....	4,113,950		4,800,000	
Washington.....	2,818,042		3,200,000	
West Virginia.....	35,283,382		42,000,000	
Wyoming.....	5,446,525		5,750,000	
Alaska and Nevada.....	85,000		95,000	
Total bituminous.....	310,285,015		335,738,059	
Anthracite:				
Colorado.....	60,503		68,343	
New Mexico.....	24,000		28,000	
Pennsylvania.....	78,647,020		70,922,090	
Total anthracite.....	78,731,523		71,018,433	
Grand total ...	389,016,538		406,756,492	
(f) Fiscal year.				

PRODUCTION OF COKE IN THE UNITED STATES

States.	1905.		1906.	
	Short Tons.	Short Tons.	Short Tons.	Short Tons.
Alabama.....	2,756,498		2,900,000	
Colorado and Utah.....	795,650		1,395,888	
Georgia and N. Carolina	69,200		70,000	
Indian Territory, (f).....	41,193		59,088	
Kansas.....	10,000		12,000	
Kentucky.....	65,475		60,500	
Missouri.....	3,100		3,500	
Montana.....	43,500		40,000	
New Mexico (f).....	76,737		118,000	
Ohio.....	112,250		160,000	
Pennsylvania.....	18,519,310		20,750,000	
Tennessee.....	382,300		410,000	
Virginia.....	1,203,650		1,280,000	
Washington.....	51,072		60,000	
West Virginia.....	2,738,777		3,500,000	
Other States.....	1,535,000		1,750,000	
Total.....	28,404,112		32,568,926	
(f) Fiscal year ending June 30.				

The comparison of last year's output with that of 1905 is ready obtained from the table. In this connection it should be remembered that 1905 was a banner year in the coal industry and showed a gain in production of 10.7 per cent. over the 1904 output.

PIG IRON AND IRON ORE

Statistics of Production—Summary of Commercial Conditions—Review of the Industry

A year ago we recorded the rising wave of prosperity in the iron and steel trades; this wave has continued to rise throughout 1906, with no indication that it has yet reached its full height, or begun to recede. Early in the year there were some predictions that the highest point had been reached, and that the period of recession—which long experience has taught us to look for—was coming. The brief cloud soon passed over, however, and the second half of the year was a time of unbounded activity. The result is seen in a production of iron and steel beyond all previous records; a production which exceeds that of Germany and Great Britain combined.

Notwithstanding the extraordinary output, which taxed to the full the large increase in capacity of furnaces and mills, made during the past three years, it was not possible to meet promptly the demands from consumers for material. In the closing month of the year it became necessary to import considerable quantities of pig iron to meet the demands of Eastern foundries. Though large in comparison with other years, the quantity of these imports is really insignificant when compared with the total consumption.

Iron and Steel

BY FREDERICK HOBART

The important transactions of the year are recorded briefly in the following columns. The changes made were the placing of the United States Steel Corporation in a position which precludes the possibility of any effective attack on its commanding influence in the iron and steel industries; and the establishment of the fact that the point where capacity of production exceeds the demands of a prosperous year has not yet been reached.

Some statements of production in 1906 will be found below.

IRON ORE

As for a number of years past, the Lake Superior region was the leading factor in the supply of raw material for the furnaces. The record of shipments from that region is very closely kept, and as the shipping season practically closes early in December, it is possible to give exact figures for that part of our iron-ore output, from which between 75 and 80 per cent. of our pig iron is made.

Next to the Lake country, the South is the most important producer of iron ore, and it is possible to make a fair approximation to the Southern output. The remaining iron-ore regions are scattered through the country, but the known ac-

tivity everywhere leaves no doubt of a considerable gain in their production.

The production of iron ore in 1906 is estimated as below, in long tons:

IRON-ORE PRODUCTION			
	1905.	1906.	Changes.
Lake Superior...	34,353,456	38,313,600	I. 3,960,144
Southern States..	7,175,000	7,450,000	I. 275,000
Other States.....	3,050,000	3,920,000	I. 870,000
Total	44,578,456	49,683,600	I. 5,105,144
Add imports.....	845,651	1,090,000	I. 244,349
Total	45,424,107	50,773,600	I. 5,349,493
Deduct exports...	208,058	305,000	I. 96,942
App.consumpt'n	45,216,049	50,468,600	I. 5,252,551

The value of the iron ore at the mines was at least \$100,000,000. The average consumption of iron ore per ton of pig iron made is, by the figures, 1.98 tons.

In all the different districts outside of the leading ones above mentioned, operations were carried on steadily. In the Lake Champlain and Hudson river districts in New York; in the Lehigh Valley and Cornwall mines in Pennsylvania; in Colorado and New Mexico, much was done. No important new mines were opened during the year except in the Lake Superior country; the work in that region is described in a separate article below.

Limestone Flux—The limestone and dolomite used as flux in the blast furnaces was approximately 14,228,500 tons. Limestone is the more usual flux, dolomite being used chiefly in the Alabama furnaces.

PIG IRON

In the table below we give the figures for the first and the second half of 1906 separately. Those for the first half are the figures of the American Iron and Steel Association; for the second half they are calculated closely on the known capacity of the furnaces in blast. It is believed that the total given will be found to vary but little from the final statement, which will appear later.

PIG-IRON PRODUCTION			
	1st Half.	2d Half.	Total.
Foundry and forge	2,889,592	2,960,710	5,850,302
Bessemer	6,899,066	7,077,748	13,976,814
Basic.....	2,449,275	2,503,261	4,952,536
Charcoal.....	204,135	212,100	416,235
Splegel, ferro, etc..	160,533	165,191	325,724
Total	12,602,901	12,919,010	25,521,911

The total gain shown in 1906 was 2,529,231 tons, or 11 per cent. That this was hardly as great as had been expected is due chiefly to a drop in production in the third quarter of the year. This was enforced by the condition of the furnaces, a number of which were in urgent need of repairs after long and arduous campaigns. Under the circumstances the work was hurried as much as possible. By October the active capacity was restored; in November and December there were large

gains, and the year closed with the greatest iron-making capacity ever known actively at work.

The growth in production of pig iron is shown by the following table, which gives the output for 10 years past, in long tons:

PIG-IRON PRODUCTION, 10 YEARS			
1897.....	9,652,680	1902.....	17,821,907
1898.....	11,773,934	1903.....	18,049,252
1899.....	13,620,703	1904.....	16,497,063
1900.....	13,789,242	1905.....	22,992,380
1901.....	15,878,354	1906.....	25,521,911

In these 10 years the production has much more than doubled, the increase of 1906 over 1897 being 15,869,231 tons, or 164 per cent. This growth has involved the investment of vast sums of money in new furnaces and auxiliary plants; in new mines of iron ore; in machinery, ships, railroads and equipment for handling and transporting the ore, fuel and flux; and in coal mines and coke ovens for supplying fuel. Besides all the new furnaces which have been constructed, there is practically no furnace in the country, which was standing 10 years ago, which has not been entirely re-constructed since then.

STEEL PRODUCTION

No official statement for any portion of the year has been published which covers the steel production for 1906. Assuming, however, the same ratio of steel to pig-iron production as in 1905, the output of steel ingots for 1906 was approximately 22,230,000 tons, of which about 12,180,000 tons were bessemer, or converter steel, and 10,050,000 tons open-hearth steel. This estimate is certainly conservative, especially as to the open-hearth steel. In the last quarter of the year an unusual quantity of scrap was used in many steel plants, owing to the difficulty in getting basic pig in sufficient supply.

In this estimate we do not include the crucible and special steels, the quantity made in 1905 having been only 121,000 tons, while there was no considerable gain in 1906.

The increase in steel output over 1905 was 2,196,249 tons, or 11 per cent. In 1897 ten years ago, the total steel production was 7,174,508 tons; showing an increase during that period of 15,055,492 tons, or 209.8 per cent.

No figures are available at this date for the production of finished iron and steel. It may be said, however, that the increase this year must have corresponded closely to that in steel ingots. There was a strong demand for all finished forms, which was especially pressing for structural material, rails and plates. Mills were generally full of work through the year; and many of them go into 1907 with their

capacity for the first half fully taken up, and with contracts for deliveries running into the third and even the fourth quarter of the year. This is especially the case with rails and plates. With rails there was a usual demand from electric roads, and also for light rails for mining and industrial uses.

UNITED STATES STEEL CORPORATION

This review would be incomplete without some reference to the corporation which controls about 60 per cent. of the finished iron and steel output of the country. For three-quarters of the year we have figures of operation. The company's statement shows net earnings for the September quarter and the nine months ending Sept. 30 as follows:

	1905.	1906.	Changes.
Third quarter.	\$31,240,582	\$38,114,624	I. \$3,874,042
Nine months..	84,571,594	114,374,147	I. 30,302,553

Unfilled orders on the books Sept. 30 reached a total of 7,936,884 tons; which compares with 6,809,589 tons on June 30, and 7,605,086 tons on Jan. 1, 1906.

There is no doubt that the net earnings for the last quarter of the year were very large. The probability is that the report for the full year will show net earnings of at least \$155,000,000; and that the company entered 1907 with over 8,000,000 tons of material on its order books. Very large sums were set aside during the year for improvements and additions to plant. The company paid the usual 7 per cent. on the preferred stock, and also resumed dividends on the common stock, paying two quarterly dividends of $\frac{1}{2}$ per cent. each on those shares.

Blast-furnace capacity is still the Steel Corporation's weakest point. This is compensated in part, however, by its command of ores which enables it to make advantageous deals with some of the outside merchant furnaces.

INCREASE IN CAPACITY FOR PRODUCTION

New work for the year has been directed largely toward increase in productive capacity. How great that is expected to be will be seen by the statement that the number of blast furnaces under construction, recently completed, or for which contracts have been let, is 62, the yearly capacity of which, when completed, will be 7,300,000 tons of pig iron. This does not include the increased capacity which will be derived from old furnaces now being reconstructed or otherwise renewed. If we add these, the work now in hand ought to give an increase of over 8,000,000 tons yearly. Not all of this new work will be available in 1907, but more than half of it will be ready to operate during the year, and the balance will come in in the early part of 1908. There is little doubt that by the close of that year our blast furnaces will be able to turn out between 33,000,000 and 35,000,000 tons yearly. In steel production also preparations are being made for a great increase in capacity. Prominent among these are the new open-hearth fur-

naces which are being added to the Carnegie steel plants around Pittsburg, to the Illinois Steel Works at Joliet and South Chicago, and to the Ohio works of the American Steel and Wire Company.

The most important work now under construction is found in the new and extensive plant which the United States Steel Corporation is constructing at Gary, Indiana. This is intended to be a model plant of the largest capacity, and will include 16 blast furnaces with a corresponding number of open-hearth steel furnaces, to which the molten iron will be fed direct from the blast furnaces. These will be accompanied by rolling mills which will convert the steel from the furnaces directly into rails, plates, structural forms and other finished shapes. Only a small portion of this plant will be ready during the coming year, and the whole of it will not be in operation until after the end of 1908. This plant will be supplied, by water, with ore from the corporation's mines on the Mesabi and Vermillion ranges in Minnesota; the coke will come from its works in Connellsville region and in West Virginia.

CHANGES AND CONSOLIDATIONS

Not many new consolidations have been recorded during the year. The amalgamation of the interests of the Republic Iron and Steel Company in the South with those of the Tennessee Coal, Iron and Railroad Company was announced a year ago. The consequent changes have not yet been fully carried out, but will doubtless be completed during the new year. They involve the concentration of work at certain points, the enlargement of some of the works owned by the companies, and other improvements which will help to increase production and reduce costs. The great innovation brought about will be a very large increase in the production of steel from Southern iron, and the consequent diversion of a large quantity of Alabama pig from the foundry trade. Already the basic open-hearth steel plant at Ensley has proved successful; so much so, indeed, that its full capacity for 1907 is already engaged for the manufacture of rails. This plant will be much enlarged and possibly supplemented by others at different points.

The most remarkable occurrence of the year, however, is found in the transfer of the Hill iron-ore lands on the northern Mesabi to the United States Steel Corporation. This transfer was foreshadowed more than a year ago, when negotiations had already been begun; but it was not completed until late in 1906. The terms of the deal were fully explained in our columns at that time. In brief they provide for the rental of the lands in question to the United States Steel Corporation on a royalty beginning at 85c. a ton and increasing by $2\frac{1}{2}$ c. yearly, with a high minimum. It is calculated that the average price paid by the lessee for ore in the

ground will be a little over \$1 a ton, which is the highest figure yet reached in any leases in Minnesota. It is, of course, provided that all ores mined from these lands shall be shipped to the Lake docks over the Great Northern tracks. Computations of the quantity of ore contained in these lands vary widely, for the reason that only a small portion of them have been proved by actual operations. There is no doubt, however, that some very large mines will be developed at an early date, though it may be doubted whether among them will be found any which will equal the older giants of the Mesabi, such as the Biwabik, the Mountain Iron, or the Fayal.

The conclusion of this negotiation was foregone when Mr. Hill announced that the lands could only be disposed of in a single block. The United States Steel Corporation was then the only possible purchaser, since no other existing concern could handle so large a transaction. The delay, it is understood, was caused chiefly by discussion over the terms. Mr. Hill, however, was in command of the situation, since the main point in the whole transaction was that this transfer practically prevents the establishment of any effective competition with the Steel Corporation on a large scale. There is no other large block of iron ore, readily accessible, which could be secured by any other company. Under our present conditions no steel company is secure of its standing or future operations unless it controls its own supply of iron ore. Small mines may be picked up here and there on the Mesabi or Gogebic ranges, but no great body can possibly come upon the market; while nowhere else in the United States can be found ores in sufficient quantity to support permanently a large industry. The only possible exceptions are to be found in Wyoming and southern Utah. These iron deposits are not developed and possess the great disadvantage of being remote from all deposits of fuel and available only by a long and costly railroad haul. The Southern ores are already controlled by existing companies.

METALLURGICAL CHANGES

As for several years past, the attention of engineers has been directed chiefly toward the facilitating of work on a large scale. Improvements in handling ore in transportation, in the feeding of furnaces, in casting machines, in mixers, and in the direct transfer of iron from the blast furnace to the steel furnace still continue. The great effort everywhere is to dispense with manual labor as far as possible, and to handle great masses of material by machinery.

The most important improvement of recent years, however, the Gayley dry-air blast, has made some progress and two furnaces with this improvement are now in active operation. The results so far obtained from these furnaces have been such that there is great probability that

the improvement will be extended to others.

An important point in steel practice in this country is the passing of the converter. It is noticeable that in all the new plants now under construction the open-hearth furnace is used. The great increase in steel-making capacity mentioned above does not include a single converter. The open-hearth furnace, moreover, is being substituted for the bessemer converter in several prominent works, such as the Carnegie. The great plant at Gary, above referred to, will not have a single bessemer converter.

The utilization of blast-furnace gases is also an important point. Until a year or so ago, this improvement made little progress in this country, although it had been so widely adopted in Germany, and to a less extent in Great Britain. The first company in this country to introduce this improvement on a large scale was the Lackawanna Steel Company in its new works at Buffalo. Now, however, it has been taken up by the Steel Corporation; gas-driven blowing engines and gas engines generating electric power will be used at all the new works under construction and will be gradually introduced at many of the older plants. American practice will no longer be subject to the reproach of wasting a valuable source of power.

Another kindred improvement, however, the use of the by-product coke oven for preparing metallurgical fuel, has made little or no progress. American makers still adhere to the old-fashioned bee-hive oven, with its wasteful methods. In the Connellsville region we still have the enormous waste of power involved in the dissipation of the gases, and the loss of valuable chemical products which might be derived from the coal.

FOREIGN COUNTRIES

The iron and steel trades have been exceedingly prosperous in other countries as well as our own. In all Europe, except Russia, production has been on a high level and foreign trade unusually good.

Great Britain—Full figures are available only for the first half of the year, but the estimates give a total production for the year of 9,805,000 tons of pig iron and 6,260,000 tons of steel, of which nearly 75 per cent. was made by the open-hearth process. The export returns, so far as available, show an extraordinary foreign trade.

The exports of iron and steel and of machinery from Great Britain for the 11 months ended Nov. 30 are valued by the Board of Trade returns as below:

	1905.	1906.	Changes.
Iron and Steel..	£29,153,627	£26,396,027	I. £2,742,400
Machinery	21,140,838	24,400,081	I. 3,259,243
New Ships	5,187,187	8,211,837	I. 3,024,650
Total.....	£55,481,652	£59,007,945	I. £3,526,293

The increase in the total was 24.4 per cent., a remarkable gain. Imports of iron and steel and of machinery for the 11 months are valued as follows:

	1905.	1906.	Changes.
Iron and steel...	£7,628,411	£7,809,669	I. £181,258
Machinery.....	4,192,670	4,754,216	I. 561,546
Total.....	£11,821,081	£12,563,885	I. £742,804

The total increase was 6.3 per cent.

Germany—The returns of the German Iron and Steel Union for 10 months of the year indicate that the total production of iron in Germany in 1906 was about 12,495,000 tons, the largest quantity ever produced in that country, and an increase of about 12 per cent. over 1905. For steel production no definite figures are available, but it is probable that the total output of steel was not less than 10,500,000 tons. Like England, Germany had a prosperous foreign trade, showing a large increase in the exports. There was rather surprising gain in the imports, but this was mainly in raw and semi-finished material which is worked up into finished shape in the German mills.

The exports of iron and steel, and of manufactures, from Germany for the 11 months ending Nov. 30 were, in metric tons:

	1905.	1906.	Changes.
Iron and steel.....	2,661,602	3,044,972	I. 383,370
Machinery.....	248,156	259,511	I. 11,355
Total.....	2,909,758	3,304,483	I. 394,725

This shows a moderate growth in the export trade.

Imports of iron and steel, and manufactures thereof, into Germany for the 10 months ended Oct. 31 were, in metric tons:

	1905.	1906.	Changes.
Iron and steel.....	263,114	520,288	I. 257,174
Machinery.....	65,785	70,918	I. 5,133
Total.....	328,899	591,206	I. 262,307

This shows a larger increase in the imports than for several years past.

Of other European countries there is little to be said. Belgium, Austria and Hungary showed gains in their productions. The French output was limited by coal strikes and other troubles over fuel supply.

Canada had a good year, owing to the activity of business and to the steady operation of two important plants, the Dominion Steel Works at Sydney, and those of the Lake Superior Corporation at Sault Ste. Marie.

The Iron and Steel Markets

The special reviews given below cover the important markets of the country. Pittsburg, of course, is the chief primary market. Cleveland is the center of an active producing and distributing region, while Chicago is the chief supply point for a great western and northwestern territory. Birmingham is the center for the Alabama iron country and the most important point in the foundry-iron trade. These and the seaboard markets cover practically the whole country, and there is little to be added to them in the way of general comment.

They all tell substantially the same

story of a market opening strongly; then a brief period of hesitation while crop prospects were uncertain; finally of strong and steady buying for a series of months, culminating, toward the end of the year, in a scramble by consumers to secure their supplies for the first and second quarters of the new year. The leading interests made an effort throughout the year to keep prices steady, and prevent irregular and too rapid advances. In this they were largely successful, and there was comparatively little increase in quotations; much less, indeed, than might have been expected from the nature of the market.

The railroads were good customers throughout the year. While the work done on new lines was not very great, there was a great demand for rails for renewals, second tracks, etc.; for new cars and locomotives; and for bridge work. The larger use of steel cars demanded a great quantity of structural shapes and plates. There was also an excellent demand for rails and equipment for electric railroads. Structural steel for new buildings, bars for machine and other work all helped to make up the great demand of the year.

Pittsburg Iron and Steel Markets

BY S. F. LUTY

The year 1906 opened with the iron and steel markets strong in all lines. One of the remarkable features was that, despite the advance in the prices of pig iron, there were no material changes in the prices of finished steel products until the fourth quarter. It was undoubtedly a boom year for pig iron, in both tonnage and prices, but not in finished material, except in tonnage.

A runaway market was prevented by conservative management all the way through. Pig iron did not bring the prices that could have been obtained, had producers been disposed to take advantage of conditions. In the third and fourth quarters fancy prices were paid in some instances for small lots of both foundry and bessemer iron, but the market was not affected. Sales of foundry iron were made at higher prices than for bessemer in the closing months of the year.

Mild weather in midwinter permitted heavy production and the market in the first quarter was steady and satisfactory. In the latter part of March a lack of confidence on the part of both consumer and producer was developed. A drop of \$3 a ton in the price of bar iron threatened to disturb conditions. Two pig-iron producers, fearing a slump in the second half, began to cut prices for second quarter, principally in the Cleveland district, but the general market was not affected. About the middle of June there was a break in the South and heavy sales of foundry iron were made on a basis of \$13.

Birmingham, for No. 2 grade. These conditions did not last long, and the second half opened with the whole market stronger.

Buying was heavy, and the entire production for the rest of the year was soon under contract. The market for 1907 opened in August, and while it was not the earliest opening on record, it may be called the most sudden and unexpected. Before the beginning of the fourth quarter every producer in the Pittsburg and Valley districts was practically sold up to July 1, 1907. There was no heavy buying for third quarter, consumers evidently preferring to wait until the opening of the new year before providing for their second-half requirements.

The highest point in pig-iron production was reached in March, when it was at the rate of 26,000,000 tons a year. From that time until August there was a steady decline until production was at the rate of 23,000,000 tons a year. Furnaces had been put out of blast for repairs and the curtailment of production resulting from this cause, probably, is responsible for the subsequent remarkable strength of the pig-iron market. From the low point in August production steadily increased and in November but few furnaces were idle and the production was at the rate of 27,000,000 tons a year. Early in December there was an extraordinary spurt and production was still further increased by from 200,000 to 300,000 tons. From these figures it is roughly estimated that the production of pig iron in this country for the year 1906 will be about 25,000,000 tons. Fully 1,000,000 tons were lost through necessity for making repairs to furnaces from March to August.

Strength was given to the pig-iron market on Jan. 15, when the United States Steel Corporation bought 115,000 tons of bessemer iron, 50,000 tons from the Bessemer Pig Iron Association and 25,000 tons from W. P. Snyder & Co., for delivery in the first quarter and 40,000 tons from W. P. Snyder & Co., for second-quarter delivery, all at \$17.25, Valley furnaces. The Jones & Laughlin Steel Company and other steel interests made purchases early in the year. An idea of the course of the pig-iron market may be obtained from data furnished by a leading independent producer. It is a record of all sales of bessemer iron in lots of 1000 tons or more for the entire year, and the average monthly prices from which contracts for some finished steel products based on bessemer pig-iron rates were adjusted. The tonnages and prices at Pittsburg in round numbers are as follows: January, 120,000, \$18.20; February, 38,000, \$18.15; March, 42,000, \$18.15; April, 95,000, \$18.10; May, 150,000, \$18.10; June, 75,000, \$18.25; July, 82,000, \$18.45; August, 200,000, \$18.85; September, 50,000, \$19.30; October, 50,000, \$20.95; November, 35,000, \$22.85; December (estimated), 10,000, \$23.75.

The demand for pig iron of all grades was so urgent in the last half that importations were necessary, and prices paid were several dollars higher than the figures of the average prices given in the accompanying table. Some small lots of Southern No. 2 foundry sold in this market at \$23, Birmingham, equal to \$27.60, Pittsburg. Northern bessemer and foundry sold above \$25, Pittsburg, but these were only for small lots and were not considered in preparing the general averages.

There were no idle periods for any of the mills due to lack of orders. When a plant suspended operations it was because of a scarcity of steel, lack of coal, or for necessary repairs. In some finished lines the mills were practically sold up for the year before the second half fairly opened. Railroads began to place contracts for rails earlier than usual and before the year closed almost the entire capacity of the mills for 1907 had been booked. The railroads also contracted heavily for steel cars and bridge-work. It is estimated that orders booked for steel cars will exceed 60,000.

Important extensions were made to most of the steel plants in the Pittsburg district and included a new light-rail mill at the Edgar Thomson Works; open-hearth furnaces at the Homestead and Duquesne plants of the Carnegie Steel Company; additions to the Park and Crescent works and a new spring plant to the McKees Rocks plant of the Crucible Steel Company of America. The Pittsburg Steel Company is preparing to build two blast furnaces, open-hearth furnaces and a blooming mill. Contracts were let by the Jones & Laughlin Steel Company for four blast furnaces to be built at Aliquippa, a few miles below Pittsburg on the Ohio river, where the company also will build a large steel plant, the details of which have not been definitely arranged. Contracts were also closed for two blast furnaces for the Carnegie Steel Company at McKeesport. The open-hearth steel capacity of different subsidiary interests of the United States Steel Corporation is being enlarged, as some

railroads are insisting on open-hearth steel rails for 1907.

Although the price of pig iron was high during the year, there was no change in the price of structural material, the rate remaining on the base of 1.70c. for beams and channels. Tank plate remained at 1.60c. until December and steel bars were 1.50c. until advanced to 1.60c. in November. Wire prices were irregular until November, when an advance of \$1 a ton was ordered, followed in December by an increase of \$2 a ton. Advances of finished products during the year were as follows: Jan. 8, black sheets, \$2 a ton to 2.40c.; galvanized sheets, \$2 to 3.45c.; galvanized corrugated roofing, 10c. a square to \$3; tin-plate, 10c. a box to \$3.50; wire products, \$1 a ton, making nails, \$1.85 a keg, plain wire, 1.70c. and galvanized barb wire, 2.30c. Feb. 9, hoops, \$1 a ton to 1.90c. April 2, light rails, \$1 a ton to \$29. April 7, tin-plate, 10c. a box to \$3.60. May 18, tin-plate, 15c. a box to \$3.75. June 5, black and galvanized sheets, \$2 a ton to 2.50c. and 3.55c. Oct. 13, merchant steel pipe, two points, or about \$4 a ton. Oct. 25, tin-plate, 15c. a box to \$3.90; black and galvanized sheets, \$2 a ton to 2.60c. and 3.65c. Nov. 7, hoops, \$2 a ton to 2c. Nov. 10, wire products \$1 a ton, making nails, \$1.90 a keg, plain wire, 1.75c. and galvanized barb wire, 2.35c. Nov. 13, light rails, \$1 a ton to \$32. Nov. 15, steel bars, \$2 a ton to 1.60c. Nov. 26, plates, \$2 a ton to 1.70c. Dec. 1, splice-bars, \$3 a ton to 1.65c. Dec. 3, wire products, \$2 a ton, making nails, \$2 a keg, plain wire, 1.85c. and galvanized barb wire, 2.45c. Dec. 5, merchant steel pipe, one point, or about \$2 a ton. The Carnegie Steel Company advanced sheet-bars for the second quarter from \$26 to \$28, for the third quarter to \$29 and for the fourth quarter to \$30. Lake Superior iron-ore prices were fixed for 1907 on Nov. 2, base prices being advanced 75c. on bessemer and 50c. on non-bessemer, the basis of iron content being reduced, making the actual advance greater. The new prices named are: Old Range bessemer, \$5; Mesabi bessemer, \$4.75; Old Range non-bessemer,

AVERAGE PRICES AT PITTSBURG, 1906.

MONTH.	PIG IRON.			Ferro Manganese.	STEEL.					NAILS.	
	Bessemer.	No. 2 Foundry.	Gray Forge.		Bessemer Billets.	Rails.	Sheets No. 28.	Tank Plate.	Steel Bars.	Wire Per Keg.	Cut Per Keg.
January.....	\$ 18.20	\$ 18.10	\$ 17.35	\$ 135.00	\$ 26.50	\$ 28.00	2.40	1.60	1.50	1.85	1.75
February.....	18.15	18.10	17.10	150.00	27.00	28.00	2.40	1.60	1.50	1.85	1.80
March.....	18.15	17.85	17.00	140.00	27.50	28.00	2.40	1.60	1.50	1.85	1.80
April.....	18.10	17.35	16.60	125.00	27.00	28.00	2.40	1.60	1.50	1.85	1.80
May.....	18.10	17.35	16.60	105.00	26.50	28.00	2.40	1.60	1.50	1.85	1.80
June.....	18.25	17.35	16.35	90.00	27.00	28.00	2.50	1.60	1.50	1.85	1.75
July.....	18.45	17.60	16.60	85.00	27.50	28.00	2.50	1.60	1.50	1.80	1.75
August.....	18.85	18.85	17.85	85.00	28.00	28.00	2.50	1.60	1.50	1.80	1.75
September.....	19.30	19.85	18.35	83.00	28.50	28.00	2.50	1.60	1.50	1.85	1.75
October.....	20.95	21.10	19.35	78.00	28.50	28.00	2.50	1.60	1.50	1.85	1.90
November.....	22.85	23.60	22.35	82.00	28.50	28.00	2.60	1.60	1.60	1.90	1.95
December.....	23.75	24.35	22.85	83.00	29.50	28.00	2.60	1.70	1.60	2.00	2.05

\$4.25; Mesabi non-bessemer, \$4, at Lake Erie ports. On Dec. 26 merchant pipe was advanced \$2, coal boiler tubes \$4 per ton. This was the latest advance of the year.

There were no labor disturbances of any consequence during the year to interfere with production. The strike of the International Association of Bridge and Structural Iron Workers against the American Bridge Company and members in this district of the National Erectors' Association was continued all year but was not effective. Strikes of iron molders and machinists were threatened, but the labor organizations could not muster enough strength to carry out the plans.

The annual convention of the Amalgamated Association of Iron, Steel and Tin Workers was held early in May and the existing wage scales were reaffirmed except for boiling, where an increase of 25c. a ton in the base was decided upon; but the demand was withdrawn at the conference with manufacturers held in June. All the old scales were signed for the year ending June 30, 1907, but a few modifications were made in some of the foot notes. The bi-monthly adjustment under the Amalgamated Association scale, on Jan. 11 showed the average price of bar iron to be 1.5c., an increase of 0.1c., which advanced the pay of puddlers from \$5.50 to \$5.75 and the finishers' wages were increased 2 per cent. The bi-monthly settlement on March 13 showed another increase to 1.6c. and the puddling rate was increased to \$6 a ton and the finishers got a proportionate increase. The next settlement on May 11 showed no change. On July 11 the settlement showed a decline of 0.1c. and the puddling rate dropped to \$5.75, where it remained during the rest of the year.

The Cleveland Iron Market

BY G. H. CUSHING

The Cleveland market opened the year 1906 with a brisk demand for all commodities. The preceding year had been one of exceptional possibilities, and there were those who believed the market was surely riding for a fall. A survey of conditions disclosed the fact the use of material had not been such as to lend itself to a reaction as had been the case during 1902 and the early part of 1903. There had also been no price advances of note. In the two vital particulars, therefore, the market was on a different plane from that of 1902 and 1903 and conditions seemed to be shaping themselves for a further expansion of activity.

In the pig-iron trade the market opened with the same strength which had characterized it during the preceding year. Prices, on the foundry grades, ranged, according to delivery, from \$14 to 15.50 in the Valleys until well along toward the end of the first half of the year. In May and June there began to appear evidences

that prices were going to advance and some of the more astute began to lay in a supply, on a speculative basis, to be disposed of later in the year when the prices should advance, making the speculation profitable.

Shortly after the turn of the half-year the price of No. 2 Northern foundry began to mount to higher levels and was soon selling at \$18 in the Valleys, and higher for immediate delivery, with almost as high prices on contracts. At this time, the Bessemer Association, influenced largely by the stable price policy of the Steel Corporation, was trying to keep the price of bessemer and basic on the basis of \$16.50 in the Valleys for both immediate and future delivery. It was not far along in the third quarter when the price of foundry iron began to climb and by the opening of the fourth quarter it was a runaway market. By the close of the year No. 2 foundry for spot shipment was selling on the basis of \$25@26 for immediate shipment, at about the same price for first-quarter delivery in 1907, and at \$23 @24 for second-quarter. At the same time sales were made for second half of 1907 delivery at \$21@22 at furnace and buyers were in a scramble to obtain the amounts they might need. As for the Bessemer Association its position was first shifted from a price of \$16.50 in the Valleys to \$17.50, where it was desired to hold the market, if possible. Later it was admitted conditions called for \$18 in the Valleys and the next step was the admission that buyers had taken the market out of sellers' hands and were forcing prices upward with dangerous rapidity. Before the opening of the fourth quarter the price of bessemer and basic was on a parity with that of foundry and it was actually the case that consumers of steel-making irons led in covering needs for second half of 1907 delivery at \$21 in the Valleys. The last half of the year was one of grief for the consumers, many of whom had extreme difficulty in covering their needs, either for immediate shipment or for use during the first quarter of next year. Conditions began to approach those of 1902, where the consumers in this territory sought relief by buying abroad.

In steel it was apparent the Pittsburg mills had increased the percentage of their output set aside for the use of the car companies, the railroads and the Lake ship-builders. This was due to extraordinary demands in all these quarters, especially, as far as Cleveland is concerned, in the ship-building trade. This lessened the amount going into general lines, where the demand was exceptionally good, despite labor difficulties. The only relief was found in the increase in productive capacity of the larger mills, mainly the Carnegie Steel and the Jones & Laughlin companies. The market was compelled to hobble along with a smaller amount of structural shapes, plates and

even rails than it could have consumed. Toward the end of the year there was a movement to supply the deficiency through importations, since mills were unable to supply the demand. The last half of the year saw many consumers in this territory going into the East, where small mills had reserved part of their capacity for such an emergency, and paying premiums for immediate delivery. As the price of pig iron rose, scrap also advanced and this affected the price of bars, but without reducing the buying. Bar steel which appeared weak, early in the year—so weak in fact a recession of \$2 a ton was made, to get in the agricultural implement works—strengthened after this buying had stopped and closed one of the strongest elements in the situation. Notwithstanding the enormous increase in productive capacity of sheet steel, there was such a shortage during the last half of the year that prices were advanced by the association, without checking buying. At the close of the year all of these conditions were aggravated and there was enough business on the books of the various companies to assure prosperity through the new year.

The Chicago Iron Market

BY E. MORRISON

General conditions of the iron trade in the year 1906 have been very satisfactory to Chicago furnace agents and dealers in finished products. The first half of the year was sluggish for pig iron, though sales of iron and steel products were heavy, particularly of railroad supplies. But the middle of July saw a remarkable recovery from the slump of the market caused by the dissolution a month previous of the Southern Furnace Association, and an unprecedented midsummer activity followed. The market grew stronger week by week, and prices advanced to such an extent that by December many melters refused to buy except for the most urgent needs.

The year opened with heavy contracts for finished products, but only a moderate demand for pig iron. Large contracts for structural material were placed in January, but pig iron sold only in small lots, melters being reluctant to contract ahead for supplies. The same condition continued until late in February, when there was a slight boom in Southern iron due to the announcement of an advance in the rate from Birmingham to Chicago territory, effective March 1, from \$3.65 to \$3.90. This rate of \$3.90 continued throughout the rest of the year, despite efforts of the Southern operators to secure a reduction of 50c. early in July.

In May a large number of foundries shut down because of labor troubles with the molders, reducing the demand for foundry iron materially. The molders'

strike cancelled many orders in May and June and the market for pig iron reached its lowest point for the year in the two weeks following the dissolution of the Southern Furnace Association in the middle of June. Southern No. 2 sold at \$13 Birmingham (\$16.90 Chicago) and Northern No. 2 at \$18, the drop in Southern due to the dissolution being 50c.@\$1. Early in July the price of Southern rallied to \$13.50 and melters hastened to cover their needs for the last half of the year.

By the end of July there was heavy buying of both Southern and Northern and this continued unchecked, with a steady rise of prices, until the middle of October, when it was announced that furnaces generally were sold out for deliveries before the end of the first quarter of 1907. From the middle of October to the end of the year the demand for quick-delivery iron became more and more urgent, with a moderate amount of contract-making for deliveries in the second and third quarters of 1907. The lots available for quick deliveries were small and heavy premiums were paid for such lots by melters whose requirements outran their contract supplies.

The following table shows the range of prices during the year, compared with the range in 1905:

	1905		1906	
	Highest.	Lowest.	Highest.	Lowest.
L. Superior Charcoal, \$0.50	\$16.50	\$26.50	\$19.00	
North'n No. 2 Foundry, 19.75	15.50	27.00	18.00	
South'n No. 2 Foundry, 18.65	14.65	26.90	16.90	
Connellsville Coke, 6.40	5.15	6.90	5.40	
Bar Iron, 1.90c.	1.50c.	1.85c.	1.665c.	
Structural Material,*	1.865c.	1.665c.	1.865c.	1.865c.

*Beams and channels, 3-in. to 15-in., and angles 3-in. to 6-in., ¼-in. or heavier.

The demand for coke was large throughout the year and in the last quarter much difficulty was experienced in getting supplies, because of car shortage. In January Connellsville 72-hour sold for \$3@3.25 at the ovens, or \$5.65@5.90 Chicago. The price weakened slightly by March 1—\$2.75 at ovens being the minimum—and continued \$2.75@3 until the end of August, when \$3.25 became the standard quotation. In November the price rose to \$3.75 at ovens (\$6.40 Chicago) on contracts, with spot coke commanding 50c. more.

The Seaboard Iron Market

The two more important iron markets on the Eastern seaboard are Philadelphia and New York. Of these Philadelphia leads, partly because it is a primary market for the mills and furnaces of eastern Pennsylvania, as well as a distributing point; and partly because it serves a very active manufacturing region. New York serves mainly the Hudson river country, southern and western New England. Eastern and northern New England buy from Boston, but that city follows the others closely in its fluctuations. New York, it may be added, is an important distributing point for Southern iron.

One of the chief points in 1906 was the strong and steady demand for structural steel. In the cities an unusual amount of construction of large buildings was in progress, or planned, in which steel is needed. There was also a great number of smaller buildings in which the use of a certain quantity of steel is required by law. Bridge work throughout the country was active. The nominal, or base prices of structural shapes were steady, but in the second half of the year—especially in the fourth quarter—there were real advances in the shape of premiums to secure delivery, while jobbers advanced their prices largely on small lots. Among the important contracts let in New York were those for several very large buildings, and the superstructure for the Manhattan and Blackwells island bridges over the East river.

Business in rails of standard section is generally done direct with the mills. There have been in the East a good many transactions in trolley rails, and in light rails for industrial works. The machine shops and boiler shops have been generally full of work, causing a steady demand for bars, pipes, tubes, boiler plate and similar material.

City improvements have been many, sharing the activity of all construction work. This has been the case in the smaller towns and villages, as well as the large cities, causing a strong demand for cast-iron pipe. Prices steadily advanced during the year, closing high at a basis of \$35 per ton for 6-in. pipe, with premiums asked on orders for special deliveries.

Foundries throughout Eastern territory were well employed. In fact, many found, as the year passed on, that they had not contracted for enough iron. This brought many into the market in October and November, seeking pig iron for early delivery, and there was a rush to buy at any price, as the iron must be had. By the end of November the market was practically bare of spot iron, and only small lots from jobbers and second hands could be had. Prices were wild and irregular for a time, and considerable importations of Scotch and Middlesboro pig from England failed to quite meet the demand. December was marked by heavy contracting, running over the first half of 1907, and even into the third quarter. Closing prices are high, Northern pig selling at tidewater, for 1907 delivery, at about \$25.50 for No. X foundry; \$24.50 for No. 2 X; \$23.50 for No. 2 plain; \$23 for basic pig. Southern iron for first quarter was about on the basis of \$24.50 for No. 2 foundry, New York or Philadelphia. Imported iron sold at \$23.50, ex-ship, for Middlesboro and \$24.50 for Scotch pig.

Although there were some resales, there does not appear to have been any large quantity of speculative iron on the market. The attempt to push sales of pig-iron warrants on the New York Produce

Exchange met with no success. Sales on the daily calls were small, and attracted no attention from the trade.

IMPORTS AND EXPORTS

There was a considerable growth in the exports of iron and steel during 1906, the increases being chiefly in rails, bars, plates, wire and nails. Official returns are available at this date only up to the end of October.

Exports of iron and steel, and of machinery, from the United States for the 10 months ending Oct. 31 are valued by the Bureau of Statistics of the Department of Commerce and Labor as follows:

	1905.	1906.	Changes.
October.....	\$12,673,947	\$15,910,437	I. \$3,236,540
Ten months.....	115,596,224	142,609,320	I. 27,013,096

The increase in October was 25.5 per cent.; for the 10 months it was 23.4 per cent. Mexico and the West Indies are large buyers, while South American countries are moderate customers only.

Imports of iron and steel, including machinery, into the United States for the 10 months ending Oct. 31 are valued by the Bureau of Statistics as below:

	1905.	1906.	Changes.
October.....	\$2,255,194	\$3,407,763	I. \$1,152,569
Ten months.....	21,820,949	27,784,650	I. 5,963,701

The increase in October was 51.1 per cent.; for the 10 months it was 27.3 per cent. The largest increase was in pig iron.

The Alabama Iron Market

BY L. W. FRIEDMAN

Even with difficulties—labor troubles, labor shortage and last, but by no means least, a railroad car shortage—the year 1906 was a most favorable one to the iron and steel industry in Alabama. The production, in the face of serious obstacles, has been satisfactory, though not as great as it might have been had there been every commodity at hand. The quality, as well as the quantity, met expectations; the State's output of iron and steel, both in crude and manufactured form, has been large.

Transportation, probably, was the greatest difficulty of the year. When the demand for the manufactured product became brisk, and there was a desire to increase production, there was a lack of cars and locomotive power was short, causing delay in handling not only the raw material, but the finished product, blocking the production at both ends. The labor problem asserted itself early also, and while there was hope for relief in the importation of desirable labor through New York, New Orleans or last, Charleston, the task was not so easy and the men brought into the district were not numerous, and they did not fill the want.

The year 1906 witnessed much concentration and much acquisition of property by the producers of pig iron and steel in Alabama and preparations for a larger

production were noticeable, demonstrating the faith in this section. Much repairing was done on various properties and other developments took place, all looking toward a better production.

With the exception of a few weeks, there was an active demand for iron. Prices were strong and those who expressed no apprehension at the short period of depression will be able at the close of the year to show excellent balance sheets. The labor problem was a hard one through the year. It became apparent more than two years ago that the negro labor on which the South depended for some time was becoming unsteady and was scattering. While much was done toward introducing labor-saving devices at mines, furnaces and mills, the demand for the product and the anxiety to increase the production grew faster. As a consequence, there was complaint of shortage of raw material at the furnaces and steel mills. Transportation facilities during the latter half added to the difficulty.

The first half of the year, according to the statistics, fell below the last half of 1905 in the production of pig iron. The production of pig iron in Alabama during the first half of 1906 was 830,040 tons. The reports indicate for the second half that there will be but little difference from the production during the last half of 1905, when the figures were 860,515 tons. With an increase of 86,493 tons for the first half of 1906 as compared to the first half of 1905, it is reasonable to expect an increase for the year, the total to be approximately 1,680,000 tons.

As to quotations there was a good price for the product through the year; 1906 opened pretty strong. There was some iron on the yards, but not much. In June and July there was a little depression, compared to what had been experienced for months and months before. The market was startled when it was announced that two of the larger companies had cut prices on iron. Explanation was given that efforts were being made to get another company into an amalgamation, but this was denied. It transpired, however, that the original cutters of price were the only ones to sell iron at the low price. With iron down to \$12 per ton for No. 2 foundry, at that time, the lowest price was reached for the year. The high-water mark was reached after October and in November No. 2 foundry, immediate delivery, was not to be had, with \$21 to \$17.50 for iron to be delivered with three and six months. Before the close of the year announcement was made that the probable make for the first six months of the coming year had been well covered and that for the first three months all iron wanted would have to be termed "spot" iron and carry the premium.

One of the Tennessee furnaces, at Ensley was practically rebuilt during the year and another old furnace started on to be

rebuilt. The Woodward Iron Company completed its new furnaces and started work rebuilding one of the old furnaces. The Birmingham Iron Company (Tutweiler Coal, Iron and Railroad Company) started work on a new furnace at Vanderbilt. The Southern Steel Company acquired by purchase during the year 1906 the properties of the Lacey-Bueck Iron Company, including a furnace, the properties of the Chattanooga Iron Company, including a furnace, and the properties of the Georgia Coal and Iron Company, also including a furnace. The Tennessee Coal, Iron and Railroad Company acquired 2200 acres of ore lands from M. L. Potter during the year and organized the Potter Ore Mining Company as a subsidiary organization, capital stock \$800,000. Other purchases were made by iron and steel companies during the year, every deal indicating faith in the district and preparing for the future making of iron.

The cost of iron making was increased in 1906 on account of the labor problem and the transportation charges. The labor troubles in the coal-mining district were expensive.

The only financial troubles of the year were those of the Lookout Mountain Iron Company, furnace and properties located at Battelle, in DeKalb county. The properties were placed in the hands of a receiver and were sold by a special master, bringing less than one-fourth the original cost of the plant. One other small mining corporation was thrown into court.

An important happening of the year was the change in directors of the Tennessee Coal, Iron and Railroad Company, the largest iron and steel corporation in the Southern territory. The directors, after looking over the field, decided on immense investments in development and improvements. The erection of a larger steel plant at Ensley was one of the decisions arrived at and already much work has been done on the foundations. Contracts have been let for the buildings and machinery and by the end of 1907 it is believed the industry will be completed and in operation. The present steel plant, which has been working steadily since its erection, will be improved and enlarged later on. The steel and finished products manufactured at this point have been sold a year ahead. Another important move made was to purchase from the Southern Railway and the Louisville & Nashville companies the Birmingham Southern Railway, which is a line operating between the plants and mines of the Tennessee Company. This railway line formerly belonged to that company, but was sold during the depression several years ago to the two railroads mentioned and was operated as the Birmingham Southern Railroad. Already plans are being worked out looking to an extension of the road so that much of the transportation between the plants and

mines and factories will be under direct control.

The Southern Steel Company, a large independent producer of steel rod, wire and nails, made during the year some important additions to the plant at Ensley, including endless-wire machines, the patent of which is controlled by Moses Taylor, president of the company. Other improvements were made about some other large plants, and the year closes with nearly all our industries operating with improved modern plants.

The Lake Superior Iron Ore Region

BY DWIGHT E. WOODBRIDGE

Iron-ore shipments out of Lake Superior mines for the past two years have been as follows, including whatever has been shipped from the Michipicoten mines on the Canadian side of the lake, and also all-rail business, the latter as closely as it can be estimated at this time:

Range.	1905.	1906.	Changes.
Mesabi.....	20,153,699	23,759,156	I. 3,605,457
Menominee.....	4,496,461	5,282,910	I. 787,459
Marquette.....	4,210,522	3,687,494	D. 523,028
Gogebic.....	3,705,207	3,388,111	D. 317,096
Vermillion.....	1,677,186	1,799,247	I. 122,061
Michipicoten.....	169,527	121,555	D. 47,972
Total.....	34,522,965	38,038,473	I. 3,515,508

Shipments of the various districts on Lake Superior, not including Michipicoten, with dates of commencement of operations, have been as follows:

Range.	First Year.	Total to date.	Per cent.
Marquette.....	1855	80,488,108	23.83
Menominee.....	1877	58,856,307	17.42
Gogebic.....	1884	50,222,971	14.87
Vermillion.....	1884	28,437,151	7.56
Mesabi.....	1892	122,709,212	36.33
Total.....	1855	337,767,569	100.00

Shipments by the various railroad systems that handle ore from mines to upper lake ports have been as follows:

Railroad.	1905.		1906.	
	Tons.	Per Ct.	Tons.	Per Ct.
Duluth, Missabe & N.	8,604,443	25.9	11,220,218	29.5
Duluth & Iron Range	7,778,768	22.9	8,205,128	21.6
Chicago & Northw'n.	6,729,975	19.8	6,706,986	17.7
Great Northern.....	5,118,385	15.1	6,133,057	18.8
Chic., Mil. & St. Paul.	1,310,021	3.9	1,981,244	5.1
L. Sup. & Ishpeming.	1,844,923	5.4	1,889,631	5.0
Duluth, S. S. & Atlan'g.	1,243,388	3.6	1,074,045	2.9
Wisconsin Central..	799,894	2.3	693,852	1.9
Wis. & Ml. (car ferry)	.....	.....	62,757	0.2
All rail, not included.	198,000	0.6	.....	.....
Algoma Central.....	169,527	0.5	121,555	0.3

All these figures do but emphasize the importance of the Mesabi, which furnished 62.4 per cent. of the year's total, and all but 100,000 tons of the increase over 1905.

There has been one overshadowing event of the year, which was not only important in itself, but has had its influence on almost everything that has taken place on the iron ranges. That was the so-called "Hill deal" for the sale of the Great Northern and associated ore deposits on the western Mesabi to the United States Steel Corporation. This transaction placed in the hands of the Steel Corporation the great bulk of remaining independent iron-ore tonnage, thus eliminating more than ever before the possibility of

any new important competition in steel making. So far as the buyer was concerned, this was the compelling cause of the purchase. So far as the Great Northern road is concerned, it is more difficult to determine what the impelling reason was. To be sure the seller gets a higher royalty than had before been given for any Mesabi ore and secures a high annual product. But there is little question that the road could mine this ore for the market and make a larger profit than the 85c. a ton it secures from the Steel Corporation. In the matter of annual minimums, others than the Steel Corporation stood ready to make contracts that would have insured as high a product and as favorable terms as were finally obtained. The estimates of tonnage in sight from these lands vary greatly, but it is generally understood that it is less than has been frequently stated. That there are possibilities for a tremendous increment upon complete exploration along the miles of Mesabi formation held under this lease is well recognized, and one of the important matters to be considered by the lessee is the immediate development of that land.

Royalties of 85c. a ton, increasing annually by the amount of the interest charge, and minimums of 750,000 tons the first year, increasing by the same volume annually, have set a new pace for Mesabi range owners. About the same time this deal was closed another was made to an interest in need of good ores, for even a higher price—\$1 a ton—and now the owners of undeveloped lands are putting up their figures to something far above any rate ever made in the past.

The Hill deal was one of the factors directly responsible for the construction of the West Mesabi branch of the Duluth, Missabe & Northern road, the other being the Steel Corporation's purchase of the Canisteo lands, made a year ago and commented upon in the review of that time. Upon portions of these lands the ores are quite sandy, and will be concentrated before shipment. Experiments looking to the solution of the problem of concentration are under way, and it is expected that they will be settled very shortly. The Oliver Iron Mining Company is building at Coleraine, on the western Mesabi, the first 1000-ton unit of a series of washeries, and will make tests in a few weeks. The problem is not regarded as especially difficult, but it is taking considerable study to determine the most economical process. These ores, once washed, are desirable, both from their grade chemically, and their structure physically. The character of the western Mesabi enterprise was such that it naturally fell to the lot of a great company to carry it forward; no small concern could undertake operations of the nature and extent required to make it a success. There were the construction of long lines of railway, of suitable machinery for concentration, with the atten-

dant experiments, the opening of enormous deposit for steam-shovel mining on a large scale, and the building up, from the beginning, of every item going toward the makeup of a vast mine proposition. As an instance, one of the stripping operations consequent upon this undertaking covers a total of more than 13,000,000 cu.yd. of material.

The marked tendency toward the substitution of open pits for underground mines is still in evidence. Labor costs are advancing, and what is worse, it is hard to get labor commensurate with the work to be done. Then timber is rising in price very fast, now in a greater ratio than ever, and the two items have completely changed former conditions governing the depth to which stripping might be carried. The deepest open pits now on the Mesabi are about 90 ft., but a mining company operating in a large way is to let contracts for striping an orebody of 168 ft. of overburden, and another company is considering the stripping of 125 ft. of surface. The question of depth of overburden that may economically be taken from over ore is somewhat complicated, far more than by the mere ratio of thickness of stripping to depth of ore. Questions of location of pit, grades into it, spoil banks, regularity of the ore chemically, probable tonnage to be produced annually, are among the more important questions, and lead many to continue underground operations rather than adopt what might seem far more suitable for their situations. Few Mesabi deposits cannot be economically stripped, so far as depth of overburden is concerned, but there will doubtless be underground mines there so long as the district is a producer. Many large and far-reaching plans for stripping operations have been made of late, and the Oliver Iron Mining Company especially is undertaking or is soon to begin, the stripping of important groups of mines from which an annual tonnage of enormous proportions may be secured. Costs of stripping have been steadily lowered, and now range well below 18 to 20 cents a yard. These figures are, of course, somewhat exceptional, and are for favorable operations and well located properties. One development of the stripping of deep mines is sure to come soon—that of hoisting the ore by other means than by the standard railway car attached to a locomotive. In the milling process ore is hoisted in skips, but where ore is sticky when wet—and in open-pit mines it must be wet whenever there are rains—this is no slight difficulty. The time will soon come, doubtless, when instead of the long and costly approach at grade into a mine there will be a stationary engine above the pit and railway cars will be loaded by shovels and hauled out by cable, to be made into trains above.

During 1907 from 35 to 40 large steam-shovels will be constantly employed in earth excavation on the Mesabi range,

about half by contracting firms, and half by mining companies. The average work of a shovel is about 35,000 yards per month. These shovels should move during the season of operation about 10,000,000 yards of material. One contracting firm is moving at the rate of 3,000,000 yards per annum.

The concentration of ore into few hands has been maintained during the year, though, with the exception of the Hill deal, there have been few large purchases. This is for the reason—and it might as well be faced now as later—that there are few deposits to be sold. It is well within the mark to say that there is not one 40-acre tract on the Mesabi that has not been explored at least once, and thousands of them many times. The orebodies that have escaped this search are few and small. With the lowering of grade that has been going on during the past few years properties are now workable that a short time ago were useless, and most of the so called new discoveries are of this nature.

A year ago this review stated that: "There has been talk of a greatly increased shipment during 1906. Some estimates have gone so far as 40,000,000 tons for the year out of Lake Superior region. It is hard to see how such an increase can be made, or where the ore is to come from. It is undoubtedly true that the old ranges have reached their maximum; the additions of the immediate future must be from the Mesabi. After such a magnificent jump as this range has made in 1905, 7,171,000 tons, is it capable of another five or six million tons in a single year? It does not so appear. Neither railroads nor mines are now in position to stand such a strain, nor are the contemplated betterments of the winter calculated for such a tonnage, extensive and elaborate as they are."

That this prediction was well founded is evident enough now. Today estimates for the coming year are for more than 40,000,000 tons. It is a practical impossibility that they pass that. The same causes that militated against such a stupendous advance in 1906 will continue their effect. So far as the railways are concerned, they can probably make a greater increase than during the past year. Terminal and dock capacity is materially improved, while 3000 to 4000 new 50-ton cars and equivalent motive power will be added in time for a part, at least, of the traffic of 1907. So far as shipping is concerned, it will be ahead of the demand the coming season. The brakes will be put on by capacity of lower lake docks and, possibly, of mines. Lower lake docks have always been a bar to the greatest increases, but mines have usually responded to any demands. Now, owing to a variety of causes, they cannot be so depended on. One of these causes is labor, another is the requirements for specific grades of ore.

LAKE SHIPPING

The size of lake iron-ore shipping has increased steadily and rapidly. The lake leviathan of 1897 is a pigmy beside that of 1907. In lake shipping, as in ore mining, the wildest expectations of one year are weak beside the realizations of the next. Vessels are now carrying upward of 13,000 gross tons of iron ore, or 380,000 bushels of grain. These cargoes are not equaled by freight ships on any ocean, and it can now be asserted that the largest cargoes in the world are carried regularly by the vessels plying the inland lakes of America, with iron ore and other freights. Together with additional size has come more rapid handling of cargoes, and it would be no surprise if a 13,000-ton ship should be loaded in one hour. Of course conditions must be right, the ore must be of a character easily handled, it must be in a solid block so the ship will not lose time by shifting from place to place, and the vessel must be handled expeditiously. The record cargoes of the past year have been those of steamship "J. P. Morgan," from Lake Superior, 11,868 gross tons, and "H. H. Rogers," from Escanaba, 13,333 gross tons. Both ships might have loaded deeper if channels and harbors had permitted, though the "Rogers," on account of running through no connecting channels, was able to carry nearer capacity than the sister vessel. These ships are 600 ft. long. The steamship "Earling," with about 10,000 gross tons, was loaded at the Duluth, Missabe & Northern docks in 135 minutes, of which period only 70 minutes were consumed in actually running ore into the vessel. The fastest time ever made in loading was a year ago, when the ship "Wolvin" took 10,000 tons in 90 minutes. Unloading records have been speeded up also. Several times this year ships have left the head of the lakes Wednesday morning with cargoes for eastern Lake Erie, and have started back up lakes again on Sunday morning. The "W. E. Corey," with 9574 gross tons of ore, was at Conneaut docks but four hours and 29 minutes, while the net unloading time was three hours and 32 minutes. Automatic electric unloaders of the Hulett and Brown types handled out of this ship at the rate of 389 and 284 tons per hour, each, respectively. Of this cargo more than 7000 tons was put on board railway cars, as part of the unloading operation, the rest being dumped into dock stocks.

The average iron-ore freight for 1906 has been 75c. per gross ton, the distance carried being 880 miles. This was 0.076c. per net ton-mile. Probably freights are carried nowhere else at such a figure. The average rate for the past ten years has been 88.5c. per ton. For 1907 it has been fixed at the same price as during the season now closed.

NEW EXPLORATIONS

Exploration has proceeded during the

year along Lake Superior with the vigor that might have been expected on an advancing market for ore, and an increasing consumption of metal all over the country. Exploring syndicates and drilling firms have never been more busy than now, and are limited not so much by the amount of work offered as by the lack of suitable drill runners. In this respect the situation, while not unique, is unusual. The Mesabi range, as for many years, furnishes the bulk of drill operations. This is carried on, not alone in a search for mineral, but in redrilling of previously explored properties, with the idea of development for mine operations in a more scientific and accurate manner than has been the general rule in the past. No great tonnage of new ore has been uncovered on the Mesabi during the year; deposits found have been small and scattered. Orebodies that a few years ago would not have been considered worth developing, on account of their slight tonnage or their low iron content, have now been carefully explored and are being turned to account. The great bulk of ores found during the year on this range has been at the west end, and development has proceeded west of the Mississippi river, where some good indications of orebodies have been cut into. It is very hard to make any estimate of tonnage thus shown up during the year, for the operations of one year tie themselves into that succeeding so closely that any differentiation is impossible. But it is probably safe to say that as much tonnage has been added to the ore in sight on the Mesabi as has been taken out during the same period. This, indeed, has been an annual occurrence on that range.

On the eastern Mesabi, where original discoveries of the district were made, 30 or 40 years ago, developments during the late months of 1906 indicate that ore will be found in workable quantity, and it is possible that a considerable tonnage may be found during the coming year. These ores are flat, and lie in thin beds, chiefly of a hard hematite. Exploration is now proceeding with considerable vigor.

NEW RANGES

On the Cuyuna range, 100 miles west of Duluth, there is little to report. For the past three years it has been the unfortunate fact that my own opinion of results secured there, and prospects of the future, have been diametrically opposed to that of those chiefly interested there. Another year's operations have not been such as to satisfy iron-ore men that merchantable ore exists in workable quantity on the Cuyuna. From 20 to 40 drills have been punching holes along both formations there for the past twelve months, but few claim the range looks better than it did a year ago. Operating mine concerns, which had taken lands there, have abandoned explorations, and in most cases have given up their options. This is true of such concerns as the United States Steel Corpora-

tion, which has quite recently dropped options on a large acreage around Rabbit lake. Pickands, Mather & Co., who sank a shaft last year, have ceased work, and abandoned most of the properties they held. A large amount of money has been spent in the district without commensurate results, and the number of drills at work will probably dwindle. The facts as to the Cuyuna seem to be that it contains a very large amount of lean iron ore, running from 35 to 45 per cent., largely non-bessemer, and frequently manganiferous.

Work has been carried on during the year west of the Mississippi river, in an attempt to connect the Mesabi and Cuyuna districts on an ingenious but unnecessary and improbable theory. This is over and was without result. Some rainbow-chasers worked farther south along the Mississippi river, in Morrison and Crow Wing counties, where float indications are present, but found nothing.

In the Palmer district, Cascade range, south of Marquette, several large interests have been drilling all the year, and one of these alone has discovered more than 40,000,000 gross tons of ore, while others are finding lesser amounts. There is, doubtless, an enormous quantity of ore in that district. It is low-grade, silicious ore, close to, and in part under, the bessemer limit, and quite dry. In addition to this it is close to surface and can be cheaply mined. It may be that the quantities of such ores which may be found in the Cascade district and on the Menominee range will far exceed any prognostications, and that hundreds of millions of tons of ores ranging from quite lean to fairly good will be opened there. But, notwithstanding tonnages discovered, the use to which these ores can now be put is rather limited, and none of the operators is able to mine to capacity.

Considerable work has been done along the Menominee during the year, and a few good deposits have been opened, while several others give promise enough to warrant careful exploration.

Some work is under way along the western Gogebic, which has been a discarded territory for years, and while the region is not liable to produce large mines, it may reveal small deposits of good ore.

The Gunflint district of northeastern Minnesota, idle for many years, is under exploration. That ore exists in the district is well known, but it is magnetic; some of it carries titanium and some sulphur, though neither of these elements is present where development is now proceeding. The discovery of a minable property at Gunflint would stimulate exploration over a large area where surface conditions are most favorable for the deposition of iron ore.

CANADIAN IRON ORES

On the Canadian side, work has lagged. The Atikokan Iron Company is still pre-

L. VOGELSTEIN BENJAMIN HIRSCH E. G. HOTHORN
Special Partner

L. Vogelstein & Co.

90-96 Wall Street, New York

AGENTS FOR

ARON HIRSCH & SOHN
HALBERSTADT, GERMANY

Copper, Argentiferous and Auriferous Copper,
Mattes and Bullion, Lead, Tin,
Antimony, Spelter.

See Adv. United States Metals Refining Co., on page 150

Beer, Sondheimer & Co.,

Frankfort-on-Main, Germany,

Metals and Ores,

New York Office: 42 Broadway.

PATENTS

SHEPHERD & PARKER

Attorneys-at-Law and Solicitors of Patents
American and foreign patents secured promptly and
with special regard to the legal protection of the in-
vention. Handbook for inven'ors sent upon request.
532 Dietz Bldg., Washington, D. C.

RARE MINERALS

purchased and sold direct or on consignment.
Constantly in the market for Tungsten Ores,
Molybdenite, Columbite, Uranium, Garnet, etc.

EDGAR C. RIEBE & CO.
97 Warren St. - New York City

Emil Baerwald,

100 Broadway, New York City
Representing

Lewis Lazarus & Sons,

London, England.

—Importer of—

Pig Tin and Tinplates.

Ores, Mattes and Metals.

Nichols Copper Co.,

25 BROAD ST., NEW YORK

COPPER REFINERS

Consignments of Ores, Mattes
and Blister Copper solicited

COPPER SULPHATE

MANUFACTURERS OF

The Herreshoff Copper Smelters
The Herreshoff Roasting Furnace

See advertisement on page 118

The American Metal Co., Ltd.

52 Broadway, New York.
Security Bldg., St. Louis, Mo.

EUROPEAN CORRESPONDENTS

HENRY R. MERTON & CO., Ltd.
London

METALLGESELLSCHAFT
Frankfort, Main

UNITED METALS SELLING CO.

42 BROADWAY, NEW YORK

European Agents, C. S. HENRY & CO., Ltd., 12 Leadenhall St.
London, E. C.

Balbach Smelting and Refining Co.

NEWARK, N. J.

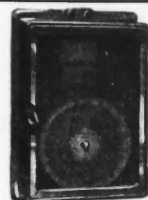
Smelters and Refiners of

Gold, Silver, Lead and Copper Material
ELECTROLYTIC COPPER REFINERY

Louis Straus & Company

Dealers in ores and minerals. Purchase and
sell ores of all kinds. Advances made on
consignments. Rare minerals a specialty.
Correspondence Solicited.

60 and 62 NEW STREET, NEW YORK CITY.



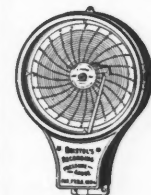
Wm H. Bristol
Electric Pyrometers

Recording, Indicating
and Portable.

For all ranges to 3000° Fahr.
Accurate, Durable and Inexpensive. Practi-
cal for everyday service in connection with
Smelting, Roasting and Assaying.
Fully guaranteed. Send for Circulars.

Wm. H. Bristol,
45 Vesey Street New York City

BRISTOL'S Recording
GAGES



For Mine Ventilation
and for all other
purposes.

Simple, Accurate,
Reliable, Durable.

Send for Catalog A.D.

THE BRISTOL COMPANY,
WATERBURY, CONN., U. S. A.
New York Office, 114 Liberty Street.
Chicago, 753 Monadnock Bldg.

Telephone, 315 John

Cable address, "Osrac" New York

O. T. ZINKEISEN, 135 WILLIAM ST.
NEW YORK

BUYER AND SELLER OF **Rare Minerals and Alloys**

MATHISON & CO.,

71 Pine Street, NEW YORK

Buyers of

Antimony Ores

INCORPORATE YOUR BUSINESS
UNDER LAWS OF ARIZONA.

Cheapest cost Most liberal laws in the United
States. No franchise tax, private property ex-
empt. Write for copy of corporation laws,
blanks, and full information.

The Hayes Incorporating Co.,
Phoenix, Arizona.

Positions Vacant

Advertisements under this heading, 50 cents for 50 words or less. Additional words, two cents a word. Cash or stamps must accompany order.

Draftsman -- Large engineering company wants thoroughly competent mechanical draftsman who is capable of working into position of chief draftsman later on. Technical graduate given preference, but any good man will be considered; salary \$1200. HAP-GOOD'S, 305 Broadway, N. Y. TF.

Draftsmen--Large works require competent men with experience on general engineering and construction work; preferably those who have worked on heavy special machinery, power plants, mill buildings, etc.; applications must state age, qualifications, initial salary and references. Address "R. C. W.," ENGINEERING AND MINING JOURNAL. 1.19

Mechanical draftsman wanted for detail work with large mining company in western Pennsylvania; applicants must state age, experience, salary expected and date for entering position. Address "F. C. H.," ENGINEERING AND MINING JOURNAL. 1.12

Technical and experienced man wanted to fill position of chief mechanical draftsman with a large mining company in western Pennsylvania; state age, experience, salary expected and date for entering position. Address "F. C. C.," ENGINEERING AND MINING JOURNAL. 1.12

Will consider immediate application of a mechanical engineer, thoroughly competent as draftsman, fully understanding and competent to design zinc-oxide plant and smelter plant, using coal as fuel; in reply give full references and experience. Address "J.," ENGINEERING AND MINING JOURNAL. 1.12

Wanted--Competent chemist and assayer for copper smelter in the West; salary \$100 per month, with good chances for advancement; state fully as to training and experience. Address P. O. Box, 147, Berkeley, Cal. 1.12

Wanted--Mining graduate to act as assistant superintendent of copper mine and smelter in the West; salary to commence, \$125 per month; give full particulars as to experience and ability. Address P. O. Box 147, Berkeley, Cal. 1.12

Wanted--Metallurgist thoroughly up in modern practice of lead smelting; state experience and salary expected. Address P. O. Box 268, Ogden, Utah. 1.5

Wanted--One competent instrument man and one draftsman by large bituminous coal company; give record in full, with samples of work, if possible, and earliest date available for work; salary \$75 to begin with. Address "S. H. A.," ENGINEERING AND MINING JOURNAL. 1.5

Wanted--Master mechanic, one thoroughly familiar with electrical machinery, to look after three electric plants; one capable of winding armatures, repairing motors, electric locomotives, pumps and fans; location, Fayette County, W. Va.; state experience, reference and salary expected. Address "Master Mechanic," ENGINEERING AND MINING JOURNAL. 1.12

Situations Wanted

Advertisements under this heading, 50 cents for 50 words or less. Additional words, two cents a word. Cash or stamps must accompany order.

An engineer of five years' field experience; two years as resident manager of mines in southern Mexico; now superintendent in charge of a producing mine and mill with compressors, pumps and hoists in northern Mexico; success in handling Mexican labor and mule and wagon transport; erection of machinery and operation of air drills; familiar with keeping costs and writing reports; Spanish spoken. "Mexico 30," ENGINEERING AND MINING JOURNAL. No. 22,047, TF.

Acids, heavy chemicals--Experienced manufacturing chemist and factory superintendent desires position with progressive company; competent to handle large undertaking, including designing and construction; would be able to leave present position at reasonable notice. Address "Progress," ENGINEERING AND MINING JOURNAL. No. 22,013, Jan. 19.

Accountant, auditor and systematist desires engagement, permanent or limited, requiring executive experience and ability; strictly first-class services; highest references; is losing present position of traveling auditor and systematist on account of reduction in operations. Address "Accountant," ENGINEERING AND MINING JOURNAL. No. 22,094, Feb. 16.

Expert mine accountant, Australian, African experience, at present chief accountant large mining and smelting company, Mexico, desires change on account of wife's health; thoroughly acquainted with mine accounts, costs, material department; practical experience underground, milling and cyaniding; Spanish; good administrative capability; wants position as accountant, business manager or assistant to general manager; best references and testimonials; States or foreign. "Englishman," ENGINEERING AND MINING JOURNAL. No. 22,105, Jan. 26.

Chemical engineer--Eleven years' experience, during which time has been superintendent of electro-chemical works, chief chemist of industrial plant, secretary and general manager of paint company; has also been connected with a prominent banking house; desires permanent position with industrial or other concern; further particulars and best of references furnished upon application; age 33. Address "Law," ENGINEERING AND MINING JOURNAL. No. 22,106, Jan. 19.

Mine manager, engineer, student Lehigh and Columbia universities, wants position; practical man, thoroughly competent, with perfect knowledge of underground work, also familiar with report and segregation work; identified in various capacities with amalgamating, cyaniding and concentration plants; practical assayer and surveyor; will consider any operative position; excellent references. Address "R. E. B.," ENGINEERING AND MINING JOURNAL. No. 22,098, Mar. 9.

Mining engineer, with 10 years' practical experience in Western States, Mexico and South America, is open for engagement as superintendent or mining engineer of mine in Mexico; all-round experience, mining, milling, assaying, mine surveying, superintendence, etc. Specialty, opening and development of mines in Mexico; best of references; Spanish spoken. Address "Sonorensis," ENGINEERING AND MINING JOURNAL. No. 22,065, Jan. 5.

Mining engineer, with 15 years' experience, desires position as superintendent or manager, or as engineer with a mining corporation; has had experience in mining, milling, concentration, smelting, erection of plants and installation of machinery, examining and reporting on mineral properties; experienced superintendent and manager; speaks Spanish. Address "T. N. N.," ENGINEERING AND MINING JOURNAL. No. 22,055, Jan. 5.

Mining engineer, age 27, married, graduate of Michigan College of Mines, with three years' experience in mining and civil engineering, now employed, desires change of position; location not important; will be available after Jan. 1. Address "E. M.," ENGINEERING AND MINING JOURNAL. No. 22,092, Jan. 5.

Mine superintendent wants position technical graduate, 29, single; successfully resident engineer, chief engineer and superintendent of

coal mines; experience in South, Southwest and West Virginia, with both native and foreign labor, union and non-union; also experienced in coal washing and coke burning. I desire position of superintendent with reliable coal-mining company; good references; salary \$150 per month. Address "Kanawha," ENGINEERING AND MINING JOURNAL.

No. 22,097, Jan. 5.

Mining engineer, Columbia graduate, with eight years' varied experience in the United States and foreign countries, in mine and mill management and exploration work, is open to engagement; capital for exploration work in the tropics on an interest basis especially desired; examinations, surveys, reports made. Address J. W. Tudor, 60 Wall Street, New York. No. 22,008, TF.

Mining engineer, at present manager of producing gold mine, graduate German school of mines, desires change, as property is exhausted and will be abandoned; thorough metallurgist with 10 years' experience in the treatment of all classes of gold ores; highest references from present and former employers as to ability and honesty; age 36. Address "H. R.," ENGINEERING AND MINING JOURNAL. No. 22,104, Jan. 12.

Mexico--Accountant and systematist desires permanent position in Mexico or Spanish-speaking country; steady and accurate worker, not afraid of long hours; large experience in mining camps; speaks and writes fluently Spanish and English; salary expected \$150, United States currency; highest references. Address "S. C. R.," ENGINEERING AND MINING JOURNAL. No. 22,108, Jan. 12.

Open to an engagement as manager or examining engineer by mining engineer, graduate, with 20 years' varied and practical experience, working up through from assayer, surveyor, working miner and millman, mine and mill foreman to superintendent, manager and examining engineer; experience in the Western States, Canada, Mexico and South Africa; up in the latest and best practice in mining and milling; well up in the mechanical line, in the designing, erection and general equipment of mining and milling plants; successful in the general business management of affairs at the mine and in handling labor. Address "M. E.," ENGINEERING AND MINING JOURNAL. No. 22,103, Jan. 19.

Superintendent, manager or examining engineer; 13 years' practical experience in Michigan, British Columbia, Colorado, Alaska and Utah; in iron, copper, gold and lead-silver mines; Michigan College of Mines graduate; have successfully reopened four abandoned mines and cut expenses materially on two; practical miner, millman, bookkeeper.

See also page 77

THE MISSING LINK

Between **ENGINE WASTE** and **ENGINE ECONOMY**

can be found quite often in the PACKING used. If it is gripping the rod like a vise, waste energy--waste steam, occurs. If added to that a high price is paid for PACKING, then the waste is increased.



"EUREKA" PACKING

has behind it 28 years painstaking effort to make the best PACKING at the least price. Its popularity and growth are its reward.

NEXT TIME TRY GENUINE "EUREKA"

Get Wise to the faults of your engine. She will "soldier" if not watched - a **ROBERTSON THOMPSON INDICATOR** will show where all troubles lay and how to remedy.



VICTOR REDUCING WHEELS and **WILLIS PLANIMETERS** are accurate and labor-saving devices. Sold at moderate prices and on easy terms.

Jas. L. Robertson & Sons, Inc.
48 WARREN ST., NEW YORK.

BOOKS WORTH HAVING.

Gold Mining Machinery

BY

W. H. TINNEY.

A practical handbook on the selection, arrangement and installation of mechanical devices and labor-saving equipments employed in the practice of gold mining. Embodying in detail their sizes, capacities, speeds and estimates of cost, together with the rules and formulae governing their use. A useful and up-to-date authority for mine managers and mechanical engineers.

TABLE OF CONTENTS.

- Chapter.
 I—Introductory.
 II—Motive Power.
 III—Erecting Engines.
 IV—Boilers.
 V—Chimneys, Fuel, Feed.
 VI—Management of Motive Power.
 VII—Pumping Machinery.
 VIII—Winding Machinery.
 IX—Air Compressors.
 X—Rock Drills.
 XI—Crushing Machinery.
 XII—Concentrating and Gold-Extracting Plant
 XIII—Transmission of Power.
 XIV—Transport.
 XV—Pipes and Joints.
 XVI—Construction.
 XVII—Tackle and Tools.
 XVIII—Details of Estimates.

Octavo cloth, freely illustrated including numerous working drawings.

Price \$5.00 postpaid.

LEAD SMELTING AND REFINING

Edited by W. R. Ingalls.

A splendid collection of important articles on Lead Smelting and Refining by eminent authorities, reprinted from the numerous contributions on the subject which have appeared in THE ENGINEERING AND MINING JOURNAL for the past three years. The present compilation concentrates in compact form a vast amount of literature applying to the industry, and also incorporates elaborate descriptions and accounts of the new processes of lime-roasting, including the Huntington-Heberlein, the Carmichael-Bradford and the Savelsberg experiments. The volume is up-to-date in every detail, and conveys comprehensively the progress and advancement made in other branches of lead smelting that has been developed in the recent past. It embodies valuable information which will materially assist the lead smelter when perplexing problems confront him, and altogether the treatise will prove of the greatest practical utility to all smelters and metallurgists.

Table of Contents.

- Chapter
 I—Notes on Lead Mining.
 II—Roast—Reaction Smelting in Scotch Hearths and Reverberatory Furnaces.
 III—Sintering and Briquetting.
 IV—Smelting in the Blast Furnace.
 V—Lime-Roasting of Galena.
 VI—Other Methods of Smelting.
 VII—Dust and Fume Recovery, Including Flues, Chambers and Bag-Houses.
 VIII—Blowers and Blowing Engines.
 IX—Lead Refining.

Octavo cloth, freely illustrated, including numerous diagrams and drawings.

Price \$3.00 (Postpaid.)

NOTES ON METALLURGICAL MILL CONSTRUCTION.

Edited by W. R. INGALLS.

The material embodied in this useful compend consists of a complete reproduction of the various articles and papers on modern practice in mill construction in its many phases, which have appeared at various times in the columns of the Engineering and Mining Journal. The subject has been handled exhaustively by eminent experts in the mining profession, and has also undergone a most thorough and careful revision by Walter Renton Ingalls, the editor. The data in its new and improved form combines in comprehensive style every detail involved in the construction of concentration mills, cyanide plants and smelting works. The volume is copiously illustrated, including numerous diagrams, which will prove of great practical value to all millmen and smelters.

Table of Contents.

- Chapter.
 I.—Brickwork and Concrete.
 II.—Building Construction.
 III.—Ore-Crushing Machinery.
 IV.—Dryers and Drying.
 V.—Conveyors and Elevators.
 VI.—Disposal of Tailings.
 VII.—Miscellaneous.

Octavo Cloth. Price \$2.00 (Postpaid.)

IN PRESS

Copper Mines of the World

By Walter Harvey Weed.

An authoritative account of the copper resources of the world, presented both from the geological and commercial standpoints. The author is an eminent expert on Ore Deposition, and has had during his long career with the U. S. Geological Survey numerous opportunities to study the various important mining localities of America, while his professional work has taken him to the copper districts of foreign countries. The volume embodies in an attractive manner every important feature applying to the subject, and is written in an easy style, which, without limiting its value to the mining engineer and geologist, will make it appeal strongly to everyone who is interested in copper mining and the copper output of the whole world.

TABLE OF CONTENTS:

- Chapter.
 1. Geographic Distribution.
 2. Production of Copper.
 3. Mineralogy of Copper Ores.
 4. Geologic Distribution and Occurrence.
 5. General Features of Copper Deposits.
 6. Genesis of Copper Deposits.
 7. Classification of Copper Deposits.
 8. Copper Deposits of Europe.
 9. Copper Deposits of Africa.
 10. Copper Mines of Asia, Oceania and the East Indies.
 11. Copper Mines of Australasia.
 12. Copper Mines of South America.
 13. Copper Deposits of the West Indies.
 14. Copper Deposits of Canada and Newfoundland.
 15. Copper Deposits of Mexico.
 16. Copper Deposits of the United States.

Octavo Cloth, Illustrated.

Price, \$4.00 (17s) postpaid.

Combustion and Smokeless Furnaces

BY

JOSEPH W. HAYS.

A thoroughly comprehensive and reliable treatise on smoke abatement has been for many years a keenly felt want in the profession of steam engineering. The above compend practically bridges the gap and will prove useful to all owners and engineers of steam-power plants. The chapter on the smoking-chimney evil is instructive and suggestive. The statements and facts contained therein are formidable, and the remedies propounded by the author will appeal to and interest the general public. Altogether the work is written in plain, common-sense English, and the various divisions on Heat, Mechanical Stoking, Hand-fired Furnaces and Mechanical Draft are singly worth the price of the entire book.

TABLE OF CONTENTS

- Chapter
 I—Heat and Combustion
 II—Combustion and the Boiler Furnace
 III—Combustion and the Steam Boiler
 IV—The Chimney Evil
 V—Smokeless Furnaces in General
 VI—Mechanical Stokers
 VII—Hand-fired Furnaces
 VIII—Some Conclusions

Octavo cloth, illustrated with numerous figures and diagrams.

Price \$1.50 (postpaid).

NOW READY

MICA and the MICA INDUSTRY.

By George Wetmore Colles.

The only authoritative text-book on the subject which incorporates reliable and detailed data relative to the mineral. In this excellent volume, Mica is treated from an industrial standpoint, and considerable space is allotted to its chemical constitution and geologic origin. The work is interspersed with numerous statistical charts, and the vital facts as to the present status and probable outlook of the industry are all exhaustively discussed in the concluding chapter.

TABLE OF CONTENTS.

- Chapter.
 I.—Mineralogy.
 II.—Geology of the Granitic Micæ.
 III.—Geology of the Pyroxenic Micæ.
 IV.—Geographical Distribution.
 V.—Historical.
 VI.—Mining and Milling.
 VII.—Uses.
 VIII.—Statistics.
 IX.—Conclusions.

Index.
 Octavo cloth, copiously illustrated, including 36 plates and charts.

Price \$2.00 (8s. 6d.) post-paid.

HILL PUBLISHING COMPANY,

Publishers of Engineering and Mining Journal, American Machinist, Power

505 PEARL STREET, NEW YORK

20 BUCKLESBURY, LONDON, E. C.