

INDEX

**THE ENGINEERING AND
MINING JOURNAL**

VOLUME LXXXV.

JANUARY TO JUNE

1908

HILL PUBLISHING COMPANY,

505 Pearl Street, NEW YORK

The Engineering and Mining Journal

VOL. LXXXV.

NEW YORK, JANUARY 4, 1908.

NO. 1.

Mineral and Metal Production in 1907

Statistics of the Output of the More Important Substances. Commercial Movements. Market Conditions. Mining and Metallurgy

MANY INCREASES, SOME DECREASES

In the accompanying table we summarize the production of the more important minerals and metals in the United States in 1907 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

gold and silver in the United States are the preliminary estimates of the Director of the Mint.

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

tics that are precise, or within 1 per cent. of the actual, submitted six months or a year later.

It will be observed that in some cases there are differences between the statistics given by the various contributors to this number and our editorial statistics. This is because the articles of our outside con-

MINERAL AND METAL PRODUCTION OF THE UNITED STATES.

PRELIMINARY STATISTICS, SUBJECT TO REVISION.

PRODUCT.	CUSTOMARY MEASURE.	1906.			1907.			CHANGES IN QUANTITY.
		QUANTITY.	VALUE.		QUANTITY.	VALUE.		
			TOTAL.	PER UNIT.		TOTAL.	PER UNIT.	
NON-METALLIC:								
Coal, bituminous	Short ton.	341,629,113	\$400,550,951	\$1.17	383,480,070	\$441,949,931	\$1.15	I. 41,850,957
Coal, anthracite	Short ton.	72,209,566	166,307,002	2.30	85,063,264	159,942,986	1.88	I. 12,853,698
Garnet	Short ton.	5,404	179,548	33.22	6,500	216,125	33.25	I. 1,096
Iron ore	Long ton.	49,217,489	102,372,377	2.08	52,418,755	110,079,385	2.10	I. 3,201,266
Limestone flux	Long ton.	14,552,000	9,604,320	0.66	14,925,000	10,447,500	0.70	I. 373,000
Petroleum	Barrel.	131,771,505	80,277,279	0.609	165,877,906	118,408,409	0.71	I. 34,106,401
Phosphate rock	Long ton.	2,052,742	12,342,741	6.01	1,917,000	13,419,000	7.00	D. 135,742
MANUFACTURED:								
Bromine	Pound.	1,229,000	184,350	0.15	1,062,000	138,060	0.13	D. 167,000
Coke	Short ton.	32,690,362	86,887,392	2.66	40,090,670	106,757,970	2.69	I. 7,400,308
Copper sulphate	Pound.	50,925,932	3,157,408	0.062	40,138,117	2,733,405	0.068	D. 10,787,815
Copperas	Short ton.	22,839	228,390	10.00	26,212	262,120	10.00	I. 4,373
Graphite, artificial	Pound.	4,868,000	312,764	0.064	6,924,000	483,717	0.0698	I. 2,056,000
Lead, sublimed white	Short ton.	7,988	798,880	100.00	8,700	1,026,600	118.00	I. 712
Zinc oxide (a)	Short ton.	77,800	6,257,361	80.43	83,280	7,516,360	90.25	I. 5,480
METALLIC:								
Aluminum	Pound.	14,350,000	5,166,000	0.36	25,000,000	11,250,000	0.45	I. 10,650,000
Copper	Pound.	917,620,000	180,000,339	0.1960	895,104,000	184,937,437	0.20661	D. 22,516,000
Gold	Oz. fine.	4,648,385	96,101,400	20.67	4,335,560	89,616,017	20.67	D. 312,825
Iron, pig	Long ton.	25,307,191	486,151,139	19.21	25,975,944	592,251,523	22.80	I. 668,753
Lead	Short ton.	(b) 345,529	39,093,151	113.14	(b) 359,058	38,239,677	106.50	I. 13,529
Quicksilver	Flasks.	25,309	1,035,138	40.90	19,900	805,950	40.50	D. 5,409
Silver	Oz. fine.	56,183,500	37,525,521	0.66791	56,925,911	37,187,990	0.65327	I. 742,411
Zinc	Short ton.	225,494	27,961,256	124.00	246,688	29,415,077	119.24	I. 21,194

(a) Includes zinc-lead pigment. (b) See explanation in the statistical table of the special article on lead.

communicated their actual output during 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 chiefly on the reports of producers, State mine inspectors, and special correspondents. The statistics for the production of

only by careful investigation involving considerable time. However, we are confident that the statistics which we are able 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 four days after the close of the year, are more valuable to the industry than statis-

tributors were necessarily written and put into type before our own statistics were available, which in some cases was not until Jan. 2, 1908, 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
 JOHN A. HILL, Pres. and Treas. ROBERT MCKEAN, Sec'y.
 505 Pearl Street, New York.

London Office: 6 Bouverie Street, 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, Mexico, Cuba, Porto Rico, Hawaii or the Philippines. \$6.50 in Canada.

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.

For sale by all newsdealers generally.

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

CIRCULATION STATEMENT:

During 1907 we printed and circulated 507,500 copies of THE ENGINEERING AND MINING JOURNAL.

Our circulation for December, 1907, was 40,500 copies.

Jan. 4..... 13,500

None sent free regularly, no back numbers. Figures are live, net circulation.

Contents PAGE

Mineral and Metal Production in 1907.....	1
Current Prices of Metals.....	2
Gold, Silver and Platinum in 1907.....	3
The Copper Production of North America	6
The Production of Lead and Spelter in 1907.....	11
Review of Metallurgical Progress in 1907: Progress in Gold-ore Treatment During 1907.....	Alfred James 17
Gold Dredging in 1907.....	John Power Hutchins 18
Zinc Smelting in the United States in 1907.....	Walter Renton Ingalls 20
The Metallurgy of Lead in 1907.....	Walter Renton Ingalls 23
The Metallurgy of Copper in 1907.....	Walter Renton Ingalls 25
The Iron and Steel Industry in 1907.....	26
Fatal Accidents in Coal Mines.....	Frederick L. Hoffman 34
Graphite in New York.....	D. H. Newland 36
Mining in the United States During 1907	37
The Fibrous Talc Industry.....	D. H. Newland 52
Review of Mining in Foreign Countries	53
Coal Mining in the United States in 1907	70
Coal and Coke Production in the United States.....	80
The Petroleum Industry of the United States.....	81
Production of Other Metals and Minerals:	
Aluminum.....	87
Antimony.....	87
Bismuth.....	88
Cadmium.....	88
Tin.....	88
The Tin Market in 1907.....	88
Quicksilver in California.....	Charles G. Yale 89
Quicksilver.....	89
Zinc Mining in Wisconsin in 1907.....	J. E. Kennedy 90
Zinc and Lead in the Joplin District.....	Jesse A. Zook 91
Garnet in New York.....	92
The Mining Index.....	93

Silver Market Dec. 30.

SILVER AND STERLING EXCHANGE.							
Dec.	Sterling Exchange.	Silver.		Dec.-Jan.	Sterling Exchange.	Silver.	
		New York, Cts.	London, Pence.			New York, Cts.	London, Pence.
26	4.8450	52½	....	30	4.8450	52½	24½
27	4.8475	52½	24½	31	4.8425	53½	24%
28	4.8425	52½	24½	1	.....	.....	.....

New York quotations are for fine silver, per ounce Troy. London prices are for sterling silver, 0.925 fine.

Shipments of silver from London to the East are reported by Messrs. Pixley & Abell as follows, for the year to Dec. 12:

	1906.	1907.	Changes.
India.....	£ 14,496,296	£ 10,531,354	D. £ 3,964,942
China.....	430,700	417,350	D. 13,350
Straits.....	1,750	691,150	1. 689,400
Total.....	£ 14,928,746	£ 11,639,854	D. £ 3,288,892

Receipts for last week were £116,000 coin from the Straits; £145,000 bars and £2700 in Mexican dollars from New York; £263,700 in all. Exports were £5000 coin to Australia; £242,100 to India; £81,200 in bars and £4400 in Mexicans to China; £332,700 in all.

Other Metals Dec. 30.

Dec.-Jan.	Copper.			Tin. Cts. per lb.	Lead. Cts. per lb.	Spelter.	
	Lake, Cts. per lb.	Electrolytic, Cts. per lb.	London, £ per ton.			New York, Cts. per lb.	St. Louis, Cts. per lb.
26	13½ @13½	13½ @13½	.....	27	3.45 @3.55	4.10 @4.15	3.95 @4.00
27	13½ @13½	13½ @13½	60%	26½	3.45 @3.55	4.15 @4.25	4.00 @4.10
28	13½ @13½	13½ @13½	.....	26½	3.45 @3.55	4.15 @4.25	4.00 @4.10
30	13½ @13½	13½ @13½	61½	27	3.50 @3.60	4.20 @4.30	4.05 @4.15
31	13½ @13½	13½ @13½	62	27½	3.50 @3.60	4.20 @4.30	4.05 @4.15

London quotations are per long ton (2240 lb.) standard copper, which is now the equivalent of the former g.m.b's. The New York quotations for electrolytic copper are for cakes, ingots or wirebars, and represent the bulk of the transactions made with consumers, basis, New York, cash. The price of cathodes is 0.125c. below that of electrolytic. The quotations for lead represent wholesale transactions in the open market. The quotations on spelter are for ordinary western brands; special brands command a premium.

Copper—A good business has been doing from day to day for shipment over the next two months, but the greater portion of it is still for export. Stocks in the hands of producers have been materially reduced. On the other hand, domestic consumers have not yet replenished their reserve supply and are working from hand to mouth. Consumers abroad, however, are in most cases carrying normal stocks, and this explains how the large accumulations have finally found their outlet, not to speak of the curtailment in the production during recent

weeks which made it necessary to draw upon the available supply. The market closes cheerful and higher at 13½@13¾c. for Lake copper; 13¾@13½c. for electrolytic in ingots, cakes and wirebars. The average at which business in casting was done during the week is 13@13¼ cents.

The improvement in the standard market in London continued throughout the week, and the close is cabled firm at £62 for spot, £62 15s. for three months. Refined and manufactured sorts we quote: English tough, £57@58; best selected, £65@66; strong sheets, £68@69.

Copper Sheets and Wire—Base price of sheets, 20c.; wire, 16¼@16½c. per pound.

Tin—The market both here and in London has been very firm. Consumers have shown interest in future deliveries, but the business was of small proportions only. The London close is cabled at £123 10s. for spot, £124 10s. for three months, while prices in our market are quoted at 27.25c. for spot delivery.

Lead—While quotations which are being named from day to day are rather mixed, the activity on the whole has been well maintained. Fair sized orders were placed during the week and, stimulated by the increasing inquiry, sellers have been gradually raising their prices. The close is steady at 3.50@3.60c. New York.

Owing to heavy arrivals, the London market broke suddenly to £13 17s. 6d., but the tone is better at the close at £14 for Spanish lead, £14 2s. 6d. for English lead.

Spelter—The low prices have at last attracted the attention not only of consumers but also of speculators, and the inquiry from the latter source particularly has been on a large scale. As a result, the market has turned and closes higher at 4.20@4.30c. New York, 4.05@4.15c. St. Louis.

The closing quotations from London are also somewhat better, being cabled at £19 10s. for good ordinaries, £19 15s. for specials.

Antimony—A stronger tone developed in the past week and local dealers seem confident that prices will advance. There have been more dealings in the metal than for several weeks. Quotations are 9@9½c. for Cookson's; 8½@8¾c. for Hallett's; and 7½@8¼c. for ordinary brands.

Platinum—Quotations are unchanged: Hard metal, \$28.50; ordinary, \$26; scrap, \$17@18 per troy ounce.

Nickel—For large lots, New York, the chief producer quotes 45@50c. per lb. according to size and terms of order. For small quantities, 50@65c., same delivery.

Quicksilver—New York quotations are \$45 per flask for lots of 100 flasks or over, and \$46 for smaller orders. San Francisco quotations are \$44.50@45.50 for domestic orders; for export nominal, at about \$1.50 lower. The London price is £8 5s. per flask, with £8 3s. 9d. quoted from second hands.

Gold, Silver and Platinum in 1907

Review of the Influences and the Commercial Conditions Which Governed the Production of the Precious Metals

WORLD'S GOLD PRODUCTION \$403,229,735

The gold production of the United States, which had for several years shown a steady and considerable gain, was, in 1907, less than that of the preceding year, showing a halt for the first time in five years. In 1903 the total was \$73,597,700; in 1904 it was \$80,723,200; in 1905 it reached \$88,180,800, and 1906 the total was \$94,373,800. The increases each year were 9.7 per cent., 9.2 per cent., and 7 per cent. respectively. In 1907, however, the preliminary figures for which we are indebted to the courtesy of the Director of the Mint show a total of 89,616,017 which is \$5,257,783, or 5.5 per cent., less than in 1906, and only a little above that of 1905. The aggregate, however, is still greater than that of any year prior to 1906. The three chief producing States show decreases; in fact almost every State reports a diminished production, the only important gain being \$5,425,000 in Nevada, and that was less than had been expected in many quarters. It was sufficient, however, to establish the growing importance of the Nevada mines, and to give encouragement for their future; and it is to be remembered that the hard facts presented by smelter and assay office returns never support fully the glowing anticipations of prospectors and boomers.

Gold and Silver Production in the United States

BY FREDERICK HOBART

The accompanying table gives the preliminary statement of the Director of the Mint, compared with the corrected figures for the previous year:

GOLD PRODUCTION OF THE UNITED STATES.			
(In dollars.)			
	1906.	1907.	Changes.
Colorado.....	\$22,934,400	\$20,888,833	D. \$2,045,567
Alaska.....	21,365,100	18,251,610	D. 3,113,490
California.....	18,832,900	17,394,363	D. 1,438,537
Nevada.....	9,278,600	14,704,658	I. 5,426,058
South Dakota..	6,604,900	4,085,446	D. 2,519,454
Utah.....	5,130,900	4,652,941	D. 477,959
Montana.....	4,522,000	4,206,345	D. 315,655
Arizona.....	2,747,100	2,539,516	D. 207,584
Oregon.....	1,320,100	1,179,988	D. 140,112
Idaho.....	1,035,700	1,067,655	I. 32,955
Other States...	602,100	624,592	I. 22,492
Total.....	\$94,373,800	\$89,616,017	D. \$4,257,783

The gold production for 1907 includes \$1219 from Porto Rico and \$5766 from the Philippine Islands; the first time anything from these outlying possessions has been reported. The silver production was very

small, only 5 oz. from Porto Rico and 86 oz. from the Philippines. In the table these are included under "Other States."

Director F. A. Leach comments upon his results as follows: "The table shows a reduction in the gold yield of the United States for 1907, the estimated total production in 1907 being \$89,616,017 as against \$94,373,800 for 1906.

"There is but little difference in the total production of silver, the apparent yield in 1907 being 56,925,911 fine ounces as against 56,517,900 for the year 1906.

"The gold recovered from the copper ores of California in 1907 will amount to about \$2,190,000, an increase of about \$340,000 over last year's product from that source. The yield of gold from the other sources of mining show a falling off of about \$2,340,000, making the net loss, in round numbers, \$1,440,000 in the gold yield of California. The shrinkage in Colorado is about the same as for the previous year. The large falling off in South Dakota is due to labor disturbances and the fire in the big Homestake mine.

"For the first half of the year, the output from the mines, of Utah, Idaho, Montana and Arizona, indicated increased yields for those States, but the sudden drop in the selling price of those metals which gave gold as a by-product, caused a great curtailment in the yields of these mines in the last part of the year, by reason of the closing down of many of the big producing mines."

SILVER PRODUCTION

The production of silver suffered somewhat from the restriction of lead-ore purchases by the smelters in the later part

SILVER PRODUCTION OF THE UNITED STATES.

(In fine ounces.)			
	1906.	1907.	Changes.
Montana.....	12,540,300	12,118,000	D. 422,300
Colorado.....	12,447,400	11,648,136	D. 799,264
Utah.....	11,508,000	11,747,562	I. 239,562
Idaho.....	8,836,200	6,977,718	D. 1,858,482
Nevada.....	5,207,600	7,767,510	I. 2,559,910
Arizona.....	2,969,200	2,715,564	D. 253,636
California.....	1,517,500	2,326,184	I. 808,684
New Mexico.....	433,400	431,246	D. 2,154
Texas.....	277,400	301,545	I. 24,145
Alaska.....	203,500	148,609	D. 54,891
Other States.....	557,400	737,837	I. 180,437
Total.....	56,517,900	56,925,911	I. 408,011

of the year, and from the closing, or partial closing, of some important copper mines, which are also large producers of silver, in November and December. The important Park City district in Utah was a small producer in 1907, owing to the break in the Ontario-Daly drainage tunnel and to labor troubles.

The Commercial Movement of Gold and Silver

BY FREDERICK HOBART

As shown in another column the gold production of the world, which had been increasing for several years at a rapid rate, was practically stationary in 1907. The total, however, was still over \$400,000,000, and it is probable that nearly two-thirds of this great sum, or almost \$275,000,000 may be regarded as an addition to the world's stock of money, either as actual coin or in bank reserves as a basis for circulating currency. It is a matter of extreme difficulty to determine the actual disposition of gold mined; and it is only by careful study of international commerce and exchanges that even an approximation can be reached.

The large production of gold in the last decade, while not the sole cause, was undoubtedly one of the complexity of causes leading to the extraordinary activity in manufacturing, trade and commerce which has been witnessed almost all over the civilized world for several years past. As is almost always the case, this activity finally outran its support. In 1907, which opened well, the commercial world was confronted with an actual lack of money to carry on the enterprises which had been begun. Floating capital had been fixed or absorbed, and new supplies were no longer to be had. Credit has been strained almost to the limit—if not beyond it—and there was no alternative but to limit enterprise and reduce activity. This is never a pleasant work, and is undertaken only under the pressure of strict necessity. Usually there are preliminary warnings, but most men do not heed these, and do not stop until there comes the alarm which we call a financial panic.

Notwithstanding the addition of a quarter of a billion dollars to available gold supply, during several months of 1907 there was an actual scramble for gold in the markets of the world. In the United States the commercial activity had been greatest, and there the break-down of credit was sharpest and most acutely felt. Gold was secured at heavy cost, in sufficient amount to tide over the worst, but the recovery of business and the re-establishment of credit will be a slow and laborious process.

The following notes, while necessarily incomplete, are sufficient to give general

indications of the direction of the currents in which the precious metals move.

GOLD MOVEMENT IN THE UNITED STATES

In 1906 there was a steady movement of gold to the United States from abroad. In 1907, for the greater part of the year, the conditions were reversed and considerable gold was exported to Europe. With the coming of the financial upheaval in October, a demand for gold arose, and bankers were able to secure large amounts, although their withdrawal was contested so far as possible. The Bank of England raised its discount rate to 7 per cent., a figure unknown since the Baring panic, but failed to check the shipments, so great were the inducements offered on this side. Notwithstanding a trade balance in favor of America, this gold was, in large part, secured at considerable cost in interest charges, and perhaps also in the sale of securities at low prices.

The movement of gold in the United States for the 11 months ended Nov. 30 was as follows:

	1906.	1907.	Changes
Exports.....	\$ 44,828,263	\$54,211,240	I. \$ 9,382,977
Imports.....	147,962,143	98,837,722	D. 49,124,421
Excess, imp.	\$103,133,880	\$44,626,482	D. \$58,507,398

The month of December probably added about \$15,000,000 more to the imports, making the total net imports for 1907 close to \$60,000,000. The larger part of this came from Great Britain, France aiding indirectly.

For the 10 months ended Oct. 31, for which the details of the movement are at hand, there were imports from Canada amounting to \$16,114,931; largely of Yukon gold which comes to Pacific ports. Much of this is a transit movement, as the exports to Canada for the same period were \$12,068,862. Of the exports in the earlier part of the year no less than \$25,283,894 went to France; most of it, probably, in settlement of loan accounts.

GOLD MOVEMENT IN FRANCE

The gold movement in France for the 10 months ended Oct. 31 is reported as follows:

	1906.	1907.
Imports.....	Fr. 400,050,000	Fr. 436,359,000
Exports.....	113,085,000	94,004,000
Excess, imports....	Fr. 286,965,000	Fr. 342,355,000

The increase in the net imports in 1907 was 55,390,000 fr. The total amount shows the extent to which France attracts—and keeps—gold.

GOLD MOVEMENT IN GREAT BRITAIN

Great Britain is usually a large importer of gold, because of its heavy exports of manufactures and its large foreign investments. The movement of gold for 11 months ended Nov. 30 was as follows:

	1906.	1907.	Changes.
Imports.....	£41,846,861	£49,306,609	I. £7,459,748
Exports.....	39,428,907	45,986,743	I. 6,557,836
Net imports..	£ 2,417,954	£ 3,319,866	I. £ 901,912

The exports to the United States were

£14,148,394 in 1906, and £14,841,783 in 1907. Exports to France rose from £4,611,451 in 1906 to £7,105,154 last year.

BANK GOLD HOLDINGS

The gold reserves reported by European banks in the closing weeks of 1906 and 1907 were as follows:

	1906.	1907.
England.....	\$ 145,322,390	\$ 165,383,645
France.....	541,150,235	538,787,150
Germany.....	137,940,000	137,140,000
Austria.....	233,045,000	228,795,000
Netherlands.....	27,680,000	38,239,500
Belgium.....	17,076,665	17,610,000
Italy.....	159,440,000	193,320,000
Spain.....	76,840,000	78,210,000
Russia.....	589,520,000	607,125,000
Sweden.....	19,780,000	20,325,000
Total.....	\$1,947,794,290	\$2,024,935,295

The associated banks of New York reported total specie holdings, including silver, of \$179,323,000 at the close of 1906, and of \$181,503,100 at the close of 1907. The United States Treasury, by the December report, held \$173,917,898 gold in its current balances; in addition it held \$150,000,000 reserve against outstanding notes and \$747,218,869 against gold certificates; making a total of \$1,071,136,767, the largest accumulation of gold in the world.

In the bank holdings above, the great reserve of the Bank of Russia is due to the fact that it holds the reserves of the Russian treasury, as well as its own commercial balances. Moreover, it is understood that foreign gold bills are included in the total. To the extent that this is done, there is a duplication in the totals, the amount of which cannot be ascertained.

EGYPTIAN ABSORPTION OF GOLD

Comparatively little attention has been paid to the extent to which Egypt has, in recent years, absorbed gold, the larger part of which appears to be hoarded, or withdrawn from commerce. This has been the case ever since the country acquired a stable and equitable government; and especially since the introduction of the cultivation of cotton on a large scale provided an article of export which is always in demand and commands money in the markets of the world. In a recent article in the *North American Review*, M. A. Muhleman shows that in the 28 years ending with 1906 the imports of specie into Egypt exceeded the exports by \$244,700,000, of which \$230,000,000 was gold. In the four years 1903-1906, inclusive, the excess of gold imports was \$81,000,000 or over \$20,000,000 a year. And this movement increases, as the British returns show net exports of gold to Egypt for the 11 months ended Nov. 30, 1907, amounting to \$22,000,000. These large imports have not been accompanied by any corresponding increase of the gold in circulation, held by banks, or otherwise visible. The conclusion is unavoidable that the Egyptian landholders and farmers have hoarded a large amount of gold in the period of their prosperity;

thereby following the custom to which they, or their fathers, were forced by centuries of misrule and governmental extortion.

THE SILVER MOVEMENT

The silver market in 1907 showed comparative steadiness during ten months of the year, the price remaining strong long after those of the other metals began to recede. At the close of the year, however, there was a break of nearly 25 per cent. For January the average prices were 68.673c. in New York, and 31.769d. in London, and February showed the highest averages of the year, 68.835c. and 31.852d. From this point there were gradual recessions—due partly to large supply and partly to a bear movement in London—until, in April, averages of 65.462c. and 30.253d. were reached. An improvement then set in and continued until in August a point very near the February maximum was reached. A slight decline followed, which was accentuated in October and became more pronounced in November, when the average price was 10.068c. below that of August. The moving cause of this was an almost total cessation of buying on Indian account, coupled with the reports of the failure of the rains in India, which meant short crops—possibly famine—and a probable absence of buying power for months to come. This was helped by the financial disturbance and a sharp check to the buying of silver for use in the arts; manufacturing companies anticipating a period of dull trade. The United States Mint, which had been out of the market for some time, made considerable purchases for coinage, taking as much as 300,000 oz. per week for several weeks; but this had comparatively little effect on the market.

The maximum quotations of the year were at its opening, 70.125c. in New York and 32.4375d. in London being named on Jan. 3. The lowest points reached were 52.5c. New York and 24.25d. London, on Dec. 21. The decline in the New York price, which is for fine silver, was 17.625c., or 25.1 per cent. On the United States yearly production of silver, this would mean a difference of \$9,870,000.

The monthly average prices of silver in the New York and London markets are shown in the following table:

AVERAGE PRICE OF SILVER

Month.	New York.		London.	
	1906.	1907.	1906.	1907.
January.....	65.288	68.673	30.113	31.769
February.....	66.108	68.835	30.464	31.852
March.....	64.597	67.519	29.854	31.325
April.....	64.765	65.462	29.984	30.253
May.....	66.976	65.981	30.968	30.471
June.....	65.394	67.090	30.185	30.893
July.....	65.105	68.144	30.113	31.366
August.....	65.949	68.745	30.529	31.637
September.....	67.927	67.792	31.483	31.313
October.....	69.523	62.435	32.148	28.863
November.....	70.813	58.677	32.671	27.154
December.....	69.050	54.565	32.003	25.362
Year.....	66.791	65.327	30.868	30.188

New York, cents per fine ounce; London, pence per standard ounce.

The year was another striking instance of the dependence of the silver market upon the East which, in good years, absorbs two-thirds of the world's production of the metal.

SILVER EXPORTS AND IMPORTS

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

	1906.	1907.	Changes.
Exports.....	\$53,552,186	\$57,212,168	I. \$3,659,982
Imports.....	40,228,572	41,437,995	I. 1,209,423

Net exports... \$13,323,614 \$15,774,173 I. \$2,450,559

Exports continued large throughout the year. Detailed figures were available only for the 10 months ended Oct. 31; these show that the more important exports were as follows for that period:

	1906.	1907.	Changes.
Great Britain..	\$42,513,893	\$41,562,489	D. \$ 951,404
Other Europe..	2,942,218	4,427,733	I. 1,485,515
China.....	888,447	2,124,755	I. 1,236,308
Japan.....	1,564,802	1,955	D. 1,562,877

Japan dropped out of the market entirely in 1907. Direct shipments to China increased, though the total was not large. The larger imports for the 10 months were as follows:

	1906.	1907.	Changes.
Mexico.....	\$30,439,540	\$27,689,515	D. \$ 2,750,025
Canada.....	4,388,982	7,271,833	I. 2,882,851
Central America..	1,103,007	796,930	D. 306,077
South America..	252,993	1,463,887	I. 1,210,894

The increase in receipts from Canada reflects the large silver output of the Cobalt mines. The gain in imports from South America comes chiefly from the copper matte and bullion imported.

SILVER MOVEMENT IN GREAT BRITAIN

London continues to be the great silver market, where buying for the East is done and where Eastern exchanges are adjusted. For the 11 months ended Nov. 30 the total movement of silver was as follows, in value:

	1906.	1907.	Changes.
Imports.....	£16,292,810	£14,667,024	D. £ 1,625,786
Exports.....	17,829,885	15,813,329	D. 2,016,556

Excess exp. £ 1,537,075 £ 1,146,305 D. £ 390,770

Of the imports in 1907 the United States is credited with £10,975,282, or 74.8 per cent. of the total, against 78.7 per cent. in 1906. These amounts include a large quantity of Mexican silver refined in the United States. Canada sent £135,298 in 1907.

Exports to the East from Great Britain were as follows for the 11 months:

	1906.	1907.	Changes.
India.....	£ 14,479,927	£ 10,666,876	D. £ 3,812,151
Ceylon.....	65,700	25,398	D. 40,102
Straits.....	1,750	1,011,856	I. 1,010,106
China.....	433,957	360,250	D. 73,707

Total..... £ 14,980,434 £ 12,064,580 D. £ 2,915,854

While India showed a decrease of nearly one-third, the Straits Settlements again appeared as a taker of silver. China was a light purchaser; in fact that country sent last year to London £377,397 in silver, or £17,147 more than it took away. This movement is probably in part the consequence of the heavy buying two years ago, and in part also of large purchases in Australia.

As has been the case from time immemorial, the great bulk of the silver sent to India is practically withdrawn

from commerce and remains in that country.

The Gold Production of the World

BY FREDERICK HOBART

The gold production of the world, as shown in our successive reviews, continued the steady increase, which has been such a marked feature of the past decade, up to the close of 1906. In 1907, however, the total was somewhat more than stationary; it showed a slight decrease, although it was still greater than that of any year preceding 1906. The total reported for 1904 was \$349,088,293; for 1905 it was \$378,411,754, and for 1906 it reached \$405,931,320. In 1907 the preliminary figures, estimated as closely as possible at this date, were \$403,229,735; showing a decrease of \$2,701,585, or 0.6 per cent. from 1906; but still an increase of \$24,817,981, or 6.8 per cent., over 1905.

However, it is not safe to draw firm conclusions from the preliminary figures for 1907, which are so close to those of 1906 that the final figures may show an increase instead of a decrease, or *vice versa* a greater decrease than has been here estimated.

For three of the four chief producers, and for several of the minor ones, we are able to make close approximations. The figures collected by the Director of the Mint for the United States are close to the final results. For Australasia, the Transvaal, India and other important districts, we have the full production for 11 months, so that it has been necessary to estimate only the December production. Russia, as usual, is the uncertain quantity.

The Transvaal maintains its position as the leading producer, and is, moreover, the only one showing a large increase. The United States comes second, and showed a loss in production. The mines of Australasia report a considerable loss as compared with the preceding year. Canada lost nearly a million in British Columbia, and there was a further decrease in the Yukon, which is still in the period of transition, though a gain is anticipated in the current year. In India, one or more of the large mines of the Kolar district is still in a zone of lean ore, cutting down the production. For will be found in the following pages.

most of these countries detailed reviews GOLD PRODUCTION OF THE WORLD.

	1906.	1907.	Changes.
United States...	94,373,800	89,616,017	D. 5,958,710
Transvaal.....	119,609,373	128,750,000	I. 9,140,627
Australasia.....	82,237,328	75,143,718	D. 7,093,610
Russia.....	22,469,432	21,500,000	D. 969,432
Mexico.....	16,639,350	17,250,000	I. 610,650
Canada.....	12,023,032	9,500,000	D. 2,523,032
China, Japan & Korea.....	11,500,000	11,500,000	
Rhodesia.....	9,902,073	11,250,000	I. 1,347,927
India.....	11,030,711	10,090,000	D. 940,711
West Africa.....	4,122,260	5,620,000	I. 1,497,740
Other countries	22,023,961	23,000,000	I. 976,039
Total.....	405,931,320	403,229,735	D. 2,701,585

In 1907 there were no new producing districts of great importance found or opened, and the production was very largely from the same districts and the same mines as in 1906.

In round figures, the African Continent furnished about \$147,500,000 of the gold output of 1907; North America about \$120,500,000; Australasia, \$75,250,000; Asia—including Siberia—\$44,000,000; the remainder coming from South America, Europe and the East Indian islands. The four leading producers—the Transvaal, the United States, Australasia and Russia—report in all 315,787,000, or 78 per cent. of the world's production.

SILVER PRODUCTION

So far as figures are accessible at the present time, the silver production of the world did not show an important change from the total of 185,035,496 oz. reported for 1906. It is probable that there was some increase. Mexico continued the first producer, with the United States second with Australia third and Canada fourth in rank; though Canada showed the largest increase.

Platinum

In the first three months of 1907 the demand for platinum was strong. Early in April a break in the market occurred which was followed by a steady decline. In the last quarter the financial depression had a marked effect on the platinum industry in that manufacturers of jewelry and electrical supplies, using platinum, greatly curtailed their purchases; the demand for platinum chemical-ware was also reduced.

The falling off in consumption is shown in the following statement: Imports of platinum into the United States for the 10 months ended Oct. 31 were 9829 lb. in 1906 and 5197 lb. in 1907; a decrease of 4632 lb. in 1906.

AVERAGE MONTHLY PRICES OF PLATINUM AT NEW YORK.

(In dollars per troy ounce.)

	1906.		1907.	
	Ordinary.	Scrap.	Ordinary.	Scrap.
January.....	20.50	16.00	38.00	31.50
February.....	25.00	19.00	38.00	31.75
March.....	25.00	19.00	37.00	30.75
April.....	25.00	19.00	32.50	24.75
May.....	25.00	19.00	29.50	21.125
June.....	25.40	19.75	26.20	20.30
July.....	26.00	21.50	26.75	21.437
August.....	26.00	21.50	28.125	22.625
September.....	32.10	24.00	28.70	23.30
October.....	33.00	25.50	27.125	21.25
November.....	35.50	28.38	26.312	18.937
December.....	38.00	31.25		
Year.....	28.04	21.99		

The price for hard or iridio-platinum is usually \$2.50 more per ounce than for the ordinary metal.

The Copper Production of North America

The Production of the United States Was 895,104,000 Pounds;
of Mexico, 126,710,000 Pounds; of Canada, 44,546,000 Pounds

A N E V E N T F U L Y E A R

The production of copper in the United States in 1907 is given in the following table, the statistics of which are based on official reports from all of the producers, with a few exceptions, whose outputs it has been possible to estimate closely. The figures for Lake Superior represent the production of refined copper; those for the Western States represent the copper content of the anodes or pig copper produced by the converters of the various smelting works.

Contrary to many predictions, it will be observed that the production in 1907 did not decrease enormously below that of 1906. This was because the curtailment in production in the last quarter of the year was insufficient to offset the increase during the first three quarters. If statistics of the quarterly production were available, it would probably appear that the production was about stationary in the first quarter, advanced in the second and third quarters and decreased largely in the fourth quarter.

PRODUCTION OF COPPER IN THE UNITED STATES.

State.	1906.	1907.
Alaska.....	8,700,000	9,797,000
Arizona.....	263,200,000	260,356,000
California.....	24,421,000	28,844,000
Colorado.....	9,565,000	10,293,000
Idaho.....	9,493,000	9,860,000
Michigan.....	224,071,000	234,104,000
Montana.....	299,850,000	227,063,000
New Mexico.....	6,262,000	7,730,000
Utah.....	49,712,000	79,000,000
East and South.....	18,821,000	19,893,000
Other States(a).....	3,525,000	7,564,000
Totals.....	917,620,000	895,104,000

(a) Includes Washington, Oregon, Nevada, Wyoming, South Dakota, Texas, Missouri, and also some copper originating in the States mentioned in the table which can not be accurately distributed among them.

Arizona—The production of this Territory in 1907 experienced only a small decrease. Some of the individual mining districts showed increases. The works of the Consolidated Arizona Smelting Company at Humboldt were closed during the fall, when the company went into the hands of a receiver. The Imperial Copper Company was engaged in the construction of a smelting works at Sasco, but this was not completed at the end of the year. The general conditions of copper production in Arizona in 1907 are carefully reviewed in the article by Dr. Douglas elsewhere in this issue.

California—It is impossible at this early date to give the precise production of this State, whose ores go largely to other States for smelting, but clearly there was a considerable increase. As in 1906 the Mammoth and Mountain were the

largest producers. The Balaklala failed to complete its smelting works, which proved to have been underfinanced, wherefore the company now has to raise more money. The Bully Hill made no production, its smelting works being still unfinished. They are expected to be in operation in the spring of 1908. The American Smelters Securities Company abandoned, temporarily at least, the construction of its San Bruno plant. The Mountain refinery was operated about nine months, being closed in the autumn.

Colorado—The production in this State shows but little change from 1906.

Idaho—The production in this State showed a small increase in 1907, notwithstanding the suspension of operations by the Snow Storm company of the Cœur d'Alene in the autumn. In spite of this shut-down the Snow Storm was the largest producer. The next largest was the Empire Copper Company of Mackay. The Lost Packer, Monitor, and Weimer mines were small producers, and the Seven Devils district made a small output.

Missouri—The North America Lead Company, of Fredericktown, on the southern edge of the disseminated lead district, made a considerable output, which appears in the statistics credited to "other States." This company operates a refinery.

Michigan—Some of the mines of Lake Superior made slightly diminished outputs in 1907, but others increased, and the net result was a rather considerable increase in the production of the whole district. The intentional curtailment in this district in the last quarter was insignificant.

Montana—The great decrease in the copper production of this State was due, in the first place, to the restriction of operations by the subsidiaries of the Amalgamated Copper Company in October, and finally by the closing of the Washoe smelter in December, which cut off the North Butte and Butte Coalition companies from a market for their ores. The closing of the Washoe works was to concentrate the curtailed production of the Amalgamated to the mines and works of the Boston & Montana company, which could be operated more economically at full capacity than all the mines and works at reduced capacity.

Nevada—The Steptoe Valley smelting works were delayed in construction and consequently the Ely mines will not be producers until the spring of 1908. Some

rich copper ore was shipped from the Yerington district and other districts in the State contributed more or less to the output, which increased over 1906.

New Mexico—The production of this State shows a good gain over 1906 although there were no especially noteworthy developments.

North Carolina—This State made a small output of copper, the Union mine being the principal producer.

Tennessee—The Ducktown district made about the same production as in 1906. It could have been materially increased, but movement in that direction was deferred owing to the adverse condition of the market.

Utah—The State showed a great increase, due especially to the operation of the Garfield works, which afforded smelting capacity for the ores of the Newhouse, Boston Consolidated and Utah companies. The Utah Copper Company put the first section of its new mill into operation in June and by the end of the year had eight sections (4000 tons capacity) in operation. This company alone accounts for a large part of the increased production of Utah. The Boston mill will go into operation in January, 1908, and there would normally be every reason to anticipate another great increase in Utah's production in 1908, but the closing of the United States, Bingham and Highland Boy smelters will have an effect which cannot yet be outlined. On the other hand the Garfield smelter is being doubled in capacity; the additions will doubtless be completed early in 1908. The statistics for Utah in the accompanying table are only approximately correct. The smelters received a good deal of ore from California, Idaho, Nevada, Colorado, and other States, which have been roughly allowed for, but even so the figures credited to Utah are perhaps a little too high while those of certain other States are correspondingly low.

Vermont—New developments in this State are described in a special article elsewhere in this issue. The production increased in 1907.

Virginia—This State produced nearly a million pounds.

Wyoming—The works of the Penn-Wyoming at Encampment were destroyed by fire in the spring, but were rebuilt and this company was a considerable producer.

Other States—North Carolina, Oregon, and Washington were considerable producers. Small quantities of ore were obtained from several other States.

Imports and Exports of Copper The Copper Market in 1907

The imports of copper into the United States in 1907 are estimated at 267,000,000 lb., against 225,843,281 lb. in 1906. The exports were about 492,000,000 lb. in 1907, against 467,839,041 in 1906. Our information as to the stocks of refined copper on hand is too incomplete to enable us to compute the apparent consumption at this time. It is well known that there was a great decrease in the consumption, but after the confusion of judgment, accompanying the recent financial disturbances has cleared away, it will probably appear that the actual falling off in consumption was not so great as has been commonly surmised. It is to be remembered that manufacturers were very busy well into the second half of the year.

Production of Copper in Canada

The smelters of the Boundary district suspended operation in the autumn, but previous to that the British Columbia company had made such a large increase that the total for the district shows only a small decrease from 1906. Rosslund made a small increase. The smelters of Vancouver Island made a decrease. On the other hand the Sudbury district made a large increase. The net result is a small increase in the Canadian production, which was 44,546,000 lb. in 1907, against 42,121,000 lb. in 1906. Our statistics are based on direct reports from the producers (except one of the small custom smelters of British Columbia).

Production of Copper in Mexico

The copper production of Mexico decreased materially in 1907, chiefly on account of the readjustments at Cananea which were going on in the early part of the year, and finally the complete suspension of operations there in the autumn. As a consequence of these developments, the Green-Cananea company produced only about 34,000,000 lb. of copper. The Teziutlan company, of Puebla, also suspended operations late in the year. This company is erecting a new smelting works, which is expected to be ready for operation during the summer of 1908. The Moctezuma Copper Company, of Nacoziari, Sonora, and the Compagnie du Boleo, of Lower California, made about the same production as in the previous year. On the basis of the net imports into the United States, plus the Boleo production, we estimate the production of Mexico at 126,710,000 lb. in 1907 against 135,800,000 lb. in 1906.

The enormous consumption of copper which marked the year 1906 continued into 1907, and until spring the market was strong and active. The outlook was promising, and manufacturers the world over, anticipating a large business and a continued short supply of the metal, bought heavily for future delivery. In the spring of the year a severe decline in securities occurred, and sentiment throughout the United States, which had heretofore been very optimistic, became cautious and doubting. This kept buyers out of the market. The feverish activity, which had run for several years, abated, and the business which had been anticipated was not forthcoming. In consequence, manufacturers kept out of the market entirely, and consumption was reduced so suddenly and so sharply that the supplies bought early in the year lasted many months longer than had been expected, and it was not until the fall, after the price of copper had been cut in half, from 25 to 12½c., that the market became active.

Meanwhile, producers had accumulated stocks variously estimated at from 200,000,000 to 250,000,000 lb., and they decided, owing to the low price, to curtail production. By that time manufacturers everywhere had worked off their stocks and were carrying less copper than a normal supply. The cheapness of the metal was apparent, and a buying movement set in, which absorbed almost all the stock in the hands of producers, the market advancing to about 15c. Thereafter there was a slight reaction to about 13c., but as the mines, wisely recognizing the decrease in consumption, showed no signs of reopening, the market continued firm, and at the close of the year it became strong and advancing. The curtailment of production will make itself even more felt early next year.

January opened with Lake copper selling at 24c. and electrolytic at 23½c. Transactions were small, but owing to the scarcity of the metal, prices advanced about 1c., and stocks of standard copper in warehouses abroad decreased to about 3500 tons.

In February a shortage of fuel interfered with production, and the prospects for a large consumption were good. In consequence, American consumers bought heavily, covering their expected requirements as far ahead as June, some sales being made for July delivery. This advanced the price still further, Lake copper selling at 25½c. and electrolytic at 25c.

During March a large sale of Lake copper took place at 26c., and electrolytic sold at 25½c. European buyers, who had generally held aloof from the market during January and February, now came in and bought heavily. Toward the end

of the month, however, the market was checked by the large decline in securities. Buyers held back and sellers met the market more freely. This caused the premium which had ruled for spot copper to disappear. In sympathy with the liquidation in the share market, large quantities of standard copper were sold, which resulted in a decline from £110 early in the month to £92 at the end of the month. Meanwhile, the statistics for the first three months of 1907 showed an increase in the imports of about 6000 tons and a decrease in the exports of 9000 tons, making a total increase in the available supplies of 15,000 tons. However, up to that time the consumption here was so enormous that these additional supplies were readily absorbed.

In April the market became quite unsettled. The largest American selling interests held for 25c., but made no sales, as owing to the decline in standard copper to £92, this copper was imported to this country, refined into electrolytic copper, and sold at 24c.

During May the market was completely stagnant. In London standard copper declined sharply, particularly for three months. Prices for spot copper were maintained on account of the depletion of the stocks and the scarcity of warrants. A backwardation to £3 occurred. By this time some of the large American consumers became nervous about the outlook and resold some of the copper previously purchased.

During June, although the largest sellers were still holding for 25c. for electrolytic copper, it was freely offered at 23c. without finding buyers. In London the backwardation increased to £4. There had been no buying on the part of American consumers since March, and everybody expected that their stocks would be depleted by July 1, and that they would have to come into the market for large quantities, which, however, did not prove to be the case.

On July 9 the leading selling agency reduced its price for electrolytic copper to 22c., a drop of 3c. from that previously asked, thus approaching the point at which actual sales had been made by other interests. This, however, did not stimulate purchases, and the little business that offered was eagerly competed for. At the end of the month Lake copper sold at 21c. and electrolytic at 20c. Meanwhile there had been a sharp break in the London market for standard copper, which closed weak at £86 for spot and £86 10s. for three months. European buyers kept entirely out of the market.

During August buyers continued to hold aloof and the market gradually declined to 18c. for Lake and 17½c. for electrolytic.

It was confidently expected that by September 1 manufacturers generally would be compelled to buy, but sellers

were again disappointed. Business had fallen off to such an extent that manufacturers had used much less copper than they had anticipated in the spring, and they were still working off the purchases then made. The little buying that took place was entirely from hand to mouth, and prices declined to 15c. for Lake and 14¾c. for electrolytic. Prices went lower from day to day, and at the end of the month the leading interest reduced its price to 15c. Conditions, generally, began to get worse and buyers who had been waiting for the 15c. price to place some of their orders were again content to look on and restrict their purchases to the most exacting hand to mouth basis.

Stocks had accumulated in the hands of producers and there was considerable pressure to sell, under which the market declined toward the end of October to 117½c. for Lake and 115½c. for electrolytic. In consequence of the stringency in the money market and the inability to finance further quantities of copper, many of the larger mines closed down, and European consumers, recognizing that copper was selling practically at cost, bought heavily. The Chinese also came forward as fairly large buyers. Immense transactions took place, amounting, in the aggregate, to probably upward of 150,000,000 lb., thus greatly reducing the accumulation. Under the circumstances, prices advanced by leaps and bounds, Lake copper selling at 15c. and electrolytic at 14¾c.

During November the market again lapsed into dullness. European buyers, having covered their requirements for the remainder of the year, held off, and domestic buyers were adverse to contracting ahead on account of the disturbed financial conditions, although they purchased more or less to supply their immediate requirements.

In December the demand for export continued and domestic consumers bought more freely. The year closes with Lake copper at 13¾ and electrolytic copper at 13½ cents.

AVERAGE PRICES OF COPPER

	NEW YORK.				LONDON.	
	Electrolytic		Lake.		1906.	1907.
	1906.	1907.	1906.	1907.		
January...	18.310	24.404	18.419	24.825	78.869	106.739
February...	17.869	24.869	18.116	25.236	78.147	107.356
March....	18.361	25.065	18.641	25.560	81.111	106.594
April.....	18.375	24.224	18.688	25.260	84.793	98.625
May.....	18.475	24.048	18.724	25.072	84.867	102.375
June.....	18.442	22.665	18.719	24.140	83.994	97.272
July.....	18.190	21.130	18.585	21.923	81.167	95.016
August....	18.380	18.356	18.706	19.255	83.864	79.679
September	19.033	15.565	19.328	16.047	87.831	68.375
October...	21.203	13.169	21.722	13.551	97.269	60.717
November.	21.833	13.391	22.398	13.870	100.270	61.226
December	22.885	13.163	23.350	13.393	105.226	60.113
Year.....	19.278	20.004	19.616	20.661	87.282	87.007

New York, cents per pound. Electrolytic is for cakes, ingots or wirebars. London, pounds sterling, per long ton, standard copper. The average for casting copper, New York for 1907, was 19.376c.

The Copper Situation in Arizona

By JAMES DOUGLAS *

The anticipations formed in 1906 that the output of certain mines in the Warren district would be largely increased in 1907, and that the Copper Queen, for instance, while it might not increase its production, would probably, at least, maintain its former rate, and that other companies in the district would enter the field as large producers in 1907, have not been realized. During the early months of 1907 there was great activity and a production in excess of 1906. During March the Copper Queen works at Douglas turned out 10,350,000 lb. of copper, and the Calumet & Arizona smelter over 4,000,000 lb. The average of the first half of the year was considerably in excess of the latter months of the year, when the output of the Copper Queen works at Douglas only slightly exceeded 6,000,000 lb. and that of the Calumet & Arizona 2,500,000 lb. per month from their own product and also from custom ores.

Approximately the production of the Copper Queen works was 100,000,000 lb. for the year 1907, but for the first five months the matte from the Detroit works in the Clifton district, containing 8,765,000 lb. of copper, was reduced in the converters of the Copper Queen plant at Douglas. There was also treated at the Douglas smelter of the Copper Queen Company some of the ores and concentrates of the Moctezuma Copper Company of Nacozari, Sonora, Mexico, containing approximately 6,000,000 lb. of copper, and from the mines of the Indiana-Sonora Copper Mining Company at Cananea, Sonora, ores containing 1,070,000 lb. of bullion. Deducting these three sources of production, together with small quantities of other Mexican ores, the output of the Copper Queen smelter from ore of the Copper Queen mine and from custom ores drawn from southern Arizona, amounted to approximately 84,165,000 lb. Considering the large production of the early months of the year, these totals show a heavy shrinkage during the closing months.

CLIFTON AND GLOBE

While there has been a diminished production from the Warren district, the three smelting companies in the Clifton district increased their production over 1906 by approximately 6,000,000 lb., making 63,000,000 lb. in 1907. This increased production, however, was due in part to the increased activity in the district at large, a number of smaller companies and prospectors having contributed to the ores supplied from the mines

*President, Copper Queen Consolidated Mining Company, New York.

of the three smelting companies themselves. The Old Dominion smelter turned out approximately 37,000,000 lb. of copper, which is slightly in excess of the production of 1906. This amount is made up of about 5,000,000 lb. of copper in sulphides from Mexico and 32,000,000 lb. from domestic ores, which represents an increase in copper from domestic and a decrease of copper from foreign ores. The United Verde will probably show a slight decline over last year, owing to the reduced activity during the latter months.

The decline in price, which became acute with the drop to 12c. in October, had the effect of closing a number of smaller mines throughout the whole territory, and unfortunately shutting up the Humboldt smelter on the Agua Fria in Yavapai county, and thereby closing the only open local market for the product of a number of small mines within the Prescott district, and some as far south as the Saddle Mountain mines on the Gila.

SILVER BELL AND TOMBSTONE

The most notable subtraction of copper from the Southwest and from northern Mexico was brought about by the closing of the Greene-Cananea smelter, which had turned out about 34,000,000 lb. of copper up to the time of its closing.

Looking to the future, the Imperial Company, with mines south of Red Rock, has been shipping its ores throughout the year to the Copper Queen smelter at Douglas, but expects to blow in its own smelter, built at the termination of its own branch railroad at Sasco, not later than the month of February. The development of that mine has been such that the copper production from the company's own works will largely exceed that extracted from the ores which it has heretofore shipped to Douglas, and unless appearances are fallacious, next year's statistics will show copper coming from the deeper levels of the great Tombstone veins which the same interests that own the Imperial mine have been so courageously exploring for the last few years.

PROSPECTS FOR 1908

The recent decline in production in both the Warren district and in northern Mexico has not been due to the depletion of the orebodies, but to good business judgment in restricting output until the accumulation of copper created last summer is worked off. This accumulation occurred through the producing mines' not appreciating in time the decline of demand for the metal which they could supply, and therefore maintaining a maximum production for at least five months while they should have been running at slackened speed. It was generally felt that it would be imprudent, unless again urged by the extravagant price, to run

the works as actively as was done during the early months of 1907, and that by reducing the production to a figure somewhat below the normal, opportunity is given to not only make necessary repairs, but for the staff to recover from the excessive strain to which they were exposed. During 1908, therefore, there is little reason to suppose that the output will exceed that of 1907, nor will it fall far below it, for it is unlikely that the copper trade can be supplied with an output from the mines as low as that to which it has fallen during the closing months of 1907.

The capacity for production has been augmented at the Calumet & Arizona works, and by the building of the Imperial works, but it does not follow that either the Copper Queen smelter, the Calumet & Arizona, or the Imperial, will be run to the full capacity. The Copper Queen works at Douglas will receive an accession from the Moctezuma Copper Company in Sonora, when its new concentrator is completed, before next spring; but unless the price of copper revives, this augmented quantity will, perhaps, be compensated for by a falling off in custom ores from which the same works during 1907 made about 17,725,000 lb. of copper.

METALLURGY

No notable metallurgical improvements were introduced into any of the works of the Southwest during 1907. The Copper Queen built one large reverberatory furnace for experimental purposes in cleaning slag, and disposing of flue dust and fine concentrates; but as yet no decisive results have been obtained. The same works is also putting in the Walker table to handle the copper from the converters through an intermediate ladle. The Calumet & Arizona Company has not only enlarged but likewise has remodeled its whole smelting plant, but without introducing any conspicuous novelty. The direction of change will be toward the combination of reverberatory with cupola smelting.

Tennessee Copper Company

By J. PARKE CHANNING*

During the early part of 1907 the continued shortage of labor in the South prevented any material increase in the production of the tonnage treated from the mines of the Tennessee Copper Company and the depression in the price of copper in the latter part of the year of course discouraged any increase at that time, and although the labor situation had

*President, Tennessee Copper Company, New York.

materially improved, this condition of affairs still exists. The production is in the neighborhood of 12,500,000 lb. a year, though the mines, railway and smelter have been so equipped that if conditions demand it the production could readily be increased to 20,000,000 lb. per year. At the principal mine of the company, the Burra Burra, the 2.5-ton skips have been replaced by five-ton skips and the steam pressure on the hoisting engine raised proportionately, it previously having been reduced from boiler pressure before entering the cylinders. This idea was held in view in the original equipment of the property and has worked out with remarkable success.

For handling the men, man-cages similar to those used at the Quincy mine on Lake Superior have been introduced. The shortage of labor prevented much development work during 1907, but this has now been taken up again and the shafts at the various mines will be sunk during the coming winter. An order has been placed with the Bucyrus company for a special type of dipper shovel operated by compressed air, and this will be installed underground on one of the Burra Burra levels for the purpose of loading ore from the underhand stopes into the mine cars. It is hoped that this will produce a material saving in the cost of loading and will also solve to a very large extent the difficult problem of securing the common labor necessary for this very important part of mine operations.

On the railway a large number of cars have been rebuilt and one new 100,000-lb. locomotive added to the motive power. At the smelter an immense improvement has been made in the metallurgical operations, due very largely to increased mechanical efficiency of the charging system and the slag disposal system. Heavier locomotives and larger and stronger cars have been introduced. Heavier rails have been installed so that delays from derailments have been practically overcome. It has also been found that the tuyere area of the furnaces was too small to permit of proper punching of the crust inside the blast furnace. However, by paying particular attention to this point and keeping the tuyeres well open the volume of blast has been very materially increased with a consequent better running of the furnaces. In fact, four furnaces at the end of the year are handling as much ore as six furnaces were at the beginning of the year. It is intended to very materially enlarge the tuyere openings by making out of each pair of tuyeres a long slotted tuyere and it is hoped that the tonnage of the furnace will be still more largely increased. The increased volume of air, curiously enough, has resulted in an increased amount of FeO in the slag and a consequent reduc-

tion in the amount of silica necessary or else by an increase in the grade of the matte. During the early part of the year the first matte went about 10 per cent. copper. At present it seldom runs below 19 per cent. copper and at times with a new furnace and the tuyeres well open, a 30 per cent. matte has been made continuously for 48 hours. There is a possibility that in time the second or concentrating operation may be entirely eliminated, though it is still too early to predict such a radical change. Now that the problem of making sulphuric acid is of as great importance as the production of matte, it is necessary to consider very materially the volume of air blown into the furnace. Still, however, indications point to the probability that all air within reasonable amounts blown into the furnace combines with either the carbon of the coke or the sulphur and iron of the ore.

In the converting department the only change has been in the final determination to abandon the resmelting of converter slag and the pouring of that portion which is fluid into the settlers. This has been a much mooted question, but at Tennessee it has been definitely proven that unquestionably the commercial gains are far in excess of any possible metallurgical loss. The converter floor is kept remarkably clean by pouring the last dregs of melted material from the converter ladles into small hand pots which are then run out and dumped. The skull in the ladle is dumped on the floor, breaks into pieces and is not cemented together by the usual small amount of slag left in the ladle under old conditions.

The sulphuric-acid plant has just been completed and at the present time the gases are going through it and such minor adjustments are being made as are necessary in any plant of this size. Sufficient progress has, however, been made to show that without doubt the process will be a success. It is found that the proper grade of gas may be obtained by an adjustment of the various dampers. It is still too early to go into any of the details of the process, but it is hoped that later on a careful technical description of the results achieved will be given out.

The Lake Superior Copper District

By C. L. C. FICHTEL*

The year 1907 was a successful one in the Lake Superior district. The demand and price of the metal for the first half of the year were such that all the mines were able to operate to the limit of their

*Engineer, with Calumet & Hecla Mining Company, Calumet, Mich.

capacity, and had labor been more plentiful during this period even a larger production would have been recorded. Throughout the year a great deal of construction and development was undertaken and several new mines were opened and operations were resumed at abandoned properties. The year was free from any serious labor troubles. While the mines of the West and Southwest curtailed their productions in the autumn, few of those at the Lake did so.

There were 19 producing mines in 1907, compared with 20 in 1906. The Atlantic did not produce owing to the caving in of the old workings. The largest individual gain was made by the Quincy, which returned to its former place as the second largest producer on the Lake. "Air blasts," which were such a hindrance to its production during 1906, did not occur in 1907. The Calumet & Hecla gained in production due to the increased tonnage from the main mine and a little better showing on the Osceola amygdaloid. The greatest losses were recorded by the Wolverine and Mohawk mines, due partly to accidents at their mill.

Owing to the adverse conditions in the copper market, each of the mining companies was forced to decrease their last dividend, but even with such reductions the total amount disbursed during 1907 was in excess of that in 1906. A general reduction in wages was made, and during December the scale was practically the same as at the end of 1906.

KEWEEAW COUNTY

There was considerable mining activity in this county, and several new mines were opened. On the land of Keweenaw Copper Company the Medora shaft was sunk to a depth of 950 ft. where the formation was found to be less fissured than higher up. There are now about 4000 ft. of openings, and a good grade of soft amygdaloid stamp rock, which is easy to mine and mill, has been disclosed. The acquisition of the Phoenix property in April gave this company ample stamping facilities for some time to come, and the Keweenaw Central Railroad has been in operation from the Mandan location to Mohawk. Work of grading from Mohawk to Calumet has been suspended for the winter, but should probably be completed by June 1, 1908.

The Calumet & Hecla company suspended operations on its Manitou and Frontenac properties after considerable exploratory work and diamond drilling. The showing is sufficient to warrant opening the property in a systematic manner and this will probably be done in the spring of 1908.

The Tamarack Mining Company developed the Cliff property in a systematic manner. The new shaft is being sunk and all necessary surface equipment is in place.

The Ojibway company, since its formation in March, sank two shafts; one is

down 250 ft. but the other was started only a short time ago. These have disclosed a rich copper-bearing amygdaloid. The company is at present without railroad facilities, but surveys have been made for a line.

At the Mohawk mine all five shafts were in operation and sinking is going on in all of them. During 1907 the heads at the mill were changed from simple to compound, and the capacity was thus raised to about 3000 tons of rock per day.

The Ahmeek is the best equipped small mine on the Lake. A good deal of construction work was completed and the underground conditions are now in fine shape. Between 800 and 1000 tons of rock are being shipped daily to the Tamarack mills.

The Allouez Mining Company came under the control of the Calumet & Hecla Mining Company and development is progressing systematically. All rock came from No. 1 shaft and amounted to about 700 tons per day. No. 2 shaft is down about 1000 ft., but has not yet cut the lode. It is being sunk at an angle of about 80 deg., but will turn and follow the lode.

HOUGHTON COUNTY

The Calumet & Hecla Company assumed the management of the Centennial and Allouez properties and continued development of the mines. At the same time the company purchased stock in the Osceola company but an injunction, brought by the management of the Osceola restrained the Calumet & Hecla from voting the stock acquired. This case has not yet been settled.

At the main mine of the Calumet & Hecla all shafts were operated and the output of rock was fully maintained and in some instances increased. On the Osceola amygdaloid all the shafts were in operation and the new shaft, No. 18, was started at the extreme north of the property. Shafts No. 19 and 20 on the Kearsarge lode were closed down and it is likely that this lode will be worked through drifts from either the Osceola amygdaloid shaft or from the Centennial. Preparations are being made for a new electrical pumping station at No. 5 shaft, which will take care of all the water from the north end of the mine and eliminate water hoisting at the Red Jacket shaft. This will give another compartment for rock hoisting and will probably be used to take care of the rock coming from the new sub-shaft.

New construction and equipment include the foundry and pattern shop; recrushing mill, containing 175 tables and 48 Chilean mills; one 2000-kw. generator; two boiler houses and various other improvements. During the year Walter Fitch was appointed superintendent and John Knox succeeded J. B. Risque as head mining captain.

The Tamarack Mining Company ex-

tended its drifts to the extreme limits of its property and stoped back, allowing the ground to cave behind the workings, thus eliminating the cost of timbering. This, with the addition of electrically operated locomotives for tramping, which probably will be installed next year, should greatly lessen the cost of production. The Osceola will show a slight falling off in production due to the curtailment which was in effect during October and November. Production was again nearly normal during December. The North Kearsarge branch was again opened after having been closed for some time due to fire. The South Kearsarge maintained about normal production.

The Wolverine mine still holds its distinction of producing copper cheaper than any other mine at the Lake. There were no particular events at this mine during 1907. Among the smaller mines of Houghton county considerable development was carried on, but there were no features of importance.

On the Quincy property, No. 8 shaft, on the Mesnard tract, showed good stamp rock, and drifting was extended to the southern boundary of the newly acquired Arcadian land. This tract carries the outcrop and dip of the Pewabic lode for nearly 1½ miles. Some diamond drilling has been done and No. 9 shaft will be located here. Work at the Hancock consisted largely in cleaning out and retimbering the old workings and sinking the new (No. 2) shaft, which has attained a depth of about 475 ft. A new hoisting plant and compressors were installed. Isle Royale spent most of the year in sinking shafts and other development work.

The three companies which comprise the Copper Range Consolidated Mining Company had a prosperous year. The Champion and Baltic increased their production and more than overcame the slight falling off at Trimountain. At the Globe tract the shaft has passed through the overburden and is well into the ledge. The company experienced great quicksand difficulties in sinking this shaft, but these were overcome, and in June the ledge was struck, after nearly two years of work.

ONTONAGON COUNTY

The feature of the year in this county was the disclosure on the Lake property of a highly mineralized formation, 35 to 40 ft. wide, which proved to be the Baltic lode. Development was begun and the ledge was opened by trenching, and was found to be rich. A shaft was started and is progressing satisfactorily. A diamond-drill core, taken from the shaft-site, showed the same mineralized formation at a depth of 450 ft. This discovery has greatly encouraged property owners in Ontonagon county.

The Michigan property is in good condition and sinking is going forward in all the shafts.

The Production of Lead and Spelter in 1907

Statistics of Production and Price—Imports and Exports—A Review of Mining Conditions—The Markets

LEAD, 359,058; SPELTER, 246,688 TONS

The statistics in the following table are based on direct reports from all the producers except one (whose output is small and has been estimated from good data). The statistics represent the production of refined lead. The separation between domestic and foreign is as reported by the producers. At this early date it is impossible to make any accurate distribution among the States, and even the separation between foreign and domestic is probably only approximately correct.

PRODUCTION OF LEAD IN THE UNITED STATES.

(In tons of 2000 lb.)

	1906.	1907.
Desilverized, domestic*.....	220,095	225,546
Southeast Missouri.....	100,492	104,434
Southwest Missouri.....	16,528	18,312
Miscellaneous.....	980	1,292
Totals,.....	338,095	349,584
Antimonial.....	10,120	9,474
Total domestic†.....	348,215	359,058
Desilverized, foreign.....	67,441	56,680
Grand Total.....	415,656	415,738

* A considerable proportion of the lead of Southeast Missouri is desilverized, but in this table the old classification has been retained.

† A small portion of this antimonial lead is of foreign origin, but separation for 1907 can not be made at this time, and consequently the figures for 1906 have been combined so as to correspond with those for 1907.

IMPORTS AND EXPORTS OF LEAD.*

(In tons of 2000 lb.)

	1906.	1907.
Imports of refined.....	11,255	8,582
Exports of foreign lead.....	40,066	41,345
Imports in ore and base bullion.....	61,899	53,907
Lead in bond, January 1.....	8,148	5,691
Lead in bond, October 31.....	6,136	6,386

* For the 10 months ending October 31.

The stock of domestic lead in the hands of the refiners was 4000 tons on Jan. 1 and at the end of the year was probably in the neighborhood of 50,000 tons. It is obvious from the above statistics that the domestic consumption fell off heavily.

The Lead Market in 1907

The consumption of lead, like that of all other metals, had assumed unprecedented proportions at the opening of the year 1907. Manufacturers had difficulty in supplying the wants of their customers and business was flourishing in all branches. The greatest proportion of the increased consumption was furnished through the enormous demands for the manufacture of sheets for the chemical industry and lead-covered cables. What-

ever lead could be furnished by the smelters found a ready market at the price then ruling of 6c. New York—the highest figure which the market had reached in a period of 30 years. Prices doubtless would have been driven still higher if it had not been for the fact that the bulk of the entire production was furnished to the manufacturers under average contracts.

This situation continued into March, when the convulsions of the money market began to enforce the policy of retrenchment which became more and more extensive as time passed. It was in the larger industries requiring heavy amounts of capital that the effect was first felt, and it developed that while the outlet to the small consumers requiring white lead, lead pipe and mixed metals continued unabated, the effect of diminished sales being first felt through the falling off in the demand for chemical sheets and lead-covered cables. Nevertheless, prices were nominally maintained, because the largest producer had a regular outlet to its subsidiary concerns. Other important sellers, however, began to have difficulty in placing their product, and during May started their policy of forcing sales by shading what was known as the official quotation, which was reduced early in June to 5.75 New York, without, however, altering the basic conditions; the only result being that outside producers again shaded their prices. A repetition of these conditions was experienced when on July 3 the official price was reduced to 5.25 New York. The lower market did not stimulate the demand, and the general pressure to realize brought about a lowering in the quotation to 4.75c. New York, early in September.

The severe panic which occurred in October forced a number of producers to try to find a market for their stocks regardless of price. A state of utter demoralization followed and it became evident early in November that the quantities available had grown so large that the official quotations were absolutely ignored, and it was then evident that the market was bound to become an open one. This was accelerated by large sales of Missouri lead at considerably lower prices than the nominal quotations.

In our issue of Nov. 23, we made the following announcement: "Last week we stated that, for reasons then given, our quotations for lead would hereafter be those of the open market—that is, the

prices of large quantities on actual sales—and not the contract prices of the chief producer, as heretofore. That producer has accepted the situation. The American Smelting and Refining Company announced last Monday that it withdraws its official quotations and in future will compete in the open market. By this action the artificial situation which has existed hitherto is at an end, and more normal conditions can be expected to prevail henceforth, since prices are again to be regulated by the law of supply and demand."

What we said above has been true of the market ever since. The moment the bars were down the quotations reflected the actual situation by declining from day to day, and by the end of November lead was freely offered at 4.10c. New York, and 3.95c. St. Louis. Even at these low prices consumers persisted in a hand-to-mouth policy. The situation was aggravated through the average contracts for fixed quantities, which were considerably larger than were required under the new conditions, so that a great many consumers were placed in a position where they were powerless to take advantage of the low prices. Sellers, being thus deprived of a market, tumbled over each other to book what small business turned up from time to time.

The downward rush continued into late December, when the market reached 3.25c. St. Louis, 3.40c. New York. Prices as low as these had not been established in over 10 years; they marked, however, the end of the protracted decline; both consumers and speculators became attracted to the metal and bought up large quantities, with the result that prices quickly advanced to about 3.40c. St. Louis, 3.55c. New York. At these figures the market stands at the end of the year.

AVERAGE PRICE OF LEAD

Month.	New York.		London.	
	1906.	1907.	1906.	1907.
January.....	5.600	6.000	16.850	19.828
February.....	5.464	6.000	16.031	19.531
March.....	5.350	6.000	15.922	19.703
April.....	5.404	6.000	15.959	19.975
May.....	5.685	6.000	16.725	19.688
June.....	5.750	5.760	16.813	20.188
July.....	5.750	5.288	16.525	20.350
August.....	5.750	5.250	17.109	19.063
September.....	5.750	4.813	18.266	19.775
October.....	5.750	4.750	19.350	18.531
November.....	5.750	4.376	19.281	17.281
December.....	5.900	3.658	19.609	14.500
Year.....	5.657	5.325	17.370	19.034

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

Lead

BY WALTER RENTON INGALLS

There were no new discoveries of lead ore of importance in the United States in 1907, and indeed none were needed, inasmuch as the older districts were more than able to furnish the required supply. Up to June the demand for lead was good, but about that time a relaxation became evident, and during the second half of the year the supply was at all times in excess of the demand. Stocks accumulated heavily and the American Smelting and Refining Company lost control of the market which it had held for several years, the independent producers breaking away from their previous policy of selling according to the schedule of the trust. This gradually developed an active open market in which large transactions were made, and finally, in November, the trust itself abandoned the establishment of a schedule of settling prices. During this time the price of the metal fell steadily, and in December it reached a low level.

RESTRICTION OF PRODUCTION

Throughout the decline strenuous efforts were made to secure a restriction of production. The American Smelting and Refining Company and the United States Smelting, Refining and Mining Company discontinued the receipt of lead-bearing ore except such as they were bound to take under previously existing contracts, but even in those cases they urged the producers to restrict their shipments in their own interest. Two subsidiaries of the American Smelting and Refining Company, viz., the Federal Mining and Smelting Company of the Coeur d'Alene and the Federal Lead Company of Missouri, curtailed their outputs. On the other hand, the two great independent producers, viz., the Bunker Hill & Sullivan of the Coeur d'Alene and the St. Joseph-Doe Run of southeastern Missouri, both resisted all persuasion to cut down their production. However, about the middle of December, the St. Joseph-Doe Run bowed to the adverse conditions of the market and sent orders to the mines to restrict their output 50 per cent. At this time the price for pig lead was about 3.60c., New York, or say 3.50c., St. Louis. It might be inferred that this was uncomfortably near the actual cost of production under present conditions, but subsequently orders were given to resume production at the normal rate on Jan. 1, 1908. Five or six years ago Missouri lead could be laid down at St. Louis at 2.25c. per lb., but since then the cost of mining and milling in southeastern Missouri has risen immensely owing to repeated increases in the wages for labor and corresponding decreases in the rate of efficiency per man.

FEDERAL MINING AND SMELTING COMPANY

On the other hand, the cost of mining and milling in the Coeur d'Alene has remained nearly stationary, or even has decreased, the wages for labor having continued unchanged, while steady improvements have been made in the mining and milling practice. In the case of these mines the cost of producing lead is greatly dependent upon the silver content of the ore and the price for silver. The reports of the Federal Mining and Smelting Company, which is the largest single producer of lead, not only in the Coeur d'Alene but also in the United States, for the years ending Aug. 31, give the following figures:

	1905.	1906.	1907.
Tons ore mined.....	664,830	874,332	888,950
Average lead a.....	6.64%	7.21%	6.72%
Average silver, oz. a.....	4.05	4.48	4.15
Tons concentrate b.....	85,205	130,855	130,373
Ratio.....	7.8:1	6.7:1	6.8:1
Oz. silver.....	2,689,867	3,920,884	3,689,298
Average per ton.....	31.57	29.96	28.30
Tons lead.....	44,137	63,029	59,746
Average.....	51.8%	48.17%	45.83%
Net profit.....	\$1,242,698	\$2,685,300	\$2,532,250
Dividends paid.....	1,098,896	1,647,457	1,917,741

a Average yield, not average assay. b Includes mill concentrate and shipping ore.

COST OF PRODUCTION IN THE COEUR D'ALENE

The report of the Federal Mining and Smelting Company gives no data as to the cost of production, but a rough approximation may be made on the basis of average prices for silver and lead during the corresponding periods. Assuming that the company sold its ore on the same basis as other large producers in the Coeur d'Alene, the total proceeds and costs to the company were approximately as follows:

	1905.	1906.	1907.
Total proceeds.....	\$4,575,300	\$7,345,804	\$7,260,105
Less freight and smelting.....	1,363,280	2,093,680	2,085,968
Net value.....	3,212,020	5,252,124	5,174,137
Net earnings.....	1,242,698	2,685,300	2,532,250
Direct operating cost	1,969,322	2,566,824	2,641,887
Add development account.....	100,000	100,000	100,000
Total cost of production.....	2,069,322	2,666,824	2,741,887
Deduct silver value.....	1,508,684	2,410,642	2,388,452
Net cost of lead.....	560,638	331,245	353,435
Cost of lead per lb.....	0.70c.	0.29c.	0.33c.
Cost of mining and milling per ton of crude ore.....	\$3.11	\$3.05	\$3.08
Av. price of silver.....	58.82c.	64.72c.	68.15c.
Av. price of lead.....	4.45c.	5.42c.	5.79c.

In the above computation an addition of \$100,000 per annum has been made for development account. In the fiscal year ending Aug. 31, 1907, the company charged off \$300,000 for this purpose, nothing having been thus written off in the two years previous. It is probable that this allowance is insufficient. Moreover, experience has amply proved that the net earnings from operation are not wholly applicable to the payment of dividends, a surplus being required by the company for application to new construction and extraordinary expenses. Consequently the actual cost of production to this company is higher than the above figures indicate.

However, on their basis, the cost of

mining and milling per ton of crude ore was \$3.11 in 1905, \$3.05 in 1906, and \$3.08 in 1907, while the cost per pound of lead was 0.70c., 0.29c. and 0.33c. respectively. It appears that while the cost for lead decreased rather largely from 1905 to 1906 the cost of mining and milling decreased only a trifle. The difference is explainable by an increase in the grade of the ore. This appears from the statistics which show that in 1906 the crude ore raised from the mines yielded an average of 7.21 per cent. lead and 4.48 oz. silver per ton, while in 1905 the figures were 6.64 and 4.05 respectively. Moreover, the value of silver increased largely from 1905 to 1906 and this has a highly important bearing on the mines of the Coeur d'Alene. Thus if the figures of the Federal Mining and Smelting Company for 1907 were computed on the basis of 50c. per oz. for silver, instead of 68.15c., it would appear that the cost of a pound of lead would have been approximately 1c. instead of 0.33c.

Of course it will be understood that these estimates mean that 1c. or 0.33c., as the case may be, must be received for a pound of lead in the Coeur d'Alene for the mining company to come out even. The cost on the basis of delivery at New York is another matter. This again is a fluctuating affair, depending upon the grade of the concentrate, the profit expected by the smelter, and other factors, but allowing a reasonable profit to the smelter, the cost of freight, smelting and refining on concentrate containing 45 to 50 per cent. lead may be fairly estimated at 2.33 to 2.5c. per lb. of lead. It may be inferred, therefore, that under the conditions of the Federal Mining and Smelting Company, with silver at 50c. per oz., the cost of delivering lead at New York is at least 3.33 to 3.5c. per lb., but with proper allowances for amortization of mining and milling plant, etc., the actual cost must be close to 4c. per lb. With silver at 67½c. per oz., on the other hand, the cost is 2.65 to 2.8c. without allowance for amortization, and probably about 3.3c. with it.

THE BUNKER HILL & SULLIVAN

The cost of production to the Bunker Hill & Sullivan company figures out in much the same way as the Federal, but more favorably, because of the higher grade of its ore and its lower cost of mining and milling. In the year ending May 31, 1907, this company mined 336,630 tons of ore, yielding 40,169 tons of lead and 1,645,719 oz. of silver. The average yield of the ore was about 12 per cent. lead and 5 oz. of silver per ton. The direct operating expenses were \$665,379; the total expenses, including new construction, exploration, litigation, taxes and insurance, and in fact all charges, was \$934,657. The average price for silver during this period was 67.497c. per

oz., at 95 per cent. of which the company realized for silver \$1,055,268, which was more than \$100,000 in excess of the total cost of production; consequently, the property would have been profitable if nothing at all had been received for its lead production. If, however, the price for silver had been only 50c. per oz., the amount realized for the silver product would have been less than the total expenses and the lead product would have cost about 0.2c. per lb. However, even then the total cost of this lead delivered at New York would have been only a little more than 2.5c. per lb. The Bunker Hill & Sullivan product is undoubtedly the cheapest large supply of lead in the United States at the present time.

The three companies considered in this discussion—the St. Joseph, Federal Mining and Smelting, and Bunker Hill & Sullivan—furnish nearly 40 per cent. of the domestic production of lead. The two districts of which they are representative—the Coeur d'Alene and Flat River-Bonne Terre—furnish nearly 60 per cent. Consequently the market for lead is always determined largely by the conditions in these districts.

SILICIOUS ORES—A NEW REFINERY

The restriction of operations by the American Smelting and Refining Company and United States Smelting, Refining and Mining Company affected seriously the producers of silicious gold ore at Tonopah and Goldfield, Nevada. These ores are smelted largely on the lead basis. They are mixed with lead ore, and consequently in smelting them, pig lead is produced, but lead being quite unsalable, the companies naturally desired to produce as little as possible and consequently were unable to smelt so much of the silicious ore as usual. The refusal of the companies to accept silicious ore caused considerable outcry in Nevada, where the conditions were not understood, but of course, the smelters in self-defense could not do otherwise than they did, the financial situation being such that an increased amount of money could not be safely locked up in ores not immediately available for smelting.

The condition of lead mining in Missouri and Idaho is described in following articles, as is also the progress in the metallurgy of lead. The United States Smelting, Refining and Mining Company, which started its electrolytic lead refinery at Grasselli, Ind., at the end of 1906, overcame the initial difficulties during the spring of 1907 and became a large producer of electrolytically refined lead, which took a high place in the market. Including this company there are now three important desilverizers and refiners of base bullion outside of the American Smelting and Refining Company, the other two being the Balbach Smelting and Refining Company of Newark, N. J., and

the Pennsylvania Smelting Company of Pittsburg, Penn.

Southeast Missouri Lead District

By J. H. A. WHEELER*

The output in 1907 of the southeastern Missouri lead district is estimated at 98,000 short tons, approximating \$10,150,000 in value. This is the largest in its history, as it exceeds the banner output of 1906 by 11 per cent., notwithstanding that production was heavily curtailed after the recent panic. The Flat River and Bonne Terre camps in St. Francois county as usual not only produced almost this entire tonnage, but also the increase was entirely derived from this source. These camps furnished about 94 per cent. of the output, while the Madison county mines that center about Fredericktown supplied about 5 per cent., and the outlying counties of Washington, Jefferson and Franklin produced about 1 per cent.

The ore produced in these three counties—Washington, Jefferson and Franklin—is still derived from innumerable shallow diggings worked on the leasing system. Some efforts were made in 1907 to test the deep ground under the shallow mines in Washington county, but the financial stringency brought the prospecting to a standstill before tangible results were obtained, although considerable encouragement was met. When it is considered that for more than 70 years the lead production of St. Francois and Madison counties was derived exclusively from similar small shallow deposits, it is surprising that greater effort has not been made to prospect the other shallow lead camps. It is true that the base of the Bonne Terre limestone, in which the large bodies of disseminated ore occur, is much deeper in Washington, Jefferson and Franklin counties, so that the drilling must be from 800 to 1200 ft. deep as compared with 100 to 800 ft. in St. Francois and Madison counties. It is also true that during the first 20 years after the disseminated lead was discovered by drilling, the holes rarely exceeded 200 ft. in depth, and it is only recently that drilling has been carried to depths of 500 to 800 ft. Yet what is today probably the finest mine in the district is one of the recent discoveries made at a depth of 500 ft., and two shafts are now being sunk to ore-bodies lying more than 700 ft. deep. Since the large, deep ore-bodies of St. Francois and Madison counties are found to be intimately associated with the shallow lead deposits, it will be remarkable if the richer and more numerous shallow deposits of Washington county are not similarly underlain with the disseminated ore-bodies.

*Consulting mining engineer, 510 Pine street, St. Louis, Mo.

It is certainly an attractive field for the courageous prospector; the low price of the lands in Washington county that have been large producers of shallow lead makes possible a very handsome profit if intelligent drilling discovers the deeper deposits that geological evidence so strongly indicates.

GENERAL CONDITIONS DURING THE YEAR

The past year opened auspiciously with an unprecedented demand for lead at very high prices; the St. Louis market ranged from 6c. to 6.25c. per lb. until June. Since then prices have receded, slowly at first, but since Sept. 1 at a rapid and most discouraging rate, so that the year closes at almost a 3c. level. Demand has slackened with the lowering in prices so that rather large stocks have accumulated. To meet the present conditions the output was reduced by most of the companies until it is now only about 50 per cent. of the capacity of the district.

Wages have been only partially reduced from the abnormally high level that prevailed in 1907, but no doubt a lower wage will shortly become universal and the district will again enjoy its old reputation of being one of the lowest labor markets in America. The miners' union will also probably be a disappearing factor this winter, for with the large number of idle men who are now willing to work for anything they can get, it will be an easy matter to cull out the labor agitators, while 90 per cent. of the men will be only too glad to withdraw from the union.

The absorption of the smaller companies made further progress in 1907 and 90 per cent. of the production now rests with two powerful interests. During the prosperous period the large companies did considerable prospecting, especially on lands held under option. Several of the options were exercised and the large acreage held by the two prominent interests was considerably increased. Nearly 100 diamond-drills were at work until Sept. 1, which is the largest number in the history of the district; but all this work has been stopped and the drills housed.

One of the important events during the year was the completion of the mill which the Federal Lead Company has built on its Central tract. The building is of steel; the mill consists of six units of 400 tons capacity, thus having a total capacity of 2400 tons, and is said to have cost \$1,250,000. It is equipped with a fine independent crushing and sampling department; the storage bins have a three-days capacity. The mill is operated by electricity furnished from three Curtis turbine generators of 500 kw. each.

THE ST. JOSEPH LEAD COMPANY

The St. Joseph Lead Company still holds its prestige of being the largest as well as the oldest producer of the district; its No. 1 mine is over 40 years old. While no new shafts were sunk in 1907, its plants were greatly improved in capacity and effi-

ciency; Bonne Terre, which the company monopolizes, has been made a model mining camp. The town is now equipped with a very complete system of sewers, new water-works furnishes water from a source that is beyond contamination, the streets are now lighted with electric lights, and many of the older houses have been torn down and replaced with attractive cottages. A fine fire-proof stable has been erected, a large new concrete store is under construction, and the steel frame is completed for a new power-house, in which gas producers will replace the present steam plant, with a large saving in fuel. The new No. 13 shaft at Bonne Terre was equipped with an electric hoist and is now an important producer. Nos. 11 and 12 shafts on Big river are now able to keep the new 1500-ton mill supplied with plenty of ore and a well-built town, called Leadwood, has grown up near the No. 12, or Hoffman shaft. The smelter at Herculaneum, 30 miles north of Bonne Terre, was greatly improved in capacity and efficiency. Two large, modern furnaces have replaced the old small, round stacks and mechanical feeding has superseded the hand feeding. The Savelsberg pot-roasting process is now used for roasting the ores and mattes and a marked economy has resulted over the Freiberg hand roasters; the new plant consists of five roasting pots. The Hill and Gumbo shafts were shut down in October; in December the production was cut in half by putting the smelter employees on half time, but as yet no reduction has been made in the wage-scale.

THE DOE RUN AND OTHER COMPANIES

The Doe Run Lead Company completed the new shaft on the Mitchell tract and re-opened the old abandoned shaft at Flat River station that was flooded 17 years ago; the latter was recently found to be dry; the adjacent shafts had drained it. It has been re-equipped with a steel head-frame and an electrically driven hoist and crushing outfit. The ore is still hauled 10 miles south to the old mill at Doe Run which was built about 22 years ago as a 500-ton unit to treat the output of the mines at Doe Run. This mill has since been enlarged to a 1200-ton plant and considerably improved. A large, modern concentrator will be built to treat the ore from the Mitchell tract; in fact the foundations of this mill have been started on the west side of Elvins. An attractive fire-proof office has been built of brick with a tile roof at the No. 3 shaft, and the steel frame has been erected for a gas-producer power plant.

The Doe Run company took an option on the Union Lead Company's tract and by again prospecting it this company found a rich orebody and the property was purchased; this tract had already been drilled and turned down by four different parties. The company also took an option on the tract belonging to the Columbia Lead

Company. After considerable drilling this also was purchased; the No. 2 shaft and 300-ton mill have been overhauled and are again producing. These two acquisitions added about 1000 acres to the company's extensive holdings at a cost of about \$1,000,000.

The Desloge Lead Company operated its mill at full capacity throughout the year. This company was the first to reduce wages, but the wages are still too high for the present outlook of the lead market. Work at the No. 2 shaft has recently been stopped but this will not seriously curtail the production of the company as this mine has not been a large producer.

The National Lead Company completed its No. 5 shaft at Esther and it is now an active producer. The mill is being reconstructed on lines that should materially increase its efficiency. The Hancock jig is replacing the plunger jigs; Huntington mills are being installed to grind the middlings finer and the number of tables and vanners in the slime department is to be increased. The Richards classifier will be used. Electric haulage has replaced mules underground and a handsome brick, fire-proof office has been built.

The Federal Lead Company completed its new Central mill, as previously mentioned; this is the largest concentrator in the Mississippi valley. The old 400-ton Central mill has been torn down and the old Central smelter has also been dismantled, as the concentrates are now shipped 80 miles north to the company's smelter at Alton, Ill. The No. 8 shaft has been completed on the 40-acre tract in Flat River, while No. 9 and No. 10 shafts on the old Missouri Lead Fields tract were being sunk to an orebody that is over 700 ft. deep. Construction work on the latter, and on the railroad spur thereto, has been discontinued since the slump in lead prices; the No. 1 mill has been shut down, and only three, the Central, Rogers and Derby, out of the ten shafts are producing; these shafts supply two of the six sections in the new mill.

The Madison county output is less than in 1906, as the principal producer, the North American Lead Company, has gone into the production of copper, nickel and cobalt and so only produces a small amount of lead, it being recovered as a by-product. A \$250,000 smelter has been completed; this is equipped with an electrolytic refining plant and about two car-loads of copper anodes are produced per month. The ore is said to run 4 to 7 per cent. copper, so that, with the favorable conditions surrounding this smelter, a fair profit even at present low prices should be obtained. The other mines of Madison county, the Madison (formerly the Catherine), the Hudson Valley and the Mine la Motte, were actively operated during 1907, but labor shortage interfered with a full output until near the end of the year.

PRESENT CONDITIONS COMPARED WITH THOSE OF FORMER YEARS

The past year saw the first serious check in the output of the district during the 40 years that the disseminated ores have been worked. Previous to working the deep, low-grade ores, the output from the shallow mines was very small and quite erratic. When the panic of 1873 occurred, there were only two small producers, the St. Joe and Mine la Motte, and the total output was less than 6000 tons. The panic of 1893, with its severe aftermath that culminated in 1897, found several more producing mines, those belonging to the Desloge, Doe Run, Central, Donnelly and Leadington companies, and the output had grown to about 20,000 tons; but instead of curtailing production, on account of the decreasing price, the output was forced to a maximum, in order to reduce the costs. The general plane of prices was so much lower than today that, although pig lead receded to 2.45c. in the St. Louis market before prosperity returned in 1893, the strain to produce lead without loss was probably no greater than today with a 3.5c. market. The underground men were then paid \$1.25 to \$1.50 per 10-hour shift as against \$1.90 to \$2.25 for eight hours in 1907, and surface labor received \$1.10 to \$1.25 for 10 to 12 hours as against \$1.50 to \$1.75 last year, while supplies were 20 to 40 per cent. cheaper. The growth of the district has been steady and continuous; new development and new equipment have rendered it possible during 1907 to produce at the rate of 120,000 tons lead annually. But at present the district is only producing at half this capacity and, until labor and supplies have been re-adjusted to the plane of the present low prices of lead, it would appear preferable to even further curtail production and allow the lead to remain underground.

Production of Spelter in 1907

The production of spelter in the United States in 1907 is given in the following table, which is based on reports from all the producers, who have estimated their probable production during the last few days of December. The statistics represent only the production of virgin spelter, i.e., spelter produced directly from ore. Oklahoma appears as a producer of spelter for the first time.

In spite of the putting of many furnaces under dead fire in November and the closing of several works in December the total spelter production in the United States in 1907 shows an increase, the gain over 1906 having been so large during the first 10 months of 1907 that it failed to be offset by the reduction in production during the last two months.

PRODUCTION OF SPELTER IN THE UNITED STATES.

State.	(In tons of 2000 lb.)	1906.	1907.
Colorado.....		6,260	5,200
Illinois.....		48,238	56,001
Kansas.....		129,741	136,023
Missouri.....		11,088	11,547
Oklahoma.....			5,016
South and East a.....		30,167	37,917
Totals.....		225,494	246,688

a Virginia, West Virginia and Pennsylvania.

The exports of spelter during the 10 months, ending Oct. 31, were 414 short tons, against 409 in the corresponding period of 1906. There were no imports. Exports of zinc ore, 13,991 long tons, against 22,730; of zinc dross, 8608 tons, against 12,258 tons.

The Spelter Market in 1907

The year 1907 opened under the most favorable auspices for the spelter industry. Smelters throughout the West operated at full capacity. Prices were at a level which permitted the mines in this country, as well as in Mexico and British Columbia, to furnish a full quota of ore at prices satisfactory alike to the miner and smelter. No stocks of metal existed and the spelter was shipped by the smelting works as fast as produced. Prices at the beginning of the year stood around 6½c. St. Louis. A heavy demand from galvanizers and brass manufacturers gradually forced the market higher until in the early part of March it reached about 6.75c. St. Louis. The available supplies by that time had become so scarce that spelter for immediate delivery commanded a premium. This was particularly the case with the higher grades of spelter used by the brass manufacturers, whose requirements had broken all previous records.

During this wave of exceptional prosperity a number of the small coal smelters in the Kansas and Missouri districts, which had been idle for years past, were started up. Moreover, three new smelting enterprises were organized, which have since materialized in the erection, by the United Zinc and Chemical Company, of a smelter at Springfield, Ill.; and also in the formation of the Bartlesville Zinc Company and the National Zinc Company, both at Bartlesville, Okla. These three smelters have about finished construction and are now beginning to turn out spelter on a small scale. The Lanyon-Starr Smelting Company at Bartlesville, Okla., began operations during April. An important smelting center has therefore been created at this point, but owing to adverse conditions which have since developed, the three smelters have not been completed to their full capacity, which will be a total of 16 blocks.

The March disturbances in the stock market took the edge off the brisk movement in the spelter market. The requirements of brass manufacturers, owing to

the peculiar conditions which developed in the copper market, began to show a rapid falling off. As a result, larger quantities of spelter became available for galvanizing purposes, so that the pressure to sell gradually increased. Prices began to decline, at first slowly, but as the season advanced, the movement accumulated force and practically without reaction 4.90c. was reached about the middle of September.

High prices having ruled for such a long time, they had become more or less a habit, and as an outgrowth of it, it was generally assumed that the Joplin field could not furnish ore at a parity of a spelter price lower than 5c. St. Louis. As a seeming confirmation of this, production fell off rapidly when the smelters tried to buy ores at the equivalent of the lower spelter price. Consumers of spelter, recognizing this situation, drew the conclusion that bottom had been reached, and a very large buying movement developed on the part of galvanizers throughout the country, fostered by the unabated activity in the iron and steel business, which quickly carried the market back to 5.40c. St. Louis, which price was reached toward the middle of October. This advance proved to be short-lived, and when the October panic upset the iron and steel business and the demand from that quarter became almost nothing, spelter again started on its downward course, and the decline did not stop until the price had fallen to 3.97½c. St. Louis during the last few days of the year.

Again there was great apprehension in Joplin about the impossibility of making both ends meet, but it turned out that, as everywhere else, the Joplin producers learned to adjust themselves to the new conditions by cutting wages, reducing expenses and lowering royalties, so that as a result of the lower prices, the production was not curtailed to the extent that was anticipated two months previously.

With respect to the other mining camps, it is generally recognized that the calamine ores coming from Mexico cannot be taken out of the ground with spelter below 5c. During the tremendous fall in prices of the last few months, shipments from there have almost ceased. In Colorado too, the production of zinc ore has shrunk to about 30 per cent. of high-water mark, so that the reduced supplies of raw material are, of necessity, bringing about a readjustment in the production of spelter commensurate with the actual requirements of the country. Since the middle of November, furnaces everywhere have been shut down, and the production of spelter at the close of the year is probably not more than 60 per cent. of the highest figure reached during 1907. A number of the smelting works are still working up stocks of ore which they have been in the habit of carrying in normal times. When these stocks are exhausted,

the output of spelter will be still further curtailed, unless prices should improve in the interim. Meanwhile, the market has not been able to absorb the current production of spelter and during the last few months of the year a large stock has accumulated, which is variously estimated at from 25,000 to 35,000 tons.

The existing conditions render a rather gloomy outlook for the new year. Yet, as the year closes there are evidences that the undeniable fact of the great cheapness of the metal is impressing itself both on consumers and speculators. They recognize that as soon as a more normal state of affairs is felt in the large consuming centers, the quantity of spelter which can be profitably produced at the current prices will not be adequate to meet the requirements.

AVERAGE PRICE OF SPELTER

MONTH.	New York.		St. Louis.		London.	
	1906.	1907.	1906.	1907.	1906.	1907.
January....	6.487	6.732	6.337	6.582	28.225	27.125
February....	6.075	6.814	5.924	6.664	25.844	25.938
March.....	6.209	6.837	6.056	6.687	24.563	26.094
April.....	6.087	6.685	5.931	6.535	25.781	25.900
May.....	5.997	6.441	5.846	6.291	27.000	25.563
June.....	6.096	6.419	5.948	6.269	27.728	25.469
July.....	6.006	6.072	5.856	5.922	26.800	23.850
August.....	6.027	5.701	5.878	5.551	26.938	21.969
September..	6.216	5.236	6.056	5.086	27.563	21.050
October.....	6.222	5.430	6.070	5.280	28.075	21.781
November..	6.375	4.925	6.225	4.775	27.781	21.438
December...	6.593	4.254	6.443	4.104	27.938	20.075
Year.....	6.198	5.962	6.048	5.812	27.020	23.771

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

Spelter

BY WALTER RENTON INGALLS

In spite of the steady decline in the values of spelter and ore during the second half of 1907, and the financial catastrophe in October, the production of ore in the principal districts will show an increase. Up to Nov. 30 the shipments from the Joplin district amounted to 270,445 tons and from the Wisconsin field to 47,000 tons. The totals in 1906 were 278,930 and 42,130 tons, respectively. What might have been if it had not been for the set-back is manifested by the statistics for the first six months of 1907, which show shipments of 158,000 tons from Joplin and 25,000 tons from Wisconsin. Statistics for the districts west of the Rocky mountains are not yet available, but probably they will show an increase. On the other hand, the importation of ore from Mexico was completely checked when the price for spelter fell to 5c., St. Louis, in September. But little ore was brought in from British Columbia at any time, the supply in that province being blende. During 1907 all importations of zinc ore were made with payment of duty under protest, the decision of the Board of Appraisers having been appealed to the courts by the Gov-

ernment. A decision from the latter was expected early in the year, but owing to the illness of the judge before whom the case was argued it has not yet been rendered. In the meanwhile the smelters feel no doubt as to what the decision will be respecting calamine, wherefore large imports of that class of ore have been freely made; there is more doubt as to blende, wherefore the absence of imports from British Columbia. In any event, the experience of 1907 seems to show that these foreign ores are not serious competitors of the American, duty or no duty.

THE MARGIN ON JOPLIN ORE

During the early part of 1907 the margin on Joplin ore was strongly in favor of the smelters and they realized handsome profits, but in July, when the price for spelter began to fall off sharply, the margin diminished to less than the smelters should normally have in order to earn a fair return on their investment, and in subsequent months the margin fell to the point where there was no profit at all. The monthly figures are given in the following table, whereof the first column gives the value of 1020 lb. of spelter at St. Louis (85 per cent. of 1200 lb.), the second column the value of blende containing 60 per cent. zinc at Joplin, and the third column the difference, or margin.

Month.	Spelter.	Ore.	Margin.
January.....	\$67.14	\$46.90	\$20.24
February.....	67.97	48.30	19.67
March.....	68.21	49.75	18.46
April.....	66.66	49.25	17.41
May.....	64.17	46.90	17.27
June.....	63.94	47.00	16.94
July.....	60.40	46.80	13.60
August.....	56.62	44.56	12.06
September.....	51.88	41.00	10.88
October.....	53.86	41.75	12.11
November.....	48.71	38.60	10.11
December.....	41.86	31.50	10.36

CONDITIONS IN THE JOPLIN DISTRICT

The decline in the value of ore was felt keenly both in the Joplin district and in Wisconsin, where the market price fell below the actual cost of production in so far as a large proportion of the output is concerned. The difficulties of the situation were enhanced by the simultaneous decline in the value of lead ore. An attempt to check the decline by restriction of production by agreement among the Joplin operators was made in September, but although this had a temporary effect, it was of course ineffectual in combating the general industrial depression that was impending. In November, when it became a question with many operators either to close down or to reduce the cost of production, a reduction in wages was made, drill-runners, who had previously been receiving \$3 per eight hours, being reduced to \$2.50, while back-hands, who had been receiving \$2.25@2.50, were reduced to \$1.75@2, and muckers and trammers, who had been receiving 6@7c. per can (1000 lb.), was reduced to 4@5c. In all cases these reductions were received by the men in good humor, and indeed, in many cases the men themselves

proposed that the reductions should be made.

It is impossible to generalize the cost of production at Joplin, so many different factors entering into the consideration. The most important is, of course, the yield of the ore, after which are the factors of cost of mining and milling and the amount of royalty to be paid. Assuming that blende containing 60 per cent. zinc is worth \$40 per ton, and lead ore, \$42 per ton, and that one-sixth of a ton of lead ore is obtained with each ton of zinc ore, the gross value of the two concentrates is \$47 per ton. If a royalty of 20 per cent. is to be paid, the net value to the operator is \$37.60 per ton. If it be necessary to mine 33 tons of ore to obtain one ton of blende concentrate, i.e., to obtain a yield of about 3 per cent., and the cost of mining and milling be \$1.10 per ton, the total cost of production is \$36.30, leaving a profit of only \$1.30 for the mining and milling of 33 tons of ore, or only 4c. per ton of ore hoisted from the mine.

A good deal of ore was produced in 1907 under precisely the above conditions. On the other hand there was more or less concentrate produced from ore of a better grade, even up to a yield of 5 per cent., or at a lower royalty, or perhaps even at a little lower cost for mining and milling, which could be produced profitably at less than \$40 per ton for blende concentrate. It is obvious that a great drawback to mining in the Joplin district is the excessively high royalty that must be paid to the owners of the land. The methods of mining and milling in the district have been raised to a high degree of efficiency, especially the mining, and in respect to the amount of work done per man there are few mining districts in the world which surpass the Joplin district. In the matter of milling there is considerable room for further improvement, particularly in the reduction of losses. It is believed that the actual extraction from the ore of the sheet ground, which now furnishes nearly a half of the Joplin output, is about 65 per cent. on the average, which may be increased to 75 per cent. or possibly more, by only a small addition to the cost of the milling process. In this particular and in the readjustment of royalties lie the future prospects of the Joplin district if the price for ore continues low.

PRODUCTION IN THE ROCKY MOUNTAINS

The cost of producing zinc ore in the districts to the west of the Rocky mountains is quite variable and uncertain. In general the cost of mining is much higher than at Joplin, but also the crude ore is much higher in grade, although the component minerals are not so easily separated. Leadville, which is the largest single source of supply among these districts, began the production of zinc ore as a by-product, and only five years ago was glad

to sell any quantity of it at \$5 per ton, f.o.b. cars. Since then the zinc-lead ore originally mined, from which the blende was obtained as a by-product, has been largely exhausted and the recent production has been made chiefly from blende-pyrites from which a commercial grade of zinc ore cannot be so cheaply produced. In 1907 a good deal of Leadville zinc ore was sold on the formula of T--8 less a returning charge of \$15 per ton, basis Iola. However, other ores were bought at much lower terms, and indeed during the latter half of the year the only margin of profit to the smelters was on their purchases of Western ore. When the price of spelter fell to the neighborhood of 4c., St. Louis, a good many of the Leadville producers, including the Yak and the Western Mining Company found that there was no more profit in the business and suspended operations.

The great drawback to a large production of zinc ore in the Rocky mountains is the costliness of the processes required to bring the zinc concentrate up to good commercial grade. The first cost of a magnetic separating plant is high, and the operating cost also is high. The principal plants of this character are those of the Empire Zinc Company, at Cañon City, Colo., and of the American Zinc Extraction Company, at Leadville, Colo.; other plants in regular operation are those of the Colorado Zinc Company, at Denver, Colo., and the United States Zinc Company, at Pueblo, Colo. Outside of these plants, however, neither magnetic separation nor electrostatic separation has yet proved to be a great new source of ore supply. Of course this does not refer to Wisconsin.

PROCESSES OF SEPARATION

Some interesting new installations in this line were made in 1907. Among these was the completion of the mill at the Tiro General mine, at Charcos, in Mexico, where the Sutton-Steele pneumatic tables and dielectric separator are used. Magnetic separation was conducted on a large scale in Wisconsin, but in some cases it was found that the roasting-separating process was too expensive, and improvement is hoped from the electrostatic process, which is to be given another trial in Wisconsin. Danger of litigation over this process was eliminated in 1907 by the combination of the interests controlling the Blake and the Huff separators, which are now in the hands of parties connected with the American Zinc, Lead and Smelting Company.

At Broken Hill, New South Wales, the Potter and Delprat processes continued to be used successfully, especially by the Proprietary Company.

The articles reviewing the progress of mining in the Joplin district, together with the statistics of production, etc., will be found on pp. 90-92 of this issue.

Review of Metallurgical Progress in 1907

The Year's Developments and Improvements in the Practice of Smelting and Refining Gold, Silver, Lead, Copper and Zinc

SOME IMPORTANT ADVANCES

The year which has just closed has witnessed steady improvements in the metallurgy of the precious and common metals. While it is impossible at this early date to review carefully the nature and scope of all the developments of the year, some of the important features in connection with the metallurgy of gold, copper, lead and spelter are touched upon in the following articles.

Progress in Gold-ore Treatment During 1907

By ALFRED JAMES.*

It will not be possible for me to review the progress of gold-ore treatment for 1907 in as detailed a manner as is usual, owing to these notes being written while traveling some thousands of miles away from my base.

Fine sliming and the treatment of slimes is again the most interesting feature of the year's progress—even former exponents of coarse crushing are now converts to, and profit-takers of, modern slimes practice. From Eastern Asia to Western Australia and from South Africa to North America sliming methods are pre-eminent and have modified the other methods or processes employed in the industry, such as crushing to tube mills and roasting ores ground to very fine particles.

CRUSHING

We have heard less this year of "Pans vs. Tube Mills." Experiments in the Transvaal appear to have resulted in favor of the latter, and many more tube mills have been installed. With the heavy stamps previously referred to in these notes the Luipaards Vlei appears to have been able to output 8.5 tons per head per diem, but in Rhodesia I am advised that 10 tons per head is being obtained in more than one instance—crushing, however, to pans instead of to tube mills. In Rhodesia the practice differs from that on the Rand; with their much smaller installations pans are found to be more suitable, as being cheaper to install efficient, more convenient units and making less demand on power; consequently we hear of but few tube mills operating in Rhodesia. The pans thus used are of the West Australian type.

But tube mills have unquestionably been

improved in their *modus operandi*. Linings now last much longer and instead of having to lay off a mill every three weeks or so for a week for a new lining a mill can be run for three to six months with a lining placed in position in from two to three days. "Automatic" linings such as those of El Oro, where pebbles are supposed to fix themselves in rebates cast in iron liners, do not yet appear to have proved themselves entirely satisfactory, and changes have recently been made in the shape of the recesses, which now have their sides chamfered to each other.

The use of quartz or other reef matter to be crushed in place of imported pebbles has much increased, and this and the utilization of reef matter and local chert or other hard rock in linings of the Barry or Brown type have very materially reduced the cost of operating tube mills. In Africa a mill is started with a charge of pebbles containing say 10 per cent. of reef matter (stones), then in regular work it is found possible to reduce the daily feed of pebbles by 5 per cent., adding reef matter (stones) to balance until the daily feed contains only, say, 10 per cent of pebbles, the whole of the remainder being reef matter.

SLIME TREATMENT

It is in the treatment of the slimes produced by tube mills and otherwise that the progress of 1907 was most manifest. It may be regarded that the decantation process, which originated in Africa, and has so long survived there, has now had its day. Designed to treat material of low value, at that time not amenable to any method of treatment known to the industry, it resulted in profits being realized from material which otherwise must have run to waste. But the huge and expensive plant and low extraction had to give place to more modern automatic methods capable of cheaper equipment and higher saving, and already such well-known workers as J. R. Williams, W. A. Caldecott, E. J. Way, and H. S. Denny have been looking into methods employed elsewhere, notably the Ridgway, Butters, Burt and Merrill.

In my notes of last year reference was made to the new Denny plants at the Meyer & Charlton and the New Goch. The Denny brothers severed their connection with these two mines shortly afterward, but in spite of their absence filter-pressing appears to be regarded as successful by the heads of the group, although much doubt has been expressed

as to the wisdom of running cyanide solution through the mortar boxes. George Albu has criticized this as making it difficult to obtain the assay value of the mortar-box product, but I assume this point would not be regarded as serious if Mr. Albu were convinced he were obtaining a higher recovery of his gold. This discussion has been fully dealt with in another place.

On the Rand, however, the Denny methods have not been followed. Rhodesia on the contrary, having investigated the results, has had quite a Dehne filter-press boom, plant after plant having been installed during 1907.

VACUUM FILTERS

But undoubtedly filter-pressing even with Dehne presses must give way before the suction filters of which so much has been heard in 1907. Cheap and efficient, the daily tonnage handled by vacuum filters is increasing by leaps and bounds.

Of the various vacuum filters on the market I must unhesitatingly refer first to the Ridgway. This differs from the filters of the basket type in being more rapid, working with thinner cakes, giving better washing and emptying itself (automatically) in more cleanly fashion, than the basket filters. Working as it does with the whole cycle of operation complete in 60 seconds on normal slime pulp, it will be seen that difficulties of keeping material on cloths during transit of frames or during emptying and filling of tanks, which arise in other methods, are entirely avoided, while the washing of so thin a layer ($\frac{1}{4}$ to $\frac{3}{8}$ in. thick) is much more rapid and complete than the washing of a cake of double or treble the thickness. The Ridgway is thus able to work with a much smaller area of filter cloth for any given capacity.

During 1907 a 500-ton-a-day plant was put into successful operation at the Great Boulder in West Australia, and I understand another plant of similar capacity has already been started. Plants of similar and smaller capacities have been erected (or are in course of erection) in Mexico, India, South Africa, Eastern Asia, etc., and altogether we hear much of the Ridgway filter at the present moment.

The official figures of the West Australian Chamber of Mines show Ridgway to be working under expensive local conditions (purchased power, dear labor and supplies) for under 4d. per ton treated; in Africa the cost should be little more than half this.

*Consulting mining engineer, 2 Broad Street Place, London, E. C., England.

BUTTERS-CASSEL VS. MOORE.

The Butters-Cassel filter has been installed very largely in Mexico as well as in the United States, not perhaps because it was the best vacuum type of filter—the recently published correspondence shows the pioneer Moore to be at least the equal and probably the superior—but because it was pushed by a man of repute and of great energy who was recommending the best thing he could get hold of.

But in the recent correspondence in the technical papers it appeared to me that the only persons writing in favor of the Butters-Cassel filter were those who were, or had formerly been, associated with Butters, while the Moore was recommended time and again by persons in no way associated with Moore, who had installed it after investigation and who were apparently in no way connected—not even by paying royalties—to Moore or his associates. Certainly if the Moore process had been run with half the energy, experience, knowledge and skill of the Butters I cannot imagine the latter type of filter to be employed at all.

For it is obvious that the hoisting of a basket of frames is a much neater and better and quicker expedient than the pumping in and out of pulp and solution or wash, each successive charge being mixed with the residue of the previous charge whether of pulp or of solution—if used—or of water, and it is within the knowledge of men experienced in slimes filtration that the maintenance of a vacuum in a basket half immersed—or partially immersed for say four periods of 10 minutes each during each cycle of operations—does not make for good results. The lower portion of the cake is being thickened by pulp deposit while the upper is cracking from the inrush of air, an unequal cake is formed and the washing must be unequal and there seems to be a very great waste of water in discharging the cake after filtration. From the published correspondence it seems to be laid down without serious contradiction that the Moore is more accessible and open to inspection and that it does more work for a plant of given cost or in a given time.

Further modifications of the basket filter have appeared in the form of enclosed filters worked by pressure or vacuum, such as the Blaisdell, Burt, and Kelly. This form of filter is scarcely new and when tried some years ago proved itself unhandy, liable to freeze or choke, difficult to wash thoroughly and difficult to discharge—in a word it seems to be an attempt to work in the dark. Of course modifications of the standard immovable inclosed type are made; one runs the frame into a cylinder or runs the cylinder away from the frame; this makes the operation more accessible, but so far does not appear to be as successful as the pioneer basket type.

MERRILL'S PLANT.

Reverting, however, to filter presses, Merrill has at last got his big plant at work after three years labor. It appears now to be working to nearly its full capacity—according to my recent information—and to be treating slimes at a remarkably low rate. Advantage has been taken of every natural condition to make a successful working plant, and using static pressure to fill the presses and wash their charges, the Merrill costs are probably as low as any slimes treatment method yet put into practice. But my information is that with such a method the satisfactory treatment and hydraulic discharge of thick cakes in huge filter-presses is possible only with crystalline or granular slime pulp and with a great waste of water. In a word it appears that successful results may not be anticipated by the process on ordinary slimes pulp in ordinary gold fields under ordinary economic conditions; the thorough washing of 4-in. cakes is feasible only with crystalline, granular or readily permeable slimes pulp.

The successful handling of slimes pulp has also caused more attention to the solution of the gold contained therein. Last year I referred to the system of treatment based on feeding solution or wash water at the bottom of a tank, the slime contents of which were in a state of gentle agitation, the idea being an overflow of clear solution containing the gold content of the charge. W. L. Holms of Mexico City (late of Consolidated Gold Fields of South Africa) brought this to my notice some years ago, but it did not appear to make headway. Bewick, Moreing & Co. were working it in 1906 in West Australia, but evidently without commercial success; in 1907 Adair Usher boomed an apparently similar process in South Africa. Possibly some metallurgist at the Geldenhuis Deep or elsewhere may make something tangible out of the idea, but it looks as though the only result would be to call attention to the extra extraction obtained by the increased agitation of the pulp, and in this connection the work of the Brown agitator ought to be investigated carefully.

THE BROWN AGITATOR.

This apparatus, introduced into New Zealand at the Komata Reefs, depends on the principle of the lessened specific gravity of a center column into which air has been introduced at just such a pressure as will overcome the weight of the column of water at the point of introduction. There is no question of a jet of air circulating solution on the principle of the injector, but merely the physical lightening of the weight of a column by the displacement of a small proportion of the water by air.

Brown uses long narrow vertical (cylindrical) tanks of say 40x10-ft. or 55x15-

ft. with a center column of 1-in. diameter per 1-ft. of tank diameter. Into this central tube or column the air is introduced and agitation is so effective as to lift stones at perhaps the smallest horse power per ton agitated of any efficient mechanical agitator. The power taken appears to be about 2½ h.p. per 50 tons (slime) pulp charge, which is the slime content of a 40x10-ft. tank. By this method the advantage of the accelerating action of air agitation in certain ores is obtained at a small cost.

The use of these tanks has been offered to the Waihi—the manager of which speaks very highly of these agitators—and Waihi Grand Junction in New Zealand, and a number have been installed in Mexico under the name of the Pachuca agitator.

CYANIDATION OF SILVER-GOLD ORES.

The progress of cyanide treatment for the silver-gold ores of Mexico has been one of the features of the slime-boom. Chihuahua has been adopting cyanide with avidity, and Pachuca appears to be now coming into line. Of course El Oro has done pioneer work and Guanajuato has also been in the forefront.

In almost all instances the practice is similar, tube-mill sliming and treatment of the slime pulp at first by decantation, but now by basket or Ridgway filter. Very high extractions are claimed, but having regard to the natural refractoriness of silver sulphide ores—in some instances as at Chinacates associated with pyrites, chalcopyrite, galena and blende—one is impressed by the necessity of having recourse to the most modern practice, whether for getting the silver and gold into solution or for recovering the solution from the pulp for precipitation of the precious metal.

There is but little new either in roasting or concentration on gold ores this year. Merton and Edwards still hold the field for roasting, and the many flotation processes more or less (unfortunately with more of the less) successfully applied to the zinc-lead ores at Broken Hill, such as the Potter, Delprat, De Bavay, Cattermole and Elmore, do not yet appear to be successfully running at any gold mines known to me; although it is thought that the mechanical and metallurgical skill at the back of the Elmore process will bring it to the forefront during the coming year (1908).

Gold Dredging in 1907

By JOHN POWER HUTCHINS*

The year 1907 demonstrated most forcibly that dredging may not be successful even where very rich ground is encountered. It showed that the ma-

*Consulting mining engineer, 52 Broadway, New York.

chinery and methods which at Oroville, Cal., were successful in ground yielding less than 15c. per cubic yard, because of the extremely favorable environment, could thus far not be made to succeed in the rich but frozen gravel of the Klondike creeks. This demonstration has not been in the line of progress.

DREDGING FROZEN GROUND

Attempts have been made to dredge the frozen alluvion of Klondike from time to time since 1899, and considerable experience had shown not only the futility of attempting to excavate frozen gravel, which is very much like concrete in hardness, either with dredges or steam shovels, but had also shown that it was very difficult, slow and costly to thaw ground to prepare it for dredging. Without giving this experience proper weight, dredges were installed and a new means of thawing the ground was attempted. It was assumed that stripping the over-burden would result in progressive thawing to bedrock, even below water level.

This was an assumption and nothing more; no work has even been done in frozen gravel in Klondike or elsewhere that would justify the belief that such thawing would result. To be sure, where gravel is drained, as in open-cut mining by hand methods, progressive seasonal thawing takes place, and to bedrock, if it is not too deep; but no work has ever been done to show progressive and continued thawing below water level through the open season or from year to year. It was the belief among those not experienced in Arctic conditions that ground could be thawed in this way, and it was this belief, combined with enthusiasm aroused by the high gold content of Klondike gravel, that has made it necessary to chronicle defeat.

The problem of dredging frozen ground is in a most discouraging state. Attempts to dredge it without first thawing were complete failures, even though, as in the Klondike during 1907, large and powerful dredges were used. Attempts to thaw the ground showed that the process is so slow and so expensive as to make the cost prohibitive. An attempt is now being made to devise an electrical thawer; but at best this device can be no more than a partial success. Much of the ground that needs thawing is so deep and contains so many hard boulders that it is impossible to drive the points of either steam or electric thawers to bedrock without first drilling a hole.

It is time that some detailed investigations were made of the temperatures at various depths and different times of the year in the frozen alluvion of the far North. No work of this kind has ever been done except in a most superficial way. There is here an opportunity to acquire a mass of invaluable information that may result in success for the powerful dredges recently installed to work

ground under these conditions. At present they seem sure to be at least very disappointing as far as returns are concerned.

The investing public has much to guard against in making dredging investments. Since experience in Klondike shows that dredges can not operate successfully in frozen ground even when the gold content is high, the prospective investor should scan any proposed operation in arctic or antarctic zones with a proper amount of suspicion. As a general rule solidly frozen gravel can not be dredged profitably.

A few words more to the investor are apropos. A dredge operating in tropic South America and handling gravel yielding nearly \$1 per cubic yard has been a failure. To be sure the dredge was a very poor one, but the failure was in great degree due to the hostile conditions encountered. Dredging is extremely sensitive to environment; too great caution can not be exercised in investing in dredging propositions located where hostile environment is encountered.

SALTED-GROUND

Several flagrant attempts at "salting" dredging ground were made during 1907. It is easier to salt dredging ground than other placers, for the employment of a crew is necessary in sampling subaqueous alluvion. There may be dishonest members among the crew, and it may be extremely difficult to detect tampering with samples or apparatus. The constant exercise of the keenest watchfulness and the utmost caution is essential. A ripe experience and wide familiarity with placers on the part of the engineer conducting the investigation is the only absolute safeguard against salting. Engineers of the requisite knowledge and experience can detect any discrepancies likely to occur unless the salting is done by someone of very great intelligence and skill.

SEARCH FOR NEW AREAS

The dredging horizon was not materially widened during 1907. Investigation in Siberia seems to have developed a new dredging region. It is said that some successful dredging is being done in Lapland. Extensive investigation of tropic South America is being conducted, and this will be continued. It is probable that some good dredging ground will be found, particularly in Colombia, which has a total gold production of about \$900,000,000. Good dredging ground is very hard to find.

MISDIRECTED EXPLOITATION

The attempts to dredge frozen ground described in the foregoing paragraphs are excellent examples of misdirected exploitation. Similar undertakings on the frozen tundra near Nome will surely fail unless a new and cheaper method of

thawing can be evolved. A dredge now being installed in Dutch Guiana, though an excellent machine, is foredoomed to failure because of low gold content of the ground and hostile conditions and environment.

The success of dredging in a few favored fields has encouraged unscrupulous promoters to float dishonest schemes. There are several fake companies working, unfortunately, with success, to raise money to exploit new ground. The method is the usual one of circulating a large mass of literature supplied with illustrations in which the gold content of the California dredging fields is compared with that of the ground to be exploited. When no mention is made of the extreme difficulties to be met in installation and operation, this is essentially dishonest.

PROSPECTING DREDGING GROUND

No particularly new developments were made in prospecting, which is the essential preliminary operation in working ground by dredging. The methods and means are practically the same as last year. The drill and shaft methods still have their respective advantages for particular applications, recognized some years ago. Prospecting costs did not vary materially during 1907, and the same figures, \$1 to \$8 per foot for prospecting by shaft, and \$1 to \$2.50 per foot for drilling, are fairly representative where conditions are not difficult. The use of hand drills involves lower cost than steam drilling on inaccessible areas. Drilling shallow, easy alluvion with hand drills operated by cheap labor was done during 1907 for less than 25c. per foot.

No other kind of placer ground requires more careful prospecting than dredging ground. To be reliable the exploration must be conducted with the utmost care. In calculating the gold content of a large volume of material from that of comparatively few small samples every inaccuracy is magnified many times.

The total number of dredges installed on placer ground throughout the world was about the same as last year, namely, about 500. The California dredging fields are well supplied; at Oroville, in particular, few more dredges will be built except to replace the old ones which have outlived their usefulness.

VARIATION IN PRACTICE

Variations in practice and design were about as wide as ever. Lack of uniformity is still noticeable, particularly in the gold saving phase of the operation. In this respect New Zealand and California practices show as great a variation as ever. This is more remarkable when one recalls the fact that the gold of these two countries is practically identical in all features affecting recovery. Both the California method, which employs quicksilver, and that of New Zealand, which uses

cocoa matting, probably save more than 90 per cent. of the gold. It is fortunate that a large proportion of placer gold is easily saved; in fact, it is almost impossible not to save it. The portion not easily recovered is difficult to save. The general practice is, therefore, to work the dredges at a rapid rate, save the gold which is easily saved, and to let the rest go overboard. No systematic work on any considerable scale was done to determine the gold content of tailing.

DREDGE DESIGN

The year witnessed general progress in improving the design and strengthening the construction of dredges. Steel hulls have not been introduced for gold dredges in North America, though a larger amount of structural steel is used. Hulls of steel are used in tropical climates.

The water-power dredge used in New Zealand worked well, and it is claimed that ground formerly involving too great a cost is now worked at a large profit. Water is brought aboard under pressure from a gravity supply through an articulated steel pipe, and is applied to impact water wheels. There are several advantages in having water under heavy pressure available on the dredge. (1) More thorough washing in the screen with clean water is possible; (2) clean water runs over the gold-saving apparatus; (3) water can be used for breaking down high banks ahead of the dredge. It is only in exceptional cases that topographic and meteorologic circumstances permit the use of water in this way.

STEAM SHOVEL DREDGING

Dredging with the steam shovel, which is generally unsuccessful because of the immobility of the plant, was again carried on in Atlin during the year. The plant at this place has had the troubles inherent in installations of this sort, the disposal of tailing being particularly troublesome. A disinterested engineer of wide experience is said to have placed the operating cost at about 30 to 40c. per cubic yard.

DIFFICULTIES AT OROVILLE

The so-called "ideal" dredging region at Oroville, Cal., had a somewhat strenuous year. The dredgemen were harassed more or less by the Anti-debris Association, which insists that no water from the dredge ponds shall be permitted to reach the Feather river. Considerable damage was done by high water last February, the month of yearly floods. Two dredges owned by one company and operated in exposed positions instead of being landlocked and so protected, as they should have been, were completely wrecked. This does not mean that dredges can not be operated in very swift current, but it emphasizes the importance of foreseeing difficulties which come annually and regularly, and of guarding against them.

RESTORING DREDGED GROUND

While no large acreage was restored during the year, still interesting and instructive progress was made. James H. Leggett, of Oroville, whose efforts were most effective, transplanted fruit trees from before the dredges to the tailing piles behind them. He says that this can be done for less than \$5 per tree and that orange trees in particular produce better when growing in tailing than in virgin ground. Had this been known earlier, thousands of valuable trees might have been saved.

STANDARDIZATION

Progress toward standardization was marked during the year. One company owning a large acreage in California has selected the 7½-cu.ft. bucket dredge as the best size for its ground. All the dredges on the property are of this size, and those to be built in future will be of the same dimensions. Uniformity of size and design effects considerable economy. The dimensions adopted indicate a tendency toward the use of larger buckets.

The largest dredges, having buckets holding about one-half cu.yd., made no surprising reductions in operating cost during the year. Many operators still prefer the smaller buckets, the 5-cu.ft. bucket having a large number of advocates.

COSTS

Some unusually low operating costs were reported from New Zealand, but it is probable that these reduced figures resulted from cheap labor, cheap fuel, and cheap dredges, and were due, particularly, to the easy material encountered. The dredges now operating in New Zealand

Zinc Smelting in the United States in 1907

BY WALTER RENTON INGALLS

There was a large increase in the zinc-smelting capacity of the United States in 1907. The National Zinc Company, Bartlesville Zinc Company, and Lanyon-Starr Smelting Company, erected large plants in close proximity at Bartlesville, Okla. That place now ranks second to Iola in number of works and retorts. A new plant was erected by William Lanyon at Deering, Kan. This, together with his plant at Caney, was purchased during the year by the American Zinc, Lead and Smelting Company. The United Zinc and Chemical Company erected a small plant at Springfield, Ill. The works of Hegeler Bros. at Danville, Ill., were nearly completed but were not put into operation. James Latourette erected a small plant at Marion, Ind., especially for the treatment of galvanizers' dross.

Some additions to previously existing works were made. The Mineral Point Zinc Company, of Depue, Ill., was engaged in the installation of three additional furnaces, each of 800 retorts. The Grasselli Chemical Company added one furnace to its plant at Clarksburg, W. Va. Extensive additions were made to the works of the American Zinc, Lead and Smelting Company at Caney, Kan.

The total zinc capacity of the United States at the end of 1907 was approximately as shown in the accompanying table.

ZINC SMELTING CAPACITY OF THE UNITED STATES.

Name.	Location.	Furnaces.	Retorts.
Grasselli Chemical Co.	Clarksburg, W. Va.	10	5760
Matthiessen & Hegeler Zinc Co.	Lansalle, Ill.	5	4520
Illinois Zinc Co.	Perru, Ill.	7	4800
Sandoval Zinc Co.	Snadovol, Ill.	2	448
Mineral Point Zinc Co.	Depue, Ill.	6	4800
Hegeler Bros.	Danville, Ill.	2	1700
Edgar Zinc Co.	St. Louis, Mo.	9	2000
"	Cherryvale, Kan.	24	4800
Lanyon Zinc Co.	Iola, Kan.	5	3000
"	Iola, Kan.	5	3000
"	Iola, Kan.	5	3000
United Zinc and Chemical Co.	Iola, Kan.	4	2304
"	Iola, Kan.	2	a 480
"	Springfield, Ill.	2	640
Cockerill Zinc Co.	Iola, Kan.	5	3000
"	Iola, Kan.	3	1800
"	Altoona, Kan.	5	3000
"	Pittsburg, Kan.	3	672
"	Nevada, Mo.	2	448
"	Rich Hill, Mo.	2	448
Granby Mining and Smelting Co.	Neodesha, Kan.	6	3840
United States Zinc Co.	Pueblo, Colo.	6	a 1440
American Zinc, Lead and Smelting Co.	Caney, Kan.	6	3720
"	Deering, Kan.	6	3720
New Jersey Zinc Co.	Bethlehem, Penn.	3	672
"	Palmerton, Penn.	12	2400
Bertha Mineral Co.	Pulaski, Va.	10	1400
Prime Western Smelter Co.	Iola, Kan.	9	5344
"	Iola, Kan.	5	3220
Bartlesville Zinc Co.	Bartlesville, Okla.	6	3456
Pittsburg Zinc Co.	Pittsburg, Kan.	3	672
Lanyon-Starr Smelting Co.	Bartlesville, Okla.	6	3720
National Zinc Co.	Bartlesville, Okla.	4	2432
Chanute Zinc Co.	Chanute, Kan.	8	1600

a Rhensish furnaces, with muffles.

could not be used successfully in many parts of the so-called "ideal" Oroville district. They are too light and too weak.

GENERAL CONDITIONS IN 1907
During the early part of 1907, the margin on ores was quite satisfactory

to the smelters, so much so that the Collinsville Zinc Company contemplated putting its old plant at Collinsville, Ill., into operation again. The remarkable setback in the zinc industry in the latter half of the year, however reduced the margin to a narrow figure, and the tendency was strongly to put furnaces out of commission rather than to fire up old ones. Nevertheless, the old coal smelters at Rich Hill and Nevada, Mo., and two of the old works at Pittsburg, Kan., continued in operation on a small scale. The new life of these old works is based (1) on the increased cost of gas to many of the gas smelters, reducing materially the difference in cost between smelting with the two fuels; (2) on careful attention to the metallurgical work and the commercial side of the business; and (3) on the reduction of general expense to a very small figure by the direct attention of the proprietors.

With respect to the cost of smelting in general, it is now well known that the cost of natural gas to many of the smelters in Kansas, is so much that a coal smelter in Illinois is at least on equal terms, and perhaps on superior, if sulphuric acid be recovered as a by-product. There are still, however, some smelters, especially those at Caney, Deering, and Bartlesville, which are able to obtain natural gas at low figures. A smeltery in the natural gas field has the great attraction that its cost per ton of capacity is much less than that of a modern smeltery to use coal as fuel. The development of the industry in the United States is taking place precisely on the line that I predicted several years ago, namely, there is the installation of new plants at new points in the gas fields where the builders are willing to risk short life with the expectation of reaping quick and large profits; while on the other hand there is an increasing tendency to build more costly and more substantial plants in the coal fields of Illinois, where a permanent business may be expected.

As to the situation at Iola, it may be summed up in the statement that the smelters still have an adequate supply of gas. It has been predicted during each of the last four years that the next year would be the end, but the smelters still have sufficient gas to run the 42 blocks of furnaces of the district. Nevertheless, the opinions that were expressed four years ago were not incorrect. It is the fact that the old Iola pool, which was the original source of supply, has been exhausted, but new pools have been discovered to the north and west, from which these smelters have been obtaining their gas. This year some of the smelters united in putting down a deep, experimental well, in East Iola, to prospect for gas at a lower horizon. By the middle of November this had attained a depth of 2500 ft. and there was not

much hope that the prospecting would result successfully.

BARTLESVILLE ZINC COMPANY

The new works of 1907, especially two of those at Bartlesville, show some interesting modifications of previous practice. In most cases the distillation furnaces are Iola furnaces, with only four rows of retorts. The merits of the furnace with only four rows of retorts as against the older furnaces of five retorts in height now seem to be well established. The National Zinc Company has four furnaces, each of 608 retorts. The Bartlesville Zinc Company has six furnaces, each of 576 retorts. For roasting the sulphide ore both works have Zellweger furnaces, of which the National Zinc Company has two and the Bartlesville Zinc Company three. This furnace is now well established as the favorite for blende roasting in Kansas and Oklahoma, in spite of its enormous consumption of fuel.

The Bartlesville Zinc Company has a well equipped crushing and sampling mill, with a large cylindrical drier of good design and construction, which is commendably provided with a dust chamber.

The crushed ore is received in elevated storage bins of 4000 tons capacity in the aggregate. From these bins the ore goes to the roasting furnaces. From the latter a sunken tramway brings the roasted ore to a platform elevator, by which the cars are raised to be discharged into a series of elevated steel bins. From the latter the roasted ore is drawn into cars which convey it to the mixing house where the mixture with reduction material is effected by a Vapart mill. The Vapart mill discharges upon a conveyer which delivers into large cars to go to the distillation furnaces. A tramway extends in front of the inner ends of the furnace houses, and connection is made with the tracks running down in front of the furnaces by means of the ordinary transfer car. The charge cars are of wood, and extraordinarily large, there being only two per furnace, one for each side, which makes them rather unwieldy. Nothing is gained by so large a charge car.

The pottery is decidedly superior to the ordinary constructions in Kansas and Oklahoma. In the mill, the clay is crushed by means of a dry-pan. The clay is mixed in a taper-tub pug-mill and the retorts are formed by a Mehler hydraulic press. The condensers are made by a Vanatta & Stafford machine, which is now generally in use in Kansas and Oklahoma. The store rooms for the retorts are comprised in a two-story building of standard slow-burning mill construction, except for the roof. There are separate rooms, heated by steam, for the retorts, with an aggregate capacity for 10,000.

The pottery and crushing and sampling mills are driven directly by shafting from the engine-room. The latter contains electric generators, which supply electric power for use elsewhere in the works. The air for the distillation furnaces is supplied by two large fans, with a main leading to the furnaces in the usual manner. The draft for the roasting furnaces is provided by two Custodis chimneys, 120 ft. in height. The general layout of the works is good and shows a marked advance over that of many of the older Western smelteries; if any criticism is to be made, it might be said that the plant is rather too compact.

NATIONAL ZINC COMPANY

The works of the National Zinc Company, which has been designed by Otto Rissmann, is decidedly original in many features. The storage for ore and coal, the crushing mill, roasting furnaces, and mixing department are all contained in one large shed, of light steel construction. The crushing machinery is of the usual Kansas style. For drying the ore, there are two circular, plate driers, heated from below, upon which the ore is moved by a revolving stirrer, these driers being identical with those at the works of the United Zinc and Chemical Company at Iola. There are two Zellweger roasting furnaces. The hot ore delivered by the latter is elevated into two brick bins, one at the end of each furnace. Crushed calamine and reduction material are received in wooden bins nearby. The components of the charge are drawn from these bins and dumped into a Ransome mixer, which stands in a pit below the floor level. The mixed charge is delivered into a tub which is elevated from the pit by a traveling electric hoist, and by the latter is conveyed upon an overhead runway, extending by the ends of the distillation furnace houses, to the charge cars which are pushed out under this runway.

The charge is dropped into the charge cars, and the latter when filled are ready to be pushed down the tracks in front of the furnaces. This is a very simple system, which eliminates the construction of heavy trestles, the use of a transfer car, curves and switches, and other annoyances. It is a straight run from the mixer to the last furnace, and except for the overhead track, the only tramways in the works are the short pieces of track in front of each furnace, the track from the pottery, and the track for taking away the spelter; on the last a gasolene locomotive is to be used.

Another novel feature of these works is the arrangement of the blowers for the distillation furnaces. Instead of a large fan, with a long main from the engine room to the furnaces, each furnace has its own blower, or rather its pair of blowers because the installation

is made in duplicate, one to run by day and the other by night, placed in a shed at the end of each furnace house. These blowers, which are of Sturtevant manufacture, are driven by direct-connected electric motors. This system of forced draft is decidedly superior to the older system; if forced draft is to be used at all, this is the way it should be done; as to whether there is any advantage in forced draft over natural draft is another matter.

A further novelty in the works of the National Zinc Company is the design of the pottery. This building is entirely upon one floor, in fact the brick for the latter is laid directly on the ground. In the press-room it is necessary to have a pit for the press to stand in, but this pit is small and not particularly objectionable. The hydraulic pump and all the other apparatus are on the same floor with the top of the press. From the press, the molded retorts are taken to the drying rooms, which are a series of brick vaults with arched roofs. Each vault is 16 ft. wide and 65 ft. long in the clear, and holds 1000 retorts. The installation comprises 12 vaults. A wooden grating is laid on the main floor, the steam pipes extending under this grating. Down the center of each vault there is a track. The retorts are conveyed down an alley in front of the vaults on a transfer car, from which they are readily trammed into any of the vaults as required. This arrangement requires a good deal more ground space than the ordinary store house of two or three stories, but it is convenient, and if properly designed it is cheaper to carry a large weight per square foot, such as occurs in this kind of storage, on the ground than upon elevated floors.

SMELTING PRACTICE AT IOLA

At Iola several interesting experiments in details of the practice have been made. The United Zinc and Chemical Company is using prolongs on the condensers up to the first draw of metal and finds the additional recovery of metal effected thereby to be satisfactory. Prolongs were used in Kansas many years ago, but were abandoned as unprofitable. It is to be remarked, however, that now in smelting the Western ores, high in iron, it is found to be the best practice to bring the retorts quickly to a high temperature instead of slowly as in the case of the more docile Joplin ore. This, of course, is a good reason why it may be worth while to employ prolongs now where formerly it was not. At certain works, Leadville ore assaying 40 per cent. zinc, 17 per cent. iron and 4 per cent. lead is received, and after roasting is smelted without admixture of any other ore. Of course, this means about 20 per cent. of iron in the roasted ore. In some cases mixtures of ores are made to reduce the iron content of the average, but in other

cases ores are smelted as they come, and we find certain works with every furnace on a different charge. An interesting experience was noted in an attempt to smelt a peculiar ore from Aspen. This ore contained 10 per cent. of lime, 5 per cent. of baryta, and 2 per cent. of magnesia. All attempts to work it failed. It was found that the zinc content of the ore would reduce satisfactorily, but the vapor burned away as oxide, which was perhaps the result of too much carbon dioxide in the gas and too strong a development of gas.

SMELTING WESTERN ORES

In smelting Western ores containing about 12 per cent. of iron, the daily loss of retorts is about 4 per cent. Ore assaying 40 per cent. zinc yields 75 to 80 per cent. of its metal. Nearly all the works now have hydraulic presses for the manufacture of retorts, and condensers are generally made with the aid of the Vanatta & Stafford machine, which is simple, efficient and economical. This machine costs \$1000 including royalty. With it one man and helper make 1000 to 1100 condensers per day at a contract price of \$0.60 per 100, against the former price of \$1 per 100 by hand work.

The retorts used at a certain works are 15/16 to 1/8 in. in thickness of wall and 8 to 8 1/2 in. in internal diameter, the larger figures in each case arising from the gradual wear of the die of the press. The Queneau composite retorts are still being tried at one of the works of the Prime Western Spelter Company. They are said to show a little longer life than the ordinary retorts, but to be of doubtful advantage. It seems to be impossible by this system of manufacture to give the retorts an even lining, and difference in the coefficient of expansion of the lining and the outer portion of the retort tends to crack them. At the best the benefit of their increased durability appears to be insufficient to outweigh their increased cost, at least not to any important extent.

Experiments with the Greenawalt porous-hearth roaster at the Prime Western works proved a failure and the furnace has been remodeled so as to run as an ordinary straight-line mechanical reverberatory. The difficulty was in maintaining an even passage of air through the hearth, the latter becoming clogged by ore that had any particular tendency to sinter.

Several of the works at Iola which use Western ore pay a good deal of attention to the residues, which are shipped back to Colorado to the lead smelters and constitute an important by-product. At one works the surplus of reduction material is simply screened out. At another works the residues are run over a Hancock jig, which takes out the surplus of reduction material. The latter is used again in making up the furnace charge, for which

purpose it is found to be sufficiently clean. As a reduction material Spadra semi-anthracite is commonly employed. The proportion is about 50 to 55 per cent. of the weight of the ore, but in one case is as low as 40 per cent.

CONSUMPTION OF NATURAL GAS

With the increased cost of gas, more attention is paid to economy in its use. In several cases the consumption has been metered for test. The figures for an ordinary block range from 630,000 to 750,000 cu.ft. per day. In round numbers this is 40,000 to 50,000 cu.ft. per ton of raw sulphide ore, or 48,000 to 60,000 cu.ft. per ton of roasted ore or calamine. I do not know of any measurements in the case of the roasting furnaces commonly used. In the case of a well designed roasting furnace the consumption was about 4500 cu.ft. per ton of raw ore, which is a reasonable figure, but the Zellweger furnaces are very extravagant of gas. Probably they consume 30,000 to 40,000 cu.ft. per ton of raw ore.

This is an important matter now that gas is becoming more and more costly. According to the report of the U. S. Geological Survey, the average value of the gas consumed by zinc smelters in Kansas, in 1906, was 1.8c. per 1000 cu. ft., the cost ranging from 1 to 3c. per 1000 cu.ft. These figures appear to be nearly correct. They are none too high.

SMELTERS IN ILLINOIS

Among the Eastern works, those of the Illinois Zinc Company, at Peru, Ill., have recently been reconstructed to a large extent, especially with a view to affording more economical handling of material, better furnace design, and increased safety against fire. All of the distillation furnaces at these works are now of the Neureuther-Siemens design. The gas is furnished by Swindell producers. The old Taylor producers have been modified into approximately the Swindell form. With the badly clinkering coal of this district, the producer with a sloping grate, which gives access to the bed of fuel from below, affords better results than the water-sealed producer without a grate. The roasting furnaces are Hegelers with regenerative gas firing. Mr. Noon has done excellent work in remodeling this old plant, which ranks now among the most efficient of American zinc-smelting works.

At the works of Matthiessen & Hegeler, at LaSalle, there has been but little change during several years. The furnaces which were formerly five rows of retorts in height have been increased to six rows in height. Consequently the tendency at these works and at the various works in Kansas has been directly opposite. The large furnaces previously noted which had 1008 retorts, arranged

in 21 sections, has been cut down to 18 sections, or 864 retorts. It is said that beyond the latter number the limit of capacity of the furnace crew was exceeded. The furnace equipped with a hot-gas blower between the battery of producers and the furnace is sometimes worked with the blower, sometimes without it; it is said that there is no particular advantage in the blower, the furnace running equally well when the latter is cut out for repairs, etc. The producers are blown with air only.

The works of the Mineral Point Zinc Company, at Depue, Ill., have six Neureuther-Siemens furnaces, arranged end to end, three in a house. Each furnace has 800 retorts. The working floor of the furnaces is elevated above the ground in the modern way, but in this case the height is extraordinary. The gas is furnished by Duff producers, which stand in a house between the two furnace houses. The roasting furnaces are Hegelers, two in number, both gas-fired, one of them regeneratively. Sulphuric acid is made from the roast-gas by the Grillo-Schroeder contact process. The Depue plant is one of magnificent distances, in this respect surpassing even Palmerton.

The three works at Lasalle, Peru, and Depue, are fine object lessons in respect to the sulphur smoke problem. Each of them converts all of its sulphurous gas into acid, while the use of gas-fired furnaces largely eliminates the nuisance of black coal smoke. In close proximity to the Matthiessen & Hegeler works, particularly, there are fine lawns and gardens, and magnificent shade trees, which flourish as if there were no smelting within 100 miles.

The Metallurgy of Lead in 1907

BY WALTER RENTON INGALLS

No new lead-smelting works of large capacity were erected in 1907, although one or two small plants were put up, and metallurgical practice pursued the even tenor of its way. The art of lead smelting is by no means a perfect one, but in the long experience at Denver, Pueblo, Leadville and Salt Lake City it has been developed to a high degree of efficiency both in respect to smelting cost and to extraction of the metal.

The great improvement during recent years has been the introduction of the Huntington-Heberlein and Savelsberg processes, which were introduced originally as lime-roasting processes, but in the plants of the American Smelting and Refining Company, at least, have been modified into simple processes of "pot-roasting." There is, perhaps, some doubt as to whether in making this change some advantages of "lime roasting" have not been lost sight of.

THE HUNTINGTON-HEBERLEIN PROCESS

As installed at Murray, Utah, as also, I believe, at the other plants of the American Smelting and Refining Company, the Huntington-Heberlein process presents only a general resemblance to the early application of that process. Whatever part lime may play in the Savelsberg and Carmichael-Bradford processes, in the modern American process of pot-roasting it appears to be a very subordinate factor, if it be a factor at all. Recent experiment and practice seem to show that the rapidity of the desulphurization in pot-roasting is due simply to the more efficient oxidation by blowing air through the charge and that the condition of successful operation is simply a matter of mixing with the sulphide ore a proper proportion of diluent. Under certain conditions even that may be unnecessary, although in pot-roasting proper it appears to be; indeed a good deal of care seems to be required to compound the charge to the best advantage, and there is considerable variation in the time and degree of desulphurization of different ores.

At the Murray plant there are five Heberlein roasting furnaces and 25 pots, the latter being of the standard size—9 ft. in diameter. On the average a charge of nine tons of ore is desulphurized in 12 hours, and the whole installation is attended by only six men on the pot floor. Considering the relatively small space occupied by this installation the large roasting capacity, and the few men required, and turning to an installation of hand-operated reverberatory furnaces of the same capacity, the advantage of the pot-roasting plant is impressive.

As operated by the American Smelting and Refining Company, the pots are cast with long, heavy trunnions by which they are supported on open bearings, and are not fixed in position as in other installations. The pot sets down in a masonry pit, the rim being a foot or so above the brick working floor of the department. The pots are arranged in two parallel rows and are handled by a traveling crane which spans the working floor and travels lengthwise, just as in a copper smelter. An empty pot being in position, the crane brings down a car full of hot calcines which is dumped into the pot as the "priming" charge and a light blast is turned on. Then the crane brings a pot full of damp semi-roasted ore from the Heberlein furnaces, which is dumped into the pot that is being prepared. It will be observed that the charge is no longer introduced in layers, but is put in at one time. After the surface has been leveled off the full blast, about 12 oz., is turned on (the valve in the air pipe being convenient to the pot), the cover is put on, connection with the smoke pipe is made and the operation proceeds. A heavy smoke of sulphur dioxide comes off immediately. The only attention that

is afterward required by the charge is an occasional tamping down of blow holes.

When the charge is finished it glows on the surface like a smoldering fire on a grate with live coals shining amid the ashes. The cover is then lifted off by the crane. Next, hooks are caused to catch upon the projecting trunnions of the pot and the latter is lifted clear of its pit and partially tipped above the floor in front of the pit. This is to discharge the portion of the surface which has not been fused and is not completely desulphurized. The proportion of this fine material is very small. It is returned to the next charge, being spread out on top of the priming charge. The pot of finished charge is then restored to normal position and carried by the crane to the breaking floor at the end of the department. There it is inverted, the cake of desulphurized ore dropping out and breaking as it falls upon the floor. At one side of the breaking floor there is a 24x36-in. Blake breaker for the further reduction of the lumps. The lumps that are too big to go into the breaker are lifted by the crane and dropped again. The floor of the breaking floor is laid with steel rails set close together. Four men per shift do the work upon the breaking floor.

This is certainly a very simple and efficient method of handling the large cakes of semi-fused ore, which in some other installations had been found troublesome and expensive. Indeed, whereas in certain plants there has been no economy in the Huntington-Heberlein process as compared with ordinary roasting in so far as direct operating expense is concerned, as practised at Murray the saving is obviously important. As used at Murray the pot-roasting process is not confined to galena ore but is applied to all kinds of sulphide ore, but not to matte. Also charges of all kinds of sulphide ore are worked by direct blowing (without any preliminary roasting) with satisfactory results. The desulphurized ore handled in the way described above naturally contains more fines than where it is screened after breaking and all the fines returned to a subsequent charge.

ECONOMIC RESULTS OF THE H-H PROCESS.

The use of the Huntington-Heberlein process at the Murray plant has materially reduced the cost of roasting. As to the matter of lead and silver losses there appears to be some uncertainty. Not so, however, with respect to the blast-furnace operations. Although the proportion of H-H material used in the charge for the latter is comparatively small, being only 12 to 15 per cent. of the charge, the capacity of a 48x168-in. furnace has been increased from about 175 tons to about 200 tons per day, these being average figures. In a single day as much as 250 tons has been smelted by one furnace. However, the average of 200 tons, day in and day

out, with the silicious, rather slow-running slag that is made is certainly a highly satisfactory result. The charge for the furnaces averages about 12 per cent. lead, with an ordinary range of 9 to 14 per cent., and 7 to 16 per cent. as the extremes. The charge contains ordinarily about 80 per cent. of ore, the remainder being fluxes, between-products, etc.

A NEW SYSTEM AT THE U. S. PLANT

The lead smeltery of the United States company at Bingham Junction, near Salt Lake, has 15 hand-operated roasting furnaces of the standard design, which roast 12 tons of ore per day, or 15 tons of matte. An experimental installation of what may be called blast-roasters was made in 1907 after the design of Cyrus Robinson. These are a modification of the principle employed in the Huntington-Heberlein process. Instead of an installation of pots, however, there is a series of upright box-shape furnaces of cast iron with large doors opening on two opposite sides. The proper mixture of ore is charged in at the top, falling upon the grate in the lower part of the furnace. Air is then turned on and the operation conducted as in the Huntington-Heberlein process. In the top of the furnace there are suitable doors for observation, tamping down blowholes, etc. When the blow is completed, the doors on both sides are opened and the cake of desulphurized ore is pushed out by a traveling ram in a manner quite similar to that whereby coke is discharged from a retort-oven. The advantage of this system is not quite obvious; it is doubtful if the battery can be handled by any fewer men than the pots worked by a crane according to the system of the American Smelting and Refining Company, while the cake will probably be as troublesome to break up as in the original Huntington-Heberlein system.

FUME FILTRATION

In connection with the renewal of attention to the advantages of fume filtration through cotton bags, which I remarked in my review last year, it is interesting to note that both the American Smelting and Refining Company and the United States Smelting Company installed bag houses at their works near Salt Lake City in 1907. It must be mentioned, however, that in each case the primary object was to ameliorate the smoke nuisance and thus satisfy the agriculturists of the surrounding district. Nevertheless in both cases the bag houses will doubtless prove to be economical additions from the strictly metallurgical standpoint.

At the works of the United States Smelting Company the bag house has been connected to the end of the former flue-system. It is of the conventional design, comprising 2200 bags, each 18 in.x

30 ft., which are arranged in five sections, each section having three dust-collecting cellars below the nipple-floor. The bag sections are arranged so that any one can be cut out for shaking the bags. The filtered gas passes into a sheet-iron flue running longitudinally on the roof of the building, which comes down at one end of the chimney and then connects with the chimney. Of course there is no longer any black smoke discharged from these works, except from the boiler house. It is anticipated that the burned fume collected from the bag house will amount to approximately 1 per cent. of the charge smelted in the furnaces, or 10 tons per day. The treatment of this fume has not yet been worked out. It is high in lead and also high in arsenic, running 30 to 35 per cent. in the latter element, the high proportion of which is probably due to the Eureka ore.

The gas entering the bag house is 175 to 180 deg. F. in temperature, which in comparison with the conditions at the Globe works at Denver is low, but is not low considering that the furnaces are open at the top. Filtering bags can be operated at a considerably lower temperature (*vide* the practice at the Murray plant of the American Smelting and Refining Company) without incurring trouble from condensation of moisture. The fan moving the gas requires 90 h.p. and works against a pressure of 1 in. of water, which varies of course with the condition of the bags as to dust accumulation, shaking, etc. The total of 2200 bags gives about 310,860 sq.ft. of filtering area, or a little over 50,000 sq.ft. per furnace or 300 sq.ft. per ton of charge smelted. Under the conditions of operation at the United States plant this appears to offer considerable lee-way. In other words there is at present more than ample filtering capacity.

At the Murray plant the bag house is a brick building, 100x216 ft., of the usual construction, the design, arrangement of the bags, etc., being similar to the bag house at the Globe works, Denver, Colo. The Murray installation has 4160 bags, 30 ft. long and 18 in. in diameter, grouped in four sections, any one of which may be isolated for shaking the bags, etc. The gas is taken from the long flue system of the works and delivered to the bag house by an 18x6-ft. fan, handling 250,00 cu.ft. of gas per min., at a pressure of about 1 in. of water, requiring 125 h.p. The temperature of the gas is low, being only 120 to 160 deg. F., the gas cooling to that point during its passage through the long flue which formerly conveyed it to the chimney. The bag house is surmounted by four steel chimneys, the tops being 175 ft. above the ground, which discharge the filtered gas. Notwithstanding the low temperature of the gas passing through the bags, the latter do not be-

come soggy from the condensation of moisture. The cost of the bag house was approximately \$150,000.

DUST FLUE—BLOWERS

Aside from the new features of the Murray plant which have been noted above, it is sufficient to call attention to the unsatisfactory result of the concrete dust flues, which crack and disintegrate under the action of the heat and sulphur compounds in the gas; and the addition of a No. 10 rotary blower to the power house, which was provided originally with four piston blowers. The blast furnaces are operated with 36 oz. pressure. The introduction of the rotary blower here, as at other works, indicates that the piston blower has gone quite out of fashion for the production of blast of that moderate pressure, simply for the reason that the rotary blower is more economical. If the piston blower still has its advocates they are few in number.

At the United States smeltery also it is worthy of remark that whereas the original installation consisted of piston blowers, the recent additions to the plant have been rotary blowers—Connersville and Roots—direct connected with the engines. The blowers for the lead-smelting furnaces are entirely rotaries.

LEAD SMELTING IN MISSOURI AND ILLINOIS

In southeastern Missouri the Savelsberg process was introduced at Herculaneum by the St. Joseph Lead Company, which installed a five-pot plant. It was given successful results, both as to reduction in metal loss and expense of desulphurization, and the plant is to be increased in capacity. At the Alton smeltery of the Federal Lead Company, Huntington-Heberlein pots are used with success, but they have not displaced the Scotch-hearth bag-house process, which is hard to beat. However, the Scotch hearths are difficult to run during the four hot months of the year, the exposure of the men being severe, and during that period another method is useful. At the Collinsville smeltery of the St. Louis Smelting and Refining Company, the Scotch-hearth bag-house process alone is still used. This process is so highly efficient that the extraction of lead at Collinsville is 98½ per cent., figured on periods of six months, all calculations being based on the actual lead content of the ore as shown by wet assay. At Alton the extraction is 98 to 98½ per cent.

The lead produced at Collinsville, although chiefly from the galena concentrate of southeastern Missouri and consequently low in silver (only 2 or 3 oz. per ton), is refined by the Parkes process for the purpose of producing a high grade of lead for corroding purpo-

ses. The silver content of the work-lead being so low only one zinking is required. This reduces the silver to $\frac{1}{8}$ oz. and eliminates the copper entirely. The refined lead is extraordinarily pure, assaying 99.99 per cent. The cost of this desilverization and refining is just about offset by the small amount of silver extracted and the increase in the value of the lead by the improvement of its quality.

The Metallurgy of Copper in 1907

BY WALTER RENTON INGALLS

No new copper-smelting works of any great consequence were completed in 1907. The Garfield works were ready to go into operation at the end of 1906, and were operated continuously throughout 1907. In the latter half of 1907 the doubling of the capacity of this plant was begun; the additions will be completed early in 1908, when the plant will be capable of smelting 2500 tons of ore per day. The only new plant of great importance to go into operation in 1907 was at Chrome, N. J., where the United States Metals Refining Company added a smeltery to its refinery.

The other important plants of 1907, viz., the Balaklala in Shasta county, Cal., the Imperial at Sasco, Ariz., and the Steptoe at McGill, Nev., were not completed at the end of the year, but it is expected that each of them will be in operation during the first half of 1908. The Balaklala and Imperial works are ordinary blast-furnace plants. The Steptoe, like the Garfield, is a reverberatory-furnace plant, with, of course, blast furnaces as a necessary accessory. The Steptoe works, which will be capable of smelting 1000 tons of concentrate per day, will be one of the great metallurgical establishments of the United States.

BLAST FURNACES VS. REVERBERATORIES

It is particularly noteworthy that the most important of the new copper-smelting works of the United States have both been reverberatory-furnace plants, but both have been provided with a certain number of blast furnaces. This shows the tendency of present smelting practice, viz., to erect combination plants. Several of the older blast-furnace plants have installed reverberatory furnaces as accessories. The modern smelting works may be considered a combination plant in which smelting in the blast furnace or smelting in the reverberatory furnace will predominate according to the character of the ore. In some cases the capacity for smelting either way will be about equal, which probably will be the case for smelting under such conditions at Salt Lake city.

The reverberatory furnaces of the newer

works are uniformly of the large dimensions, viz., about 112x19 ft., introduced originally at the Washoe works at Anaconda, Mont. However, at the Butte Reduction Works, at Butte, Mont., the furnaces have recently been rebuilt to increased size, but only to 80 ft. length. As to the blast furnaces there appears to be some hesitation about following the lead of Mr. Mathewson at Anaconda in constructing extremely long furnaces. At Garfield and Steptoe the furnaces are only 20 ft. in length. They are set end to end so that they may be united as one very long furnace at some future date, but either from the desire to go slowly in making this innovation or because the ore supply at present is insufficient, the enlargement is delayed.

THE GARFIELD WORKS

The Garfield works, when completed, will consist of six reverberatories 112x19 ft., and four blast furnaces, 20x4 ft. Each of the reverberatories has two 350-h.p. Stirling waste-heat boilers, arranged in tandem. There will be 24 MacDougall furnaces and 25 Huntington-Heberlein pots for desulphurizing and sintering the ore. There are to be 10 converters, 8x11½ ft. The air for the blast furnaces is furnished by rotary blowers; for the converters by cross-compound piston blowers. The draft for all the furnaces in the works is furnished by a single chimney 300 ft. high, 30 ft. in diameter inside at the top and 42 ft. 6 in. in diameter outside, at the bottom. The flues lead uphill to the base of the chimney, the rise being such that the top of the chimney is about 500 ft. above the furnaces. The system of flues leading to the chimney is very elaborate.

THE STEPTOE VALLEY MILL AND SMELTER

This plant follows the plan of the Washoe smelter in having the concentrating mill and smeltery proper in close association. The concentrating mill will have a capacity for the treatment of 4000 tons of crude ore per day. The smelter proper may be rated as of 1000 tons daily capacity. The leading features of this plant are the complete separation of the various departments; the drafting of each set of furnaces through independent flues and chimneys and the simplification of the transportation of ore and material among the various departments. There will be sixteen 18-ft. MacDougall roasting furnaces, three reverberatory smelting furnaces, each 112x19 ft. and one blast furnace 42 in. by 20 ft. The converting department comprises three 96x150-in., electrically operated converters. Each of the reverberatory furnaces is provided with two 400-h.p. boilers arranged in parallel, of course with suitable by-passes. This appears to be preferable to the tandem arrangement which obtains in many plants. The plans for the Steptoe smelter contemplate the eventual installation of 32

roasting furnaces and six reverberatories. It is foreseen that some day there may be a direct line of railway from Ely to Tonopah and Goldfield, which will make Ely a great custom smelting center. Indeed, it is rumored that the survey for this line will be begun early in 1908.

IMPROVEMENTS IN THE ART

Perhaps the most important improvement in 1907 was the introduction of pot-roasting for the desulphurization and sintering of semi-roasted pyrites at the Garfield works. At this plant there are 25 pots of the standard size, each of which desulphurizes and sinters three charges of seven tons each per 24 hours, making a product with 3 to 4 per cent. sulphur. They start with ore burned down to about 12 per cent. sulphur in the MacDougall furnaces. The hot, semi-calcines from the latter are discharged into bins, from which they can be chuted into water in a pot for moistening. Then they are taken in that pot by a traveling crane and dumped on the priming charge in the pot to be blown. The pots stand in a row and are handled by an overhead traveling crane. The sintered cake is dumped on the breaking floor at the end of the line of pots and with the aid of a crew of four men is broken up sufficiently to pass through a 24x36-in. Blake crusher. The product from the crusher is removed by conveying belts, elevators, etc., to the bins for the blast furnaces. The ore sintered in this way is an excellent material for the blast furnace, but the breaking by means of crushers produces considerable fines, wherefore the full advantage of the coarseness of the material prepared by the pot-roasting process is not realized in the blast furnace.

The successful introduction of this process, together with the probability of the appearance of an improved method of sintering sulphide fines, which is now being experimented with, may alter the present opinion as to the relative efficiency of the blast furnace and reverberatory furnace. By the desulphurization of the ore to a low degree and its conversion into lump form a more rapid smelting in the blast furnace is enabled, together with the release of an increased amount of iron for fluxing purposes. The displacement of the reverberatory furnace is not to be predicted, but it is probable that the blast furnace will come again more prominently to the front.

At the works of the Greene-Cananea company experiments were made with coal-dust firing for the reverberatory furnaces. Although some unexpected difficulties were encountered, it was considered probable that they would be overcome and that this method of firing would increase the capacity of the furnaces and reduce the consumption of coal. Unfortunately these experiments were interrupted by the closing down of the works.

At many other works improvements in detail, more or less important, were made, but there were no radical innovations.

The Iron and Steel Industry in 1907

A Year of Unexampled Prosperity and Immense Production, Ending in Partial Collapse. Output in United States and Foreign Countries

PIG IRON — 25,975,944 TONS

The period of unexampled activity and prosperity in iron and steel which has marked the past four years came to an end in the later months of 1907, and a decline has begun, the full extent of which is not yet apparent. In the wave-curve which has marked the progress of the industry for many years, however, each successive rising wave, or upward movement, has gone to a higher level; and, on the other hand the receding wave, or period of depression, has failed to reach the low point of its predecessor. At the present time there is hope that the depression of 1907-1908 will be less marked than any of former years, and of briefer duration. The growth of the United States in population and material resources has been so great as to warrant the belief that the demand for iron and steel will not again fall to the low point of 1893 and the following years. It may be also that the facilities for securing export trade and supplying foreign demand which now exist may, to some extent, offset the temporary diminution in home consumption.

Iron and Steel Production in 1907

BY FREDERICK HOBART

The record of 1907 shows a half-year or more of extraordinary production and consumption, followed by a period during which doubt and apprehension began to be felt, though production continued at a high level; and during the closing quarter a sharp and sudden contraction.

IRON ORE

The production of iron ore again showed a considerable increase, of 8.3 per cent. Nearly all of this gain came from the Lake Superior region, our chief reliance for the supply of raw material. In that region work was pushed actively, not only on the production and shipment of ore, but on exploration, development and other preparations for a much greater output in the future. Conditions in that district are described in a separate article. Lake ores last year furnished over 80 per cent. of the raw material for our furnaces.

The estimated production of iron ore was as follows:

	1906.	1907.	Changes.
Lake Superior....	38,522,239	42,288,755	I. 3,766,516
Southern States..	6,350,000	6,450,000	I. 100,000
Eastern States....	2,640,000	2,750,000	I. 110,000
Western States....	910,100	930,000	I. 19,900
Total.....	48,422,339	52,418,755	I. 3,996,416
Imports.....	1,060,390	1,266,000	I. 205,610
Total Supply....	49,482,729	53,684,755	I. 4,202,026
Exports.....	265,240	270,000	I. 4,760
App. consumption	49,217,489	53,414,755	I. 4,197,266

This would show an apparent consumption of 1.94 tons of ore per ton of pig iron made in 1906; and 2.06 tons in 1907. It is probable, however, that a part of the late shipments from the Lake Superior region, owing to the blowing out of furnaces, will go into stock-piles and not into consumption. This quantity cannot be ascertained until later, but it is variously estimated at from 2,500,000 to 3,000,000 tons. The latter figure is probably nearer the truth; if we deduct this from the figure above, it would bring down the consumption of ore per ton of pig iron to 1.96 tons, or very nearly the same as in 1906.

The shipments from the Lake Superior region, by ports, for two seasons, have been as follows:

	1906.	1907.	Changes.
Escanaba.....	5,851,095	5,761,988	D. 89,107
Marquette.....	2,791,033	3,013,826	I. 222,793
Ashland.....	3,388,111	3,437,672	I. 49,561
Two Harbors....	8,180,128	8,188,906	I. 8,778
Superior.....	6,083,057	7,440,386	I. 1,357,329
Duluth.....	11,220,218	13,445,977	I. 2,225,759
Total Lake.....	37,513,642	41,288,755	I. 3,775,113
Rail.....	1,008,597	1,000,000	D. 8,597
Total.....	38,522,239	42,288,755	I. 3,766,516

The distribution by ranges is not yet complete. Escanaba and Marquette are the shipping ports for the Marquette and the Menominee ranges; Ashland for the Gogebic. Two Harbors takes the ore from the Vermillion range and a part of the Mesabi; while the docks at Superior and Duluth are supplied entirely from the Mesabi range. The rail shipments come from all ranges; they go to Zenith furnace at Duluth, to the furnaces at Marquette, Gladstone, St. Ignace and other points in Michigan and Wisconsin.

Next to the Lake Superior region, the largest production is in the South, where also are found the greatest ore reserves. Indeed the ore deposits of Alabama, Tennessee and Georgia are believed to exceed in quantity those of the Lake country. While the actual gain in ore mined was not very large in 1907, considerable development work was done and many improvements in the way of machinery were made, in preparation for a larger output.

In the East, New York is the largest producer. In the Hudson River and Lake Champlain districts there was little change, but in the Adirondack region there was a gain, especially at Chateaugay, Lyon Mountain and Mineville. Pennsylvania follows New York closely, but with little change in output. The old mines of New Jersey held their own, burning out nearly 600,000 tons of ore.

In the West the production was from widely scattered regions. The Wyoming mines made the best showing. These and

the iron region of southern Utah, which has been hardly touched yet, afford the best promise for the future.

Limestone Flux—The production of limestone and dolomite for use as flux in iron blast furnaces in 1907 is estimated at 14,925,000 long tons. Dolomite is used chiefly at the Alabama furnaces; limestone being the usual flux elsewhere.

Manganese Ore—Imports of manganese ore for the 10 months ended Oct. 31, the latest complete figures, were 185,281 tons in 1906, and 173,045 tons in 1907; a decrease of 12,236 tons.

PIG IRON

The production of pig iron at the opening of the year was at the high level which marked the closing months of 1906. In January it was approximately 2,240,000 tons, and it continued at near this rate, with only small variations, for 10 months of the year. In July it was about 2,294,500 tons, falling a little in the two following months, but reaching the maximum in October, just before the cut came, with about 2,372,000 tons. The blast furnaces had been working to their full capacity, when production began to be curtailed. The cut was sharp and decided; in November the output was 1,856,000 tons, while in December the radical reduction continued, bringing the total for the month down to, approximately 1,450,400 tons, or only 61 per cent. of the October maximum. Seldom in the history of the iron trade has there been such a sharp and prompt reduction in activity. It was most marked in the case of the steel company furnaces, but the commercial furnaces were not far behind. The Steel Corporation and the other large steel-making companies now control over three-quarters of the make of pig iron, so that changes, when necessary, are promptly made. They have been agreed in the policy of reducing output in preference to accumulating stocks. There is, probably, no large quantity of pig iron in the yards of the steel companies; such iron as is stored is to be found in merchant furnace yards, and the quantity there is not very great.

For the first half of the year the American Iron and Steel Association has collected the full figures. Estimating the second half on the basis of the capacity of the active furnaces, we have the following production for the year:

	1906.	1907.	Changes.
First half.....	12,582,250	13,478,044	I. 895,794
Second half.....	12,724,941	12,497,900	D. 227,041
Total.....	25,307,191	25,975,944	I. 668,753

The reduction in output came too late

in the year to overcome the gains of 10 months, so that the total shows a small gain, 2.6 per cent., over 1906, and is, therefore, the largest yearly production on record.

Assuming that the division of the iron, according to the uses for which it was intended, was approximately the same in the second half of the year as in the first half, for which we have official figures, we find that the production of 1907 compares with that of the preceding year as follows, the figures being in long tons:

	1906		1907	
	Tons.	PerCt.	Tons.	PerCt.
Foundry & forge..	5,714,492	22.6	6,254,459	24.1
Bessemer pig.....	13,840,518	54.7	13,847,178	53.3
Basic pig.....	5,018,674	19.8	5,145,796	19.8
Charcoal iron.....	433,007	1.7	393,296	1.5
Spiegel and ferro..	300,500	1.2	335,275	1.3
Total.....	25,307,191	100.0	25,975,944	100.0

The gains shown were 539,977 tons in foundry and forge; 6660 in bessemer; 127,062 in basic; 34,775 in spiegeleisen and ferromanganese. The only loss was 39,707 tons in charcoal iron. The classification is necessarily not complete, and some of the iron included under foundry and forge finds its way to the basic open-hearth furnaces. Bessemer pig includes all low-phosphorus iron, whether it is used in the converter or the open-hearth furnace.

The year closed with an unusual number of furnaces out of blast. These included a number of the larger stacks owned by the steel companies; and also a number of the older furnaces which can produce iron at a profit only when prices are high and demand large. It is quite probable that some of the latter class will never be started up again.

PIG-IRON CONSUMPTION

The consumption of pig iron in the United States in 1907 was, approximately, as follows, in long tons:

Production.....	25,975,944
Imports.....	482,940
Total supplies.....	26,457,884
Exports.....	76,500
Approximate consumption.....	26,381,384

This shows an average yearly consumption of 688 lb. per person in the United States. No allowance is made for stocks on hand, as they probably did not differ greatly at the end of the year from those at the beginning.

The exports of pig iron were about at the usual level. Imports were heavy in the first quarter of the year, when it was difficult for consumers to secure early deliveries; but after the first quarter they fell off to a moderate monthly average.

PIG-IRON PRODUCTION FOR TEN YEARS

The course of pig-iron production in the United States for 10 years past has been as follows:

1898.....	11,773,934	1903.....	18,009,252
1899.....	13,620,703	1904.....	16,497,083
1900.....	13,789,242	1905.....	22,992,380
1901.....	15,878,354	1906.....	25,307,991
1902.....	17,821,307	1907.....	25,975,944

The increase in 1907 over the production of 1898 was 14,002,010 tons, or 119

per cent. This shows that our furnace capacity was more than doubled during the 10 years. The making of nearly 26,000,000 tons of pig iron in a year requires the handling of over 100,000,000 tons of material—ore, flux, fuel, etc.—in that period. Nearly three-quarters of the iron ore used is transported about 1000 miles to the furnaces.

BLAST FURNACES

The number of blast furnaces in the United States on June 30, the middle of the year, was 442, of which 360 were in blast at that time and 82 idle. The idle list included, as usual, a number of furnaces which will never again go into blast. The proportion active was about the greatest ever shown. At the same date there were under construction 29 furnaces, of which 10 were in Pennsylvania, 9 in Ohio and 5 in Indiana. Of these furnaces not more than 10 were ready to start in 1907. In addition 13 new furnaces were projected, and work was started on 6 of them during the year.

The existing blast furnaces in the United States, making allowance for the proportion always necessarily under repair, can produce at least 27,500,000 tons of pig iron in a year. The additions under construction and projected, will bring the capacity, with the same allowance, up to 32,500,000 tons yearly.

The charcoal iron furnaces showed a decline again in 1907. Most of the remaining furnaces of this class are in Michigan and Wisconsin, and use Lake ores. The industry in the South is now limited to three or four small furnaces in Alabama and Tennessee. The Cleveland Cliffs Iron Company has several stacks in the Lake country, which are profitable because they turn out a special grade of iron which commands high prices; and because they are provided with plants for saving the by-products from the charcoal ovens.

STEEL PRODUCTION

No official figures of steel production for any portion of 1907 have been published. Estimates must be based on the pig-iron production and such figures of finished material as are accessible. The course of steel making followed that of pig iron closely. For 10 months of the year output was large, and steel works generally were pushed to their capacity, to meet contracts. In October there was a stop in new orders, followed by some cancellation of contracts; specifications stopped coming in, and all the indications of lower demand were manifested. The larger companies met this change by a prompt curtailment of production, and there was a rapid decline in the make. Allowing for this, the year still showed some increase over 1906, and the approximate quantity of steel made may be given as follows, in comparison with the complete figures for the preceding year:

	1906		1907	
	Tons.	PerCt.	Tons.	PerCt.
Basic open-hearth..	9,649,385	41.3	10,150,000	42.3
Acid open-hearth..	1,321,613	5.7	1,358,000	5.7
Total open-hearth	10,970,998	47.0	11,508,000	48.0
Bessemer.....	12,275,253	52.5	12,348,000	51.5
Crucible & special..	118,500	0.5	119,000	0.5
Total.....	23,364,751	100.0	23,975,000	100.0

On this estimate the increases were, in basic open-hearth steel, 500,615 tons; in acid open-hearth, 36,387; in bessemer, 72,747. The make of crucible and special steels was about stationary. The total gain was 610,249 tons, or 2.6 per cent.

For the total output of wrought iron and of steel in finished forms, it is not possible to give any definite figures at the present time. It is certain, however, that many of the finished forms—especially structural steel, plates, sheets and bars—showed an increase over 1906. The demand for structural material for buildings and bridges was very large.

IMPORTS AND EXPORTS

The latest complete figures obtainable at the present time are for 10 months, ending Oct. 31; they show considerable gains in our foreign commerce, amounting to 30 per cent. in the imports and 15.8 in the exports.

The imports of iron and steel, including machinery, for October and the 10 months ending Oct. 31, are valued by the Bureau of Statistics as follows:

	1906.	1907.	Changes.
October.....	\$3,407,763	\$2,419,184	D. \$ 988,579
Ten months.....	27,784,650	34,117,204	I. 6,332,554

The chief items of the iron and steel imports for the 10 months were 459,040 tons pig iron; 25,619 scrap; 32,761 bars; 14,295 wire-rods; 51,623 tons tin-plates. Early in the year there were large imports of pig iron and heavy steel scrap, to meet immediate demands, which could not be supplied from home furnaces. In the later months these imports fell off to a low figure.

The exports of iron and steel, including machinery, from the United States for October, and the 10 months ended Oct. 31, are valued as below by the Bureau of Statistics of the Department of Commerce and Labor:

	1906.	1907.	Changes
October.....	\$15,910,437	\$18,951,128	I. \$3,040,691
Ten months.....	142,609,320	165,181,605	I. 22,572,285

The more important items of export in 1907 were 288,002 tons rails; 132,299 wire; 117,774 structural steel; 102,563 sheets and plates; 85,114 bars; 50,099 tons nails and spikes. The only decrease in these items was in wire.

With the recurrence of a period of light demand and quieter home trade, it is altogether probable that strong efforts will be made to push our export trade. The United States Steel Corporation has an efficient organization for that purpose which has not been idle; though naturally it has not been especially active in a period when it required nearly all energies to meet the pressing demands for material at home.

THE UNITED STATES STEEL CORPORATION

As the United States Steel Corporation controls not far from 65 per cent. of the output of finished iron and steel in the United States, some review of its operations is an essential part of the yearly summary. The corporation publishes full statements quarterly, and it is, therefore, possible to give a summary of its results for the nine months of the year ended Sept. 30. For that period the statement is as follows, the net earnings being the amount remaining after deducting operating expenses; while the charges include depreciation, interest and sinking funds:

	1906.	1907.	Changes.
Net earnings.....	\$119,984,621	\$128,430,482	I. \$8,445,861
Charges.....	39,733,870	38,797,819	D. 936,051
Net balance.....	\$ 80,250,751	\$ 89,632,663	I. \$9,381,912
Special appro.....	44,000,000	51,000,000	I. 7,000,000
Balance.....	\$ 36,250,751	\$ 38,632,663	I. \$2,381,912
Dividends.....	21,456,269	26,539,296	I. 5,083,027
Surplus.....	\$ 14,794,482	\$ 12,093,367	D. \$2,701,115

For the quarter ending June 30 the net earnings were \$45,503,735, the largest quarterly return in the history of the company; for the September quarter they were \$43,804,285, an amount second only to that reported for the June quarter. The special appropriations were for the construction of new plants and the acquisition of additional property. The dividends paid in 1907 included three quarterly payments at the rate of 7 per cent. yearly on the preferred and 2 per cent. on the common stock. The total surplus on Sept. 30 was \$109,814,081. The statement of unfilled orders on the company's books at the periods given below affords some comparison as to the business on hand:

Date.	Tons.	Date.	Tons.
Sept. 30, 1902.....	4,843,007	Dec. 31, 1906.....	8,489,718
Sept. 30, 1903.....	3,278,742	March 31, 1907.....	8,043,358
Sept. 30, 1904.....	3,027,436	June 30, 1907.....	7,603,878
Sept. 30, 1905.....	5,865,377	Sept. 30, 1907.....	6,425,008
Sept. 30, 1906.....	7,936,884		

In the closing quarter of the year the changes were so marked and so quick that it is difficult to estimate the earnings of the fourth quarter. It is probable that they were considerably below those of the third quarter, and that the net earnings for the full year were not far from \$165,000,000. The stocks of all kinds of material on hand on Sept. 30 were unusually low.

CHANGES AND CONSOLIDATIONS

The most important change during 1907 was the sale of the Tennessee Coal, Iron and Railroad Company to the United States Steel Corporation. The control of the Tennessee company, the most important in the Southern field, had for several years been owned by a speculative group in New York, and the company had been operated in connection with the Southern branch of the Republic Steel and Iron Company. The panic in New York placed the owners in a precarious position, and to save themselves they sold their interests to the Steel Corporation, which also agreed to take the minority stock. The price was \$84 per share payable in Steel Corporation second-mortgage, 5 per cent. bonds at 84. The sale was, therefore,

made on the basis of \$11,094,766, face value, in the bonds for \$10,000 par value of the stock. Practically all the stock was deposited under this agreement; the total issued by the Tennessee company having been \$33,067,900 common and \$248,300 preferred. In 1906 the company turned out 641,887 tons of pig iron and 401,882 tons of steel; quantities equal to 5.7 and 3 per cent., respectively, of the Steel Corporation's output. The improvements and additions in progress were expected to increase production to 1,000,000 tons of pig iron and 600,000 tons of steel.

The main value of the acquisition was in the supplies of raw material controlled. The policy of the Tennessee company had been to secure iron-ore reserves wherever possible in its territory. It owned by far the largest quantity of ore existing in the United States anywhere outside of the Lake Superior region. An expert careful estimate of the iron ore unmined in the lands which it controls is 700,000,000 tons. This ore is of lower grade than the Lake Superior ore; but the company also had coal lands estimated to contain 2,000,000,000 tons, and the proximity of the coal and iron-ore deposits, reducing transportation to its lowest possible limit, offset the lower tenor of the ores. The Southern ores are, almost universally, above the bessemer limit in phosphorus, and steel making there is necessarily confined to the basic open-hearth process. The use of the open-hearth furnace, however, is quite in line with recent developments. With the reserves acquired the Steel Corporation added largely to the hold on the raw material of the iron industry, the control of which has, apparently, always been its object.

The purchase added about \$2,500,000 to the yearly fixed charges which the Steel Corporation has to meet. There is no doubt, however, that with proper management the property purchased can provide for these charges without difficulty. Moreover, the iron-ore control is an asset the value of which can hardly be estimated in money.

NEW WORK

The most important work in progress during the year 1907 was on the great new steel plant of the United States Steel Corporation at Gary, Ind., to which reference was made a year ago. Substantial advance has been made in the construction of this plant, and some of its units will be ready to operate in 1908. The Carnegie branch of the Steel Corporation made many changes and improvements, and at the close of the year had begun the remodeling of its Edgar Thomson plant, the construction of several new mills and the substitution of open-hearth furnaces for a number of its bessemer converters. The Steel Corporation also began work on an extensive steel plant at Duluth, which is intended to supply the trade in the Northwest.

The Jones & Laughlin Steel Company at Pittsburg, the Cambria Steel Company at Johnstown and several other independent companies were engaged in making additions to their productive capacity. The Tennessee Coal, Iron and Railroad Company began work on the additions to its steel plant at Ensley, Ala., which will double its capacity.

TECHNICAL PROGRESS

As noted for several years past, work has been largely directed to improved methods for handling material and for increasing the rate of production. Reference was made last year to the adoption of gas engines operated by the waste gases from blast furnaces. Such engines will soon be in use in large units in the Carnegie steel plants, in the new Gary plant and in other Steel Corporation plants, as well as in the Lackawanna works at Buffalo, where they were first adopted in this country. At Ensley, Ala., the duplex process, in which both the converter and the open-hearth furnace are used, is giving satisfactory results, and will be introduced in the new extension of the works.

The making of nickel-steel, tungsten-steel, vanadium-steel and other special steels has received a considerable impulse from the large demand for high-grade steel in the making of engines for automobiles and motor-boats. Some interesting work has been done in this direction, notably in the Johnson works at Spuyten Duyvil, N. Y., and the Carpenter works at Reading, Penn., which supply a large part of this demand.

It is understood that the plans for the new Steel Corporation works at Duluth will include some interesting applications of electric power in operating rolling mills and other plant.

The works at Heroult, on the Pit river in California, where iron and steel are to be made in the electric furnace, were substantially completed in 1907, and will be in operation in 1908. The furnaces are of the Heroult type, now in use in France, with some slight modifications.

THE STEEL-RAIL QUESTION

A question as to the quality of bessemer steel rails furnished by manufacturers caused much discussion and controversy during the year. It was brought up by complaints from some of the prominent railroad companies that there had been an unusual number of accidents on their lines resulting from breakages of rails, and that such failures were largely of rails of recent manufacture, which had seen only short service. Charges were made that the rail mills were turning all their attention to making the largest output possible, and were sacrificing quality to quantity. These allegations were naturally resented by makers, and facts were demanded. It was represented that railroad managers had kept on increasing the weight of locomotives and cars and the speed of trains in greater proportion

than the weight of rails and the condition of the sub-structure; and that break-ages were due to the increased strains thereby caused. Both sides maintained their respective positions rather by general arguments than by the presentation of actual facts.

The question was taken up by the American Railway Association, in which all of the important railroad companies are represented. A committee of this association, composed of competent experts, after holding a number of meetings and conferring with representatives of the manufacturers, presented reports recommending a stricter limitation of the percentage of phosphorus permissible; an increased discard on ingots used in rolling rails; more care in rolling; and finally some modifications in sections, putting more metal into the base and web of the rail. The reports are still under consideration, and meantime arrangements have been made for the collection and study of facts in relation to rail break-ages. The manufacturers protested that they could not meet the proposed demands without increasing the price of standard rails. The question was still unsettled at the close of the year.

The immediate result was the placing of very light orders for rails by the leading lines, so that the rail-mills enter the new year with only a light tonnage on their books. Another result was the placing of orders for open-hearth steel rails by several companies. At present, however, only the Tennessee Coal, Iron and Railroad Company and the Bethlehem Steel Company are in a position to supply any large quantity of open-hearth rails. Both those companies have their capacity for 1908 fully taken up.

OTHER COUNTRIES

Abroad, the year has been generally a prosperous one. The iron and steel industry had nowhere reached so high a degree of prosperity as in this country; but, on the other hand, though some recession is now apparent, the depression is not likely to be as quick or as sharply marked as here.

CANADA

The iron trade was generally in good shape throughout the year. Pig-iron production is estimated at 570,000 tons. There was a gain in steel, due chiefly to the activity of the Dominion Steel Company at Sydney, Cape Breton, and the Algoma Company at the Sault Ste. Marie. The works at Midland and Hamilton were active. An important addition to Canadian producers will be the Mackenzie furnace in the Port Arthur district.

FRANCE

The iron industry of France showed a fair gain, so far as reports have been made. For the first half of the year the official report of production is as follows, in metric tons:

	1906.	1907.	Changes.
Pig iron.....	1,573,504	1,788,230	I. 214,726
Wrought iron.....	384,800	342,239	D. 42,561
Steel ingots.....	1,159,546	1,309,993	I. 150,447

A partial report of finished steel for the same period shows 711,658 tons in 1906 and 802,778 in 1907; an increase of 91,120 tons.

GERMANY

The production of pig iron in Germany for the 10 months ended Oct. 31 was 10,346,857 metric tons in 1906, and 10,827,160 in 1907; an increase of 480,303 tons, or 4.6 per cent. These figures indicate a total for the year 1907 of about 13,150,000 tons of pig iron and 11,690,000 tons of steel. Over 90 per cent. of the German make is basic steel.

For the nine months ended Sept. 30 the German exports of iron and steel were 2,569,880 metric tons, a decrease of 158,849 tons. Imports were 600,063 tons, an increase of 156,268 tons.

The iron and steel trades in Germany remain under the control of the large syndicates or combinations of companies. Without exception these report a prosperous year, though the last quarter showed a lower average of orders than the earlier periods.

GREAT BRITAIN

For the first half of the year the production of pig iron as officially reported, was 4,905,124 long tons in 1906, and 5,194,712 tons in 1907; an increase of 289,288 tons, or 5.9 per cent. As in this country, there was a decrease in activity during the second half of the year, though much less marked. The estimated total for the year will not be over 10,000,000 tons. The production of steel ingots for the first half of the year was as follows, in long tons:

	1906.	1907.	Changes.
Open-hearth.....	2,196,853	2,337,794	I. 140,941
Bessemer.....	919,620	1,068,972	I. 149,352
Total.....	3,116,473	3,406,766	I. 290,293

For the first time in several years Bessemer steel showed a slightly greater increase than open-hearth. The total make of steel for the year is estimated at 6,560,000 tons.

Great Britain continues a heavy exporter of iron and steel. For 11 months ended Nov. 30 the exports were valued as follows:

	1906.	1907.	Changes.
Iron and Steel.....	£36,396,027	£43,426,490	I. £7,030,463
Machinery.....	24,400,081	29,011,565	I. 4,611,484
New Ships.....	8,211,837	9,528,873	I. 1,317,036
Total.....	£69,007,945	£81,966,928	I. £12,958,983

The total quantities of iron and steel were 4,277,594 tons in 1906, and 4,839,782 in 1907; an increase of 562,188 tons. Exports of pig iron to the United States in 1907—mainly in the first half of the year—were 430,859 tons, an increase of 182,468 tons; of tin-plates, 55,478, an increase of 743 tons only.

Imports of iron and steel for the 11 months in 1906 were 1,141,790 tons, valued

at £7,809,669; in 1907 they were 834,791 tons, valued at £6,479,903; showing decreases of 306,999 tons in quantity and £1,329,766 in value.

The iron and steel industries were generally prosperous through three-fourths of the year, but showed a declining tendency at the close, due chiefly to the difficulty of securing capital for new construction. The decline, however, was much less marked than in this country.

Imports of iron ore for 11 months were 7,206,679 tons in 1906, and 7,118,569 in 1907; a decrease of 88,110 tons.

THE IRON AND STEEL MARKETS

The year 1907 opened with pronounced activity everywhere. Not only were mills and furnaces busy on all sides, but new orders were coming in freely, and a large demand was manifest. Prices of pig iron were on a high level, but this did not seem to check buying. Owing to the policy strictly adhered to by the Steel Corporation, prices of finished steel were not advanced, but maintained at about the same level as in the second half of 1906. In some cases advances were paid, however, under the guise of premiums to secure special deliveries; but these did not apply to the great bulk of the business. Before the end of March, the capacity of mills and furnaces had been engaged well up to the end of the third quarter of the year, and even into the fourth quarter. The March report of the Steel Corporation showed an enormous tonnage of orders on the books, and every indication was of business on a greater scale than had ever before been known.

As time wore along to the middle of the year some feeling of hesitation seemed to develop. It did not amount to an actual drop in business; but it seemed as if consumers were growing more careful and beginning to count the cost. High prices were beginning to tell on the trade. For nearly two years the cry had been to get the material—at any cost—so that it could be obtained in time. Now, however, the feeling was beginning to change; consumers hesitated to make commitments too far ahead, and began to consider whether concessions in price might not be obtained. While this feeling did not presage fully what was to come, it was a chill upon the market which was perceptibly felt.

The strike of the Mesabi miners in late July, while it was ended too soon to affect the iron trade seriously, seemed to be a signal for a further development of distrust. It was aided by the growing tension of the money markets and the difficulty of obtaining new capital for construction enterprises. It began to be evident that credit had been strained, and that business required a period of rest and recovery. The failure of one or two construction companies, which had been operating largely upon borrowed money, gave an impetus to the feeling of uncertainty.

New business declined rapidly, and fourth-quarter orders were few in number. In pig iron and steel billets, which are practically the only open markets, there were declining prices, though the fall was gradual.

The bank panic, which struck the financial centers in late October, put an end to new orders for the time, and practically for all the rest of the year. Not only this, but in a week or two cancellations and withdrawals of specifications on new contracts began to come in. The leading makers, however, declined to accept these, holding them as suspended orders. They also adopted the policy of meeting declining business by sharp curtailment of production. This has been carried out everywhere. In order to enforce its policy the managers of the Steel Corporation called a meeting, at which all the large producers were represented. This conference was informal, but a general agreement was reached to maintain prices and limit production. A supervisory or steering committee was appointed to watch the trade and to give aid and advice where it might be needed.

The year closed with this doubtful situation. At the end, however, a little more hopeful feeling was manifest, as to the prospects of the new year, though no one expects more than a gradual revival of trade.

Details of the markets will be found in the following letters, which cover Pittsburgh and Birmingham, the chief primary markets; Chicago, the leading distributing point for the Northwest; the seaboard markets; and the New York iron region.

The Pittsburg Iron and Steel Markets

By S. F. LUTY

Clever management by the leading interest prevented a disastrous termination of 1907, which at the start promised to be the banner year in the history of the iron and steel industry. A tightening of the money market late in October caused alarm, and buyers of material began to send in cancellations of orders which threatened to cause a serious slump and demoralize the markets. The United States Steel Corporation refused to accept cancellations, but entered the orders as postponed and large tonnages remained on the books, independent interests following the plan of the big producer. During the year all the iron and steel mills had had enough business on the books to keep them going steadily into the first quarter of 1908. At the opening of the fourth quarter there was a pronounced slowing down. In October the local situation had been greatly disturbed by the embarrassment of the Westinghouse Electric and Manufacturing Company and

the Westinghouse Machine Company, these concerns going into the hands of receivers on Oct. 23. Both companies were solvent at the time and had large unfilled orders. Operation of the plants was continued, and in November many additional orders aggregating several million dollars were booked. To avoid an accumulation of stocks, mills restricted production in all lines except plates and shapes and wire products.

About the middle of November, when the situation looked decidedly unfavorable, Chairman E. H. Gary, of the Steel Corporation, called a meeting of representatives of the large iron and steel interests at which plans were formulated to strengthen the situation. It was decided to restrict production in all the weak lines. The carrying out of this policy began at once and on Dec. 1 the Steel Corporation had closed more than one-half of its 95 blast furnaces and a large number of its steel plants were on the idle list. Merchant furnaces were closed during the last month in the year when all contracts had been completed. Many independent

But little new business in pig iron was booked in February and prices were somewhat lower. There was a decided scarcity early in March, which was indicated by the purchase of 5000 tons of bessemer iron at \$22, Valley furnaces, by the Carnegie Steel Company. It had inquired for a larger tonnage, but failing to get it, bought 10,000 tons of heavy melting scrap, paying \$18 delivered. On March 20, contracts were closed and options given on over 60,000 tons of bessemer iron for second quarter delivery at \$22, Valley furnaces. The United States Steel Corporation was forced into the market by the flood which closed 27 blast furnaces along the Monongahela and Allegheny rivers for two days. It was not necessary to buy all the iron, as a number of steel plants also were closed by the flood. The Corporation got 11,000 tons for April, and took an option on 14,000 tons for May, all at \$22, Valley furnaces. All of this iron was delivered, but the furnaces had some difficulty in supplying the tonnage. The Cambria Steel Company bought 36,000 tons of bes-

AVERAGE PRICE AT PITTSBURG, 1907.

MONTH.	PIG IRON.			FERRO-MANGANESE.	STEEL.					NAILS.	
	Bessemer.	No. 2 Foundry.	Gray Forge.		Bessemer Billets.	Rails.	Black Sheets No. 28.	Tank Plate.	Steel Bars.	Wire per Keg.	Cut per Keg.
January.....	23.35	25.35	22.35	81.00	29.50	28.00	2.60	1.70	1.60	2.00	2.05
February.....	22.85	24.35	21.85	74.00	29.00	28.00	2.60	1.70	1.60	2.00	2.05
March.....	23.85	24.85	21.85	75.00	29.00	28.00	2.60	1.70	1.60	2.00	2.05
April.....	23.85	25.85	22.10	71.00	30.00	28.00	2.60	1.70	1.60	2.00	2.05
May.....	24.85	25.85	22.85	69.00	30.50	28.00	2.60	1.70	1.60	2.00	2.05
June.....	24.40	25.40	22.90	64.00	29.50	28.00	2.60	1.70	1.60	2.00	2.05
July.....	23.90	23.90	22.90	63.00	30.00	28.00	2.60	1.70	1.60	2.00	2.05
August.....	22.90	22.90	21.90	62.00	29.50	28.00	2.60	1.70	1.60	2.00	2.10
September.....	22.90	21.90	20.90	58.00	29.50	28.00	2.60	1.70	1.60	2.05	2.10
October.....	22.90	20.90	19.90	57.00	28.00	28.00	2.60	1.70	1.60	2.05	2.05
November.....	20.40	20.40	19.40	53.00	28.00	28.00	2.60	1.70	1.60	2.05	2.00
December.....	19.90	19.40	18.90	52.00	28.00	28.00	2.60	1.70	1.60	2.05	2.00

concerns closed their mills, and the new year opens with scarcely any stocks on hand and large tonnages of unfilled orders awaiting instructions of buyers to resume shipment.

PIG-IRON PRICES

The year opened with the pig-iron market decidedly strong; weakness developed in February, but recovery came in the following month, and iron was at the high point in May. The furnaces had large tonnages on the books at the start and sales in the first 10 days aggregated 75,000 tons of bessemer and basic at prices around \$22 for bessemer and \$21.50 for basic, all f.o.b. Valley furnaces. Prices for early shipment advanced to \$22.50 for bessemer and this checked buying, sales for the second week amounting to but 20,000 tons. The Westinghouse Air Brake Company in January bought 30,000 tons of Northern and Southern foundry iron for last half delivery, the price for Northern iron ranging from \$22.35 to \$22.85 delivered.

semmer iron for equal deliveries running through April, May and June, the price being based on the monthly average.

Active buying of pig iron for second-half delivery began early in April, when the Youngstown Sheet and Tube Company bought 120,000 tons from the Bessemer Pig-iron Association at \$21, Valley furnaces, and the Cambria Steel Company contracted with W. P. Snyder & Co. for 60,000 tons at the monthly average. It did not take all of the iron, as one of its new furnaces was blown in during August. Sales of second-half iron in the first two weeks of April exceeded 260,000 tons. Active buying continued and prices advanced, bessemer and basic iron bringing the same price, \$22, Valley furnaces.

All the first-half iron was practically sold before May 1, when prices for second half advanced to \$23. Fancy prices for prompt iron prevailed, one carload lot bringing \$30, while several small lots were sold at \$25 and \$26. Sales of No. 2 foundry were made for second-half delivery at \$23.50, Valley furnaces.

Late in May many inquiries were received by furnaces for all grades of pig iron for 1908 delivery, but no important contracts were closed for standard bessemer, and in a few weeks interest in iron for extended delivery disappeared. It was reported at the time that 25,000 tons of malleable bessemer had been contracted for at \$22, Valley furnaces, and several other sales were recorded, but nothing has been said about them since.

In June sales of bessemer iron aggregating 10,000 tons for prompt delivery were made at \$24.40, Pittsburg. Late in the month the failure of Milliken Brothers, New York, threw a lot of pig iron on the market. This had the effect of weakening prices and the Jones & Laughlin Steel Company bought 20,000 tons of bessemer iron at about \$23.15 for the third-quarter delivery. This was regarded as a favorable price, but soon after the market began to decline.

The second half opened with a dull market. Prices were weakening in August when the Steel Corporation bought 6000 tons at \$22.90, Pittsburg, and late in the month the Jones & Laughlin Steel Company also took 6000 tons at the same price. These were the last sales of any importance made during the closing half of the year.

The average monthly prices of bessemer pig iron based on sales of 1000 tons and more are as follows, the first figure being the price at Valley furnaces, and the second at Pittsburg: January, \$22.06—\$22.91; February, \$21.93—\$22.78; March, \$22.05—\$22.90; April, \$21.36—\$22.21; May, \$23.28—\$24.13; June, \$23.25—\$24.15; July, \$22.41—\$23.31; August, \$22—\$22.90; September, \$22—\$22.90; October, \$21.88½—\$22.78½; November, \$19.75—\$20.65; December, \$19—\$19.90.

The pig-iron prices in the accompanying table are the average prices for the different months based on all sales.

Some important changes in pig-iron freight rates to this district were made during the year. Effective Jan. 1 the rate from Shenandoah furnaces to Pittsburg was reduced from \$2.55 to \$2.40, but from other Virginia furnaces was advanced 25c., from \$2.55 to \$2.80. On Aug. 1 the rates were advanced 10c., making the rate from Shenandoah \$2.50 and other furnaces \$2.90, except Bristol, which remained at \$4.35. The rate from Birmingham, Ala., to Pittsburg was advanced on April 1 from \$4.60 to \$4.85. On June 1 the pig-iron rate from Valley furnaces to Pittsburg was increased from 85c. to 90c. On July 1 the rate for coke from the Connellsville region to Valley furnaces was advanced from \$1.30 to \$1.35, but the rate to Pittsburg remained at 80c.

PRICES OF FINISHED MATERIAL

Prices in most of the finished lines remained firm and unchanged all year. On

Jan. 24, galvanized sheets were advanced \$2 a ton to 3.75c. for No. 28 gage; blue annealed sheets \$1 a ton, making the price for No. 10 and heavier 1.85c.; galvanized corrugated roofing 10c. a square from \$3.15 to \$3.25. These advances were due to the increased price of spelter. Merchant steel pipe prices were advanced one point, or \$2 a ton, in January, making five points, or \$10 increase since Oct. 12, 1906. In February boiler tubes were advanced two points, or \$4 a ton. On March 8, the National Tube Company was so filled with orders that it withdrew all quotations, but continued to accept new business subject to new discounts when announced. At that time the independent pipe makers advanced prices from \$2 to \$3 a ton. The National Tube Company announced its new card of discounts on May 14 by advancing prices two points, or \$4 a ton, except on 7- to 12-in. sizes.

The cotton-tie market opened on April 25 and the Carnegie Steel Company, the leading producer, advanced the price for the season 10c., to 95c. per bundle.

Prices of wire products were advanced \$1 a ton on Sept. 3, the price for nails being increased from \$2 to \$2.05 a keg.

About the middle of October the Carnegie Steel Company reduced the price of light rails \$2 a ton in sections of 12 lb. or less, and \$3 a ton in 16-lb. to 45-lb. sections.

STEEL RAILS

The United States Steel Corporation opened its books on April 17 for steel rails for 1908, the Tennessee Coal, Iron and Railroad Company having opened its books for open-hearth rails a week earlier. Soon after reports were received of rails breaking in different parts of the country and an inquiry was started as to the causes. The larger railroads deferred placing orders for bessemer-steel rails until more satisfactory specifications could be formulated. The Tennessee company soon had its capacity for 1908 sold to roads that had decided to use open-hearth steel rails. Among the large orders were 150,000 tons from the Harriman lines and 46,000 tons from the Louisville & Nashville. The Bethlehem Steel Company also booked a large tonnage of open-hearth rails.

LABOR CONDITIONS

There were no labor troubles of any consequence during the year and the big strike in the ore regions did not affect operations of the furnaces in the Pittsburg or surrounding territory. The Steel Corporation and merchant furnaces received a demand from James McMahan, who claimed to represent the blast-furnace workers' organization, for an eight-hour day and an advance in wages. It was learned that the organization was not strong and that a new union of blast-furnace men was being formed. A meet-

ing of furnace interests was held and it was decided to ignore the demands of McMahan.

At the annual convention of the Amalgamated Association of Iron, Steel and Tin Workers demands were formulated for heavy advances for the sheet and tin-plate workers and an important change was made in the sliding scale of wages for puddlers and finishers to become effective at the expiration of the existing scale on June 30. All demands were refused and after a three-days' conference with representatives of the American Sheet and Tin Plate Company the demands were withdrawn and the workers' representatives accepted the old scale.

An agreement on the iron scale could not be reached at conferences with the Republic Iron and Steel Company and the Western Bar Iron Association and the question was submitted to a board of conciliation. The iron scale is based on the selling price of bar iron and the skilled workers had received advances with every increase of 0.1c. in the average selling price taken every two months. The workers wanted this changed to 0.05c. and the base lowered, which would give the puddlers an immediate increase of 50c. a ton. To the surprise of both sides the board decided in favor of the Amalgamated Association on Aug. 8 and the advanced rate became effective at once, the men having worked at the old rate pending the negotiations.

Bi-monthly adjustments under the sliding scale of the Amalgamated Association resulted as follows: January, bar iron, 1.5c., puddlers received \$5.75 a ton; March, same; May, 1.6c., puddlers \$6; July, same until Aug. 10, when by decision of board of conciliation average was 1.65c. and puddlers received \$6.62½; September, 1.65c., puddlers, \$6.62½; November, 1.60c., puddlers, \$6.50.

The tin-plate workers' scale is based on tin-plate at \$3.40 a box and they receive 2 per cent. advance with every 10c. a box above the base. The bi-monthly adjustments showed the following prices: January, \$3.50; March, \$3.60; May, \$3.70, the tin-plate workers receiving 2 per cent. each settlement, or a total increase of 6 per cent. in the first half of the year. There were no further changes, the last settlement showing an average of \$3.70 a box.

The base of the sheet workers' scale is 2.30c. as the average price of Nos. 26, 27 and 28 gages and they are given an advance of 2.6 per cent. with each 0.1c. above the base. Sheet workers' wages were unchanged until May, when they got an advance of 2.6 per cent., the average being 2.40c. A similar advance was given at the September adjustment when the average was 2.50c. The next settlement in November showed a reduction to 2.40c. and the pay was cut 2.6 per cent.

NEW BLAST FURNACES AND STEEL PLANTS

New blast furnaces blown in during the year in the Pittsburg district and surrounding territory are as follows: January 1, Haselton, No. 3, of the Republic Iron and Steel Company; Jan. 14, Josephine, of Corrigan, McKinney & Co.; June 3, Carrie No. 7, of Carnegie Steel Company; Aug. 2, Carrie No. 6, of Carnegie Steel Company; Aug. 8, No. 8, of Cambria Steel Company; Oct. 11, Furnace D, of the National Tube Company. The new No. 1 furnace of the Shenango Furnace Company, was completed, but not blown in. Two furnaces are being added to the Duquesne group of the Carnegie Steel Company, and may be blown in early in 1908. The Jones & Laughlin Steel Company completed plans for four blast furnaces at Aliquippa and two are under construction, but work was suspended in November.

On Jan. 31 the Carnegie Steel Company broke ground at Youngstown, O., for an open-hearth steel plant which will contain twelve 50-ton furnaces. It is expected to be ready for operation about Feb. 1, 1908. The Pittsburg Steel Company, the largest independent wire producer, in June began the erection of a steel plant adjoining its works at Monessen, Penn. The work of construction has been rushed and it is believed the plant will be completed early in the year. At the Duquesne works of the Carnegie Steel Company the bessemer department was torn out and is being replaced with an open-hearth plant. This company is also making extensive additions and improvements at the Edgar Thomson rail plant.

Alabama Iron and Steel

BY L. W. FRIEDMAN*

Despite a complete reversal in conditions of the pig-iron market during the last two months of the year, Alabama's iron output for 1907 will not fall much under what it was in 1906, when the State produced 1,674,848 tons. While the figures are not all in hand, and it is hard to make a close estimate because of the number of furnaces going out of operation at this writing, statisticians are figuring on a production something over 1,500,000 tons for 1907.

In 1907 the high mark in production was reached in May. This was followed by a reduction, owing to the necessity of repairing several furnaces; but an increase was recorded in July. In October the total was 151,815 tons; a sharp curtailment brought it down to 126,156 tons in November, while in December the production was cut fully 50 per cent. from the highest point.

During the summer there was some

*Special correspondent, Birmingham, Ala.

trouble in securing raw materials at the furnace, partly because labor was scarce, and partly on account of transportation delays. This difficulty was overcome before the general drop came.

IRON PRICES

Pig-iron quotations went to a high level during 1907. Iron to be delivered within 60 days was considered spot iron for a large part of the year. Spot iron went as high as \$24.50, and even more, while regular quotations for No. 2 foundry iron, delivery within three months and longer, was above \$20 per ton for quite a while. The cost of making iron was also high, but the various companies made excellent reports of earnings. When the collapse came on almost all of the furnace companies in Alabama had their books well covered with orders; in fact, the statement was made that the probable make for the year had been covered and some sales made for 1908. The check in October was, however, followed by many cancellations and orders for delay in delivery. A sharp drop in prices followed, and No. 2 foundry was quoted as low as \$14 at furnace. There was, at the close of the year, no accumulation of stocks in furnace yards, the curtailment in production having fully met the decreased demand.

Owing to the conditions of the year, prices were exceptionally hard to report. The following table gives approximately the prices of No. 2 foundry, which is the standard upon which all prices are based; spot iron includes deliveries in 60 days:

PRICES OF NO. 2 FOUNDRY IRON, BIRMINGHAM.

	Spot.	2d Half		Spot.	1908.
Jan.....	\$24.00	.....	July.....	.....	\$19.00
Feb.....	22.50	.....	Aug.....	.....	19.00
March....	23.50	\$19.00	Sept.....	.....	18.50
April....	24.00	20.00	Oct.....	.....	18.00
May.....	24.00	20.00	Nov.....	\$17.00	17.00
June....	22.50	19.00	Dec.....	15.00	13.50

From July to October, inclusive, there was practically no spot iron to be had.

STEEL AND IRON PRODUCTS

The steel works at Ensley and Gadsden were full of work through the year. Cast-iron pipe works were busy until November, when there came a sudden cessation of orders, and some of them shut down. Foundries, stove works and machine shops did well. The rolling mills were also busy for 10 months of the year.

The most important new work done was on the enlargement of the steel works of the Tennessee company at Ensley, making it practically a new plant, double the capacity of the old one. This work is now well advanced. Two new blast furnaces were completed, Gadsden, of the Alabama Consolidated Coal and Iron Company, and Vanderbilt, of the Birmingham Iron and Coal Company. Three old blast furnaces were rebuilt. The Sheffield

Cast Iron Pipe and Foundry Company built an extensive new cast-iron pipe plant.

A new railroad entered Birmingham, the Atlanta, Birmingham & Atlantic, which gives the district a new outlet to the sea at Brunswick.

The Southern Steel Company, a consolidation of several small companies in Alabama and Georgia, went into bankruptcy, and is to be reorganized.

The most important change of the year was the sale of the Tennessee Coal, Iron and Railroad Company to the United States Steel Corporation. The working force was reorganized, with George G. Crawford, of the Steel Corporation, in charge. This involved a reorganization of the Southern branch of the Republic Steel and Iron Company, which had been practically consolidated with the Tennessee company.

Iron Mining in New York

BY D. H. NEWLAND*

With the awakened interest shown recently in the investigation and development of the iron ore resources of New York, a notable advance in the State's ore production may be anticipated under favorable market conditions. Since the depression of the last decade, the industry has practically regained its former relative position by small but steady growth from year to year.

In the Adirondack region the Lyon Mountain and Mineville mines have furnished practically the whole product for several years past. The two localities yielded a little over 700,000 tons in 1906 and will show some increase for the year just elapsed. There is a steady demand for the ore and concentrates from this section owing to their high iron content (average 65 per cent.) and their regularity in respect to phosphorus and sulphur. A part of the product is smelted locally by the furnaces at Standish and Port Henry, the former making a specialty of low-phosphorus iron.

At the Cheever mine, near Port Henry, the reopening of the workings and construction of a mill have been under way during the past season. This is the oldest mine in the region, as it was first worked about 1790. The ore resembles that of the Old Bed at Mineville, though somewhat lower in phosphorus.

On the western side of the Adirondacks the Benson mines again resumed production after lying idle for several years. The property includes a large low-grade magnetite body so situated that it can be worked by quarry methods. A little more than two tons of crude ore

*Assistant State geologist, Albany, N. Y.

are required for a ton of concentrates which carry above 60 per cent. iron and phosphorus below the bessemer limit. A number of improvements were instituted in the mining and milling plants, costing altogether \$150,000. The ore is broken down by drilling 4-in. holes with shot drills and loading heavily with dynamite. The unsorted material is placed on cars by steam shovel and carried to the mill, which is equipped with a pair of 6-ft. rolls for handling the large sizes. These methods are an innovation in the magnetic iron ore industry.

The exploration of the titaniferous magnetites at Lake Sanford in the interior of the Adirondacks was carried forward, and plans are nearly completed for a railroad which will afford an outlet to Lake Champlain. Trial shipments of the ore were made to Pennsylvania furnaces. It is reported that a regular market for a large tonnage can be had as soon as shipping facilities are provided. While experiments show that the titanium can be reduced by magnetic treatment, it is proposed to use the magnetite in crude condition by mixing with non-titaniferous ores. If the utilization of the ores proves practicable, the enterprise will be one of the most important in the recent history of iron mining, since the available resources at Lake Sanford are enormous.

The Clinton hematite deposits attracted much attention during the year. At Clinton, the type locality, the usual output was made by the Franklin Iron Manufacturing Company and C. A. Borst, but the main developments were in the western section in Wayne and Cayuga counties. Here the ore lies close to the surface and is obtained by stripping the overlying shale and surface materials.

At Sterling Station, Cayuga county, the Fair Haven Iron Company began shipments in the spring. The bed of ore averages from 30 in. to 3 ft. thick, which is unusual for the Clinton in New York State. The stripping is done by steam shovel, after breaking up the rock by drilling and blasting, and the ore is loaded directly on cars by a derrick. In the relative thickness of ore to overburden the property is very advantageously located, while it lies adjacent to two railroad lines.

The Furnaceville Iron Company added to its land holdings at Ontario Center, Wayne county, where it has operated for a number of years. The ore is overlaid by 18 to 20 ft. of soil and rock. The bed averages 22 in. thick, so that practically a foot of stripping is required for each inch of ore. Yet the costs are said to be not much more than \$1 per ton on the cars.

The Ontario Iron Ore Company and the Wayne Iron Ore Company began the development of lands near Ontario, while the Lake Ontario Iron Ore Company and the Rochester Iron Ore Company recently acquired lands in that vicinity.

The resources of the Clinton formation

have scarcely been touched as yet. The iron ore occurs in regular bedded deposits, which have their maximum thickness within the 140 miles of outcrop from Clinton to Rochester. With a 20-in. bed, a square mile of surface will yield about 5,000,000 tons.

The Chicago Iron Market

By E. MORRISON*

Opening with high prices and heavy consumption of pig iron, the year 1907 was for the first three months highly satisfactory to sellers of iron. The second quarter developed a plenty of raw material and a production up to the consuming limit on the part of melters. In the third quarter sales of pig iron became generally confined to the needs of the next two or three months. By the beginning of the fourth quarter hardly anybody was buying for more than 30 days ahead, and this condition continued down to the end of the year.

Such, in brief, is the history of the year. Iron and steel products showed a course similar to that of pig iron. From a beginning of unsurpassed activity the December market went to the other extreme. The causes of the year's decline are general and well understood. Local conditions, however, have shown certain peculiarities worth noting.

At the beginning of the year, buying was large for needs of the second quarter—three to six months ahead of the time of contracting. Inquiries were numerous for second-half needs, on the basis of continued heavy consumption. Finished products were active, especially structural material, bars and plates. As February progressed the demand for structural material fell off somewhat, and there became apparent a reluctance of melters to buy heavily in advance. Orders for iron to be delivered quickly increased in number and lessened in size of the individual order.

Something of the spring's activity in quick-delivery lots was due to the large amount of iron needed to supply melters whose contract shipments were delayed by railroad difficulties. In some cases iron due in November did not arrive until February or March. But with the arrival of contract lots by the bettering of transportation conditions in the spring and the growing reluctance of the market to take the products of melters as fast as they were turned out of foundries, came a change of attitude toward buying. This change grew rapidly; by the end of February the melters almost to a man seemed resolved not to buy more than was needed for one to three months ahead.

*Special correspondent, Chicago, Ill.

An advance in the freight rate on Southern iron, in the spring, from \$3.90 to \$4.35 had little effect on demand. For iron and steel products the local market continued good up to the middle of summer and then lessened perceptibly. The telegraphers' strike in the summer injured business while it lasted, and caused many users of iron to curtail buying before the general condition of business led to that course.

The range of prices of pig iron in the year and the comparison with prices in 1906 are shown in the following table:

	1906.		1907.	
	Highest.	Lowest.	Highest.	Lowest.
L. Superior Charcoal.....	\$26.50	\$19.00	\$28.00	\$25.00
Northern No. 2 Foundry.....	27.00	18.00	27.00	19.00
Southern No. 2 Foundry.....	26.90	16.90	27.35	19.35
Connellsville Coke.....	6.90	5.40	7.15	5.50
Bar Iron.....	1.85c	1.665c	1.865c	1.75c
*Structural Material.....	1.865c	1.865c	1.88c	1.865c

*Beams and channels, 3 in. to 15 in., and angles 3 in. to 6 in. x 3/4 in. or heavier.

Carload lots were almost the only sales of pig iron in the last half of the year. To some extent the smallness of the lots was due to the financial stringency that began about Nov. 1, but the general course of buyers was determined and acted upon three months before that time. The sharp decline of prices in the last quarter was due largely to financial conditions.

Northern iron reached its highest quotations, \$26.50@27, in the latter part of May and the early part of June. Southern iron had two high points, one in May and June to correspond to Northern, and the other in January. The Birmingham price of Southern for these points was \$23, making the Chicago price \$27.35. Lake Superior charcoal rose from \$27 in January to \$28 in May, the maximum quotation continuing until late in August. The low point of charcoal, like the low points of the other irons, was reached in the month of December.

Coke ranged from \$7.15 in January, for the best Connellsville, to \$5.50 in December, these prices representing \$4.50 and \$2.85 respectively at the ovens. The course of coke followed closely the course of pig iron and presented no extraordinary features.

An English company is reported to have taken over the group of mines known as Las Loras de Imperza, situated in the interior of the province of Tarapaca, Chile, at a price of \$1,000,000 gold. These mines are said to be rich in gold, silver and copper, and from now on it is proposed to push their development.

Fatal Accidents in Coal Mines

The Number of Men Killed in Coal Mines of North America in 1906. Comparison with Previous Years, Discussion of Causes, Etc.

BY FREDERICK L. HOFFMAN*

The fatality rate in coal mining during 1906 was 0.28 per 1000 employees below the average for the preceding year. The decline in the rate is equivalent to a saving of 184 lives upon the basis of the rate prevailing during 1905. In the light of recent events it is evident that the decline is only a temporary check in the upward tendency of the fatality curve, which has continued with but a single break since 1897. The great loss of life in West Virginia coal mines during December foreshadows a very considerable increase in the rate for 1907. In a matter of such vital importance it would seem that an early tabulation of the accident returns should be made compulsory by law, since from some of the States the data are not obtainable in a tabulated form until nearly a year after their occurrence. As a result, the publication of this summary has again been unduly delayed until the very close of the year.

FATAL ACCIDENTS IN 1906

During 1906 the number of coal miners killed was 2078, or 113 deaths less than during the preceding year, although the number employed increased by more than 20,000. During the 10 years ending with 1906 there have been 16,273 deaths of coal miners of North America, to which it is safe to add several thousand of cases not reported, and of deaths resulting from serious accidents within a year or two after their occurrence. A great calamity such as recently occurred at Monongah, W. Va., directs national attention to the subject, but the greatest loss is in the killing of men one by one, or in a small group, of which no mention is made in press despatches but which sum up a considerable total in the annual tabulation of the returns.

NUMBER AND RATE OF ACCIDENTS

Table A exhibits in detail for twenty States, Territories and Provinces the number of persons killed by accidents in coal mines of North America during the ten-year period ending with 1906. The returns for previous years have been subjected to a slight revision in view of supplementary information since the publication of the review of coal-mining accidents during 1906. Numerically, as would be expected, over half of the fatal accidents occurred in the bituminous and anthracite coalfields of Pennsylvania, while 268 deaths occurred in the coal

mines of West Virginia, 155 in Illinois, and 127 in Ohio.

Table B shows the fatality rate in coal mining in the United States and Canada, calculated in the usual manner upon the basis of the number employed. The fatal accident rate in 1906 for the entire coal-field was 3.16 per 1000 against 3.44 for

followed by Alabama with a rate of 5.23, West Virginia with 4.98, and Indian Territory with 4.81. The most favorable rate was returned for Maryland, or only 1.13 per 1000, and for Indiana with 1.61.

Table C exhibits the fatal accidents in coal mines during 1906 compared with the average for the preceding five years, both

TABLE A. NUMBER OF PERSONS KILLED BY ACCIDENTS IN COAL MINES OF NORTH AMERICA, 1897-1906.

	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1897-1906
Alabama.....	38	45	40	37	41	50	57	84	185	96	673
Colorado.....	35	24	41	29	55	73	40	89	59 ^a	88	533
Illinois.....	69	75	84	94	99	99	156	157	199	155	1,187
Indiana.....	16	22	16	18	24	24	55	34	47	31	287
Indian Territory..	22	17	25	40	44	60	33	30	44	39	354
Iowa.....	21	26	20	29	26	55	21	31	24	37	290
Kansas.....	6	17	16	22	26	27	36	16 ^b	36	30	232
Kentucky.....	12	6	7	17	21	19	25	19	31	39	196
Maryland.....	5	4	5	7	12	11	13	12	13	7	89
Michigan.....	...	...	4 ^c	10	6	6	8	7	8	6	55
Missouri.....	8	9	14	10	15	10	17	11	11	16 ^d	121
New Mexico.....	7	7	15	15	9	17	17	15	5	9	116
Ohio.....	40	52	57	68	72	81	114	118	131	127	860
Pa. Anthracite....	423	411	461	411	513	300	518	595	644	557	4,833
Pa. Bituminous....	150	199	258	265	301	456	402	536	479	477	3,523
Tennessee.....	10	19	20	10	53	226	26	28	29	33	454
Utah.....	3	3	...	209	10	8	7	9	7	7	263
Washington.....	7	9	45	33	27	34	25	31	13	13 ^d	237
West Virginia.....	62	90	89	141	134	120	159	140	194	268	1,397
British Columbia..	6	7	11	17	102	139	42	37	12	15	388
Nova Scotia.....	7	7	19	21	14	19	31	19	20	28	185
Total Deaths....	947	1049	1247	1503	1604	1834	1802	2018	2191	2078	16,273

^a Underground accidents only.
^c Six months only.

^b Six months only.
^d Nine months only, period ending Sept. 30.

TABLE B. FATAL ACCIDENTS IN COAL MINES OF NORTH AMERICA, 1897-1906.
Ratio of Persons Killed Per 1000 Employed.

	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1897-1906
Alabama.....	3.07	4.55	3.10	2.59	2.90	2.79	2.94	4.71	10.74	5.23	4.36
Colorado.....	4.99	3.23	5.60	3.99	6.88	8.11	3.89	8.26	4.96 ^a	7.32	5.86
Illinois.....	2.04	2.14	2.27	2.39	2.24	2.15	3.13	2.87	3.36	2.49	2.57
Indiana.....	2.00	2.63	2.07	1.82	1.98	1.83	3.64	2.70	2.53	1.61	2.30
Indian Territory..	6.34	4.82	6.24	7.59	8.35	9.62	5.42	3.63	5.76	4.81	6.12
Iowa.....	2.45	3.38	2.49	2.22	1.97	4.23	1.59	1.90	1.36	2.29	2.28
Kansas.....	0.71	1.95	1.57	2.06	2.28	2.70	3.61	3.02 ^b	2.97	2.65	2.39
Kentucky.....	1.55	0.67	0.83	2.06	2.14	1.58	1.85	1.37	2.06	2.33	1.71
Maryland.....	1.17	0.89	1.08	1.32	2.23	1.99	2.29	2.11	2.09	1.13	1.67
Michigan.....	...	...	4.88 ^c	6.11	3.26	4.24	2.54	2.58	2.93	2.83	3.16
Missouri.....	1.22	1.22	1.80	1.31	1.63	1.09	1.85	1.47	1.06	1.65 ^d	1.43
New Mexico.....	5.13	3.71	7.98	7.44	4.81	10.11	7.26	7.61	2.35	3.82	5.95
Ohio.....	1.39	1.77	2.03	2.14	2.15	2.16	2.75	2.57	2.96	2.73	2.35
Penn. Anthracite..	2.83	2.89	3.28	2.86	3.47	2.03	3.41	3.69	3.83	3.35	3.18
Penn. Bituminous..	1.72	2.27	2.82	2.43	2.56	3.37	2.65	3.45	2.90	2.76	2.77
Tennessee.....	1.58	2.43	2.60	1.15	6.10	25.80	2.69	2.81	2.38	3.07	5.00
Utah.....	4.17	4.38	...	138.96	5.81	3.24	3.21	4.06	5.14	3.69	16.57
Washington.....	2.48	2.70	13.60	7.79	5.59	7.83	5.13	6.69	2.73	2.52 ^d	5.60
West Virginia.....	2.89	3.86	3.55	5.03	4.14	3.78	4.63	3.08	4.24	4.98	4.03
British Columbia..	2.47	2.34	2.91	4.22	25.67	34.65	9.85	8.31	2.72	3.12	9.91
Nova Scotia.....	1.35	1.56	3.39	3.17	1.83	2.36	2.79	1.63	1.86	2.31	2.22
Average.....	2.34	2.59	2.98	3.25	3.24	3.49	3.14	3.37	3.44	3.16	3.14

^a Underground accidents only.
^c Six months only.

^b Six month only.
^d Nine months only, period ending Sept. 30.

the previous year and 3.14 for the decade. The rate during 1906 was above the average for the decade in Alabama, Colorado, Kansas, Kentucky, Missouri, Ohio, Pennsylvania (anthracite), West Virginia and Nova Scotia. The highest rate during the year prevailed in Colorado, where it attained to 7.32 per 1000,

upon the basis of actual numbers and the rate for 1000 employed.

The States showing an increase in the rate during 1906, compared with the previous five years, are Alabama, Colorado, Iowa, Kansas, Kentucky, Michigan, Missouri, Ohio, Pennsylvania (anthracite), West Virginia and Nova Scotia. The

*Statistician, The Prudential Insurance Company, Newark, New Jersey.

most decided reduction in the rate was in British Columbia, where the rate during 1906 was 3.12, compared with 15.73 during the preceding five years. Perhaps the most significant increase is in the rate for West Virginia, which during 1906 attained to the high figure of 4.98 per 1000 compared with 3.83 during the preceding five years.

Only three out of the twenty coal-producing States, Territories and Provinces returned a rate of less than 2 per 1000.

was seldom exceeded in the past, and, for illustration, in 1897 out of 19 coal-producing States nine returned a fatality rate of 2, or less, per 1000.

COAL MINING AND RAILROAD FATALITIES

For a convenient comparison of the fatality rate during 1906 with previous years, I add Table D, showing the number of employees and the number of miners killed, together with the rate per 1000 employed for the 15-year period 1892-

of very considerable extent which presents similar conditions is railway transportation, and as a matter of interest I add Table E, showing the comparative fatality rates for coal miners and railway employees during the last 15 years. This comparison is decidedly instructive. It shows that while there has been a slight increase, equivalent to 0.26 per 1000, in the fatal accident rate of railway employees during the last five years, compared with the preceding quinquennial period, the rate during 1902-1906 was slightly below the rate prevailing during 1892-1896, and while the highest rates prevailed during 1892 and 1893, 3.11 and 3.12, respectively, the rates prevailing during 1905 and 1906 were only 2.43 and 2.58 per 1000, respectively. Comparing the averages for the entire 15-year period, it is shown that while the fatality rate of coal miners was 2.996 per 1000, the corresponding fatality rate of railway employees was 2.54 per 1000. If the fatality rate prevailing among railway employees had prevailed among coal miners during the same period of time, 18,001 lives would have been lost instead of the 21,231 actually occurring.

DISCIPLINE IN COAL MINES

The necessity for a comprehensive and thoroughly qualified inquiry into the whole subject of accidents in coal mining is more apparent than ever. There has been a radical change in conditions, both as to methods of mining and in the class of labor employed, and the laws governing the subject demand revision and require to be brought down to date. While the increased depth, and introduction of electricity and coal-cutting machinery, may be responsible to a not inconsiderable extent for the material increase in the fatality rate of miners in most of the coal-producing States, it is quite probable that, among others, the increased danger is the result of high pressure or haste in methods of coal production on the one hand, and the extensive employment of unskilled and non-English speaking labor on the other. The complaint on this score is not new, for in fact as far back as 1874 in a valuable, although half-forgotten, prize essay upon the prevention of accidents in mines, Wilfred Creswick, of Sheffield, in the enumeration of the various causes of accidents to which miners are subject, held "loose discipline," in his judgment, to be the most important. In his own words, "This is so universal and such a fertile cause of accidents as to take my first attention, for while discipline is neglected accidents from all causes will occur, no matter what other safeguards are taken." The same subject is discussed at some length in the annual report of George Harrison, the chief inspector of mines for Ohio, for the year ending Dec. 31, 1906, in which, in part, he wrote as follows:

"Indisputable evidence is gathered that

TABLE C. FATAL ACCIDENTS IN COAL MINES OF NORTH AMERICA. Comparison of 1906 with the Five Previous Years.

	NUMBER PERSONS, KILLED, YEARLY AVERAGE.		RATE PER 1000 EMPLOYED.		Rate of Increase or Decrease Per 1000 Employed.
	1901-05.	1906.	1901-05.	1906.	
Alabama.....	83	96	4.82	5.23	+ 0.41
Colorado.....	63	88	6.33	7.32	+ 0.99
Illinois.....	142	155	2.80	2.49	- 0.31
Indiana.....	37	31	2.57	1.61	- 0.96
Indian Territory.....	42	39	6.30	4.81	- 1.49
Iowa.....	31	37	2.14	2.20	+ 0.06
Kansas.....	31*	30	2.90*	2.95	+ 0.05
Kentucky.....	23	39	1.79	2.33	+ 0.54
Maryland.....	12	7	2.14	1.13	- 1.01
Michigan.....	7	6	2.73	2.83	+ 0.10
Missouri.....	13	16 ^a	1.41	1.65	+ 0.24
New Mexico.....	13	9	6.30	3.82	- 2.48
Ohio.....	103	127	2.55	2.73	+ 0.18
Pa. Anthracite.....	514	557	3.31	3.35	+ 0.04
Pa. Bituminous.....	435	477	3.00	2.76	- 0.24
Tennessee.....	72	33	7.34	3.07	- 4.27
Utah.....	8	7	4.12	3.69	- 0.43
Washington.....	26	13 ^a	5.55	2.52	- 3.03
West Virginia.....	149	268	3.83	4.98	+ 1.15
British Columbia.....	66	15	15.73	3.12	-12.61
Nova Scotia.....	21	28	2.09	2.31	+ 0.22
	1891	2078	3.34	3.16	- 0.18

* Four and one half years only.

^a Nine months only.

TABLE D. FIFTEEN-YEAR RECORD OF THE FATAL ACCIDENTS IN COAL MINES OF NORTH AMERICA, 1892-1906.

	Employees.	No. Killed.	Ratio Per 1000 Employed.
1892.....	342,744	859	2.51
1893.....	382,133	965	2.53
1894.....	385,379	957	2.48
1895.....	395,549	1,057	2.67
1896.....	401,874	1,120	2.79
1897.....	405,433	947	2.34
1898.....	405,600	1,049	2.59
1899.....	417,415	1,247	2.98
1900.....	462,308	1,503	3.25
1901.....	494,367	1,604	3.24
1902.....	525,443	1,834	3.49
1903.....	574,210	1,802	3.14
1904.....	598,678	2,018	3.37
1905.....	637,522	2,191	3.44
1906.....	658,189	2,078	3.16
1892-96.....	1,907,879	4,958	2.60
1897-01.....	2,185,123	6,350	2.91
1902-06.....	2,904,042	9,923	3.31
1892-06.....	7,087,044	21,231	3.00

It is not necessary to argue to any considerable extent the question as to what should constitute a minimum rate of coal-mining fatality since in morals and economics every life needlessly lost constitutes a reckless waste of human energy. It would seem, however, that under present conditions, with reasonable attention to approved methods of safeguarding the lives of coal miners, a rate of 2 per 1000 should not be exceeded in the bituminous coal mines throughout the United States. According to earlier returns such a rate

TABLE E. COMPARATIVE FATALITY OF COAL MINES AND RAILWAY EMPLOYEES, 1892-1906.

	FATAL ACCIDENTS IN COAL MINES.		FATAL ACCIDENTS TO RAILWAY EMPLOYEES.	
	No. Killed.	Ratio Per 1000 Employed.	No. Killed.	Ratio Per 1000 Employed.
1892.....	859	2.51	2,554	3.11
1893.....	965	2.53	2,727	3.12
1894.....	957	2.48	1,823	2.34
1895.....	1,057	2.67	1,811	2.31
1896.....	1,120	2.79	1,861	2.25
1897.....	947	2.34	1,693	2.06
1898.....	1,049	2.59	1,958	2.24
1899.....	1,247	2.98	2,210	2.38
1900.....	1,503	3.25	2,550	2.51
1901.....	1,604	3.24	2,675	2.50
1902.....	1,834	3.49	2,969	2.50
1903.....	1,802	3.14	3,606	2.75
1904.....	2,018	3.37	3,632	2.80
1905.....	2,191	3.44	3,361	2.43
1906.....	2,078	3.16	3,929	2.58
1892-96.....	4,958	2.60	10,776	2.64
1897-01.....	6,350	2.91	11,086	2.35
1902-06.....	9,923	3.31	17,497	2.61
1892-06.....	21,231	3.00*	39,359	2.54

*To be exact the rate was 2.996.

1906. The table shows that while the rate during the first five years was 2.60 per 1000, it increased to 2.91 per 1000 during the next five years, and to 3.31 during the last quinquennial period. The table discloses a distinct tendency toward a greater average accident liability, excepting the comparatively slight fall in the rate during the last year under review. The only other American industry

a very large percentage of accidents is due to the indifference of mine bosses and superintendents as to the safety of employees, and, in some cases, it is very questionable if it does not amount to culpable or criminal negligence. It may also be said that the suicidal recklessness and undisciplined, unsustainable actions of employees is another fruitful source from which many accidents are directly or indirectly traceable. Many mine bosses and superintendents, while realizing and admitting that it is their duty to see the working places of the miners at least every alternate day, or oftener, and to examine them properly, and look to the safety of men in all parts of the mine, will frankly acknowledge that they do not do so, and that on account of their time being absorbed in the eager race of competition to produce more and cheaper coal than their neighbor, their duties of looking after the interior of the mine, and the safety of employees, is a secondary consideration. In addition to the greatly increased danger incident to the daily avocation of the miner of today, compared to 30 years ago, there is still a much wider contrast between the practical skill of the miner of that day and the absolute impossibility of a great majority of the miners of the present day having had any opportunity to become competent to judge of the natural dangers in mines."

Since thoroughly skilled labor cannot be had and coal production must continue, the employment of unskilled labor becomes inevitable, leaving no alternative but the gradual education of the men and the most rigid discipline and intelligent method of supervision over their work. Mr. Harrison calls attention to the practice of the Lorain Coal and Dock Company, in Belmont county, Ohio, as being in the lead in improvements and consideration for the comfort and safety of its employees. This company, he states, has inaugurated a very commendable system of having thoroughly practical men traverse the working places of their miners daily, instructing the men in their work and dangers encountered, and looking after the general safety of the mine. It is to no purpose to argue that the men themselves are responsible for a large number of strictly avoidable accidents and the disregard of the laws, rules and regulations governing safety in mines. The ultimate responsibility must rest upon the management, which in a large number of instances is far from having availed itself of the most practicable and satisfactory methods of accident prevention.

GOVERNMENT INVESTIGATION OF ACCIDENTS

Upon some of the most important problems in mine-accident prevention more information, however, is required than is at present available. Excellent results should follow the Government tests of safety devices for mines, which, it is understood, are to be made by the Fuel

Division of the United States Geological Survey. As it has been pointed out by Dr. J. A. Holmes, chief of the fuel-testing branch, "there seems to be no end to the gas and coal-dust explosions in mines, and instead of growing less this horror appears to be multiplying. We believe that this tremendous loss of life is unnecessary, and it will be our purpose to investigate the subject in a most thorough and practical manner. We shall not be satisfied until we have reduced these accidents to a minimum." It is to be hoped that the appropriation asked for by President Roosevelt in his last message, to conduct these investigations, will be made by the present Congress.

BAROMETRIC PRESSURE AND MINE EXPLOSIONS

The investigation, however, should be made to include an inquiry into the possible relation of high barometric pressure to mine explosions. The subject is not at all new, having been discussed as early as 1872, by Scott and Galloway, in an address on "The Connection between Colliery Explosions and the Weather," published in the Proceedings of the Royal Society. Abel, in his work on "Mining Accidents and their Prevention," refers to the same subject at considerable length and there is a further consideration in the report by H. M. Chance on "Coal Mining," in the report on "Mining Methods and Appliances used in the Anthracite Fields," published as part of the Second Geological Survey of Pennsylvania in 1883. More recently the subject has been discussed in some very able contributions to the ENGINEERING AND MINING JOURNAL by Floyd W. Parsons, James T. Beard and W. H. Booth, all of which throw much light upon the problem, the successful solution of which may aid materially in the prevention of at least one large group of accidents in coal mining. It would be advisable for mine inspectors to make special investigations along this line and tabulate gas explosions by months for a period of years, while the Weather Bureau might be required to establish special observatories, recording fluctuations in barometric pressure in the more important coal regions where gaseous mines are known to exist. It is at present quite difficult to obtain accurate records of barometric pressure immediately before and after serious accidents for the precise locality where the accident occurred. Since the location of gaseous mines is quite well known, an arrangement could easily be made by the Weather Bureau by furnishing voluntary observers in such regions with the necessary self-recording instruments. If I am correctly informed, it is one of the rules of the Prussian mining law to require self-recording barometers to be placed in dangerous mines, to give timely warning of approaching changes in air pressure which might be followed by disastrous results.

FOREIGN INVESTIGATIONS OF ACCIDENTS

While all important coal-producing countries in the world have contributed the results of extensive and thoroughly scientific investigations into the more obscure causes of mining accidents, nothing of value in this direction has been done by the Federal Government, which certainly has a duty to perform in the premises. I need only call attention to the recently published reports of the Royal Commission on Mines, which contain a vast amount of evidence, and the report on the health of Cornish miners, published in 1904; also the report of the Departmental Committee on the use of electricity in mines, published in the same year, and the elaborate report of the Royal Commission on the ventilation and sanitation of mines of Western Australia, published in the same year, to indicate the scope and direction which such an inquiry should assume.

Graphite in New York

BY D. H. NEWLAND*

The past year was uneventful in the crystalline graphite industry of the Adirondacks. As heretofore, the American mine, near Graphite, was the principal source of supply, and it remains the only firmly established enterprise in the region. There were several failures among the newer undertakings, owing to one cause or another. The main obstacle encountered is in refining the product. With the exception of the deposit at Graphite, the quartz schist which carries the graphite almost always contains a small percentage of mica. This mineral is usually developed in scales of about the same size as the graphite flakes, so that it cannot be removed readily by ordinary mechanical separation. Its presence, of course, even in small quantity, limits the uses for the product and brings down the market value as well.

A competent mine manager estimates that the proposed new Australian tariff on raw materials will add 10 to 15 per cent. to working costs in Australian mines.

According to a recent consular report, the Germans have done practically everything in their power to develop the mineral resources of the Province of Shantung, but they have thus far only succeeded in making the coal mines pay. Aside from this they have iron deposits, which will undoubtedly yield a return once they are worked, but aside from that there is nothing to speak of, and the expectations of 10 years ago that Shantung would prove to be an enormously rich mining district seem doomed to disappointment.

*Assistant State geologist, Albany, N. Y.

Mining in the United States During 1907

History of the Year in Various Camps of California, Colorado, Nevada, Montana, Utah, South Dakota, New Mexico and Other States

REVIEWS OF PROGRESS

Mining in the United States in 1907 was generally prosperous, as is manifest from the following reviews, up to the last quarter of the year, when the culmination of adverse financial conditions led to a depression in business which affected all industries, including mining. However, it is probable that when the complete statistics are collected it will appear that the prosperity during the first nine months of the year was so great that in spite of the setback in the last quarter there was an increase in the production of the year, although this will not be the case with respect to copper, and perhaps some of the other metals.

Colorado

BY GEORGE E. COLLINS*

During 1907 Colorado had a somewhat uneventful history. The long expected new bonanza camp remains undiscovered, and in the older districts we are still without any new mine of the first magnitude. On the other hand, the labor troubles, which for so many years alarmed the mining industry of the State and disturbed its development, were absent, thanks largely to a watchful attitude on the part of the operators in the principal districts. The main difficulty encountered was a shortage of labor, and above all of efficient skilled labor; but in this respect Colorado was no worse off than the other Western States.

At the close of the year the fall in the prices of metals, and to a less extent the depression in the Eastern money markets, led to some curtailment of output. It may be doubted, however, whether in the long run these last factors, which will affect our sister States and Territories more seriously than ourselves, may not prove a blessing in disguise by causing the return to Colorado of many of the skilled miners who have been attracted elsewhere during the past few years by greater activity and higher wages.

Colorado is still primarily a producer of the precious metals, and our output here experienced no such increase in value as would enable us to compete with other States for the best classes of labor by offering higher remuneration or better conditions. Colorado did not, in fact, share the exceptional prosperity of Utah, Nevada and Arizona during the last two

or three years, and on the other hand has little to fear from the depression which now menaces them.

CRIPPLE CREEK

The total production of the Cripple Creek district will probably prove to be in the neighborhood of \$11,000,000, of which the Portland will have contributed nearly one-fifth. The other chief producers were the Golden Cycle, Elkton, Vindicator, and (during the first half of the year) Stratton's Independence.

The destruction by fire of the Golden Cycle mill on Aug. 7 caused a great reduction of output. Many of the producing mines had contracted to ship their ore to this mill, and as these contracts still remain in force they were unable to make advantageous terms with the United States Reduction Company for the few months that would elapse while the mill was being rebuilt. The reconstruction of the mill has now been practically completed, and by the time this article is published it should be in operation.

The other great milling development is the new mill designed by Argall to treat the dumps and low-grade ore of Stratton's Independence by concentration and raw cyaniding, and which should be completed by about Feb. 15. Many excellent authorities believe that Cripple Creek may yet become a large producer of low-grade milling ores which will be treated locally, in which event the success of the new Independence mill may lead to greater activity throughout the district. It is understood that some tests made in milling by roasting and cyaniding at the Vindicator gave encouraging results, and that this company is only waiting the completion of the Independence mill to obtain further light on the subject before commencing a mill of its own.

Cripple Creek seems more and more to be developing into a leasing camp. On this basis the Little Clara, now operated by new lessees, was a large producer, though hardly so prominent as it was last year. The lessees in the Granite produced a considerable amount, especially during the first half of the year. The El Paso, it is said, will lease all of its upper workings, commencing about Jan. 1. According to general expectation the lease held by Becker & Travell on the southern portion of the Dante will be the star lease next year.

The drainage tunnel is in about 1100 ft. It is now being driven with one shift

only under contract by the El Paso Company. The ground is rather hard, and the present net progress is approximately 100 ft. monthly. In the meantime the lower workings on the Portland and Strong are being unwatered under a joint pumping agreement.

On the whole it is probable that 1908 will show a considerable increase of production in the district, as compared with 1907.

LEADVILLE

The output for the first ten months of the year was probably as good as or better than in 1906, but owing to the fall in the values of lead and zinc and the depressed condition of the Eastern markets, which compelled the smelters to shut off many of their customers who were not subject to long-time contracts, the output for the last two months of the year will be greatly reduced. The properties of the Western Mining Company, especially the Coronado and Wolf-tone, continued to be by far the greatest shippers in the district. The Moyer mine of the Iron Silver Company and the Yak Tunnel were the largest independent producers, and a considerable tonnage, aggregating perhaps 200 tons per day or more, was made by leasers on the Ibox properties. Among the smaller operations the Crescentia on Rock Hill, opened last year, was a considerable shipper. The Mammoth mine, reopened by the Wellington Association and very widely advertised in certain journals, was shut down and the pumps were drawn.¹

The Leadville district badly needs new discoveries, failing which its production cannot be maintained indefinitely at the present rate. Considerable work is being done in the Sugar Loaf district to the west of the town, where the Dinero tunnel is being driven in depth the property of the same name, and other adjoining claims. A good orebody has been opened up on the Sunday claim on Bald Mountain at a depth of about 300 feet.

SAN JUAN

This region was free from serious misfortunes during the year, but unfortunately the list of profitable mines was not extended. The output, however, was greatly in excess of that for last year.

¹Since the above paragraph was written, the properties of the Western Mining Company have been closed down. It is feared that orders to take out the pumps will follow, which would compel the abandonment of the entire down-town district, perhaps for years.

*Mining engineer, Denver, Colo.

In the vicinity of Telluride the Tomboy continued to be a large and profitable producer, with the Smuggler-Union and Liberty Bell following it in the second rank. The Robeson-Carter lease on the Bulion tunnel workings of the Smuggler-Union, which had been highly profitable, was terminated and the greater portion of the property is being again operated on company account. A lease on the Pandora vein is said to have opened up an important orebody. The new Black Bear mill is ready for operation, and this mine, supposed to be on an extension of the Argentine vein, will probably be a considerable producer during the ensuing year. The Japan-Flora is under option to the Mines Selection Company of London.

At Silverton the Silver Lake, Gold King and Sunnyside are still the leading mines. The new mill of the Gold Prince at Animas Forks was in operation most of the year, but never to full capacity. It is generally understood that the orebodies in the Sunnyside Extension proved to be of lower grade than was expected. The old Aspen mine was reopened and a section of the rebuilt Silver Lake mill was set aside for the concentration of its ore. At Ouray the Camp Bird produced heavily throughout the year. Developments, however, in the lower levels are not very favorable. The Revenue is being operated almost entirely on the leasing system.

NORTHERN DISTRICTS

In Gilpin county the condition of general depression is unchanged; on Quartz Hill in particular there is not a single mine working, and the water now stands at a uniform depth of about 500 ft. from the surface. The Newhouse tunnel, driving of which was suspended last February, is within 1000 ft. of some of the principal veins, but it is generally understood that it will not be completed until satisfactory arrangements have been made with all of the principal mines ahead. Operations on the Gunnell were suspended, after the main shaft had been reopened and retimbered to a depth of about 800 ft. A successful reorganization of the Gregory-Bobtail Consolidation, it is understood, provided funds for the further testing in depth of this property, which has in the past been the largest producer in the district. The Cook shaft was sunk to the 1400-ft. level where a crosscut opened up what seems to be a large body of payable ore in the Mammoth vein. Crosscuts are now being driven to the Bobtail and Gregory respectively. This level will be about 100 ft. deeper than the present lowest workings on the Gregory. Among the larger producers in this part of the district are the O. K. and the Running Lode. A good orebody was discovered in the Sleepy Hollow.

The one bright feature in Gilpin county

is the Russel Gulch district, where the Old Town and Pewabic were large producers. During the year the Old Town and Saratoga workings were connected with laterals from the Newhouse tunnel, and from both of these mines an increased production may be looked for in the ensuing year. All the properties on the Calhoun vein were consolidated under one control, and an important program of development was begun, a feature of which will be the sinking of two shafts to the level of the Newhouse tunnel, and the driving of a lateral from the tunnel level to connect with them.

In the lower Clear Creek district the chief producers were the Gem, Little Mattie, Shafter and Specie Payment. The great feature of mining in this district continues to be in connection with the deep crosscut tunnels; of these the Newhouse has already been referred to in connection with Gilpin county; the Central and Lucania also made some progress during the year, as also the McClelland tunnel, which is being driven to unwater the Freeland district, and the Rockford which intersected the Donaldson vein at great depth and will be used as the avenue through which it will be exploited.

At Georgetown there is some revival of activity, but also a notable absence of really important discoveries. Several mills are, however, at work on the low-grade zinc and lead ores, treating mainly old stope fillings and dump material. Considerable activity continues around Argentine and along the range. In the gold-bearing district near town a fine orebody is reported to have been struck in the Capital Prize, and a mill is under construction for the treatment of its production.

In Boulder county there was little new development. The Wano mill is being successfully run, and a new mill was erected at the Inter-Ocean mine at Sunshine. As a whole, however, one may safely say that the needs of the Boulder county district are rather in the direction of underground exploration than surface improvements.

OTHER DISTRICTS

In the vicinity of Breckenridge a good deal of zinc and lead is being shipped, but this will be discouraged considerably by the fall in prices. The Revett dredge on French gulch was successfully operated, and a great deal of drilling was done farther down on the Swan, which is likely to lead to a considerable increase of dredge mining. There was some excitement in the Montezuma district of Summit county, and it is reported that the railroad will be extended from Keystone up the Blue river. As yet this incipient boom has mainly manifested itself in the consolidation of properties, and it may be questioned whether sufficient develop-

ment has been done as yet to finally establish the future of the district. A large output of silver-bearing lead and zinc concentrates was made during the first half of the year from the Creede United mill at Creede; but this is now greatly lessened, owing partly to unremunerative prices, and partly perhaps to exhaustion of the deposits. Comparatively little interest was taken in other Creede properties.

At Aspen no new discoveries were reported, and the outlook is not roseate. The Smuggler and Percy La Salle were the chief producing mines; the latter, however, has been shut down for the winter pending the erection of a mill.

MINING OF RARE METALS

During the first part of 1907 the tungsten industry in Boulder county was greatly stimulated by the high prices, and the output doubtless far exceeded that for any other year. Most of the actual mining was done by leasers, this system being best adapted to the pockety nature of the enriched portions of the veins. Of late the market for tungsten concentrates has been inactive and operations have been greatly reduced. Little or nothing was done toward working the other deposits of tungsten and other rare metals throughout the State, with the exception of the vanadiferous sandstone in San Miguel county.

LABOR CONDITIONS

There were several incipient differences between operators and their employees in more than one district, but in each case the difficulty was adjusted or overcome without a strike. At Cripple Creek an attempt was made by a small coterie of local business men and politicians to overthrow the card system, but it was soon apparent that this movement met with no sympathy among either miners or mine operators. The system is now more firmly established and more thoroughly carried out than ever.

An uncalled for attempt on the part of the local union in Gilpin county to disturb the harmonious condition which for so many years has distinguished that district, was entirely abortive. At Silverton the contract between the local Mine Operators' Association and Miners' Union, under which wages and working hours had been fixed since 1902, expired. A new schedule was announced by the mine owners, but although they were unwilling in this case to enter into any further agreement with the union leaders, the latter tacitly accepted the new schedule, as it was obviously as favorable as conditions in the district would warrant. At present the only dubious condition of affairs with reference to labor is at Telluride, where the card system has been given up and where an attempt is being made to revive the sinister influence of the union.

Montana

BY EDWIN HIGGINS

The beginning of 1907 found Montana on the crest of the greatest wave of mining prosperity the State had ever known. All conditions were favorable and it was predicted that the value of the metals produced for the year would exceed \$70,000,000, the figure for 1906. The main factors which served to bring about this era of prosperity were the satisfactory financial conditions throughout the country and the high price of copper.

The latter part of the year 1906 had witnessed the advent of an unprecedented number of new mining companies in the different mining districts of the State and activity along these lines continued well into 1907. These new companies purchased a large quantity of heavy mining machinery and furnished employment to hundreds of miners. Most of them being in the development stage, their operations had little or no effect on the production of ore for the year. The high price of copper stimulated exploration and development work in every mining district of the State and many abandoned silver mines, the ores of which carry copper in commercial quantities with that metal selling above 20c. per lb., were re-opened and equipped for operation on a large scale.

One of the noteworthy features of the year is the gradual change which has been taking place in the development of power for mine and mill operations. Steam is rapidly being discarded in favor of electric power, especially in the Butte district. At the close of the year the larger Butte operators were driving all compressors and pumps electrically and this same power had been installed in several of the mines for surface and underground haulage.

In the other districts of the State many mining plants and mills are using electrical power and it is only a matter of a short time before it will come into general use, except in remote localities.

THE BUTTE DISTRICT

The Butte district, in Silver Bow county, produces from 80 to 85 per cent. of the ore mined in the State. Statements made regarding conditions here are with few exceptions applicable to all parts of Montana.

In the early part of the year there were employed in the mines of the district 16,000 men and the average monthly pay roll was close to \$2,000,000. The tonnage mined by the large companies and the name and location of the smelters treating the ores are as follows:

Amalgamated, North Butte and Red Metal companies, 10,000 tons of ore per day, treated at the Washoe smelter Anaconda; Boston & Montana, 3000 tons treated at the Boston & Montana works, Great Falls; the Clark mines, 1200 tons,

smelted at the Butte Reduction Works, Butte; other companies and leasers, 2000 tons of ore per day, shipped to the works named and the East Helena plant of the American Smelting and Refining Company; total, 16,200 tons of ore per day.

IMPORTANT EVENTS OF THE YEAR

During the months of January and February the extremely cold weather, coupled with a shortage of cars, caused a loss of 20 days of actual mining operations. However, for the first six months of the year the production of the mines was about normal and equal to that of the corresponding months of 1906.

On April 1 the miners' wages were raised from \$3.50 to \$4 per day, the Amalgamated and other large companies entering into a five-year agreement with the Butte Miners Union to pay the \$4 scale as long as copper sold as high as 18c. per lb., the old scale, \$3.50 per day to be resumed when the metal sold below 18c. The first serious drop in the price of copper was noted in the average quotation for the month of June, 22.665c. as compared with 24.048c. for the month of May. A further drop occurred in the month of July, the average price being 21.130c. per lb. On Aug. 1 the machinists, who had been receiving \$4.50 per day, went out demanding \$5 per day. They were repeatedly offered \$4.75 but would not accept, and it was not until Dec. 1 that they returned to work. By this time the price of copper, after steadily declining month by month, had fallen to between 13 and 14c. per lb. and the machinists were glad to return at the old scale, \$4.50 per day. In the meantime, under the five-year agreement, the miners had been reduced to \$3.50 per day, the new scale going into effect Nov. 1.

On Sept. 16, the price of copper having fallen below 16c. per lb. and a large surplus of the metal being on the market, orders were given by the larger companies which resulted in the curtailment of the ore production to 40 per cent. of the normal. Following this the production of all the mines was gradually cut down and by the end of the month of November all the smelters of the State had decided to accept no more custom ore for treatment. The one exception was the East Helena smelter, which continued to accept ore from mines with which it had contracts. This was a severe blow to the smaller operators and leasers, not only in Butte but throughout the State.

On Dec. 10 it was decided to close the Washoe smelter and all the mines of the Amalgamated, North Butte and Red Metal companies, except the mines and smelter of the Boston & Montana company (a subsidiary company of the Amalgamated). This company worked to full capacity, mining and shipping 3700 tons daily to the Great Falls smelter.

About the middle of December the East Helena smelter announced that it would again accept custom ore for treatment.

Toward the last of the month the production of ore in the Butte district had dropped to about 5000 tons per day. With the exception of about 300 tons produced by leasers and smaller operations, this tonnage came from the Boston & Montana company's mines and those of W. A. Clark. Many of the new companies which had started operations earlier in the year with such bright prospects were forced to suspend on account of a lack of currency with which to pay their men. Embryo companies were totally neglected for the time being. The only activity in the mining industry seemed to be in gold mines and they were sought in the outlying districts.

THE WASHOE SMOKE CASE

A matter of great importance in connection with the mining industry of the State is the attitude of the ranchers of the Deer Lodge valley toward the Washoe smelter at Anaconda. These ranchers ask for an injunction closing the smelter and for the payment of damages to livestock and land. A vast amount of trouble and expense has been gone to by the Washoe company in the preparation and submission of its side of this now famous case. Master-in-Chancery Crane, before whom the case was argued, gave an opinion to the effect that he believes the sulphur in the smoke causes no damage to animal or vegetable life, but that the arsenic is damaging to both; and that if the injunction were granted and the smelter closed the damage to the ranchers would be greater than if the plant were allowed to continue in operation. The case is now before Judge Hunt, of the Federal Court. His decision is eagerly awaited by many, for the closing of the Washoe plant, the largest concentrator and smelter in the world, would be a serious blow to the mining industry in the State.

OTHER MINING DISTRICTS

The conditions in the Butte district were generally reflected throughout the State. The year opened with many new companies operating or preparing to operate in the various districts. Unusual activity was visible everywhere. Copper properties were eagerly sought for and large prices were paid for mere prospects.

One notable feature was the lack of development of the lodes carrying silver alone, except in cases where the ore was especially rich. However, this will not affect the production of silver for the year, for the bulk of this metal is obtained as a by-product of copper. Most of the silver mines are struggling for existence under prevailing conditions.

The production of gold in the State has been on the increase for the past 10 years, and 1907 will doubtless show a slight gain over last year. The heavy snows of last winter provided an abundance of water for milling purposes and

this, coupled with the improved machinery and better methods employed, has been a factor attending the success of gold mining in the State for the year. During the last four months of 1907, when the demand for copper properties had practically ceased, increased activity was noted in gold. The end of the year found a greatly increased number of gold prospectors and producers in operation.

Placer mining was most extensively carried on in the vicinity of Virginia City, in Madison county, where five electric dredges have been in almost continuous operation during the entire year. Sluicing methods were employed in several other districts.

Except possibly in the last month nothing of great value was accomplished during the year with the complex zinc-lead-copper ores, of which there are vast quantities in the lodes in nearly all parts of the State. It was reported in the early part of December that the mill erected at the Lexington mine in Butte, for the treatment of such ore, was in successful operation. The solution of this problem and the building of a mill that can make a clean zinc and lead product and a commercial smelting copper concentrate will do much toward bringing Montana to the front as a zinc producer.

JEFFERSON COUNTY

In the outlying districts the greatest activity was noted in Jefferson county, principally in and about the Corbin district. In the vicinity of Basin, Corbin and Wickes is a mineral belt which, before the slump in the price of silver in 1893, produced many millions of dollars in silver and gold. In the early part of 1906 this section took a new lease on life. Old producers were re-opened and many of them were found to carry copper in commercial quantities in addition to silver and gold ore. Within a radius of two miles of Corbin the hills were dotted with hoists, buildings and bunk houses. Although few actual producers were developed during the year, the prospects at many of these prospects were promising. Rich strikes of copper-silver ore had been made in a number of cases. The end of the year finds nearly 50 per cent. of these operations closed either temporarily or permanently on account of financial conditions.

BEAVERHEAD AND OTHER COUNTIES

Beaverhead county was also the scene of much activity during the year. The Argenta district attracted a good deal of attention and was successful in developing several producers of copper and silver ore.

Lewis & Clark county, especially in the Rimini district, and Madison county both showed improvement over the year 1906.

Broadwater, Park and Missoula counties all experienced renewed activity in the early part of the year, but suffered from the general depression toward the close.

Nevada

SPECIAL CORRESPONDENCE

At the end of 1906 the mining boom was still on in Nevada, but by October, 1907, the wave had subsided and the enthusiasm of the speculators had been pretty thoroughly quenched. The mines, however, are doing well and 1908 should be a banner year. It is gratifying to observe that the business of mine promoting and wild-cat stock selling seems to be nearly a lost art, hardly any new companies being advertised and those in a timid way contrasting vividly with the flamboyant advertisements of the past.

The chief event for 1907 was the closing of the State Bank and Trust Company, and the Nye & Ormsby County Bank at the end of October. In their various branches at Reno, Carson, Tonopah, Goldfield, Blair, Wonder, and Manhattan, these banks had total deposits of more than \$3,000,000. It is not yet certain that they will resume; they are now having agreements signed by which the depositors accept partial payments extending over a year. These bank failures were caused by the great shrinkage in values of local mining shares; typical prices are shown in the following list, by which it will be seen that the average depreciation is 58 per cent.

PRICES OF NEVADA MINING STOCKS.

TONOPAH STOCKS.	Sat. Dec. 29, '06	Nov. 21, '07
Belmont	\$5.12	\$0.90
Midway	2.30	0.45
Montana	3.90	1.22
Tonopah Extension.	5.88	1.00
Tonopah of Nevada	20.00	7.50
West End.....	1.85	0.30
GOLDFIELD STOCKS.		
Daisy	2.20	0.76
Florence	3.25	2.53
Mohawk	13.75	8.00
OTHER DISTRICTS.		
Gold Bar.....	1.35	0.33
Indian Camp.....	1.15	0.05
Manhattan Consol.	1.05	0.23
Nevada Hills.....	3.45	3.55
Pittsburg-Silver Peak	1.65	1.00
Tramp Consolidated	1.75	0.18

An added cause in the failure of the State bank was its losses from the Sullivan Trust Company, which went up in 1906 with alleged assets of \$3,090,000, mostly of only nominal value. Writing with a desire to be painfully exact and fair it seems correct to state that the whole population of Nevada was mildly insane at the end of 1906 as regards mining stocks.

ASSESSMENT WORK

Owing to the financial stringency Congressman George Bartlett will try to have a bill passed abrogating assessment work for 1907, as was done in 1893. This action is opposed by the miners' unions, which state that this will lessen the amount of work to be done, and that their members need all the work they can get. This requirement of \$100 of annual labor causes a great waste of money and a vast amount of strong swearing, for in many cases the

work is contracted at a price less than \$100, although a sworn statement is filed with the county recorder that \$100 work has been done. If this work could be commuted by a cash payment to a fund to be used for the benefit of the mines in surveys and examinations there would be a great saving to the community.

Lately established forest reserves near Manhattan are causing some annoyance and expense to mine owners and mill men; the stumpage charge of \$2 per cord for wood that is to be used for legitimate mining purposes seems pretty steep.

NEW MINES AND CAMPS—RAILROADS

As far as I can learn none of the newer camps developed any notable mines, and no camp of importance was started during 1907 in spite of large sums spent in prospecting. There was, however, a great deal of good work done which will add largely to Nevada's future production; indeed 1907 might well be called the "mill-builders" year, for more mills were completed and planned than at any time during the history of the State.

The Las Vegas & Tonopah Railroad was completed to Goldfield, and the Tonopah & Tidewater to Rhyolite. The Western Pacific is pushing ahead rapidly and is now operating 175 miles in the eastern part of Nevada. The Nevada Northern is completed to Ely. Branch roads have been finished to Pioche, Searchlight and Fallon. Among the new railroads for which surveys have been made are the Ely-Tonopah and the Fallon-Fairview; both of these are greatly needed. The Ely-Tonopah passes through Golden Arrow, Bellehelen, Clifford, Tybo and Hot Creek; all of these camps have good prospects.

DEVELOPMENTS OF THE YEAR

There were no startling developments in the camps of southern Nevada, but the mills now building and lately finished will add materially to the output of 1908.

The Potosi mine, of Good Springs, made regular shipments of zinc ore and a number of smaller properties shipped occasionally. This is a little talked of, but very promising, camp and promises to become an important producer of both zinc and lead ore.

The copper camp of Greenwater, topographically Nevadan though politically Californian, proved the failure predicted by expert observers in its early history and very few men will be working there in 1908.

The Keane-Wonder 20-stamp mill started crushing in October, working 50 tons daily. The 100-stamp mill of the Johnnie Consolidated Mining Company is now running. A stamp mill is to be finished in March, 1908, at Skiddoo; reliable reporters speak favorably of the chief mine here, a gold quartz property in which E. A. Montgomery, of Montgomery-Shoshone fame, is largely interested.

There has been a strong booming of the Lee district by the Rhyolite papers and the camp probably has some merit. Some prospecting for oil was done south of Rhyolite, but without result.

MONTGOMERY-SHOSHONE MILL

At Rhyolite the Montgomery-Shoshone mill began work in September, but for a time was "bothered" by the refusal of the men to use "unfair" electric current generated at the power plant in Bishop Creek, where a strike was in progress. This strike lasted but a short time and the mill ran through October, crushing 3000 tons, worth \$25 per ton. Besides this, 1000 tons were sent to the smelters with an estimated value of \$100 per ton, the total product for the month being reported as \$175,000. The mill is of 300-ton capacity, crushing with rolls; the pulp passes over amalgamating plates, and is then concentrated and cyanided; no tube mills are used. Charles M. Schwab, who has lately come into unpleasant prominence in Nevada by reason of his criticisms of false statements made by Nevada mining promoters, furnished \$500,000 toward the cost of this mill.

OTHER PROPERTIES IN AND NEAR RHYOLITE

Outside of the Montgomery-Shoshone property none of the mines of Rhyolite has done much. The Tramps Consolidated, owning a large number of claims which were separately supposed to be very valuable, has proved a frost; the large quartz ledges are very low-grade and the high-grade ore very small in quantity. As this inside knowledge leaked out, the stock, which had been tipped to go to \$5 per share, dropped from \$2.50 per share to 15c.; late developments give a little encouragement. Most of the other Rhyolite properties merely present possibilities.

The Gold Bar and Homestake King mines, about five miles west of Rhyolite, show wide ledges of low-grade gold ore. Each of these mines is building a 20-stamp mill to be finished early next spring.

Contradictory reports come from the Tecopa mine near the line of the Tonopah & Tidewater Railroad south of Rhyolite, the newspapers predicting a vast production for this property which would seem justified by the fact that the mine was a producer of silver-lead ore years ago, when it was in a most inaccessible country now opened up by the railway. Reports from workmen and from experts who have examined the property are not so favorable.

The Gold Bullfrog Mining Company, nine miles northeast of Rhyolite, has completed its 35-ton Standard mill, but milling has been delayed owing to lack of water; this has been remedied by sinking an 800-ft. well. Judging from results, the Mayflower and other mines near Beatty are not opening up very satisfactorily. A 10-stamp mill has been running at Bonnie

Clare, halfway between Rhyolite and Goldfield, but results seem unknown.

Latterly there has been a vigorous attempt to boom the copper mines of Ubehebe, 60 miles westerly from Bonnie Clare. Here are found strong croppings with rich sulphides and carbonates. The immediate construction of a railway and of a copper smelter is promised; this is absurdly premature, though there is no doubt of the existence of good copper indications over considerable country.

GOLDFIELD

Goldfield is still the banner camp of Nevada, making a large production during the year and paying substantial dividends. These to the end of November, as far as I can learn, are as follows:

Goldfield Consolidated.....	\$700,000
Mohawk Jumbo.....	120,000
Little Florence.....	400,000
Frances Mohawk.....	273,000
Florence Mohawk.....	100,000
Nevada Extension.....	50,000

Besides this a number of leasing companies paid considerable sums.

A year ago the trains to the camp were crowded with passengers, and there was an acute shortage of transportation and a fuel famine. Now many more people are leaving Goldfield than are coming in; the local trains to Tonopah have been taken off and there is but one daily train to San Francisco, instead of two. There is no trouble with the transportation of sufficient supplies. There is destitution in the camp, and many poor people are being sent away to other States by the authorities; it is even proposed to send out a special trainload of refugees.

The miners are now much quieter than they were last year and it is said that a number of them are working for their board and trusting their employers for the balance of the wages. A strike as to whether the watchmen in the mines and change-rooms should belong to the unions or be independent of them, shut the mines down for 41 days ending April 27, but it was settled in favor of the mine owners. This was a vital question, for if the watchmen belong to the union it is virtually a license to the miners to "high-grade." There is now a question pending as to whether the miners will accept checks for pay instead of coin, the mine owners being unable to procure coin owing to the banking situation.¹

Many of the smaller mines and the leasing companies have quit work; in spite of the large sums made by Hayes-Monette and other successful leasers it is doubtful if the leasing business will on the whole show any profit, for many of the leasing companies have lost heavily.

The largest producer is still the Goldfield Consolidated, which is shipping high-grade ore and working the low-grade in

¹This led to a strike early in December, and at the request of the Governor of Nevada Federal troops were sent to Goldfield to preserve order.—EDITOR.

the Combination and other mills and making plans for a large mill to be built in 1908. The property is said to show large deposits of medium-grade ore with some of the very rich ore still remaining. Ore has been found in large amounts on the 450-ft. level and has been cut on the 650-ft. level. There has been a change in the management, J. W. Finch changing from general manager to consulting engineer and geologist and being succeeded by John H. Mackenzie, formerly of the Independence at Cripple Creek.

GOLDFIELD AND THE SMELTERS

One of the main reasons for the closing of some of the Goldfield mines is that the smelters are now unable to make advances against the ore shipments, but withhold payment until they receive mint returns. This requires from 60 to 90 days from the time the ore is shipped. The smelters have also lately penalized Goldfield ores by putting on an extra 10 per cent. charge so as to check shipments.

Though Goldfield is largely overbuilt there is every reason to think it will be a prosperous camp for a long time to come. The Florence mine is thought to be second only to the Goldfield Consolidated and is reported to have wonderful showings of rich ore.

TONOPAH

The Tonopah mines have run steadily in 1907, but in spite of the large production have been rather disappointing. The cutting of the dividend of the Tonopah Mining Company from 35c. to 25c. per quarter was depressing and led to a stockholders' row which caused a change in the management, President Brock being succeeded by J. S. Austin. Mr. Brock's management has been criticized because of his conservatism and his failure to prospect the mines in depth as they should have been, but more especially because of the reduced dividend. The mine will pay \$1,100,000 in 1907, thus being the second largest silver dividend payer in the United States, the largest being the Bunker Hill & Sullivan. The Belmont Mining Company has stopped paying dividends, though its 60-stamp mill at Millers is completed, and was paid for by the sale of treasury stock at \$3 per share. As this stock is now selling at 90c., there is murmuring among the stockholders, and President Brock has stepped out, Richard G. Park taking his place.

TREATMENT OF TONOPAH ORES

The ore of the Tonopah Mining Company is treated in the company's 100-stamp mill at Millers, which has a capacity of 400 tons daily. The ore is concentrated on Wilfley tables and the concentrates shipped. The coarser pulp is ground in Huntington mills and the tailings from the Wilfleys are cyanided; Blaisdell excavators are used. During

the year the Montana-Tonopah Mining Company finished its 40-stamp mill, designed by F. L. Bosqui. This is claimed, with modest Americanism, to be the finest mill in existence, and there is certainly some justification for this claim, for it is well arranged and is doing excellent work. The ore, crushed by stamps, is classified into sands and slimes, and the former concentrated on Wilfley tables. The tailings are ground in two large tube mills and this pulp concentrated by Fruevanners; the tailings from the vanners are cyanided, Hendryx agitators and Butter's filters being used. The precious metal is precipitated by zinc dust. There is no leaching of the ore in vats; the concentrates and precipitates are shipped to the smelters. No figures of costs are obtainable, but the operating expense is reported to be not far from \$3 per ton with a saving of 90 per cent. This mill will be of great utility in working the low-grade (under \$30 per ton) ores of Tonopah of which large quantities exist in a number of the mines.

The Butters mill in Virginia City has worked several hundred tons of Tonopah ores monthly, charging \$6 per ton and paying 85 per cent. At this rate there is a slight advantage over the smelters on ore running from \$30 to \$40. The smelters pay 95 per cent., but are handicapped by higher freight.

FUTURE OF TONOPAH

Tonopah has stood the panic better than most of the camps, its principal effect being to delay the completion of a fine brick hotel.

There is an uneasy feeling as to the permanence of the Tonopah mines owing to failure to find good ore on the lower levels, as pointed out by Spurr in his report on the district. In the lower levels, say below the 700 ft., are found strong quartz ledges 30 ft. to 60 ft. wide very low in value. One of these ledges is being prospected on the 800-ft. level of the Midway mine and another in the 1000-ft. level of the Tonopah Extension. If, as is possible, the richer ores of the upper levels come from the leaching of the semi-barren quartz ledges it may well be that prospecting in depth will open up good ore.

It is a great pity that this work was not started by the Tonopah Mining Company some years ago and pushed to the 1500-ft. level or deeper, for it will have to be done some day. It is surely not an ideal state of affairs that the public is kept in the dark as to the exact conditions in these and other mines.

Reports for the week ending Nov. 21, 1907, show an ore output of Tonopah mines of 6698 tons at an estimated value of \$268,540; and of Goldfield, 5801 tons, valued at \$674,300. The estimated values are in both cases too high.

MANHATTAN

Manhattan has been rather quiet during 1907 but has joined the mill-building procession. This camp was especially hard hit by the San Francisco earthquake-fire, for the mines are largely owned in that city. In the last few months there has been renewed interest in the camp, some especially good developments being reported from the Thanksgiving mine and by some of the leasers on other properties. Some of the litigation, which retarded the growth of the camp so much, has been settled and this should help greatly. Both here and at Round Mountain placers formed by the erosion of the quartz veins are worked by dry washers run by gasoline engines treating about 50 tons of gravel daily. The operations are said to be successful.

The Manhattan Ore Reduction and Refining Company has just started its 10-stamp mill which is provided with a tube mill and a cyanide plant and is expected to crush 50 tons daily. The first run is being made on Manhattan Consolidated ore, said to average \$20 per ton. The Lennon mill is also a 10-stamp custom mill. The Drake & Chapman has Huntington mills with 30-ton capacity. Both these mills are nearly completed.

OTHER CAMPS

At Round Mountain much work has been done; a hydraulic plant costing \$100,000 has been put in to work the vein placers. The Round Mountain Mining Company has a Nissen stamp and Huntington mill working its ores. The Round Mountain Fairview has a Huntington mill, and there is a stamp mill running on custom ore. The Sphinx Mining Company is putting up a 10-stamp mill for its ores.

At the new town of Blair near Silver Peak, the Pittsburg Silver Peak Mining Company has nearly finished its 100-stamp mill and is now running 20 stamps on some of the better ore. This mill will be provided with a cyanide plant and will be one of the best mills in the State. The orebodies in this property are very extensive, and there is enough ore running something under \$10 to keep the mill going for a long time. The remaining 80 stamps will be started as soon as electric power can be provided by the Nevada & California Power Company which is now enlarging its plant near Bishop creek. The Pittsburg Silver Peak company is also short of ready money and is paying off its men partly in cash and partly in time checks payable in July, 1908, and bearing 6 per cent. interest.

The 10-stamp mill of the Silver Peak Valcalda Mining Company is running and working well.

A new camp, Stimler, has been started during the last few months and has a number of leasers working; this is in Cottonwood cañon, a few miles from Silver Peak. An unusual incident for Nevada was the finding of the bodies of two

murdered prospectors recently near Silver Peak.

The Walker Lake rush following the opening of the Walker Lake Reservation in October, 1906, has resulted thus far in nothing of moment. The bulk of the claims located during this stampede of 4000 men will probably be abandoned.

Considerable work has been done on copper prospects near Luning where there are some phenomenal surface showings, but no permanent mine has been developed though the district has been known for the last 30 years and, in the aggregate, a large sum has been spent there.

The copper mines in the Yerington section have been very active during the year and much copper ore has been shipped and most of the properties are operating notwithstanding the low price of copper; the best mines are said to be those of the Nevada-Douglas Mining Company.

There was much talk in the summer of the rich silver-gold mines at Regent, 50 miles east of Wabuska, but the prospects did not develop well. Rawhide, near Regent, is now having a boom, the main street being over a mile long and the population, 1000 or more, is rapidly increasing. A number of leasers are working here on rich stringers in porphyry; one lease is said to have been sold for \$30,000. Expert opinion is that the population of the camp is about three years ahead of developments.

Goldyke and Atwood have not made good thus far; the Goldyke Mining Company has started its two Huntington mills but is short of water. It is said that the ore is probably too low-grade to pay. The Comstock mines at Virginia City are levying their usual assessments; prospecting from the Sutro tunnel has given favorable indications. It is proposed to build a large mill at the mouth of the tunnel to be run by the water power from the tunnel.

Rosebud, from whose rich surface showings much was expected, is dull. The ore has given out in depth in most of the mines. Prospecting is still going on with some little encouragement.

A SEVEN TROUGHS FAIRY TALE

Seven Troughs is said to have at least one good property in the Fairview claim of the Seven Troughs Mining Company. As an example of the fairy tales told of Nevada mines that of this property is interesting. The story is that the mine is opened by a shaft 500 ft. deep, with levels run 100 ft. each way at every 50 ft., thus developing a block of ground 500 x 200 ft. The ledge is said to average with "remarkable uniformity" 5 ft. with a streak on the hanging wall varying from 6 to 9 in. wide and assaying more than \$100,000 per ton. The 18 in. next this, according to the tale, assays \$800 and the rest of the ledge goes from \$8 to \$250 per ton. Dropping everything but the rich streak and calling this 6 in. wide, we

have a value of over \$350,000,000 for the ore in sight. This is a statement made by reputable men, but I have no hesitancy in putting it down as a good instance of the megalomaniac obsession which possesses inexperienced men when they deal with mines, and I feel certain from my general knowledge of the behavior of the human intellect when in juxtaposition with rich ore that it is perfectly safe to divide the above estimate by at least 1000. Even then it leaves a goodly sum.

FAIRVIEW, SEARCHLIGHT, WONDER

Fairview has made a good production during the year, the Nevada Hills having paid \$225,000 in dividends or \$300,000 since its discovery in 1906. None of the other mines have produced anything of note though some of them are well thought of.

The Ramsey Comstock mine at Ramsey shows wide ledges of \$15 to \$20 ore, and is to have a mill in 1908.

A great deal of work has been done in Searchlight, the best mine being the Quartette which has paid dividends in 1907.

Wonder has proved disappointing to date. Some of the chief mines have closed down owing to the fact that their money is locked up in the banks, and a number of leasers have quit because the ore proved too low-grade to ship. Wonder is heavily handicapped by being 70 miles from Fallon, its nearest railroad station, whence most of the supplies including lumber and mining timber come. Wood is scarce and water costs \$1.25 per barrel. A large amount of low-grade ore is, however, already developed, and with the bringing in of water, the construction of railroads and the building of mills, the camp should do well. The principal mines are the Nevada Wonder, the Jackpot, Vulture, and the Spider-Wasp, the latter being several miles from the main camp.

Aurora, Mark Twain's former stamping ground where he luckily missed making the fortune that would have stifled his genius, supports a 20-stamp mill, the ore being furnished by leasers. There is a vast amount of quartz showing in this camp, the croppings being wide; but it is very low in value, perhaps too low even for the largest mills, and certainly too poor for anything short of them.

Gold Circle, north of Golconda, had a small boom in September but the rich gold quartz found on the surface did not go down; prospecting is still going on.

The railway has been completed to the old camp of Pioche and there is in consequence great rejoicing and hope that the rich old mines on reopening will prove profitable.

A recent customs decision allows the free entry of cut diamonds other than bort when intended for industrial purposes, such as for the construction of bearings of electrical instruments.

New Mexico

BY CHARLES R. KEYES*

In New Mexico no year has shown so satisfactory progress in mining as 1907. There have been substantial gains in all lines of the mining industry. Many factors have contributed toward putting mining upon a firmer basis than ever before. Not the least of these has been the systematic developments in accordance with sound engineering and scientific principles. The New Mexican region is pre-eminently one in which the local geologic structures are capable of being readily deciphered. Hence, the determination of the relationships of the ore-deposits to the rock-structures can be made of great service in mine development. In many cases where this condition was taken advantage of the results were eminently satisfactory, much of the usual uncertainty was completely eliminated, and large savings were made where commonly useless expenditures are the rule.

The most decided advances made during 1907 were in the mining of copper, zinc and coal. Confidence in the future supplies of most of the ores is indicated by the projects on foot for the erection of mills and reduction-works. Some of these are still on paper; but several which have been under construction are now in operation. Despite the withdraw from entry of coal-lands by the Federal government, coal-mining greatly expanded, on the whole. Most of the best coal deposits of New Mexico are situated on old Spanish grants which are unaffected by the departmental rulings and are already controlled by the large corporations. Outside of these old grants the known coal deposits are relatively unimportant. The main effect of the present governmental policy is seriously to embarrass the activities of the small and independent companies, and the organization of new ones. So far as the Southwest is concerned the national policy now throws the entire control of the fuel supplies into the hands of a few large concerns invincibly protected behind the land grant. Previously the coal supply was in a fair way to be in the hands of the small operator.

COAL.

On the fuel resources of New Mexico is based at the present time the most important of its mining industries. Of the annual production of over 2,500,000 of tons nearly one-half is converted into coke. Some high-grade anthracite is mined. Of the dozen important coal-fields now known five only are shipping largely. These are the Raton, El Moro (extension), Carthage, Gallup, and Ortiz. The others are the Hagen, Lincoln county, Caballos, San Juan, Magdalena

*Consulting mining engineer, Socorro, New Mexico.

and Western Socorro county. The newly opened Caballas is the most southerly of all and is only about 100 miles north of El Paso.

In the Raton range, west of the town of Raton, extensive coalfields have been fully opened up recently by the building of the St. Louis, Rocky Mountain & Pacific railway, of which about 100 miles have been constructed and put in operation in New Mexico. This line gives direct connection with four of the larger railway systems. Extensive coke-ovens have also been installed, and have been for several months in active operation. The line of railway mentioned is surveyed further westward for a distance of more than 200 miles, reaching the San Juan coalfield.

East of Raton the new Yankee mines, in what is an extension of the El Moro field, are now taking out and shipping coal. A new spur from the Santa Fe railway lately built into the Carthage coalfield, in Socorro county, has enabled the product of the mines of this district to be placed on the market. The important Hagan coalfield, east of Albuquerque, has shown in its developments all that was originally predicted for it. Four slopes are now opened and when fully operated will be capable of producing over 2000 tons a day. The railway under construction to tap this field is now within 30 miles, about 125 miles having already been built and in operation.

The total coal output of New Mexico in 1907 cannot be far from 3,000,000 tons.

COPPER.

Interest in New Mexican copper properties has been very active during the last two or three years, and Southwestern New Mexico seems destined to become one of the important copper-producing centers of the country.

During 1907 the principal developments were in the Burro mountains, in Grant county, where the Phelps-Dodge interests opened up extensive and promising properties. In the Pyramid mountains, a few miles to the south, new operations are rapidly going on and important deposits opened up. Other ranges of this region are already shipping considerable quantities of good ore. Farther to the north and northwest, in the Mogollon mountains, there is great activity; but up to the present time the lack of adequate railway facilities has been a serious drawback to the proper development of the district.

In the neighborhood of Oro Grande, 75 miles north of El Paso, a large new copper smelter has lately been put in operation. At San Pedro, in Santa Fe county, the copper mines and smelter resumed active operations after several years of idleness. Magdalena continues to ship some copper ores in connection with its zinc ores.

There are in southwestern New Mexico, besides the purer oxidized ores and pyritic ores which are chiefly mined at the present time, large deposits of complex ores containing copper, lead, zinc and iron sulphides in about equal proportions, with some gold and silver, which will no doubt shortly come into market and materially increase the total copper output of the region. So soon as satisfactory milling processes for their separation become more generally known a much larger production will be credited to the region. At present no mechanical separation of these ores is undertaken.

ZINC.

Next to copper the zinc ores are the most important in New Mexico. In total value of production the ores of these two metals are about equal. Two years ago the carbonate ores formed the chief shipping ores; now the sulphides are the more important. Magdalena continues to be the principal producing camp. Among other localities which are becoming important producers are Hanover and Pinos Altos, in Grant county, Tres Hermanos, in Luna county, and the Organ district, in Dona Ana county.

In a number of mountain ranges in southwestern New Mexico considerable deposits of zinc ore have been lately developed. The great need now is some means of handling these sulphide ores, such as local mills centrally located and capable of separating effectually the zinciferous minerals from the copper, lead and iron. Much lower grades of ore could then be handled. Now only the higher grades of zinc ores can be shipped, as they have to go to distant points for treatment. At the present time most of the New Mexican zinc ores are sent to Mineral Point, Wis., Iola, Gas, and Coffeyville, Kan., Pueblo, Colo., and to Belgium. The drawbacks mentioned, however, promise to be soon removed, at least in great part.

The carbonate ores appear to be more abundantly represented in New Mexico than in any of the mining States of the West; but the great supplies of the future must be the sulphides.

GOLD.

The notable increase in the gold production in 1907 was due mainly to the copper, zinc and lead ores, the mining of which has lately shown great gains. From this source alone the gold output may be expected to make material advances from year to year. The production is almost entirely from the southwestern parts of the territory.

Although there are about 100 deep gold mines in New Mexico they do not produce what would ordinarily be expected of them. This condition is due partly to the fact that some of the most important and normally the most productive properties are far removed from adequate

transportation facilities. Several of the large mines are not in operation at this time, although they are properties of merit.

Placer mining should be much more extensively developed than it is, considering the advantages and richness of the gravels. Gold-bearing gravels of New Mexico are the richest in the United States. They are extensive and are widely distributed. Until now it has been difficult to obtain sufficient water to work the deposits properly. Only in a few places, in the northern part of the region, could hydraulic methods be used. The water problem has become less serious of late and it is not unlikely that good supplies of water can be secured in most of the placer districts. Western Socorro county and Sierra county continue to be the principal gold-producers. New and extensive developments in the vicinity of Hillsboro are of a promising character.

SILVER.

The chief silver production must be still credited to the Mogollon district in the western part of Socorro county. The silver ores here are associated with those of gold and copper. Some silver is also obtained from the gold ores of the southwestern districts. Little of the silver in the complex sulphide ores is saved as yet, although some of them contain considerable values. A few of these are known to run as high as \$10 to \$12 a ton.

None of the older silver mines in which silver alone is mined is operated at the present time, notwithstanding the fact that there have been many decided improvements in methods of mining and treating this class of ores over the manner of handling them a dozen years ago when these mines were closed down. The ores of this class are mainly horn-silvers, and are usually rich, at least down to permanent water-level, or depths of from 300 to 500 ft.

The lead ores of the region contain as a rule but little silver. Exceptions are noted in the extreme southwest corner of the territory and in the Hachita range

IRON

There is only one locality in New Mexico where iron is at present extensively mined. This is at Fierro, in Grant county. All of this ore is shipped to Pueblo, Colo., to the plant of the Colorado Fuel and Iron Company. The annual production is about 200,000 tons.

Small amounts of iron ore are now mined at various other points for fluxing purposes at local smelters. Some of these ores carry almost enough in gold to make them worth treating for that alone. No extensive mining is yet in progress on the Chupadera mesa in eastern Socorro county, where large deposits have been reported. One reason is that expected railway facilities have not yet materialized,

although one road is now within a dozen miles of the best localities.

LEAD

Carbonate ores which were formerly the chief source of this metal are now mined only to a small extent. The main ores taken out at the present time are the sulphides. The lead production is confined to the southwest counties. Only in the Caballos mountains, in Sierra county, does galena occur unassociated with other ores.

Most of the lead production is derived from the complex ores. As stated in connection with the notes on zinc, whenever local milling produces satisfactory results in the way of separations the mining of all the metals will be greatly stimulated.

Important new developments have taken place in the Tres Hermanos district south of Deming.

South Dakota

SPECIAL CORRESPONDENCE

With a strike of the mine and millmen that lasted four months, and a fire in the Homestake mine that caused an entire cessation of operations in the mills for over a month, and a partial suspension for six weeks longer, the Black Hills feared a big decrease in the annual output figures for 1907. The report of the State mine inspector, Nicholas Treweek, of Lead, and estimates gathered from mining men, show that this reduction will be about \$2,500,000, making the 1907 figures approximately \$4,100,000 for the whole Hills, the Homestake having out of this about four-fifths, which shows a heavy falling off from 1906. Mr. Treweek fails to state in his report the exact figures of each mining company for the year, presumably because the managers of the companies themselves deemed it a wiser policy not to publish the smaller production total. Several of the companies, affected by the demand for eight hours, which were compelled to shut down on Jan. 1 last, remained closed for seven and eight months, and two of them are still closed, the Gilt-Edge Maid and the Golden Crest, so that the figures would be decidedly small. From other sources it is learned that the total amount of bullion produced by the mines other than the Homestake in the Black Hills this year will approximate \$1,250,000. The heaviest producers outside of the Homestake will be the Imperial, Mogul and Golden Reward.

The monthly shipment east of the Homestake is now about \$600,000 worth of bullion while the unofficial figure from the other companies combined is about \$130,000 in bullion.

Utah

By LEWIS H. BEASON *

More wealth was produced from the mines, mills and smelters of Utah in 1907 than during any previous year. I have received confidential reports from the various bullion-producing agencies and after making a careful compilation of the statistics I am prepared to estimate an output of \$51,638,397. But before proceeding further I wish it understood that there must be some deductions made from the foregoing figures before arriving at anywhere near an accurate knowledge of the actual value of the metals produced from the mines of this State. The smelters of the Salt Lake valley receive custom ores from other States as well as Utah, and during the past year Nevada has been a prolific source; while Idaho, California, Montana and Colorado have been also represented in the local markets. On the other hand, a large tonnage has gone out of the State for reduction, notably from the Park City and Tintic districts. Owing to the system of accounts kept by the several smelting companies it is not an easy matter to make a distribution. Nevertheless it is fair to presume that if we take off 20 per cent. from the totals we will come pretty close to Utah's actual production of metals during the year. Possibly the deduction should be made on the basis of 25 per cent.; but in event we make it 20 per cent. we must subtract \$10,327,679, leaving a net result of \$41,310,626 as representing the value of the gold, silver, copper, lead, zinc and quicksilver that the mines of Utah have yielded during the calendar year of 1907. The smelting companies purchased a large amount of iron ore too, but no attempt was made to ascertain the value of this product.

I have before me a report compiled by the Government showing the value of the production of the metallic mines of Utah in 1906 to have been \$31,471,685. Comparing these figures with those in the foregoing, we have an increased production to the credit of last year to the amount of about \$10,000,000, based on the average market price of the metals for the eleven months as shown by the following:

METAL PRODUCTION OF UTAH, 1907.

Gold, 571,038 oz. at \$20.6718 per oz.	\$11,804,373
Silver, 17,204,148 oz. at 66.3c. per oz.	11,406,350
Copper, 98,791,065 lb. at 20.63c. per lb.	20,370,596
Lead, 142,176,141 lb. at \$5.38 per 100 lb.	7,649,076
Zinc, 6,411,926 lb. at \$6.10 per 100 lb.	391,127
Quicksilver, 375 flasks at \$45 per flask ..	16,875
Total	\$51,638,397

In the way of dividends, the mining camps of Utah have made a most creditable showing; 23 mining companies disbursed among shareholders a total of \$5,373,992, of which 13 are credited to

the Tintic mining district, three to Park City, two to Bingham, two to Beaver county, one to Alta, one to Park Valley and one to Fish Springs. The complete list of dividend-payers is as follows:

DIVIDEND-PAYING MINES IN UTAH, 1907.

Beck Tunnel Consolidated, (Tintic).....	\$ 340,000
Bingham-New Haven, (Bingham).....	22,869
Bullion Beck, (Tintic).....	30,000
Century, (Park Valley).....	6,000
Colorado, (Tintic).....	620,000
Columbus Consolidated, (Alta).....	212,623
Daly Judge, (Park City).....	225,000
Daly West, (Park City).....	378,000
Eureka Hill, (Tintic).....	100,000
Gemini, (Tintic).....	100,000
Grand Central, (Tintic).....	147,500
Horn Silver, (Beaver).....	60,000
Lower Mammoth, (Tintic).....	57,000
Mammoth, (Tintic).....	80,000
May Day, (Tintic).....	64,000
Newhouse, (Beaver).....	300,000
Silver King, (Park City).....	375,000
Swansen, (Tintic).....	5,000
Uncle Sam Consolidated, (Tintic).....	70,000
Utah, (Fish Springs).....	36,000
Utah Consolidated, (Bingham).....	2,100,000
Victoria, (Tintic).....	30,000
Yankee Consolidated, (Tintic).....	15,000
Total.....	\$5,373,992

The mines appearing in the dividend column for the first time were the Colorado, Columbus Consolidated, Daly Judge, Lower Mammoth, May Day and Newhouse. Heretofore it has been customary to include the United States Smelting, Refining and Mining Company as a Utah dividend-payer. While this company is extensively interested in this State, being the owner of the Centennial-Eureka mine in the Tintic district, as well as a vast area in the camp of Bingham and also the principal competitor of the American Smelting and Refining Company, it has been left out this year, as will be noted in the foregoing list. Also, for similar reasons, the American Smelting and Refining Company, directly or indirectly identified with Bingham copper mines in addition to its smelting interests at Murray and Garfield, is out of consideration. Nevertheless, without these companies represented in the dividend record, 1907 ranks as the banner year for the mining industry in the State's history.

BINGHAM

The chief mining activity of the year centered in Bingham and Tintic. The financial stringency toward the close had the effect of seriously retarding progress, yet the mines of these camps have broken all previous records. The Utah Copper Company, and the Boston Consolidated Mining Company, have done much to change the old order of things in Bingham by the introduction of steam shovels for mining purposes, which are being utilized along the lines in vogue in the iron mines of Minnesota. Both these companies put in the major portion of the year in stripping the capping from the porphyry ore deposits in their respective properties preparatory to milling the ore at Garfield.

During the autumn, the Utah Copper Company placed its concentrator at the last-named point in commission; the eighth section of the plant was placed in

service a few days ago. Each section has capacity for the treatment of 500 tons a day, which would bring the present ore treatment up to the basis of 4000 tons daily. This company still operates its Copperton mill in lower Bingham cañon. The ore treated carries less than 2 per cent. copper, but the concentrate is brought up to 30 per cent. During November, according to a statement made by the management, the company produced approximately 3,000,000 lb. of copper from its two mills.

The Boston Consolidated was comparatively inactive during the last few months. It was the first of the Bingham companies to curtail development and production. In the meantime, the construction of the concentrating mill at Garfield has gone along slowly. Preparations are being made, however, to have the plant ready to operate within the next few weeks.

The Utah Consolidated ran along in about the usual way, but probably did not produce as much copper as it did during 1906, owing to the fact that a lower grade of ore on the average was put through the smelter. New developments were of a character highly gratifying to the management, however, and there is no doubt that the ore reserves were greatly increased. The Utah Consolidated figured as one of the defendants in the smelter smoke cases begun about two years ago and which resulted in a decision favorable to the farmers who complained that their premises were being damaged by fumes. The other defendants were the United States Smelting, Refining and Mining, Bingham Consolidated Mining and Smelting and American Smelting and Refining companies. The case was appealed to a higher court, but the decision of the lower court was sustained.

The Utah Consolidated will build a new plant in Tooele county next year and may engage in the custom ore smelting business. The new smelter site will be reached by an aerial tramway about 13,000 ft. long. The move will undoubtedly prove beneficial to the company for the new works will be in a section of the country where there will be little fear of damage suits, and besides it will be relieved of paying 40c. a ton freightage on its own ores, which the Rio Grande Western now receives. Recently, the company made an effort to get a modification of the decree of court to permit a continuation of operations at the present smelter until March 1, 1909. At a mass meeting of farmers held to consider the proposal a resolution was passed favoring this, but with the proviso that the Utah Consolidated pay a bonus for this privilege and which the committee representing the farmers later fixed at \$200,000. It is probable, in view of the low metal prices prevailing, that this arrangement will not be accepted. In the meantime a writ of *certiorari* has been filed with the United

*Special correspondent, Salt Lake City, Utah.

States Supreme Court, which will delay the date for the injunction to become operative.

The Bingham Consolidated company is about to close its smelter entirely while the United States company recently stopped production from its Bingham mines and announced that it, too, would quit smelting ore in the Salt Lake valley. Just what the plans of the company for the future are, is yet unannounced. The American Smelting and Refining Company has satisfied the farmers by a money consideration and will continue the operation of its lead smelter at Murray as heretofore with the exception that it has gone to great expense in the installation of a bag-house system. The United States company did as much, but the farmers are particularly antagonistic to that company. The Garfield copper smelter of the American Smelting and Refining Company is outside the "smoke zone," and is, therefore, not affected by the court's decree. The Yampa Smelting Company, which treats the ores of the Yampa mine in Bingham only, operates a plant in Bingham cañon, and is, therefore, not subject to attack from the ruralists. The capacity of this plant was increased during the year to treat 700 tons of ore daily, whereas it formerly treated 400 tons. The mine and mill were not long ago connected by aerial tramway.

The reorganization of the Ohio Copper Company was among the chief events affecting Bingham mining properties during the year. About a year ago the control of this property passed to F. Augustus Heinze, and it was to have formed the basis for a large mining and smelting enterprise, involving the building of a railroad and smelter. Developments were of a most important character, and the mine is regarded as one of great value. Many years' supply of ore has been developed. The company is building a concentrator at the mouth of the Mascotte tunnel of the Dalton & Lark mine through which it is planned to move the ores of the property to the surface. The mill will have capacity for the treatment of 2000 tons of ore daily. Just what bearing the late financial entanglements of Mr. Heinze will have on the Ohio Copper enterprise still remains to be seen. Agents of Mr. Heinze purchased a smelter site near Garfield last summer, and shortly afterward the formation of the Miners' Smelting Company was announced, but apparently it had not become thoroughly financed before the disturbance in the financial world occurred.

The Utah Apex and Utah Development properties were producers the most of the year, and in each developments were satisfactory. The New England Gold and Copper Company increased the size of its mill and made good headway with development. A consolidation of

the Bingham Central and Bingham Standard mines was effected in midsummer. The Bingham New Haven Company completed its deep tunnel and moved the main mine buildings down the cañon to a point near the Utah Consolidated works. The ore from this mine is conveyed to the Rio Grande railroad tracks by aerial tramway.

PARK CITY, TINTIC AND ALTA

In the Tintic district some of the older mines are being opened at greater depth with desired results. The Mammoth Mining Company now has the deepest working shaft in the State, 2300 ft., and is preparing to go deeper. Many new properties were opened and placed among the list of producers. Dissatisfied with the treatment accorded them by the Salt Lake valley smelters, some of the principal producers of the Tintic camp formed the Tintic Smelting Company, and are about to complete the construction of a lead smelter capable of treating 450 tons a day, which will be ready for commission about the middle of next March. Nearly ten miles of standard gage railroad were built to connect the mines with the reduction works. The ore production from the Tintic district this year was heavier than ever before. Leasers have found it profitable to work in some of the older properties.

Park City had its share of trouble during the year. First of all, although heroic efforts were made in that direction, the Ontario drain tunnel has not been restored to its former usefulness and the lower levels of several of the larger mines of the district are still inaccessible. Operators were handicapped for a time by labor troubles which resulted in the stoppage of production at the Daly West, Daly and Ontario mines. In November the Daly West resumed, but not until all the operators had agreed on a reduced scale of wages. In January last, in order to put an end to pending litigation, the Silver King Mining Company arranged for the purchase of all the holdings in the district of the plaintiffs in the cases filed against it. Through this transaction the Silver King came into possession of a large area of additional territory, and this was followed a little later on by the formation of the Silver King Coalition Mines Company, which absorbed the property of the original Silver King company. About this time an option was given to F. Augustus Heinze on a control of the stock, but the option was never exercised.

Another important mining deal was the passing of a controlling interest in the Ontario and Daly mines to Jacob E. Bamberger, president of the Daly West Mining Company. It was thought at the time that a consolidation with the Daly West Company would be the eventual result, but as yet nothing has materialized along those lines. The merger of the

Treasure Hill, Kentucky and Creole groups laid the foundation for another big company, and in due time the Treasure Hill Consolidated Mines Company was organized and started a vigorous campaign of development. The Daly Judge Mining Company installed the first electric haulage system in the camp, made important changes in its mill equipment and entered into a contract with the Grasselli Chemical Company, whereby the latter is to install a plant for the treatment of zinc ore. On the mill dump, the Daly Judge Company has between 12,000 and 15,000 tons of zinc middlings that will average 25 per cent. zinc.

In the Alta district some good mines were developed, principal among them being the Columbus Consolidated and South Columbus Consolidated. Both are splendidly equipped. The ores of the camp are delivered five miles down the cañon by aerial tramway and from there hauled by wagon to the sampling mill at Sandy. It is likely that 1908 will see railroad facilities provided.

MERCUR, GOLD SPRINGS AND BEAVER COUNTY

At Mercur, conditions have improved. The Consolidated Mercur Gold Mines Company, the principal operator in the camp, installed a new slimes plant and made other changes in its mill equipment resulting in saving a much higher percentage of gold. A feature of the year's work at the Consolidated Mercur was the reopening of the Brickyard mine. This property had been idle for six years, having been shut down, not because it was worked out, but because the ore was of low grade and could not be profitably treated at that time. Now, with reduced expenses and improved extraction, this ore pays well, and a large tonnage of it has been made available. The Brickyard mine supplies the mill with 150 out of the 600 to 800 tons treated daily.

The Sacramento closed down in July, after nearly 15 years' steady operation; a few men were kept on for prospecting purposes. In late years the Sacramento has produced considerable quicksilver, and it bears the distinction of being the only quicksilver-producing mine in the State. The Sacramento produced about \$30,000 worth of gold in 1907. The Sunshine mine, near Mercur, has been purchased by a syndicate headed by Manager George H. Dern, of the Consolidated Mercur, and plans are now being considered to remodel the mill and begin production.

The newest gold camp in Utah is Gold Springs, situated in the western part of Iron county. The Jennie Gold Mining Company has been fairly successful, and is adding a cyanide department to the mill, placed in commission several months ago. In the Gold Mountain district the Annie Laurie and the Sevier Consolidated, carried on the principal operations. The

former produced close to \$200,000 worth of gold in 1907. The mill at the Sevier Consolidated proved to be a failure, and the company was placed in possession of a receiver. The property is in debt to the extent of about \$230,000.

The Ophir district is in a prosperous condition, with two mines producing, the Ophir Hill and Cliff. At Stockton the only active producing property now is the New Stockton.

In Beaver county, early in the year, numerous small low-grade properties made money, but the falling price of copper put them out of commission several months ago. The principal operations in Beaver county were conducted by the Newhouse Mines and Smelters Corporation, which paid one dividend of \$300,000. Experiencing difficulty in marketing its copper, the management ordered a curtailment of output for a time; but the working force is being gradually increased.

There are indications of a revival in the Stateline mining district in Iron county; but work was done there only in a small way in 1907.

Notwithstanding the curtailment going on throughout the camps of the West, the smelters of the Salt Lake valley have been running up to their capacity, and as the foregoing records show, important gains were made in the production of gold, silver and copper. Many thousands of dollars' worth of iron ores were purchased by the smelting companies, but no attempt was made to keep a record of the value of this product, or the tonnage produced.

OIL AND COAL

The discovery of oil, apparently in commercial quantity, in Southwestern Utah is attracting not a little attention at the present time. Several wells have been brought in successfully, and in the field more than 20 rigs are in operation.

The coal famine experienced a year ago caused increased activity in the coal-fields of Carbon, Emery and Iron counties, with the result that several new producing coal mines are supplying the market with their product. The State coal mine inspector reports a larger output than last year, but is unable to give out any figures at this time. The coal production of Utah in 1906, however, amounted to 1,839,219 short tons, or an increase of 236,961 tons over the year preceding. It is fair to presume, however, that the increase this year over last has been around a half million tons. The increase has come largely from "independent" mines, properties not controlled by the Pleasant Valley or Utah Fuel companies. The counties in which coal has been found to any extent are Carbon, Summit, Emery, Sanpete, Iron and Utah. Up to September last the demand for coal was more than equal to the supply, and there were strong evidences of

a repetition of the experiences of last year; but about this time the mines of Butte and elsewhere began to curtail their production of metalliferous products, and this materially eased the local situation.

SALT

Owing to the abnormal precipitation, the wet season extending well into the summer months, the production of salt in Utah during 1907 was considerably lower than usual. The output is estimated to have been approximately 30,000 tons. The yield comes from the water of the Great Salt lake, which is pumped into large evaporating ponds. The principal refinery is situated near the Saltair bathing resort, 15 miles west of Salt Lake City.

Vermont

BY GEORGE A. PACKARD*

"For a period of many years the State of Vermont stood second in the list of copper producers in this country," wrote Dr. Peters in the *JOURNAL* in 1891,¹ in an article describing the Ely mine. A recent visit shows renewed activity in this State, although the Ely, at Vershire, the greatest producer of the past, is abandoned and the old buildings are being torn down.

SOUTH STRAFFORD

At South Strafford, six miles south of Ely, is the Elizabeth mine, first worked in 1795 for copperas, and spasmodically since then for copper, activity or idleness depending largely on the price of that metal. In my own experience there, in 1890, 12c. copper was the dividing line, as the property was then equipped and operated. The ore was sorted and that carrying over 5 per cent. copper was hauled 10 miles to the railroad and shipped to New Jersey. The lower grade, running a little higher than 2 per cent., was roasted in heaps, smelted, and the resulting 35 per cent. matte shipped. The furnace had a diameter of 48 in. and we put through 30 tons in 24 hours, using 12 per cent. coke. No fluxes were used, the only variation in the charge being in the amount of an ore high in pyrrhotite which was roasted separately and added as needed.

In those days the mine was worked through a shaft and all ore had to be hoisted. Now all this is changed. The property has passed into the hands of a New Jersey company which is preparing to operate on an up-to-date basis. A furnace of 350 tons capacity* has been ordered and the long flue and dust chambers, leading to the stack, are being con-

structed. Heap-roasting will be abolished and pyritic smelting with subsequent treatment of the matte, somewhat after the plan of the Tennessee Copper Company will be adopted. An adit 1340 ft. long has been driven, cutting the ore-body at a depth of 225 ft., while a winze sunk on the incline has proved the continuation for more than 100 ft. deeper. The width varies from 20 to 80 ft., and there is over 250,000 tons of ore exposed above the lowest level. Mr. Weed has given the average composition of this ore² as follows: 3.25 per cent. Cu; 35.6 per cent. Fe; 27 per cent. SiO₂; 19.18 per cent. S; 7.76 per cent. Al₂O₃; 1.07 per cent. Zn; 1.55 per cent. CaO; 0.82 per cent. MgO; from a trace to 0.02 oz. per ton gold; and 0.20 oz. per ton silver.

A dam is being put in on the White river, eight miles away, and an electric power line will transmit a minimum of 400 h.p. to replace the old wood-burning boilers. Preparations are being made for the substitution of electric haulage, hoisting and pumping underground. The same company has taken over the Foster property, adjoining the Elizabeth to the south, and also the "South Mines," a mile away.

CORINTH AND EUREKA

About 17 miles north are the Corinth mines. The Union, formerly the largest producer, is closed, but the Eureka which adjoins it is being operated by a New York company. This mine was originally opened by a shaft, but is now operated through a tunnel connecting with the old workings at a depth of about 300 ft. Below the tunnel a 400-ft. incline gives an additional vertical depth of 135 ft. The ore here occurs in lenses as at Ely, the width varying from 8 to 20 ft. or more.

There is no smelter at Corinth; the ore was formerly smelted at Ely. Now the products are shipped to smelters in the vicinity of New York, both freight and smelting charges being very reasonable. The high-grade ore is sorted out and shipped without treatment. The low-grade, after drying and removing the pyrrhotite by a Wetherill magnetic separator, is roasted and treated by a second magnetic separating machine, the chalcopryite concentrates being shipped. A similar process was tried at the Elizabeth,³ but was not successful, perhaps in part because the ore received a partial roast in the preliminary drying, and perhaps because of the greater amount of pyrrhotite in the ore, with which the chalcopryite is too intimately mixed. At the Eureka mine the proportion of pyrrhotite is increasing as depth is attained, and the tonnage handled by the Wetherill machine consequently de-

*Notes on the copper mines of Vermont. Walter Harvey Weed, U. S. Geol. Survey, *Bull.* 225, 190.

*Mining engineer and metallurgist, 50 Congress street, Boston, Mass.

¹The Ely Mine of Vermont. E. D. Peters, *Eng. and Min. Journ.* LII, 6.

²Magnetic Separation of Pyrrhotite and Chalcopryite. *Eng. and Min. Journ.* LXXX, 1212.

creases. As the old portion of the mine is said to contain large reserves, also high in pyrrhotite, the management is considering plans for the addition of a smelter, and it is apparently advantageous to retain the silicious ore for fluxing purposes.

Half a mile south of the Eureka the Corinth Copper Company has a 150-ft. tunnel on an orebody, crosscut perhaps 40 ft., from which some fine ore is being sorted and shipped. The development is limited, the property being recently opened. Their ore, like that of the other properties except a portion of the Eureka, shows an excess of iron.

In addition to the properties named prospects are being opened at several other points. One, across the Connecticut river at Lebanon, N. H., shows the most silicious ore seen in the vicinity, an ideal flux for the baser ores if all these mines could be served by a single centrally located smelter.

The geology of this vicinity has been described by Wendt,⁴ Weed,² Smyth and Smith,⁵ and others. Probably none of these properties would exceed 3 per cent. copper as the average of the entire orebody, with a previous metal content of one-half cent for each pound of copper. They have, however, the advantages of a location close to market and low cost for labor and supplies. Timber is rarely necessary and there is little water to be pumped.

Seward Peninsula

By JOHN POWER HUTCHINS*

The gold production from this region, of which Nome is the largest town, was about \$7,500,000. The following table shows the gold production since 1900:

GOLD PRODUCTION OF SEWARD PENINSULA.	
1900	\$4,000,000
1901	4,500,000
1902	5,050,000
1903	4,437,000
1904	4,878,000
1905	4,600,000
1906	7,000,000
1907	7,500,000

These figures show a healthy increase, differing somewhat from those of many placer regions, as such districts generally attain their maximum production within five years after discovery. The Seward peninsula is different, for many of its placer deposits are extremely inaccessible; consequently it has taken time to discover these deposits and to install the ditches and machinery needed to exploit them. Indeed it is probable that the annual gold production in Seward peninsula will increase for some time to come

*The Pyrites Deposits of the Alleghanies. A. F. Wendt, *School of Mines Quarterly*, VII.

²The copper deposits of Orange county, Vermont. H. L. Smyth and P. S. Smith, *Eng. and Min. Journ.*, LXXVII, 677.

*Consulting mining engineer, 52 Broadway, New York.

as the more inaccessible regions have been developed and exploited on their proper scale.

The past year was favorable in some respects, but in others unfavorable for production. The construction of new ditches and the installation of machinery at the placers has helped production. On the other hand labor troubles, culminating in strikes, were a considerable drawback during the winter of 1906-1907 and curtailed production. The fact that in spite of this, there was an increase in the production during 1907 is a good index of prosperous conditions.

At Nome some very rich gravel was mined on the third beach line, notably on Cooper creek, where a mine, employing about 30 men, yielded approximately \$10,000 per day during the second half of 1907; litigation, resulting from the unsatisfactory state of the mining laws, prevented a longer working season. Other mines on the same and adjacent creeks, where these cross the third beach line, were also very profitable.

On Seward peninsula the rainfall is greater than in the interior of Alaska so that the water supply was ample during 1907. The season was in general a normal one, although the freeze-up was a little early. Ordinarily open-cut mining by hand methods begins about June 15 and continues until about the first of October. The labor supply during 1907 was ample except during the time that the strike was on. Wages are high; 40c. per hour and board and 30c. per hour and board is the wage for unskilled labor during summer and winter, respectively.

Open-cut, drift and vein mining are all used in exploiting the gold deposits of Seward peninsula. In open-cut mining hand methods, dredges, and hydraulic monitors are used. Owing to the fact that it is more often possible in the districts of Seward peninsula than in regions farther interior, such as the Tanana and Klondike districts, to obtain a gravity head of water, hand methods, the rocker, etc., are less important than in the interior districts; in fact the amount of gold mined by hand methods is relatively small.

OPEN-CUT MINING

Open-cut mining by hydraulic methods is done by straight hydraulicking, by hydraulic elevating and by ground sluicing.

Straight hydraulicking is not carried on extensively, as the topography is generally unfavorable to such mining; in most cases sufficient grade for sluices and dump for tailing cannot be obtained. Hydraulic elevating has been conducted successfully. One of the larger plants has been washing about 1200 cu.yd. per day. The yardage handled by ground sluicing was relatively small.

Open-cut mining by dredging was con-

ducted on Solomon river and Ophir creek. The dredge on Solomon river is of the Oroville type; the buckets have a capacity of 5 cu.ft. This dredge is said to have excavated more than 3000 cu.yd. per day and to have worked very successfully in alluvion, about 15 ft. in depth, but which is generally unfrozen.

The dredge on Ophir creek has 5-cu.ft. buckets and is of comparatively light construction. This dredge has had several unprofitable seasons, while working in frozen material, but it is said to have been operated profitably during the past season, as the alluvion handled was less frozen than formerly. Steam thawing was used to prepare the material for dredging.

A dredge having 9-cu.ft. buckets was installed on Bourbon creek. This dredge will be electrically driven. The power plant will use California petroleum for fuel and the generators will be driven by steam turbines.

Besides the difficulties due to a short working season, high cost of installation and operation greatly hampers dredging; moreover the placers on Seward peninsula are partly or wholly frozen and so are difficult to excavate. Frozen gravel, which greatly resembles concrete, cannot be excavated rapidly by any form of excavator, no matter how powerful. Blasting has little effect on frozen gravel, for, after shattering with any kind of powder, the material re-unites along the lines of fracture by regelation. Frozen ground must therefore be thawed before it can be dredged. The experience on Seward peninsula is similar to that in Klondike and is discussed on another page of this issue.

Open-cut mining with a steam shovel was used on Shovel creek, a tributary of Solomon river. This plant has the difficulties principally due to immobility common to such installations. Rich ground permitted profitable operation, although the working cost was about 50c. per cubic yard.

DRIFT MINING

More than one-third of the gold mined on Seward peninsula during 1907 was obtained by drift mining. This method is used especially in mining the old beach deposits back of Nome, as the pay gravel occurs on bedrock and is rarely covered with less than 50 ft. of poorer gravel. As this gravel is frozen, it must first be thawed with steam, then it is broken down and hoisted to a storage bin at surface; the height of this bin is sufficient to allow the sluices to be placed at the proper grade and to still give plenty of dump room for the tailing.

LODE MINING

During 1907 one gold vein was worked; this mine is on a tributary of Solomon river. The results of this work are said to be disappointing.

During the year much prospecting for veins was done. This was not confined to gold veins, but much time was also spent searching for lodes carrying tin or other metals. Considerable development was done on the tin deposits of the Cape York and the Cape Prince of Wales regions and the results are said to be encouraging. Tin mining in those districts is still on a very small scale as the difficulties, climatic and otherwise, have greatly hampered this development. During the five years since the discovery of these tin deposits the aggregate amount of prospecting that has been done is comparatively small.

Mining costs have not varied materially during 1907. The cost of drift mining was about \$3.50 per cu.yd.; hydraulic mining costs were about 30c. per cu.yd. for straight hydraulicking and about \$1 per cu.yd. where hydraulic elevating is necessary. The cost of dredging was about 20c. per cu.yd. in ground, most of which was unfrozen; when steam thawing was necessary the cost was about 60c. per cu.yd.

GENERAL CONDITIONS

During 1907 several long ditches, whose total length approximates 100 miles, were built. The ditch, 40 miles long, which will furnish the water for working the placer deposits at Candle creek by hydraulic methods was finished.

Ditch construction is very difficult on Seward peninsula for the ground is generally frozen and in many areas locally called "glaciers" or "ground-ice" lies immediately below the surface layer of soil. These circumstances make the cost of construction and maintenance high. Besides in the past there has been a tendency to construct long ditches without sufficient preliminary investigation not only of the deposits to be mined but also of the route to be followed. This is true of some of the ditches dug in 1907.

Near the coast coal is generally used for fuel as the Seward peninsula is, in general, treeless. The coal comes from the Puget Sound region. At Nome coal costs about \$20 per ton. Its cost farther inland varies with the distance from the coast. In some cases California petroleum is used as fuel at mines inland.

Two railroads lead from the coast to the interior. These have assisted in developing the country tributary to them, especially the Kougarok district. Wagon roads are few and poor. The excellent roads built and maintained in Klondike have no counterpart on Seward peninsula, or, for that matter, in any other part of Alaska.

The high cost of mining in Alaska is largely due to poor facilities for transportation. There are large areas that cannot be exploited until good wagon roads are built to them.

As an instance of high cost of supplies due to poor transport, it is interesting to

note that, in one investigation of ground by steam drilling, coal cost \$120 per ton. Other supplies for the same district were relatively high in cost.

Idaho

BY ROBERT N. BELL*

The mining industry of Idaho during 1907 was affected both favorably and unfavorably by the sharp variations of industrial conditions for which the year was notable. During the early months a fuel and car famine proved a great detriment to lead, silver and copper mining in the Cœur D'Alenes and of other districts of the State. During the middle of the year the higher wages paid in other States made it almost impossible to secure a force of miners sufficient for even ore extraction. This, together with a scarcity of mining timber and material, interfered materially with new development so that the ore reserves had to be drawn on heavily. During the closing three months of the year the rapid decline of metal prices and the lack of market for ores caused curtailment of production at several mines.

The figures on output are not all available at this date, but probably the lead ores mined in Idaho during 1907 will contain approximately 225,000,000 lb. lead and 7,000,000 oz. silver, and so is about 10 per cent. to 12 per cent. less than the production of 1906. Owing to the high prices of metals during most of the year, the State will make a handsome dividend record, approximating \$6,500,000; fully 30 per cent. of this will be credited to the Cœur D'Alene district, where the orebodies of the older mines continue to maintain remarkable strength even in the lower levels and promise (provided prices warrant) to maintain their present production for several years to come.

Two important mines that would have begun to produce, early last fall, a considerable tonnage of high-grade ore, were forced to close down, owing to the smelter situation, just as the mills, each having a capacity of 250 tons per day, were completed. The mines referred to are the Senator Stewart near Wardner and the Surprise, three miles south of Wardner, on Pine creek. The Callahan mine on Sunset Peak shipped 600 tons of ore containing above 60 per cent. lead with about 45 oz. silver per ton. This is one of the promising new mines of a district that will probably become an important source of high-grade silver-lead ore. The Tamarack and Chesapeake, the Pittsburg and the Success mines also produced considerable rich lead ore. During the year considerable development work was done in this district on both the lead and the copper-bearing deposits; apparently several of these prospects will soon become mines.

*State mine inspector, Boise, Idaho.

Labor is now plentiful and the restricted ore production will afford opportunities for catching up on development work.

LEAD

The development of lead ore in other parts of the State, notably in Lemhi and Blaine counties, received considerable attention during the year; some important developments were made which indicate that the production from these sources will become somewhat larger. At Bellevue in the Wood River district, considerable concentrating ore has been developed during the past 18 months by the Idaho Consolidated Mining and Development Company along the Minnie Moore contact; a 250-ton mill is being built to treat this ore.

Another important lead-ore development was made at the Croesus mine, three miles west of Hailey, on Wood river, where a mill of 250 tons per day capacity is being erected. At the old Muldoon mine 25 miles east of Hailey, a quantity of high-grade concentrating lead ore was developed and the machinery for a large milling plant ordered. These and other mills of the Wood River district will give a daily crushing capacity of 1000 tons; from present indications these three new plants will be ready for operation by the next fall. The lead ores of the Wood River district are invariably rich in silver and also carry some gold. It seems likely that within another year this old district will again produce considerable lead and silver. Several of the larger orebodies are rich in zinc and arrangements are being made to produce a clean zinc concentrate.

In Lemhi county the Gilmore mine made important ore discoveries. This property shipped 40 cars of 50 per cent. ore during the past season; much high-grade ore was developed in the two lowest levels. The principal ore-shoot is about 125 ft. long by 12 ft. wide, and contains an average of 35 per cent. lead and about 18 oz. silver per ton. The mine is developed to a depth of 300 ft. by a vertical shaft; the ore at this depth is still completely oxidized, consisting of a soft mixture of lead carbonate and brown oxides of iron and manganese, a combination which makes a desirable smelting ore.

In the same vicinity two other mines, the Lemhi Union and the Leadville, which have just begun to produce, shipped about six cars of ore each. At the Lemhi Union mine the ore closely resembles that of the Gilmore mine and is found under similar conditions; at the Leadville mine, the ore occurs near a contact of blue Carboniferous limestone and quartz porphyry. The ore of this property carries a small percentage of antimony and consists of a blackish steel galena and yellowish-gray carbonate ore. The crude-ore shipments averaged 60 per cent. lead with 45 oz. silver and \$4 gold per ton. The particular district in which this mine is situated is an

extensive one, with many indications of lead-silver and copper ores.

SILVER

The silver output of Idaho for 1907 will approximate something under 7,000,000 oz., of which probably 6,000,000 oz., including 450,000 oz. from the treatment of Snow Storm copper ores will be credited to the Cœur D'Alene mines. The Trade Dollar and DeLamar mines in Owyhee county will yield 800,000 oz. for 1907, and several hundred thousand ounces will be derived from the lead and copper ores mined in Blaine, Custer and Lemhi counties.

COPPER

The copper ore and matte shipped from Idaho mines during the past year contained a gross metal content of 10,620,000 lb.; this came from Shoshone, Custer, Washington, Fremont and Lemhi counties.

The principal source of copper in Idaho this year was the Snow Storm mine, three miles above Mullan in the Cœur D'Alene. This property produced 95,435 tons of ore, of which 18,695 tons was low-grade carbonate material (2 per cent. and under) that was treated on the ground by an acid leaching process; the balance was shipped to the different northwestern smelters where, on account of its high silica content, it was used for converter linings. The total production averaged better than 3½ per cent. copper and 4½ oz. of silver per ton. The high prices ruling for copper during the larger portion of the year admitted of shipping a great deal more low-grade material than usual. The gross receipts for the year's shipments from this mine amounted to \$1,623,689; the net profits were \$450,000; dividends paid, \$360,000; surplus, \$90,000. About \$100,000 was spent during the year in new equipment.

The Monitor mine, 10 miles east of the Snow Storm, shipped 600 tons of chalcopryrite ore carrying 16 per cent. copper, about \$8 gold, and several ounces silver per ton. This mine will be made much more accessible by the completion of the Chicago, Milwaukee & St. Paul Railway, which passes within a half-mile of the property; this will greatly facilitate its operation, as the ore at present must be hauled over a rough mountain road to Saltese, Montana, six miles distant, and nothing but hand-picked ore is shipped. The mine is opened by a vertical shaft 400 ft. deep, from which four levels have been driven.

At Loon creek, in Custer county, the Lost Packer Mining Company operated a 100-ton hot-blast, pyritic smelter for 34 days during the past summer, and produced 425 tons of matte containing an average of 51 per cent. copper, 10 oz. gold and 70 oz. silver per ton. This mine is unfortunately situated at a distance of 125 miles from railway transportation, and so its operation is expensive. Mackay is the railway shipping point. The ore of

the Lost Packer consists of chalcopryrite in a gangue of quartz and some spathic iron. The principal ore-shoot developed is 500 ft. long and has been opened to a depth of 500 ft. by a succession of adits. It varies in width from 1 to 8 ft. and carries an average of from 2 to 5 oz. gold and 7 to 15 oz. silver per ton, with from 7 to 20 per cent. copper.

At Mackay, the Empire Copper Company operated the White Knob mine successfully for eight months of the year and produced 2,750,000 lb. of copper and \$90,000 worth of gold and silver. The ore of this mine is mostly low-grade. Therefore, this mine shut down early in the fall on account of the low price of copper. The mine is in excellent condition, however, and can work at a profit when copper brings 15 to 16c. per pound.

The Weimer mine, in Fremont county, shipped a number of cars of 16 to 18 per cent. crude ore during the past season. This ore contained 200,000 lb. copper. Much low-grade smelting ore occurring in bodies 20 to 25 ft. wide and said to average 5 to 8 per cent. copper, was also developed.

The Copper Queen mine in Lemhi county shipped two cars of 45 per cent. copper ore, carrying \$20 gold and 8 oz. silver per ton. This came from development work while blocking out the ore-bodies.

Leasers working the old Peacock mine in the Seven Devils district, shipped 500 tons of 16 per cent. copper ore during the year, and also 50 tons of 35 per cent. ore from the Lockwood mine. These ores carry about \$5 in gold and silver per ton in addition to the copper. The leasers have developed high-grade ore in the Peacock and a completion of the Short Line extension through the Snake River cañon, now well under way, will put this mine within three miles of railway transportation. At present the ore has to be hauled 40 miles to the railroad.

The Blue Jacket mine in the same district was unwatered during the year for the purpose of examination, with a view to purchase by some well known New York and Chicago capitalists, but unfortunately the deal fell through, partly owing to the slump in the price of copper which was beginning to be felt at the time the mine was put in shape for examination. At this mine the ore is a high-grade bornite ore, associated with garnet and white limestone in a wide belt of gray diorite. The development is comparatively limited and consists of a vertical shaft 300 ft. deep with three very short levels, from which fully \$250,000 worth of crude ore was shipped. This ore assayed from 20 to 45 per cent. copper and several dollars per ton in gold and silver. The bornite occurs in kidney segregations accompanying scaly crystals of specular hematite.

At Cuddy mountain, a bold uplift of porphyry, limestone and schist, 30 miles

south of the Seven Devils, a large area of quartz-monzonite, showing disseminated copper ore over an area 2000 ft. square, has been scratched over with a hundred little shallow surface pits that disclose copper carbonate or sulphide, associated with occasional specks of molybdenite in nearly every opening. Concentrates from selected pieces of this porphyry run 50c. gold to each unit of copper. The deposit presents a far superior surface showing of copper than does the Bingham monzonite mass.

Another promising deposit of copper ore, running high in gold and silver, has recently been found at South mountain, in Owyhee county. This property is owned by George Sonnemann, of Spokane, Wash., and was operated during the year under bond by the Bagdad-Chase Gold Mining Company, of Rochester, N. Y.

GOLD

Owing to the abundance of water enjoyed by the placer miners of Idaho during 1907, and other causes, the gold output of the State will show an increase this year of fully 20 per cent. over that of 1906, and will aggregate something like \$1,500,000. From present indications this yield is likely to be again increased during 1908. An important part of the gold increase during the past year will be credited to the old DeLamar mine, where the new 100-ton mill has been kept in steady operation throughout the year. The ore of this mine averages about \$12 per ton, of which about 70 per cent. is gold and 30 per cent. silver. It is treated by straight cyaniding at a cost of something like \$2.50 per ton; a high saving of the gold is made. A good force of men is kept on development work, with the result that this old mine is in better shape today in the matter of ore reserves than it ever has been; while the ore now being treated is much lower in grade than formerly, the amount of ore developed assures this mine of several years more of profitable operation. The same is true of the Trade Dollar Consolidated property.

The Golden Sunbeam mine, near Custer City, in Custer county, has developed much free-milling gold ore during the past year. It is equipped with a small Elspass mill and produced fully \$100,000 in gold bullion during the year. The ore at this mine is a soft, white rhyolite tuff, containing free gold, to the extent of \$10 or \$12 per ton, through a width of 30 to 60 ft. The deposit is several hundred feet in width and is exposed for fully a half-mile. Crosscuts indicate that the tuff averages \$2 to \$4 per ton across a width of 500 ft.; possibly this whole mass can be mined by the "glory hole," or steam-shovel, method.

Another new source of gold will probably be the Atalanta district in Elmore county, Idaho, where the Monarch mine and the Pettit mine have recently been

equipped with 200-ton and 100-ton mills, respectively. These mines are opened on the famous Atalanta lode. The Monarch mine is developed by a vertical shaft 600 ft. deep, with six extensive levels; the ore reserve is estimated to have a gross value of \$5,000,000. The Pettit mine is opened by three adit-levels; the ore reserves above the 300-ft. level amount to \$1,500,000 gross.

ZINC

Idaho will be credited during 1907 with a production of over 5000 tons of zinc ore; almost all this came from the Success mine on Nine-Mile creek, four miles north of Wallace. This property was operated steadily until Dec. 10, when the mine shut down on account of the low price of zinc; the 100-ton mill has been increased to a capacity of 200 tons per day. This addition was only completed in November. The zinc-lead ore at the Success mine is of high grade. This mine was formerly known as the Granite mine and was worked in the early days of the Cœur d'Alene for lead exclusively. The new adit cuts the ore-shoot at a depth of 400 ft. below the old workings. About 150,000 tons of sulphide ore, averaging about 20 per cent. zinc, 4 to 8 per cent. lead and 4 to 8 per cent. iron, has been developed. The deposit occurs in a belt of hard silicified slate between two wide zones of syenite. The output of the property during the past year was 1750 tons of lead concentrates, in addition to 5350 tons of zinc concentrates; this yield can easily be doubled with the present new milling capacity should the metal prices warrant such production.

Mining in California

BY CHARLES G. YALE

In California, the oldest of the mining States of the western part of the continent, the production of gold keeps on of late years at about the same rate with very little variation. The average annual yield is about \$19,000,000 and the year 1907 is expected to show about the same result. There are something more than 1000 productive gold mines in the State, large and small, and over 2000 more which are in the development stage or held by assessment work. There are more placer mines (hydraulic, dredge, drift, surface) than quartz or deep mines, but the latter still yield the larger proportion of the gold. The yield from the quartz mines continues virtually the same from year to year, though for 1907 it is expected to be somewhat less than usual owing to labor strikes which affected several large properties. The placers, however, are showing a material annual increase, which is entirely due to gold-dredging operations. In fact, while most

of the counties in which placer mining predominates show an increase of output, those where quartz mining is the prevailing interest show to some extent a falling off in yield. The deep mines yield about 64 per cent. of the annual output, the rest coming from the various forms of placers. In placer mining the work carried on by the dredgers is by far the most important. They now produce about 70 per cent. of the total placer yield, or nearly \$3,000,000 more than the hydraulic, drift and surface mines combined. The dredges now dig out considerably more than one-quarter of all the gold yield of the State, and this proportion is gradually increasing from year to year as new and larger dredges are installed.

DREDGING

One effect of this increased importance of dredge mining is to place Butte county in the lead of gold production as compared with other counties, a position held for many years by Nevada county, through the operation of its quartz properties. There are more dredges in Butte county than elsewhere in the State, though the individual machines near Marysville, on the Yuba, are of large capacity. The largest one in California is that now operating in the Folsom field in Sacramento county. The dredges of the State obtained a little over five million dollars in 1906, but their output for 1907 is expected to be a million or a million and a half dollars more than that amount. Several very large machines were installed during the year, as well as a number of ordinary capacity. Some new dredging fields are being exploited in Shasta, Siskiyou and Trinity counties, and others in Fresno, San Bernardino and Mariposa counties are expected to show some production in 1908.

There is some disposition shown to increase the number of operating hydraulic mines in California, though few of these seem to be on a very large scale. Numerous permits to mine by this process have lately been asked for from the California Debris Commission in the older mining counties where this particular form of placer mining has languished of late years. Hydraulic mining is at its best in the northwestern counties. Siskiyou county has the largest number of these mines, but the yield from Trinity from this source is the largest in the State.

DRIFT MINING

There are only about 100 drift mines now at work in the State; few have been opened of late. The yield from this source is not as great as formerly. It is a form of gravel mining which takes considerable capital, and usually a long time must pass after beginning work before profits can be realized, owing to the necessity of running long adits to reach the buried auriferous gravel channels.

For this reason it does not seem a favorite form of gravel mining, although the results are generally rather profitable. A number of new projects of this character in the older fields of the higher Sierra are being undertaken, but it will be some time before results are known.

Surface placer mining continues to be carried on upon the rivers and water courses of the foothill and mountain region, but the gold output from this source is only about half to three-quarters of a million a year, so this branch of gold mining is comparatively of small importance.

At the ratio of increase shown in the past few years, it will be yielding more than the quartz mines of the State. The older quartz mines in the principal producing sections, such as Nevada county and the Mother Lode sections, seem to be keeping up their yield about the same as usual. Every year, however, there are changes, some ceasing production and closing down while others begin to yield profitably.

The mines about Alleghany, in Sierra county, are being exploited pretty thoroughly, both gravel and quartz; some of the latter are now making excellent yields. At Angels, Calaveras county, where there are several large producers, labor strikes have materially reduced the output in 1907.

THE VARIOUS DISTRICTS

Generally speaking, the gold mines in the southern part of the State are not making as good a showing as formerly, especially Kern, Riverside, San Bernardino and San Diego counties. In San Bernardino county considerable prospecting is being done and a number of new camps were established in 1907. These are as yet mainly in course of development with few producers of note. In Inyo county a great deal of prospecting has been carried on during the year especially in the Greenwater copper district, but there has been no production to note. In the Mother Lode counties in the upper central portion of the State, two of the old producers have been shut down during the year, but several other properties are being brought to the productive stage. In Sierra county there has been more active interest in 1907 than in most of the counties. In Plumas many new enterprises are being established. Sacramento county is making a large yield from its few dredges, and Yuba county, from an abandoned hydraulic region, is yielding now over the million mark and its figures for 1907 will show a doubled output. All this is from dredges. Amador county is now not far behind Nevada county in gold yield. Six counties of the State, Amador, Butte, Calaveras, Nevada, Tuolumne, and Yuba, now show a yield of over \$1,000,000 a year gold; one of these yields \$3,000,000, while two yield over \$3,000,000. El Dorado,

Fresno, Madera, Mariposa, Mono and a few others show a falling off in yield.

SILVER

As to silver output, something over \$800,000 per year, more than half comes from Shasta county, where the copper smelters are located. No other county produces \$100,000 per year except the counties of Kern and Mono. In the other counties, most of the silver is obtained from gold ores, and the proportion is small comparatively. The closing down of some of the Shasta county copper smelters during the latter part of 1907 will cause a material reduction in the yield of silver in California for 1907, amounting to one or two hundred thousand dollars at least. It is to be noted that over two and a quarter millions tons of silicious ore were treated in 1906 averaging \$8.36 per ton, and this will be about the run of the ores in 1907. About a million and a half tons of this comes from the Mother Lode properties, where the average value is about \$4.22 per ton. In the other counties, where the ledges are smaller, the ore averages considerably higher in value.

COPPER

As in other States, California is apt to show a falling off in both amount and value of copper for 1907, owing to the decline in prices having caused a shut-down of numerous mines and smelters in the latter portion of the year. Shasta county continues to be the leading copper producer, though the metal is mined also in Calaveras, San Bernardino, Amador, El Dorado, Inyo, Mariposa, Orange, Placer, Plumas, and San Diego. Very little of either lead or zinc are produced in the State. It was due to the increased output and value of copper that the State has been showing an increase in metallic output during the past year or two.

OIL

The oilfields of the State continue to be very productive, and now, next to gold, petroleum is the most valuable mineral substance in California. With about nineteen millions gold, and five and a half millions copper, the petroleum output is almost up to the ten-million-dollar mark. While no new fields of moment are to be noted there has been an increase from the old fields, especially those in Kern and Santa Barbara counties, and as prices have been much higher in 1907 than in the previous year, the final figures will doubtless show a material advance in value.

OTHER MINERALS

In 1906 the mineral output of the State was valued, according to the State mineralogist, at \$46,776,085. This included some 46 substances. Considerably more asphalt is now being manufactured than

formerly, but instead of being mined it is now a by-product in the refining of petroleum. The borax output is not increasing materially but some new mines have been opened which are expected to yield largely. About two million dollars worth of cement are now made annually, and new deposits of lime and clay are being utilized. The output of coal has materially fallen off, the lignites of California not being able to compete with the cheap fuel oils. Gems are found in several counties and their annual value in output is decidedly increasing. Much larger quantities of granite, sandstone, marble, and slate are being quarried than formerly. The magnesite output is not very large but could be increased were there sufficient demand. There is plenty of natural gas but comparatively little is commercially utilized. Very much larger quantities of pyrites are now mined than formerly and this is used in the manufacture of sulphuric acid. The quick-silver production is rapidly falling off owing to lack of domestic consumption. A good deal of tungsten was mined in 1906 and 1907, and this, like zinc, is a new mineral for California to produce. The output of soda continues about the same from year to year; and there is some increase in the yield of platinum.

PRODUCTION OF THE STATE

Altogether for so old a mining State as California, where gold mining began nearly 60 years ago, the mining industry is in a very satisfactory condition. Within the last ten years many mineral substances have been commercially utilized, which, while their existence was previously known, were untouched. The general output of all the substances is increasing each year, taken altogether, for while some may fall off in yield, others increase. The following table will show in brief form the annual yield in mineral products in the State in the last ten years.

VALUE OF MINERAL PRODUCTION OF CALIFORNIA.

1897	.....	\$22,142,441
1898	.....	27,289,079
1899	.....	29,313,460
1900	.....	32,622,945
1901	.....	34,355,981
1902	.....	35,069,105
1903	.....	37,759,040
1904	.....	43,778,348
1905	.....	43,069,227
1906	.....	46,776,085

This shows a good increase yearly almost without interruption.

A Government bounty of 52.5c. per bbl. upon petroleum produced in Canada is reported in the *Petroleum Review* (Oct. 26, 1907), to be reviving interest in the oil industry in that country. During 1906 bounties on crude oil were paid amounting to £60,000, but even then the total production of refined oil could satisfy only 70 per cent. of requirements.

The Fibrous Talc Industry

By D. H. NEWLAND*

The mining of fibrous talc continues to be limited to St. Lawrence county, N. Y., which has furnished for many years the entire quota of that form of talc for domestic consumption, as well as for export.

The annual product averages about 65,000 tons. During the past year it was somewhat less, owing to curtailed milling capacity. The largest mill in the district, the Hailesboro, owned by the International Pulp Company, was destroyed by fire in 1906, and while the company immediately added to the equipment of its mill at Dodgeville, the output could not be maintained at the usual rate. The decreased production had a favorable effect upon prices which were higher than for several years past, ranging around \$8.50 per ton at Gouverneur, the usual shipping point.

The erection of a new mill at Hailesboro has been under way and will be completed probably early in 1908. It is planned for a nominal capacity of 100 tons of ground talc a day, and will more than restore the former milling facilities of the International Pulp Company.

The Ontario Talc Company is now the only independent producer in the district, as the Union and United States companies have been consolidated with the International. The present mill of the Ontario company is located at Fullerville, but reports have been current that a new mill is to be built at Gouverneur during the coming spring. Additional mining capacity has already been provided for by the opening of the Potter mine on the Van Namee farm, 1½ miles below Fullerville.

While fibrous talc is the main product of the mines, the foliated variety is also found in quantity. This is prepared separately, requiring long continued grinding to reduce the flakes to the proper fineness, and finds special use in the paper trade, where it is employed in the place of ground mica for giving a lustrous surface to wall paper. The fibrous talc is marketed among manufacturers of book and writing papers in the United States, Germany, England, France, Austria and other countries. Numerous other uses are made of St. Lawrence county talc, but the requirements outside of those specified are comparatively small.

B. H. Thwaite, in a paper read at the Vienna meeting of Iron and Steel Institute, advocates a system of pooling power obtained by utilizing the waste gases from a number of blast furnaces, with subsequent distribution of the electric energy so generated to individual units as required.

*Assistant State geologist, Albany, N. Y.

Review of Mining in Foreign Countries

The Year's Developments in the Mineral Industries of the Transvaal, Rhodesia, Mexico, Canada and Australia

DETAILS OF GOLD PRODUCTION

The mining industries of Canada and Mexico suffered from the same adverse conditions which affected the United States during the last quarter of the year. The production of gold in South Africa was the largest on record. Nevertheless, the feeling on the Witwatersrand was unhappy, because of the unsatisfactory labor conditions and the diminution of mining profits, which caused a great shrinkage in the value of the Rand securities on the London Stock Exchange. In Australia the conditions were rather unsatisfactory, the production of gold showing a considerable decrease, while the hopes for an increased production of zinc ore at Broken Hill met with considerable disappointment. A remarkable feature of 1907 was the increased attention directed toward the mineral resources of South America and those of the previously undeveloped portions of Africa, which will doubtless result in an important development of those continents in the near future.

The Transvaal

BY W. FISCHER WILKINSON*

The value of the gold won from the Transvaal mines during 1907 is expected to amount to £27,000,000, a figure which, as will be seen from an accompanying table, is well above those of previous years. The number of companies making returns was the same as last year, and the increase in the gold production was due to the larger tonnage handled. The grade of the ore treated, judging by the recovery value, again showed a reduction as compared with that of previous years, as might be expected from the increased scale of operations and from the progress made in the methods of working.

There is still a considerable margin between the average working costs and the average recovery, and a still further lowering of the grade may be expected, carrying with it a corresponding increase in the tonnage available for profitable mining. Low-grade ores of a value of 5 dwt. per ton or so, which were formerly considered worthless or of little value, are now becoming a valuable asset, and the prospective lives of the working mines are constantly having to be lengthened to meet the altered conditions. Undeveloped properties or those partially developed, whose prospects with costs at

30s. per ton or thereabouts were not bright, can look forward to a profitable existence now that costs have been in many cases reduced to 20s. or less. The possibility of working low-grade ores profitably has now been amply demonstrated, and there is no danger of the Transvaal's failing to contribute heavily to the world's supply of gold for many years after the exhaustion of the richer mines of the Central Rand.

The chief producers are in the Witwatersrand district, the "outside" mines making comparatively unimportant returns. Of these, the Nigel mine in the Heidelberg district and Glynn's Lydenburg and the Transvaal Gold Mining Estates companies of the Lydenburg district were the largest producers.

In the Witwatersrand district there were, according to the September returns of the Chamber of Mines, 65 producing mines besides two small producers. The total number of stamps running, excluding 90 stamps of the small producers, was 8255 or an average of 126

stamps per company. Of these the Simmer & Jack handles the largest tonnage, while the Robinson mine produces the most gold.

The Simmer & Jack, for the year ending August 31, 1907, milled 726,654 tons of ore at the rate of 6.448 tons per stamp per day. The company has a battery of 320 stamps and four tube mills. The gold production was derived as follows:

	Value per ton milled.	
Amalgamation.....	19s	8.032d
Cyaniding sands.....	10	9.473
Cyaniding slimes.....	1	7.706
By-products.....	...	0.300
	32s	1.511d

The working costs were 18s. 4.745d. per ton milled, and the total value of gold won during the 12 months was £1,167,222.

The Robinson mine has 210 stamps, and milled, during the quarter ending Sept. 30, 1907, 103,525 tons, with a gold recovery of 83,942 fine oz. of a value of £353,133, equivalent to a return of about £1,400,000 worth of gold per annum. The costs during this period were 17s. 6d. per ton milled.

TRANSCAAL GOLD PRODUCTION.¹

Year.	WITWATERSRAND DISTRICT.			Outside Mines Value.	Transvaal Total.
	Tons Milled.	Value.	Value Per Ton Milled.		
1881-9	1,600,000	£2,440,000	48.83	£238,231	£2,678,231
1890	730,000	1,735,491	47.4	134,154	1,869,645
1891	1,154,144	2,556,328	44.2	367,977	2,924,305
1892	1,979,354	4,297,610	43.4	243,461	4,541,071
1893	2,203,704	5,187,206	47.0	293,292	5,480,498
1894	2,830,885	6,963,100	49.2	704,052	7,667,152
1895	3,456,575	7,840,770	45.2	728,776	8,569,555
1896	4,011,697	7,864,341	39.2	739,480	8,603,821
1897	5,325,355	10,583,616	39.74	1,070,109	11,653,725
1898	7,331,446	15,141,376	41.3	1,699,254	16,240,630
1899	6,872,750	15,067,473	43.84	661,220	15,728,693
1900	459,018	1,510,131	65.82	.....	1,510,131
1901	412,006	1,014,687	49.25	81,364	1,096,051
1902	3,416,813	7,179,074	42.00	74,591	7,253,665
1903	6,105,016	12,146,307	39.79	442,941	12,589,248
19 4	8,058,295	15,539,219	38.46	515,590	16,054,809
1905	11,160,422	19,991,658	35.82	810,416	20,802,074
1906	13,571,554	23,615,400	34.8	964,587	24,579,987
1907 ²	15,383,000	26,307,000	34.2	985,000	27,292,000

¹Chamber of Mines. ²Estimated.

STATISTICS OF THE CONSOLIDATED GOLDFIELDS COMPANY FOR 12 MONTHS ENDING AUG. 31 IN EACH YEAR.

	Tons Milled.	Stamps	Tube Mills.	Per Cent. Recovery	Value of Yield.	Working Costs.	Working Profit.	Working Profit	
Simmer & Jack	1906	742,257	320.0	.....	91.6	31s 9d	20s 2d	11s 7d	£431,120
	1907	844,404	320.0	4(c)	89.9	32 0	18 6	13 6	571,409
	1906	412,524	203.2	2	92.7	43 9	21 6	22 3	459,903
Robinson Deep.	1907	519,475	281.1	2	94.9	40 5	21 10	18 7	483,545
	1906	321,648	119.0	3(d)	91.3	29 8	23 8	6 0	96,761
Knights Deep...	19 7	453,017	160.7	3	90.8	28 7	20 7	7 11	180,244
	1906(a)	252,649	118.2	.....	88.8	25 5	24 1	1 3	15,971
Simmer East...	1907	496,021	234.6	.....	89.2	24 5	21 5	3 0	75,835
	1906(b)	52,083	60.0	2(e)	90.5	24 10	24 3	0 7	1,461
Luijaards Vlel..	1907	197,544	60.0	2	92.1	29 3	20 2	9 1	89,892

(a) 13.463 months. (b) 4.286 months. (c) Started June, 1907. (d) Started September, 1905. (e) Started August, 1906.

*Consulting mining engineer, London, Eng.

PROBABLE LIFE OF MINES

The mining companies as a rule publish elaborate statistics of their working results. There is, however, in the majority of cases, one important omission, and that is any information as to the probable life of the mine. As the mines have limited ore resources, they become every year depreciated in value. It is not customary to provide a reserve for the redemption of capital and consequently it is of the utmost importance to the shareholder to have some guide as to how long he may expect dividends. It is only when the mine is getting near to the end of its life that information on this important point is usually given. There are, however, companies that try to inform their shareholders what the life of their investment is likely to be, and a few examples taken from the past year's reports may be recorded. For instance, the Ferreira expects a life of 6 or 7 years; New Kleinfontein, 27 to 30 years; Crown Reef, 2½ years exclusive of 50 deep-level detached claims; Robinson Deep, 21 years; and New Heriot, 17 years.

The Geldenhuis Estate gives information as to the life by estimating the total tonnage available, which is perhaps as good a way as any, as it avoids the factor of stamps. It is, of course, only possible to give an approximate estimate of what the life will be, as the tonnage to be treated depends on the cost of working and any reduction in that cost at once increases the ore tonnage. Some information, however, as to the life of the mine is wanted, so that shareholders may make provision for redemption of capital. Knowing the life, the value of the share can according to the rate of interest required be readily calculated with the help of actuarial tables.

COST AND RECOVERY

Costs and recoveries vary considerably at the different mines according to the special conditions. On an average, the mines showed improved results over last year, increased profits having been earned by treating larger tonnages. Reduced costs are, however, frequently accompanied by a reduction in the grade and bring no increase to the profits which after all is the main consideration. But, as a rule, the increased output resulted in increased profits. The Rand Mines group, for instance, for the year ending December, 1906 (the last available report), showed an increased profit over 1905 of £83,623 contributed by the nine producing mines which crushed a tonnage in 1906 of 2,367,923 tons. The average yield for 1906 was 1s. 5.707d. less than in the previous year, and the average costs 4.361d. less. The total profit was, however, as stated, larger owing to the larger tonnage crushed.

Evidence of the progressive reduction

that has taken place in working costs in recent years was given by a committee of engineers during the year to the Mining Commission appointed by the Government to inquire into the working of the mines. The figures are:

1902	25s	4.69d
1903	24	6.74
1904	24	3.93
1905	23	2.11
1906	22	1.69

The grade of ore has, as shown in the table of annual gold production, been steadily falling and, of course, the reduction in costs is partly due to the increased tonnage handled. The figure for development redemption, which is a book entry calculated from the average cost of the total tonnage developed and charged to working costs, is specially affected by the estimated increase in the

total dividends show that the mining business is being conducted on a large and expanding scale with every outward appearance of prosperity, and many people must find it hard to understand why it is that business in Johannesburg and South Africa is depressed, and why the shares are standing at prices considerably lower than those reached in former years. In order to explain this remarkable phenomenon, it is necessary to study the past history of the Rand.

Before the war and especially in the boom year of 1895 exaggerated estimates were made as to the value of the gold field, and companies were formed without sufficient thought being given as to whether the labor supply was sufficient to work them. Deep-level ground was sold at high figures, and in many cases working

DIVIDEND LIST OF TRANSVAAL GOLD MINING COMPANIES.

Year.	Dividends.	Year.	Dividends.	Year.	Dividends.
1887	£ 12,976	1894	£1,527,284	1901*	£ 415,813
1888	112,802	1895	2,046,852	1902*	2,121,126
1889	432,541	1896	1,513,682	1903	3,345,502
1890	254,551	1897	2,707,181	1904	3,877,624
1891	334,698	1898	4,848,238	1905	4,832,436
1892	879,320	1899*	2,946,358	1906	5,735,161
1893	955,358	1900*	.....	1907 (half year)	3,258,606

*War period, Oct. 11, 1899 to May 31, 1902.

tonnage developed due to the lowering of the pay grade.

In this connection the statistics shown in the accompanying table of the subsidiary companies of the Consolidated Goldfields Company will be of interest. The same company also gives the following figures with regard to the distribution of the gold won in the entire district. They refer to the year ending June 30, 1907, during which the value of gold won was £26,640,000.

Working costs.....	£17,000,000	Per cent.
Dividends	6,750,000	63.8
Profit tax.....	600,000	25.3
Reserve fund.....	2,290,490	2.3
Total	£26,640,490	8.6
		100.0

Working costs are classified in the same report as follows: White wages, 34.98 per cent.; colored and Chinese, 19.07; stores, 37.88; sundries, 8.07 per cent.

Assuming that the proportions for the year 1907 were equal to those for the year ending June 30, 1907, and that the whole gold production for the year 1907 will be £27,000,000, the amount paid in white wages is approximately £6,000,000, and in colored and Chinese wages £3,267,000.

The dividends declared for the first half of 1907 amounted to £3,258,606, and for the whole year the dividend list will probably be not far short of £7,000,000. The amounts paid in previous years are shown in the accompanying table.

GROWTH OF GOLD MINING ON THE RAND

The figures given in the table showing

capital was raised at high premiums. Nor was speculation confined to mining ground, but real estate and buildings were bought and sold at inflated values, and generally prices were put up to figures above what the mines could pay interest on. Then came the war, which loaded the mines with further capital, as funds had to be provided to meet war losses, expenses of maintenance, debenture interest, etc.

After the war in 1902, a second boom occurred founded on exaggerated notions of what the mines could perform under the new conditions, and again the limitation of the labor supply was not sufficiently reckoned with. Further the time required to restore the labor force that had been employed before the war was miscalculated. The recovery of this labor force was made especially difficult owing to the competition of the military authorities and the public works department, who started work on roads and railways on an ambitious scale. The mining companies had, therefore, mines which could not be worked for want of labor, and the capital invested in the country received no return.

Thereupon came the cry for foreign labor, and the introduction of the Chinese. That experiment, which is now to be terminated, assisted the mines in getting to work more quickly than if they had had to wait for the normal native supply. At the present time the number of natives employed exceeds what it was before the war, and, though perhaps not

sufficient without the Chinese to meet all the requirements of the mines, is, at all events, large enough to support the mining industry on a considerable scale.

CAUSES OF DEPRESSION

This historical review will help to explain why Johannesburg is depressed. The depression is the natural consequence of the wild speculation of 1895 and 1902 and is traceable to the disregard of the quantity of unskilled labor that the country could supply. With imported Asiatic or other labor the mines could be worked on a larger scale, but the people of the Colony have decided against this importation and the mining industry must accept the conditions that exist and that existed when the greater number of the present companies were formed, and by introducing every possible economy must try to make the best return possible on the huge sums that have been so lavishly and recklessly invested in the country.

During the past year these facts were realized, and attention is now being devoted to seeing how expenses can be reduced and profits increased. To restore confidence in the South African mines profits and dividends adequate for this class of investment must be shown. Unfortunately, owing to the heavy expenditure incurred, the return in the past, taking an average of all the dividend-paying companies, is lamentable. The following evidence was given before the Mining Commission which sat during the year in Johannesburg.

CAPITAL AND DIVIDENDS

In 1906, 39 companies paid £5,565,972 in dividends on a market value of £56,305,227 (April, 1907). The estimated average life of these companies was 12.66 years, and to redeem the capital at 3 per cent. compound interest would require £3,728,363. The balance of the dividends was only sufficient to pay 3 per cent. on the capital.

At the end of 1904 there were 163 mining and finance companies with a market valuation of £276,000,000. The dividends were £3,821,846, equal to 1.3 per cent. without any amortization. In 1905, these 163 companies had a market valuation of £170,000,000 and the interest earned was 3.8 per cent. In 1906, the market valuation was £135,000,000 and the interest 4.1 per cent. No allowance is made in each case for redemption of capital.

It may be said that the market valuation is an affair of the public and that the finance companies which floated the companies are not responsible. It must, however, be remembered that the prices of Rand shares are founded on the price, mostly at a high premium, at which the working capital shares were issued to the public, and that many of the shares are now quoted in the market at lower prices than the working capital shares were issued at.

UNSKILLED LABOR

The labor requirements of the mines both as regards white and colored labor was the subject of constant discussion and debate. The decision of the government to stop the importation of Chinese labor and to repatriate those in the country on the termination of their engagements made it necessary for the mine owners to look to the Kafir supply for their future unskilled labor force. The recruiting of Kafirs was fortunately attended with success, and the numbers employed at the close of the year were in excess of any previous period. The increase in the numbers is partly, however, explained in that there was very little fresh development going on in the country, and the fear was expressed that there would again be a shrinkage in the labor supply whenever public confidence was restored and fresh capital came into the country. Anyhow the demand for unskilled labor was satisfied toward the end of the year. It is as regards the future that there is anxiety. The number of Chinese employed on the gold mines during September, 1907, was 47,465; the number of Kafirs and Capeboys 117,397; and the number of whites, 17,521. It is estimated that in June, 1908, there will be only 21,000 Chinese left, and in December, 1908, only 12,250, and that the whole lot will have gone early in 1910.

LABOR EMPLOYED IN TRANSVAAL GOLD MINES.

		White.	Colored.	Chinese.
1902..	July	8,162	32,616	
	December ..	10,292	45,698	
1903..	June	11,825	66,221	
	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
	December ..	17,495	98,156	52,917
1907..	June	17,166	111,862	51,517
	September..	17,521	117,397	47,465

The withdrawal of this labor force can hardly take place without disturbing the gold production of the Rand. The non-producing or the poorer mines are, however, those which are most likely to suffer, and increased efficiency both of white and Kafir labor, together with the substitution of machine for hand drilling, may help to modify the severity of the decline in the output which the situation appears to demand. Those who have had experience in recruiting Kafir labor for the mines say that the supply is exhausted. Possibly that is so in the field wherein recruiting has been carried on, but Africa is a big place, and with the opening up of new country which is constantly going on, especially that north of Zambesi, it does not seem unreasonable to hope that fresh recruiting districts may be found.

WHITE LABOR

Special light was thrown on the condi-

tion of white labor owing to a strike which took place in May. The strike originated over the question whether a white miner should supervise more than two machine drills. The management of the Knights Deep mine decided to reduce the price of contract stoping and proposed that the miners should supervise three drills instead of two, an arrangement which would have resulted in an increase in their individual earnings. The strike extended to other mines and assumed serious proportions, but it never seriously crippled the companies and ended in a victory for the employers. The strike led to the publication of figures showing that many of the miners were receiving princely wages, amounting to £600 and £800 per annum. At the Knights Deep for the month of April the average amount paid to machine stopers was £2 4s. per shift of eight hours, the maximum wage being £3 19s. 7d. and the minimum 14s. 11d. per shift. In hand stoping, the average wage was £1 19s. 6d. per shift of eight hours, the maximum wage being £3 3s. 3d. and the minimum 19s. per shift.

The conditions under which the miner who works a machine works are certainly deserving of good pay. The investigation, caused by the strike showed, however, that the white miners were receiving pay out of all proportion to the cost of living and far in excess of the carpenters, fitters, engine drivers, or shift bosses, and further, that much of the hard work of running the drill was done by natives or Chinamen. Consequently the machine men received but little sympathy from the public. Their places were filled without difficulty, there being many men out of work in Johannesburg at the time. Many of those who took work on the mines at this time were the Afrikaners or Colonial born who, accustomed to handle natives, were especially useful recruits. In order to encourage young men to study mining and fit themselves for work underground, mining classes were arranged for, and it is hoped that in this way the demand for efficient miners ready to work at reasonable pay will be satisfied.

The average rates of pay on the Rand for the period July to December, 1906, are given in an accompanying table compiled from the statistics of the government mining engineer.

NUMBER AND WAGES OF MINERS ON THE RAND PER SHIFT.

No.	Class.	Average Pay.
1392	Machine men, stoping	32s 9d
938	Machine men, developing	35 5
1524	Hand men, stoping	21 3
599	Engine drivers (hauling surface) ..	20 2
177	Engine drivers (mill engines)	19 3
972	Fitters	20 2
610	Carpenters	20 2
294	Amalgamators	18 3
43	Cyanide Foremen	22 11
301	Cyaniders	15 9
273	Shift bosses	24 6

WORKING COSTS

Much attention was given to the study of working costs, and numerous suggestions were made for securing greater economy. There are some who maintain that stopes are carried too wide and that an unnecessarily high amount of waste rock is put through the mill. Closer sorting is advocated by others, so as to raise the grade and increase the gold production. The more extended use of machine drills has its advocates, and especially of the small stoping drills. Much time and money was spent on experiments with these small drills, but according to Leslie Simson, the superintending engineer of the Consolidated Goldfields Company, no really satisfactory drill has yet been put on the market. The results obtained, however, with some of these drills were encouraging, and their merits were spoken of by Wager Bradford in his presidential address to the Mine Managers' Association. Trials made at the new Kleinfontein and new Comet mines with the Gordon drill gave results of 6 holes per shift, 37 in. each, with an air pressure of 55 lb. At the Robinson mine, where longer trials appear to have been made, the results were not so good, the best average of 12 machines for one month being 3.53 holes, presumably 36 in. each, per native shift.

Then the question of air losses came in for criticism, and it was pointed out that the air supplied to the mines is very often below 60 lb. The poor work done by the Kafir, namely, a 36-in. hole per shift, also caused remark. This is the task established by custom and it is one which many of the natives can perform long before the shift is up.

METALLURGICAL PRACTICE

On the milling and metallurgical side several new departures from the ordinary practice were proposed. In the new battery being erected for the Simmer Deep, the bin framing and roof trusses will be of steel. The cast-iron anvil blocks are to be done away with and the mortar boxes placed directly on a concrete foundation. The mill is to be electrically driven, each ten 1670-lb. stamps having a separate motor.

The gold thrown away in the residue did not escape the attention of critics, and finer grinding is advocated to recover something of the £2,500,000 gold that now goes over the dump.

The costly and clumsy tailing wheels are condemned by some who advocate the separation of sands from slimes effected by some form of scraper, as is the practice at some mines in the United States. Another opponent of the wheel is the sands pump, working on the injector principle invented by Mr. Roberson, the mechanical engineer of the Rand Mines.

A new method of treating ores by cyanide was introduced, called after its

patentees the Adair-Usher process. It claims to be able to give quicker and more complete extractions than hitherto obtained. The process was introduced on several mines and has been well spoken of. The result of more extended trials will be watched with interest.

EXCESSIVE COST OF WHITE LABOR

While there are many directions in which costs can be brought down, it is generally admitted that the most important economy to be effected is in the expenditure of white labor. In an earlier part of this article attention was called to the high wages that the miners have been earning, and to the fact that, while the cost of living has come down, the wages have remained more or less stationary. Perhaps the most important evidence as to the value of the white miner is that given by the well-known American engineer, Ross E. Browne, who published during the year a carefully prepared report on the subject of working costs on the Rand, which he had made a special study of during a residence of 20 months.

He compared the work done on the Rand with that done at a Californian mine, where the conditions were more or less similar as regards depth of mining and width of stoping. The results he obtained went to show that labor on the Rand was far less efficient than in California, and that, provided that both the Kafir unskilled labor and the white skilled labor was made more efficient—which he considered could be done—the cost of working could be brought down from a present cost of 22s. per ton milled to 15s. per ton. The results of his calculations are as follows: Present working cost per ton milled, 22s.; substituting Californian labor, wages, cost of supplies, economy of management, etc., 17s.; under the most favorable conditions, with efficient skilled white labor and white direction of colored labor, reduced cost of supplies, etc., 15s.; with efficient labor, exclusively white, present white wages, present cost of supplies, etc., 26s.; with present white labor and substitution of available white for the present colored labor—maintaining the present average white wage, cost of supplies, etc., a re-est- imable estimate cannot be made, but the figure would probably exceed 35s.

This report is very encouraging, and while the reduction from 22s. to 15s. may be too optimistic, there is such a wide margin that considerable improvement may be confidently looked forward to.

DIAMONDS

There was great activity in the diamond mines during the year. A large number of syndicates were floated, and gambling in this class of property was as violent as it was a few years ago in tin ventures. The Premier mine continues to be the principal producer. The diamond output

up to last March, when for some unexplained reason the returns were no longer published by the Mines Department, is given in the accompanying table.

TRANSVAAL DIAMOND OUTPUT.

Year.	Carats.	Value.
Ending June 1903	33,572.57	£46,358
Ending June 1904	497,917.14	685,720
Ending June 1905	995,002.51	1,198,530
Ending June 1906	758,406.21	968,229
July 1906 to March 1907, ..	1,036,380.84	1,564,370

The famous Cullinan diamond weighing 3025¾ carats found in the Premier mine in January, 1905, was presented by the Transvaal Government in the name of the Colony to the King as a birthday gift this year, and the gem now forms part of the crown regalia.

Rhodesia

By W. FISCHER WILKINSON*

There was much activity in mining during the year and the gold production exceeds all previous records. The total output for the 12 months approximated 616,048 oz. of bullion, having a value of £2,238,000. A table compiled by the Chamber of Mines shows the annual production since 1898. The figures differ somewhat from the table presented last year, the statistics having been adjusted to embrace the mines of Southern Rhodesia only.

GOLD PRODUCTION OF SOUTHERN RHODESIA.

Year.	Value.
1898	24,555
1899	54,855
1900	85,336
1901	172,061
1902	194,169
1903	231,872
1904	267,737
1905	407,096
1906	551,894
1907 (estimated)	616,048

The principal producing mines with their production for the month of September, 1907, are given in the accompanying table:

OUTPUT OF RHODESIA MINES IN SEPTEMBER, 1907.

MATABELELAND.	Stamps.	Tons. Milled.	Value.
Gwanda	60 ¹	8,203	£12,032
Globe and Phoenix	40 ²	6,000	12,618
Selukwe	40	6,410	8,002
Surprise	20	2,926	4,214
Nelly	15	1,700	4,819
Wanderer	100 ³	16,368	7,777
MASHONALAND			
Battlefields	10 ⁴	1,535	5,410
Glant	15	4,322	9,375
Beatrice	10	1,525	2,550
Ayrshire	60	8,000	10,170
Eldorado	20	2,584	5,652
Jumbo	20	1,752	7,275
Penhalonga	40	7,900	6,780
Rezende	25	3,700	5,257

¹One Chillan mill auxiliary.

²Two pans as auxiliaries.

³Dry crushing equivalent.

⁴Three Huntington mills.

Besides these mines, which account for about half the gold produced, there are

*Consulting mining engineer, London, Eng.

about 80 small producers, chiefly tributaries working with 5- or 10-stamp batteries.

A considerable amount of work was done in prospecting for and in mining diamonds and base metals. The total mineral production, including precious metals for the year ending March 31, is shown in an accompanying table:

MINERAL PRODUCTION OF SOUTHERN RHODESIA FOR THE YEAR ENDING MARCH 31, 1907.

	Value.
Gold, 560,750 oz.	£2,012,543
Silver, 122,740 oz.	15,933
Copper, 67 tons	5,703
Lead, 681 tons	11,040
Chrome iron, 7,051 tons	20,258
Wolframite, 18 tons	1,619
Coal, 99,201 tons, 69,015 tons sold	52,000
Diamonds, 2,361 carats	11,709
Other precious stones, 9,907 stones	2,400
Total	£2,133,205

The general condition of the mining industry is thus described in the report of the Secretary of Mines to the Legislative Council for the year ending March 31, 1907. The description would equally apply to the whole year, 1907, under review:

"Prospecting in each district was on the increase, and there are signs that the old theory of testing only ground which shows ancient workings is being set aside. In Victoria district virgin reefs were discovered in ground which was not even considered to be on the gold belt. Complaints are made at times that the best mining portions of the country are already held by companies and syndicates which require a heavy royalty before leasing the ground, but the fact remains that the major portion of the gold belts, and of the country, has not been fully prospected. The arrival of the small worker promises to alter this, as he is not prepared to work claims below a certain depth, so searches around for new reefs to keep his battery going. The classes of workers for profit are now three in number: the small worker who can only deal with properties down to a certain depth, say water level; the syndicate small workers with a little capital who can undertake more extensive mining operations; and the companies who, with larger capital available, can deal with the larger propositions. The progress of the industry is shown in the steady annual increase of gold, and the year under review constituted a record in this respect. The bigger producing mines generally maintained their outputs, and were responsible for the majority of the output. Lower working costs and the most suitable machinery were kept steadily in view, and more dividend-paying mines may be anticipated in the early future."

An important alteration in the mining law to take effect on Jan. 1, 1908, has been arranged. Hitherto, except in the case of small properties, mining companies had on flotation to give to the chartered company a certain percentage, originally 50 per cent., reduced later to 30 per cent., of the vendor capital. This system was objectionable because it tended

to make the capitalization inflated and further because it put the chartered company in a position to make money out of the mines before an ounce of gold was produced. Under the new arrangement the share interest is to be abolished and a royalty on the gold produced substituted. The royalty is fixed on a sliding scale, but will average 5 per cent. of the gross output. The richest mines, exceeding 1 oz. per ton, will pay 7½ per cent., and the low-grade mines 2½ per cent.

THE VICTORIA FALLS POWER COMPANY

was launched under the patronage of the British South Africa Company at the end of 1906. The share capital is £3,000,000, divided into £1,000,000 ordinary shares and £2,000,000 preferred shares. The whole of the ordinary shares were allotted to the African Concessions Syndicate, Ltd., in return for the lease of the falls. Of the reference shares, 625,000 were offered for subscription. There is also an authorized debenture issue of £3,000,000, of which £625,000 were to be issued, provided the issue of preference shares was fully allotted.

The company was formed to generate electric power from the falls on the Zambesi river and to convey it to the Rand goldfield. It also proposed to supply power from steam-driven power stations in the vicinity of Johannesburg. This second part of the program has been carried out, two Rand power stations of 6000 kw. capacity having been acquired.

It seems doubtful whether the company seriously intends to embark on the long-distance transmission scheme, the commercial success of which may be doubted, and it seems more probable that, what has been called the romantic side of the enterprise, the Falls power station will be united, for some time at all events, to meeting the demands for power by the industries which the directors anticipate will shortly be established in the neighborhood of the falls, and that the company will devote most of its energy and resources to developing the dividend-earning side, namely, the steam-driven power stations of the Witwatersrand goldfields.

West Africa—Gold Coast Colony and Ashanti

BY W. FISCHER WILKINSON*

The gold production of 1907 shows a considerable increase over that of the previous year due principally to the returns of the Prestea Block A mine. This mine, which commenced crushing in November, 1906, is now the leading producer, contributing about 50,000 oz. of bullion during the year. The working mines

and their production are shown in the accompanying table.

GOLD PRODUCTION OF THE GOLD COAST COLONY AND ASHANTI, 1907.

Mine.	Oz.
Prestea Block A	40,393
Ashanti Goldfields	35,065
Abbotlakoon Block 1	22,843
Wassau	21,338
Abosso	20,692
Bibiani	19,140
Broomassie	15,867
Akokerr	10,716
Taquah & Abosso	8,701
Sansu	6,171
Attasi	5,121
Four dredging companies	10,650
	216,697
October	24,013
November and December (estimated)	48,000
Total for year	288,710
Estimated value	£1,152,217.

Four of the mines, namely the Abbotlakoon Block 1, the Wassau, the Abosso and the Taquah & Abosso, are working the conglomerate or "banket" beds and produce about 34 per cent. of the total production of the colony. The other mines are working fissure veins and account for 61 per cent. of the total production, the balance or 5 per cent. coming from the dredging companies.

The gold production of the colony since 1880 is shown in an accompanying table.

The value of the gold won is considerable, being approximately £1,152,000; yet on account of high working costs profits are not large. One of the successful companies is the Abosso, which paid a 10 per cent. dividend in 1906, and a similar amount in 1907. The tonnage milled for the year ending June 30, 1907, was 36,881 tons, yielding gold to the value of £111,850 or 60s. 7.8d. per ton. Working costs for the period averaged 38s. 3.1d. per ton, including development redemption and London expenditure, but not depreciation of machinery and buildings. In June, 1907, the costs were reduced to 33s. 2.2d. per ton milled. The mill is to be increased from 30 to 50 stamps, and a further extension is recommended by the manager.

The Taquah & Abosso Company lately built a new 50-stamp mill to be run by a gas plant.

GOLD COAST COLONY AND ASHANTI GOLD PRODUCTION, 1880-1907.¹

Years.	Oz.	Value.
1880	9,129	£32,865
1881	12,567	45,240
1882	17,097	61,552
1883	14,565	52,435
1884	18,385	66,188
1885	24,994	89,981
1886	20,799	74,878
1887	22,546	81,168
1888	24,030	86,510
1889	28,666	103,200
1890	25,460	91,657
1891	24,475	88,112
1892	27,446	98,805
1893	21,972	79,099
1894	21,332	76,795
1895	25,415	91,497
1896	23,940	86,186
1897	23,554	84,797
1898	17,732	63,837
1899	14,249	51,299
1900	10,557	38,006
1901	6,162	22,186
1902	26,911	96,880
1903	70,775	254,790
1904	93,548	345,608
1905	168,457	657,330
1906	225,959	877,568
1907 ²	289,000	1,152,000

¹West African Chamber of Mines.

²Estimated.

*Consulting mining engineer, London, Eng.

The Ashanti Goldfields Corporation during the year ended June 30, 1907, produced gold to the value of £188,528 from the group of mines under its control, and paid two dividends of 10 per cent. each in April and August, 1907. The tonnage treated was 48,610 tons, of which 45,397 tons were crushed wet and 3213 tons were crushed dry and then roasted and cyanided. The dry process was started in 1907, and, although more expensive than the wet treatment, gives a higher extraction and greater profit. Making allowance for some gold won from old tailings, the recovery appears to have averaged about 70s. per ton. The costs, including London expenditure and depreciation of machinery, came to about 40s. per ton, but the amount charged for development, namely, £8405, can hardly be considered a fair charge, seeing that the total expenditure for the year on development amounted to £30,354, while no increase in the ore reserves appears to have been made. This small charge for development is the more noticeable because special attention is called in the report (June 30) to the smallness of the ore reserves, which called for a reduction in the rate of production for the coming year.

The Abbontiakoon mine was somewhat handicapped by changing from dry to wet crushing. The ore is now crushed wet in Krupp ball mills and then treated by the amalgamation and the cyanide processes. Much better extractions are obtained than formerly.

At the Wassau mine the costs for the five months ending May 31, 1907, with a 30-stamp mill were 32s. 7.14d., including a charge of 10s. per ton for development redemption. The average yield for the six months January to June, 1907, was 44s. 7.65d. The unhealthy climate is the main obstacle to successful working. White labor is expensive and has constantly to be replaced as engagements are of short duration. The usual contract is for 12 months' service on the coast, the company paying passage out and home. White labor is, however, employed on a smaller scale than formerly, as much of the skilled work is now done by natives. The cost to the companies of white miners, carpenters and fitters is about £43 per month, which includes board and traveling allowance. Mill and cyanide hands get £20 a month and £10 17s. "chop" or board allowance. A mine foreman and a battery superintendent earn £50 a month with free board; an assayer, £30 and free board.

There is not much new development work going on, and the idle companies are waiting until the returns of the present working mines encourage the expenditure of fresh capital in the country.

According to a Geological Survey report, a plant at Cedar, Colo., produces vanadium as a by-product in the concentration of carnotite ores, 20 per cent. of the concentrates being vanadium oxide.

Klondike District

By JOHN POWER HUTCHINS*

The gold production of Klondike district in 1907 was about \$3,000,000, 50 per cent. less than that of 1906. The following table shows the gold production of Yukon Territory, which includes not only the Klondike district, but several others. The gold output of these others is comparatively small, Klondike being the largest producer.

GOLD PRODUCTION OF YUKON TERRITORY.

1896	.....	\$300,000
1897	.....	2,500,000
1898	.....	10,000,000
1899	.....	16,000,000
1900	.....	22,275,000
1901	.....	18,000,000
1902	.....	14,500,000
1903	.....	12,250,000
1904	.....	10,350,000
1905	.....	7,000,000
1906	.....	6,000,000
1907	(Estimated).....	3,000,000

These figures reveal a marked similarity between this and other placer districts not only in respect to the rapid increase of the annual output to a maximum a few years after the discovery of the placers, but also in the rapid decrease in the output after the maximum figure had been reached. It is of passing interest to note that in both California and Klondike the annual production reached a maximum the fourth year after discovery. These figures were more than \$80,000,000 for California and more than \$22,000,000 for Klondike.

CAUSES OF REDUCED PRODUCTION

Klondike is essentially a placer district. As it has no paying lode mines, the exhaustion of the placer areas results in smaller annual output. Because of this fact and others stated later it is not likely that there will be a material increase in the gold output. Some placer districts, owing to the discovery and development of deep gravel deposits (like the lava-capped channels of California), have in their later years taken a new lease of life and increased for a time their annual output. In Klondike the probability of finding extensive new deposits of pay-gravel is remote, but there is the possibility that developments will extend the boundaries of the deposits already exploited. Besides, other fragments of the "White Channel" occurring as terraces and benches on sides of the present Klondike valley may be found; these would necessarily be small and of no great economic importance.

The "White Channel" is what is left of the ancient creek beds; it has a course approximately parallel to the present creeks but at an elevation from 100 to 300 ft. greater. Where it has not been entirely eroded, this channel usually appears with its rim completely removed; locally

*Consulting mining engineer, 52 Broadway, New York City.

it is called a bench deposit. There is one notable exception in the occurrence of the "White Channel;" this is the deposit between Lovett gulch and the Klondike river, for there the two rims of the "White Channel" are intact for several thousand feet. In Klondike there are no "back channels," "deep channels" or "break-outs" such as occur in California, where a wonderful plexus of "dead rivers," not all of the same geologic epoch and therefore differing from each other in a surprising degree, even now stimulates a steady search which is often rewarded by rich discovery.

Another way in which dying placer regions may be revived is by the introduction of machinery and large-scale operations to work-gravel too poor to be profitably worked by hand. The Oroville district formerly supported 5000 miners, who worked with rocker, long-tom, and sluice; but finally it was considered "worked out." The introduction of floating dredges resulted in a revival and its present prosperity. Most of the Klondike claims have been bought by a powerful corporation, and preparations are now under way to work these claims on a large scale using mechanical devices to supplant most of the hand labor. A part of the decrease in gold output is due to the fact that the Klondike district is now in a transition period and much ground is now idle while these preparations are going forward.

The snowfall of a year ago was light, only about 18 in., but, as it thawed slowly, it was possible to make full use of the small amount of water available; considerable of this water was used in ground-sluicing overburden. The season was a very dry one, as all months except September were very dry. The time of the freeze-up was normal.

During the winter only a little drifting was done on Dominion, Sulphur and Quartz creeks. None was done on Bonanza, Hunker and El Dorado creeks. A small amount of rich ground was mined on Hunker creek; the average content of which is said to have been about 25c. per pan. The labor supply was ample; there are no miners' unions and no labor troubles. Wages are still high; 40c. per hour and board, and 30c. per hour and board are the respective summer and winter wages for common labor.

MINING METHODS

There was little in the way of novelty in mining methods to note during 1907. Klondike from the time of its discovery, has been notable for the remarkable number of its mining devices. At first, when all were engaged in solving the tremendous obstacles concomitant with the rigors of a climate having a minimum temperature of 60 deg. F. to 70 deg. F. below zero, the variety of min-

ing machines used was bewildering. Remarkably rich gravel permitted extravagant owners to exercise their peculiar ideas of mechanics, as large piles of extremely costly but unsuccessful machinery, now merely rusting scrap, testify. Even in 1907 in mining creek-bed gravel by the open-cut method, the following means of transporting pay-gravel to the sluices were commonly used: Shoveling to platforms, then to sluice; shoveling into wheel barrows, wheeling to bucket, raising on inclined cableway to sluice; shoveling into buckets, hoisting by derrick to sluice; shoveling into cars, hauling on inclined track to sluice. But shoveling into wheelbarrows, wheeling to bucket and hoisting on inclined cableway to sluice was the method of transportation most generally used. Less frequently the following methods are or have been used: Steam-shoveling direct into sluice; steam-shoveling into cars, hauling on inclined cableway to sluice; steam-shoveling into skip, hauling on cableway to sluice; steam-shoveling into sluice sustained on same car with shovel; steam-shoveling into sluice sustained on another car; hand-shoveling upon a troughed belt, conveying to sluice; excavating by ground-sluicing or with water under pressure from gravity or from pump, then sluicing to chain of steel buckets, elevating to sluice; excavating by ground-sluicing or with water under pressure from gravity or from pump, sluicing to centrifugal dredging pump, elevating to sluice; and steam scraping to sluice. In fact with the exception of hydraulic elevating, which a dearth of water prevents, there is hardly a mechanical device for placer mining that has not been used in Klondike.

DREDGING

Dredging in the Klondike district was successful only where unfrozen or very rich frozen gravel was worked. The most satisfactory returns were from a dredge working an unfrozen area in the flood-plain of the Klondike river; this was installed before the large corporation, now so prominent in Klondike, became interested. The dredges installed since that time have been very disappointing in returns. Three powerful dredges began operation on lower Bonanza creek, but the experience there has been most discouraging. It was thought that the ground would thaw to bedrock when the overburden had been stripped by ground-sluicing, but instead it has been found that the ground thaws very little below water-level, as the temperature of the ground water in Klondike is little above freezing.

An attempt has been made to dig the frozen bottom gravel, which must be mined to recover the major part of the gold content; at least such is the case in the Klondike district, where a great vertical concentration has taken place; con-

sequently most of the gold occurs either on or in the bedrock. This procedure resulted in tremendous wear, tear, and damage to the excavating apparatus, although only a small amount of excavating was done; bucket lips had to be ordered by the carload by express. Steam thawing was then undertaken, but this was not rapid enough to prepare sufficient ground to keep two dredges going (the third having been partially dismantled to furnish parts to replace those worn out and broken by the other two while trying to excavate the frozen ground). The dredging outcome was altogether discouraging.

Dredging is always extremely sensitive to environment, especially such as affects the length of the working season. In the Klondike, May 1 is about the earliest in normal years that dredging can begin; but owing to the superficially frozen ground, which is found even in the milder areas, such as the Klondike river valley, it is rarely advantageous to begin so early. Besides even at that season the day and night temperatures, approximate 50 deg. F. and — 15 deg. F., respectively. Dredging can be continued until Oct. 15, when the day and night temperatures are about 30 deg. F. and — 15 deg. F., respectively; after that date, the same difficulties are encountered as in the early part of the season. Besides, owing to the fact that very cold weather may come suddenly about Oct. 15, it is well to have suspended dredging before that date so as to avoid the damage to the dredging equipment concomitant with a sudden shut-down due to a cold snap.

Dredging has been carried on at Ruby, Mont., throughout the winter with a minimum temperature of — 35 deg. F. Such low temperature lasts but a short time and is combated by heating the pond, and by using live steam to keep the sluices unfrozen. The operators exert great effort in this way, knowing that such intense cold will last but a short time. But in the Klondike the weather stays very cold after the first severe snap.

As a general rule it may be said that frozen ground cannot be dredged. This does not mean that it is impossible to dredge it, but that it is usually more economical to exploit it in some other way. Dredges have been applied in the Klondike by merged interests where the less spectacular and more humble methods of the one-man enterprise would probably be much more suitable and profitable.

Were the alluvion of the Klondike creeks unfrozen, dredging could be carried on at a large profit, for the other conditions are generally favorable to dredging. The gravel is fine, clean and of moderate depth. It generally rests on a favorable bedrock, though there are areas where blocky schists carry consid-

erable gold in their crevices to such a depth that it cannot be recovered by dredge buckets.

There is probably less than 3000 acres of so-called dredging ground in the Klondike; of this more than 50 per cent. is partially or totally frozen, and therefore of dubious value for dredging. In 1907 there was about as much ground dredged in the Klondike as during the season of 1906.

DREDGING COST

The cost accounts of the three new 5-cu.ft. dredges that worked spasmodically in the frozen gravel during 1907, are not available for publication but it is known that they are very high. As in previous years it was found that on a large dredge working mostly in unfrozen ground the operating cost was about 15c. per cubic yard.

During the year none other than narrow and shallow pay-streaks were found for, although in Klondike the vertical and horizontal concentration has been great, areas of local enrichment such as those at the confluence of a small rich creek with a larger stream have not been found. This is an interesting feature but likely to lead to misleading conclusions if not given proper weight in considerations of the area of local enrichment.

There were no modifications of dredge design, construction and manipulation during 1907. It was observed that the stacker dredge stood cold weather better than the sluice dredge; also that the steam dredge had a similar advantage over the electric dredge. Electric dredges will probably show a saving of 30 to 40 per cent. over steam operated dredges, particularly in case there be a central hydro-electric generating station furnishing power to several dredges; besides, it takes about 20 per cent. less labor to operate electric dredges.

Eight- and 12-hour shifts are worked; the approximate gross wages per day are: foreman, \$10; winchmen, \$7.50; firemen, \$6.50; deckhands, \$5.50; roustabouts, \$5.50.

NEW INSTALLATIONS

Considerable work was done upon the large ditch, flume, and pipe-line which, when completed, will furnish 125 sec. ft. of water; much work was also done at some of the claims preparing for hydraulicking with this water. Pits about 20x30 ft. and 10 ft. deep have been excavated in bedrock at No. 3 above Discovery and at No. 24 and No. 30 below Discovery on Bonanza creek. Electric bucket-elevators will operate in these pits. Material sluiced to them by water under gravity head, will be elevated together with the water, to sluices set at such a height as to give sufficient grade and dump room. In 1904 this type of plant was tried and discarded.

The plant installed at No. 60 below Discovery on Bonanza and consisting in part of a steam-shovel and belt-conveyer was moved to Poverty bar, a penepplain of Bonanza creek, opposite No. 14 below Discovery, but this plant also failed there.

A dam about 60 ft. high and planned to hold about 158,000,000 gal. was finished in 1907. This structure was begun in the summer of 1906, but its foundation was not placed deep enough. The core was built of 8x8-in. timber and a No. 14-gage iron pipe was placed through the core for an outlet. No masonry work was built around this pipe. Loose dirt and broken rock from the adjacent ridges were tamped with water around the core. This work continued with several hundred men until about Dec. 1 of 1906. Much of the material dumped into the dam after Nov. 1 was badly frozen, and so could not be properly tamped. Work was resumed in the following spring, but when the spring thaw came, the frozen material in the dam settled, crushing the outlet pipe, and twisting the timbers of the core. These difficulties are stated in order to show some of the problems of earthwork construction in the far North.

HYDRAULIC MINING

As the mining season of 1907 was very dry, only about 1,250,000 cu.yd. were sluiced, or only about 50 per cent. of the yardage washed in 1906. A duty of more than 5 cu.yd. per miners' inch per 24 hours was attained at several properties; operating cost was more than 20c. per cu.yd. No hydraulicking with water under pumping pressure was done this year.

FUEL

Wood hauled on runners in 16-ft. lengths cost \$10 to \$16 per cord delivered at the mine; that hauled on wheels cost \$16 to \$20 per cord. This cost is largely affected by the length of haul. Coal was used but in small quantity; it comes from mines outside of the Klondike district. The calorific value of this coal is low, so it cannot be used advantageously unless its cost per ton is about the same as that for wood per cord; in other words a ton of this coal and a cord of wood possessed about the same heat-producing qualities. It is planned to install a steam plant at a mine, about 30 miles from Dawson, to generate electric power which will then be transmitted to the mines in the Klondike district.

TRANSPORTATION

No new Government wagon roads of importance were built in 1907. Existing roads were well maintained and it is possible to haul about one ton per animal on them. Freight rates from Seattle to Dawson were about \$60 per ton, the same as last year. Passenger rates in Klondike

for railway, river steamer and stage were, as in 1906, about 20c., 11c., and 25c. per mile, respectively.

DRIFT MINING

In the early days of Klondike most of the gold was produced by drift mining. Shafts were sunk and drifts from them were run in the pay-gravel, which was hoisted and then trammed to the pay-dump. During 1907 there was very little of such mining done, as nearly all the ground, formerly thought suitable for exploitation by this method, is now being reserved for future working by hydraulic or mechanical methods.

It is interesting to note the strong tendency to introduce machinery of various types to exploit claims that were formerly successfully worked by hand methods and as one-man operations. In several instances, some of these same claims were operated by merged interests in the early days and with elaborate machinery; in every case such attempts were failures. Many of the creek claims are essentially for one-man exploitation, consequently future operations on a large scale by merged interests will be watched with great interest. Frozen ground, a short working season, and hostile environment, which all make operating cost high when the gravel is mined by heavily capitalized merged interests, are in much less degree an obstacle to the small operator using cheap devices that possess great mobility; especially is this true under the hostile conditions of the Northern climate.

It is said that the large water system, now being installed, will be completed in 1909. Then the work of the large corporation now preparing will be conducted on a large scale.

Mining in Australasia in 1907

BY F. S. MANCE*

Anything approaching a reliable forecast of the position of the mineral industry of Australasia during 1907 has been rendered extremely difficult by reason of the fluctuation in the price of the industrial metals during the closing months of the year. With the exception of gold, the output contributed by the mines of Australia and New Zealand during 1906 constituted a record, and the value of the mineral production has been estimated as follows:

MINERAL PRODUCTION, 1906.

Gold.....	£16,929,878
Silver and lead.....	3,674,651
Copper.....	3,435,005
Tin.....	1,569,488
Coal.....	3,610,314
Other minerals.....	1,444,372
Total.....	£30,603,708

*Department of Mines, Sydney, New South Wales.

During the first nine months of the year 1907, mining for the industrial metals was carried out with the greatest energy and persistency. That operations were successful may be judged from the fact that the value of the minerals, other than gold, won in the States of New South Wales and Queensland during this period exceeded that for the same term in 1906 by some £1,519,000. This gain, however, was made in a measure at the expense of the gold-mining industry, and a decreased production of gold has to be anticipated in all the States.

GOLD

The steady decline in the yield of gold, and which has been characteristic of the operations of the immediate preceding years, still continues, and an estimate, based on the production for the first 10 months of the year 1907, indicates that a decrease of some 350,000 oz. fine may be looked for. The position of the industry in the several States is shown by the following table, which gives gold in fine ounces:

State.....	1906.	1907.
Western Australia.....	1,794,547	1,668,000
Victoria.....	772,290	686,250
Queensland.....	544,636	470,900
New South Wales.....	253,987	222,000
Tasmania.....	60,023	66,500
South Australia and Northern Territory.....	25,592	26,000
Total commonwealth.....	3,351,075	3,139,650
New Zealand.....	534,616	495,750
Total ounces.....	3,985,691	3,635,400
Total value.....	\$82,384,233	\$75,143,718

The yield contributed by Western Australia is an evidence of the magnitude of operations in that State. However, the consistent drop in the average value of the ore won, the consequent decrease in the profits earned, and the fact that no new mines of importance are being opened up, are matters of great portent when the future of the industry comes to be regarded. In the Eastern States the year has been devoid of any really important results. The activity in the other branches of the industry has thinned the ranks of the gold miners, while investors have been tardy in furnishing the capital essential to the continuance of operations. Prospecting has been comparatively neglected, and, as in Western Australia, the lower grade of the orebodies now being worked in the established mines means that the margin between profit and loss is being gradually lessened. Unless, with the decline in the value of the industrial metals, renewed attention is given to the gold-mining industry, the outlook is anything but hopeful. It may be mentioned that dredging operations have been attended with considerable success, and this branch of the industry is an important factor in the gold production. The gold exported from the Commonwealth during 1907 was considerably below that for the previous years, and the returns up to November show that during 1907 the value

amounted to but £8,039,478 as compared with £14,293,235 in 1906.

SILVER

The Broken Hill field has been the scene of unprecedented activity, and the results achieved are possibly the most gratifying in its history. Some idea may be formed of the progress made, when it is stated that the value of the minerals exported during 1905 was £1,977,198, while that for 1906 was £2,187,930, and for the first nine months of 1907, £2,309,347. The total for 1907 will therefore show a marked increase on the production of the preceding years. Developments at a depth have disclosed the fact that the ore-bodies continue in great size; and not only are the metallic contents fully maintained, but in several of the mines they show a substantial improvement. As evidencing the possibilities of this field, it may be mentioned that the lode at the 970-ft. level in the South mine has been proved for a length of 1000 ft., and has an average width of 117 ft., the ore assaying silver, 7.5 oz.; lead, 13 per cent., and zinc, 11.8 per cent. All the mines are in the happy position of being able to report additions to their ore reserves, and this notwithstanding the heavy output maintained during the year. It is becoming more noticeable, however, that with depth the ore is increasing in density, so that the difficulty and the cost of treatment is enhanced. The production of the Broken Hill Proprietary Company during the last financial year was: Silver, 5,108,866 oz. fine, and lead, 60,522 tons. The net profit earned during this period was £622,500. The extent of the operations of the other companies is illustrated by the weekly mill returns, and the following statement has been compiled from the most recent weekly output:

BROKEN HILL STATISTICS.

Mine.	Crude Ore Treated, Tons.	ASSAY VALUE.			Concentrate Produced, Tons.	ASSAY VALUE.		
		Lead, Per Cent.	Silver, Ounces.	Zinc, Per Cent.		Lead, Per Cent.	Silver, Ounces.	Zinc, Per Cent.
South.....	4,392	15	6	13	704	71	21	6
Junction North...	1,905	14	10	10	271	60	29	6
North.....	2,380	16	6	16	400	70	18	6
Central.....	3,898	..	..	..	706	53	30	11
Block 14.....	1,679	12	9	10	206	61	28	6
South Blocks.....	1,850	16	3	10	325	62	9	7
British.....	2,703	16	9	16	468	61	26	9
Junction.....	1,404	11	9	7	158	57	29	3
Block 10.....	2,959	15	14	20	503	60	31	10

The one blot on the record of the Broken Hill field during the year was occasioned by the failure of the Zinc Corporation to secure the results from the treatment of the zinciferous tailing that had been anticipated. The corporation has now abandoned the processes originally tried and adopted the Elmore, a plant of eight units having been erected. The Broken Hill Proprietary Company came to a settlement of the dispute with the Potter company respecting the patent rights in connection with the use of the

acid process. The company's plant was improved, and a concentrate averaging 42.5 per cent. zinc is now stated to be produced. Altogether 238,000 tons of tailings were treated last financial year and produced 57,500 tons of zinc concentrate, while a total of 326,230 tons of concentrate was sold for forward delivery up to the end of 1909, containing approximately 130,492 tons of zinc. The plant which has been erected at the company's works at Port Pirie for the production of spelter has not yet been brought into successful operation. Other companies on this field produced a considerable quantity of zinc concentrates, and the Sulphide Corporation at Cockle Creek has furnished a limited output of spelter.

The Yerranderie field (N. S. W.) continues to open up well, and a good tonnage of silver-lead ore has been disposed of to the customs smelting works.

The Chillagoe company, Queensland, dealt with ore in some quantity from the

past, so that the great drop in value came as a complete check to operations.

During the year ending Sept. 30, 1907, the Mount Lyell Company, Tasmania, produced 7886 tons of copper, 19,449 oz. of gold and 700,087 oz. of silver, and paid £405,000 in dividends, which brings up the aggregate total of the bonuses and dividends paid to £1,896,574. The quantity of ore treated amounted to 406,000 tons, and the average cost of mining and treatment was \$3.58 per ton. The developments at the North Mount Lyell mine are reported as being of a particularly satisfactory nature, and the directors state that both in quantity and quality the ore reserves never appeared to better advantage than at the end of the financial year. When the low working costs are considered, this company appears to be in a very stable position. The operations of this company during the past three years are summarized in the following statement:

MT. LYELL STATISTICS.

Year Ending September.	Ore Treated, Tons.	METAL PRODUCED.			Dividends Paid, £.
		Copper, Tons.	Gold, Ounces.	Silver, Ounces.	
1905.....	412,273	8,203	24,290	739,691	150,000
1906.....	394,752	9,009	23,088	703,945	270,000
1907.....	406,397	7,886	19,449	700,087	405,000
Total.....	1,213,422	25,098	66,827	2,143,723	825,000

Mungana mines, but the output had necessarily to be restricted owing to the inability of the company to treat the sulphide ore; but this, it was expected, would be remedied when the Huntington-Herberlein plant which has been installed is in full swing.

In Tasmania, the returns from the Zeehan field show a decided increase on the output for 1906, and the capabilities of

The Wallaroo & Moonta Smelting Company, of South Australia, contributed an output of over 9500 tons of copper for the year 1907. The opportunity was seized during the period the metal market was favorable to push forward development work and to open up new ground so that the ore reserves have been materially increased. The success of future operations with a low metal market ruling is somewhat doubtful, as the cost of production is undoubtedly high. In fact, the statement of accounts for the year 1906 showed that the cost of producing each ton of copper was over £70; but then allowance has to be made for the exceptional expenditure on account of the underground fire, and in the work of development. The following table sets out the production by the Wallaroo & Moonta mines during the last three financial years:

Year Ending June.	Ore Raised, Tons.	Ore Treated, Tons.	Copper Produced, Tons.	Value.
1905.....	146,424	92,091	4,561	£291,300
1906.....	164,667	157,157	4,402	275,390
1907.....	224,441	211,748	6,016	587,289
Total..	535,532	460,996	14,979	£1,153,979

The value of the copper, ingots and ore exported from the State of New South Wales during the first nine months of the year was £717,753, which is £132,166 in excess of the same period in 1906. The bulk of the output, as hitherto, was sup-

the mines to maintain a steady production has been amply demonstrated.

COPPER

The copper-mining industry in Australia has experienced the effects of the abnormal fluctuations in the price of the metal. The favorable price ruling during the early months of the year gave a marked stimulus to operations and capital was freely embarked in the development of new mines and the opening of those which had been dormant for some time

plied by the mines on the Cobar field, and the contribution from this field for the year was in excess of 6000 tons of copper. The Great Cobar, Ltd., persisted in the policy of making extensive additions and improvements to the plant, so that the conditions favored a substantial increase on the output for 1906, which was 4030 tons of copper. The average value of the ore treated, as disclosed by the last four weekly returns, is 2.37 per cent. copper, and 1 dwt. 10 grains gold and 7 dwt. 8 grains silver per ton. A mine of considerable promise is being developed at Cangaj in the Grafton district. Work at the Lloyd mine, Burruga, was somewhat intermittent, but at the end of the year a determined effort was being made to make up the leeway. In other centers the year's operations conclusively proved that there are in this State numerous cupriferous lodes which are capable of yielding in the aggregate a large output.

The possibilities of the copper-mining industry in the State of Queensland, and its great expansion are demonstrated by the fact that the value of the copper produced during the first nine months of 1907 was £905,341 as compared with £600,844 for the same period in 1906, or an increase of over 50 per cent. The chief contributor was the Mount Morgan Company, and the average monthly output of copper was 400 tons. The importance which now attaches to this mine as a producer of copper is disclosed by the following comparative statement of the output during the first nine months of the years 1906 and 1907:

Nine Months.	PRODUCTION.		Value.	Dividends Paid.
	Gold, Ounces.	Copper, Tons.		
1906.....	99,403	1,689	£549,094	£112,500
1907.....	111,079	3,522	787,028	175,000

Another important center of production is that embracing the group of mines at Mount Perry, the yield from which for the first nine months of 1907 amounted to 1509 tons of copper. The Chillagoe company reaped the advantage of the additions and modifications made to the plant, and a considerable increase is shown in the production, both from the company's own mines and from purchased ores. This company is rapidly pushing on with the construction of the Etheridge Railway, and the completion of this line should result in the opening up of a tract of mineral country of great promise. Two mines which have been important producers are the Mount Molloy, and O. K., but the fall in the price of copper compelled the suspension of smelting operations.

The remoteness of many of the fields, and the fact that there is no railway communication with the seaboard are insuperable drawbacks to the successful exploitation of the proved mineral resources of this State, and the unfavorable condition

of the metal markets means the indefinite postponement of their development.

During the year a company was formed to undertake the electrolytic refining of blister copper and copper smelting generally. The site chosen for the works is at Port Kembla, N. S. W.; the Mount Morgan, and several other companies have joined interests with this new company.

TIN

The production of the tin mines compares favorably with that for the year 1906. The largest output has been drawn from the mines in the State of Queensland, and the returns for the first nine months of 1907 place the value of the yield at £412,794 as compared with £341,160 for the same period in 1906. Mining for lode tin is chiefly followed within a defined area of some thousand square miles within the Walsh & Tinaroo mineral field. The Vulcan mine at Irvinebank continues to be the largest individual producer, and promises to maintain this position. The main shaft has been carried down to 1200 ft., and at the 1050-ft. level an extensive body of fair-grade ore has been opened up. The Stannary Hills and Tramway Company treated an increased quantity of ore at its mill, the most important contributor being the Arbouin mine. Work at the other mines in this locality was prosecuted with considerable vigor, and the ore reserves largely augmented. The Smith's Creek mine has also to be mentioned as furnishing a large yield. Alluvial tin mining was attended with satisfactory results and the dredges operating at Stanthorpe, near the border of New South Wales, continue to give good returns.

The mines of Tasmania have long been noted for their satisfactory yields and the statistics for the first nine months of the year show an output of 3050 tons of tin-oxide, as compared with 3190 tons for the same period in 1906, indicating that the industry is fairly holding its own. The Briseis company continued sluicing operations with highly remunerative results, and the output for the year was in excess of 1000 tons of stream tin. The yield from the New Brothers Home mine was also satisfactory, but indications were recently found of an unexpected contraction in the lead, so that the estimates as to the material available may have to be reduced. The prospects of the Mount Bischoff mine are somewhat brighter than at the close of last year. The latest estimate of the quantity of crushing material in sight is 1,000,000 tons, and it has been found possible to maintain an output of 60 tons of tin-oxide monthly. The average grade of the ore obtained from the whole mine during the half-year ending June was 0.654 per cent, and the cost of mining, crushing, and dressing each ton of crude ore was \$1.232. The value of the tin exported from New South Wales

during the first nine months of the year was £467,187, which is an increase of £150,839 on the same period in 1906. The chief producing center is Tingha, where there are 23 dredges in active operation, and a conservative estimate fixes the total output of these plants for the year at 1350 tons of tin ore, valued at £160,000. Dredging for tin on an extensive scale was also carried on in the Emmaville and Wilson's Downfall districts. It is surprising what a large yield continues to be obtained from the alluvial areas by small parties of miners, especially when it is considered that comparatively few fresh deposits have been opened up, and that their operations are mostly confined to previously worked ground. Increased attention has been devoted to the development of the deposits of the West Arm and Bynoe Harbor tinfields, Northern Territory, and an augmented output has resulted, the chief supplies being drawn from the claims worked by Chinese.

OTHER METALS

The mining for wolfram and antimony has been more or less actively followed according to the fluctuations in prices of the metals. The chief supplies of wolfram have been drawn from the Herberton and Hodgkinson fields in Queensland, and the available statistics place the value of the output for the first nine months of 1907 at £77,754. The mines at Tarrington, N. S. W., have also furnished an encouraging yield. Antimony mining held out the promise of attaining considerable proportions in the Hillgrove district, N. S. W., but operations were virtually suspended during the second half of the year when the price dropped. In the Hillgrove district a considerable quantity of scheelite is also mined, and the value of the output for the nine months ending September, 1907, is estimated at £22,600. During the year iron smelting operations were successfully started at Lithgow, N. S. W., by Wm. Sandford, Ltd., and iron and steel of excellent quality is being turned out.

COAL

The output of coal from New South Wales for the year 1906 was 7,626,000 tons, valued at £2,337,000, and exceeded that of all previous years. The trade during 1907 showed a still further improvement, the chief expansion taking place in the exports. In the first nine months of 1907 a total of 2,402,000 tons, valued at £1,184,000, was shipped to places outside Australia, chiefly to the west coast of America. This is an increase of 407,000 tons and £309,000 in value on the same period in 1906. An increasing proportion of the coal supplies is drawn from the Northern district, and is derived from the Greta seam worked between Cessnock and Maitland, where it has an average thickness of some 12 ft. Professor

T. W. E. David, in his recently issued memoir, estimates that this seam contains 1,893,000,000 tons of workable coal.

A complete paralysis of trade in the Northern district was threatened at one time, as the miners came out in a body early in November, and operations were at a standstill for about a fortnight. The principal reason for this action was that the miners asked for the declared selling price of coal to be increased from 10s. to 12s. a ton, which would mean an increase of 8d. per ton in the hewing rate. The proprietors decided to advance the rate to only 11s. per ton, and the men being dissatisfied with the corresponding advance of 4d. in the hewing rate, and other minor matters, came out on strike. Owing to the intervention of the Premier of the State, the parties came to an agreement to submit all matters in dispute to arbitration, and work has been resumed under what is practically an armistice. The activity in metalliferous mining has favorably influenced the output of coke, and the ovens have been kept fully employed.

OIL SHALE

The Commonwealth Oil and Shale Corporation, Ltd., has completed the construction of the railway for a distance of some 32 miles, connecting the oil-shale deposits in the Capertee and Wolgan valleys, New South Wales, with the State railway system. The shale has been opened up by a tunnel on the Wolgan seam over a length of 2000 ft., and has a thickness of from 1 ft. 6 in. to 2 ft. In the Capertee valley, three miles distant, the seam has been proved by a tunnel for over 4000 ft. in length, and averages over 4 ft. in thickness. The Wolgan seam will yield an average of 110 gal. crude oil per ton, and a thickness of 3 ft. of the Capertee seam will give over 120 gal. oil. The corporation is also opening up a coal seam which will make an excellent coke. The interests of the New South Wales Shale and Oil Company, and the retorting works at Torbane have also been acquired. Altogether the corporation has spent some £250,000 on present undertakings.

British Columbia

By E. JACOBS*

While returns of the mineral production of British Columbia for the year 1907 are so incomplete as to make it very probable the figures given below as to production will be subject to changes after the official returns shall have been received, it is believed that the final results will not be materially different. The chief factor of uncertainty is in connection with the out-

*Editor, *British Columbia Mining Record*.

put of a number of small mines producing high-grade ore, and as well in some measure the probability that the larger copper mines during the period of high-priced copper sent to the smelters a sufficient tonnage of ore of lower than the average grade of other years to alter the proportion of metal contents of their output to an extent that will not be known until after their respective official returns shall have been received by the Provincial Bureau of Mines.

The figures showing the production of coal and coke may be regarded as approximately correct, for they are based upon information supplied by the three large coal companies operating in the Province, outside of whose production shipments have been so small as not to affect greatly the totals given.

As to the production of individual districts, it appears as if West Kootenay and the Boundary have each produced minerals to the value of about \$7,000,000, with the coast section well up toward a similar total, and East Kootenay rather more than \$5,000,000. The Boundary would have led all the districts had it not been for the general suspension of copper mining, its chief industry, and smelting in November and December, as a consequence of the fall in the price of copper.

Following the method of calculation used by the Provincial Bureau of Mines, the average prices for the year of silver, lead and electrolytic copper in the New York metal market have been used as a basis, less deductions of 5 per cent. off silver and 10 per cent. off lead. The several prices used are as follows: gold, placer, \$20 per oz.; gold, lode, \$20.67 per oz.; silver, 63c. per oz.; lead, 5c. per lb.; copper, 20c. per lb.; coal, \$3.50 per ton, an advance of 50c. on the price used in calculations in previous years, local market conditions warranting this; and coke at \$5 per ton.

The estimated value of the production, with the changes as compared with 1906, are shown in the following table:

	1907.	Changes.
Gold, placer.....	\$ 700,000	D. \$ 248,400
Gold, lode.....	3,885,920	D. 744,719
Total gold.....	\$ 4,585,920	D. \$ 993,119
Silver.....	1,890,000	D. 7,320
Lead.....	2,250,000	D. 417,578
Copper.....	7,800,000	D. 488,565
Total metalliferous.....	\$16,525,920	D. \$1,906,582
Coal.....	\$ 6,475,000	I. \$1,923,091
Coke.....	1,135,000	I. 138,865
Building materials, etc.....	1,200,000	I. 200,000
Total non-metalliferous.....	\$ 8,810,000	I. \$2,261,956
Total production.....	\$25,335,920	I. \$ 355,374

The following comparative table shows the quantities of metals and minerals produced in 1906 and, approximately, those in 1907:

	1906.	1907.	Changes.
Gold, placer, oz....	47,420	35,000	D. 12,420
Gold, lode, oz.....	224,027	188,000	D. 36,027
Total gold.....	271,447	223,000	D. 48,447
Silver, oz.....	2,990,262	3,000,000	I. 9,738
Lead, lb.....	52,408,217	45,000,000	D. 7,408,217
Copper, lb.....	42,990,408	39,000,000	D. 3,990,408
Coal, long tons....	1,517,303	1,850,000	I. 332,697
Coke, long tons....	199,227	227,000	I. 27,773

GOLD

The production of placer gold shows a smaller total than for any other year since 1898. It is distinctly disappointing, since a substantial increase over last year's total was looked for. The snowfall last winter appeared to promise ample water for hydraulicking purposes, and the operations of the Guggenheim companies in both the Cariboo and Atlin districts were expected to result in larger production, but neither of these expectations was realized. The decrease in production was general throughout the placer gold mining districts of the Province; the larger losses having been Cariboo about \$150,000 and the Cassiar—chiefly Atlin—about \$100,000.

In lode gold the more important decreases were in the Boundary district—about \$500,000—and in West Kootenay—about \$250,000. As in other years, much of the lode gold was recovered from ores yielding also silver and copper. The larger gold-quartz mines of the Province did not contribute more than about 10 per cent. of the total production. The Ymir mine made a poor showing as compared with its production of several years ago. The returns of the Nickel Plate mine in the lower Similkameen have not yet been received, but it is reported not to have made any increase over last year's production of about \$400,000.

SILVER

The three chief silver-producing districts for the year have been West Kootenay, East Kootenay, and Sloean, and they stand in that order as regards relative quantities produced. West Kootenay's proportion was about 1,350,000 oz.; East Kootenay's 950,000 oz.; Boundary something like 600,000 oz., and the Coast about 80,000 oz. It will be noted that silver was the only one of the metalliferous minerals that showed an estimated increase in quantity—a small gain of about 10,000 oz.—but the value of the year's production having been calculated at 3c. an oz. less than in 1906, a decrease of \$7320 appears in the table of value. It is gratifying to find the Sloean district showing an appreciably large increase, estimated at between 400,000 and 500,000 oz. Nearly half of this came from the Whitewater mine, while the Hewitt, Vancouver group, Rambler-Cariboo, Standard and Arlington each contributed to the increased production from this district. The St. Eugene, in East Kootenay, produced between 600,000 and 700,000 oz. and the Sullivan, in the same district, between 200,000 and 300,000 ounces.

LEAD

East Kootenay's production of lead was about 38,000,000 lb., while about 6,000,000 lb. came from the Sloean—including 2,700,000 lb. from the Whitewater mine, with the Standard, Vancouver group, Rambler-Cariboo and Hewitt, each with a fair production—and the remainder of the total from the La Plata mine in Nel-

son mining division and the Silver Cup in the Lardeau—the former by far the larger producer of these two. A temporary closing of the lead smelters at Trail and Nelson, consequent upon labor troubles at the Crow's Nest Pass coal mines, whence comes the coke supply, in a measure interfered with the production of silver and lead ores.

COPPER

As in past years, since the copper mines of the Boundary district settled down to regular production of ore, by far the greater proportion of the copper produced in 1907 came from the mines of that district—nearly 75 per cent. of it. About 14,000 tons of copper is the estimated output of Boundary mines, and this from 1,100,000 tons of ore, these respective figures indicating the general low grade of Boundary copper ores. Rossland and the Coast district each produced nearly 5,000,000 lb., while Nelson's production of this metal is estimated at about 400,000 lb. In the Boundary the mines of the Granby, British Columbia Copper, Dominion Copper, and Consolidated Mining and Smelting companies, were the producers; in Rossland camp the Le Roi, Centre Staf-War Eagle group, and Le Roi No. 2, contributed to the total, the first-named leading with about half the copper production of this camp; on the Coast the Britannia's output was more than 50 per cent. of the total, with the Outsiders group on Portland canal, the Marble Bay on Texada island, the Tye and Richard III at Mt. Sicker, Vancouver island, and the Ikeda on one of the Queen Charlotte islands, together making up the bulk of the other half. The Queen Victoria in Nelson division was a new producer, as were also the Richard III, Lenora and Ikeda on the coast.

ZINC

No progress was made toward establishing the mining of zinc ore on a satisfactory basis in British Columbia. The production of zinc was restricted to concentrates made in treating ores from Slo-can mines containing also lead and silver. No figures are yet available as to the quantity of zinc ore shipped to the United States during the year, but there could not have been more than a few thousand tons, most of the zinc concentrates being still on hand where made. The zinc smelter at Frank, Alberta, was not in operation in 1907. The only alternative to storing most of the zinc product has been its shipment to the United States. This is not satisfactory so long as a customs duty is payable on it. During the last month of the year it was reported that arrangements had been made for the shipment of 900 tons to Antwerp, Belgium, from the Vancouver group mine, Slocarl.

COAL AND COKE

The production of coal in 1907 was the largest in the history of coal mining in the Province. The total increase of 333,000 tons, which brought the year's total up to 1,250,000 tons, was shared between the three producing coal companies, the Wellington Colliery Company and Western Fuel Company, on Vancouver island, and the Crow's Nest Pass Coal Company, in southeast Kootenay. Labor troubles in the Crow's Nest Pass district, in both British Columbia and Alberta, seriously interfered with the production of the local collieries. Nevertheless the Crow's Nest Pass Coal Company made a fairly good showing, having made a gross output at its Coal Creek and Michel mines of 877,000 long tons, of which 327,000 tons were used in making coke. The company's net increase over 1906 was about 134,000 tons.

On Vancouver island both companies made increases, the Wellington Colliery Company of about 70,000 tons, with a gross production of 825,000 tons and net 795,000 tons, and the Western Fuel Company of some 125,000 tons with an output of about 500,000 tons.

The Nicola Coal and Coke Company commenced producing on a small scale, taking out coal in opening its mine in Nicola valley, but its total production was probably some 10,000 or 11,000 tons.

New coal properties are being prospected on Vancouver island, in the Nicola valley district, in the Similkameen district, and in the upper Elk river section of the Crow's Nest Pass country. At Hosmer, Crow's Nest Pass, the Pacific Coal Company, a Canadian Pacific organization, is preparing to mine coal extensively, and plant and mine openings will be equal to a large output by the end of 1908.

Coke exhibits an increase over the production of 1906. The Crow's Nest Pass Company put out 210,000 tons, which was a gain of about 20,500 tons, and the Wellington Colliery Company, with an output of 17,000 tons, was rather more than 7000 tons ahead of its 1906 production. The total output of coke was unfavorably affected by the closing of the Boundary smelters during November and December, as well as by labor difficulties in the early part of the year.

BUILDING MATERIALS, ETC.

Activity in building operations in the larger cities of the Province had the effect of increasing the production of building materials—stone, brick and lime. There was, too, an increase in the quantity of portland cement used, the Vancouver Portland Cement Company's works near Victoria, Vancouver island, having been enlarged and its output of cement increased. The export of building stone to several Pacific coast cities of the United States exhibits a larger demand in that direction for the several varieties of ex-

cellent building stone occurring on the British Columbia coast.

PROGRESS AND PROSPECTS

Concerning the chief developments of the year and the prospects of the mining industry of the Province for 1908, the following comments are made:

Cariboo—The announced decision of the Guggenheims' companies not to proceed further with construction of their water supply system, which was undertaken with the object of bringing in a greatly increased supply of water for washing the enormous gold-gravel beds in Quesnel division on which J. B. Hobson had been working about 10 years, has caused general disappointment throughout the district. The Guggenheims' engineers are stated to have reported unfavorably regarding average gold values obtained when testing the gravel, so expenditure on construction has been stopped. Total gold recovery from this property from 1897 to date is \$1,062,700. In the Cariboo division—the district includes three divisions, Cariboo, Quesnel and Omineca—hydraulic mining continues to give fairly satisfactory results on the whole, but deep-drifting has not yet proved successful. Ordinary placer-mining operations in Omineca were unimportant.

Cassiar—Atlin, Liard and Skeena are in this district. In the Atlin gold dredging has been abandoned; placer mining by individuals has steadily decreased; hydraulic mining by the larger companies in 1907 resulted in a smaller recovery of gold than in 1906. In Liard division, the Berry Creek Mining Company's results from hydraulic mining on Thibert creek were much below expectations, slides of top dirt into the pits having prevented gravel washing during part of last season. In Skeena division, a few thousand tons of ore were shipped to the smelter at Hadley, southeast Alaska, from the Outsiders' group, on Portland canal, and developments on two or three other properties are promising. Inland in this division, further prospecting was done in Telkwa, Bulkley and Babine sections, but no production will be practicable, neither of coal nor metalliferous minerals, until after the Grand Trunk Pacific railway shall have been constructed. Many prospectors have been attracted to the Queen Charlotte islands, also in Skeena division, a Japanese company having opened up a large deposit of ore at Ikeda bay and shipped thence to the Tye Copper Company's smelter at Ladysmith, about 700 tons having a comparatively high value in copper and gold.

East Kootenay—From the St. Eugene and Sullivan group mines came the greater part of the lead production of the Province for the year, also a proportion of the silver. The Crow's Nest Pass Company's mines contributed about 550,000 tons of coal beside 330,000 tons made into 210,000 tons of coke. This company has made financial arrangements for facilities to considerably increase its output of coal

and coke, for which markets are available. The Pacific Coal Company made much progress with the opening up and equipment of its colliery near Hosmer, also in the Crow's Nest Pass. Several coal properties in the Upper Elk river district were prospected and preliminary surveys were made of routes for proposed railways to provide transportation facilities. Placer gold-mining operations in East Kootenay were again small. The installation of an Elmore vacuum oil concentration plant at the Giant mine, North-east Kootenay, is in hand.

West Kootenay—Ainsworth camp had several mines at work; some 1100 tons of silver-lead ore were shipped and important development work was done. At the Blue Bell, across Kootenay lake from Ainsworth, development was discontinued last summer pending completion of the 200-ton concentrating mill in course of erection, sufficient ore having been made accessible to run the mill for about five years. On the south fork of Kaslo creek mining was continued and a concentrator was operated.

In the Slocan—at Whitewater—there was milled a lot of ore from which silver, lead and zinc concentrate were produced. The Rambler-Cariboo resumed production, after completion of the most extensive development work yet done in the district, and the outlook is now favorable for good results. No information has yet been received relative to progress at mines around Sandon. Another stage has been reached in the Slocan Star extra-lateral rights litigation, the full court having reversed the previous supreme court decision, the latest judgment being against the Byron N. White Company, defendants, but an appeal is to be taken to the Supreme Court of Canada. Around Silverton, the Hewitt, Vancouver group, and Standard each made good progress both in development and production. In Slocan City division several mines were active, notably the Arlington and Ottawa, while a new property—the Westmont—gives much promise.

Of the mines in Nelson division La Plata made the best record, its output of silver and lead having been appreciably large. The Silver King (copper-silver) and Queen Victoria (copper) were both shippers in quantity. Of the gold-quartz mines, the Poorman near Nelson, and the Arlington, Queen, Second Relief and Kootenay Belle, in the Erie-Balmo section, were all producers, but the Ymir was again disappointing. The Hunter V. sent out a considerable tonnage of silver-bearing lime ore.

Rosslund mines made a production about equal to that of 1906—something like 280,000 tons, practically all from the Le Roi, Centre Star-War Eagle group, and Le Roi No. 2. Substantial improvements and additions to the machinery and plant of the Centre Star-War Eagle mines were made by the Consolidated Mining and Smelting Company of Canada. There

was no interruption to operations in this camp, the miners having voluntarily accepted lower wages after the slump in copper prices.

In Revelstoke and Lardeau sections mining was not active. The largest producers were the Eva (gold) at Camborne and Silver Cup (silver-lead) in Ferguson camp. The Broadview, near Ferguson, was extensively developed, but did not ship any ore. The Silver Dollar, near Camborne, completed a small stamp mill and commenced crushing ore. Placer mining for gold was continued in the Big Bend country north of Revelstoke, but the total recovery there was not large.

Lillooet—Little worth noting was done in this district. Placer gold mining by individual miners has dwindled to small proportions, and dredge mining has been discontinued owing to the unsuitability of the dredges used for the work of dredging in the Fraser river.

Boundary—Published figures give a production of about 1,157,000 tons of ore, contributed in the following approximate proportions: Granby Company's mines, 629,000 tons; British Columbia Copper, 234,000 tons; Dominion Copper mines, 158,000 tons; Consolidated Mining and Smelting Company's Snowshoe mine, 136,000 tons. There was scarcely any production in November and December, the mines having been closed on account of the low price of copper and high cost of labor and materials. Although not assigned as one of the reasons for the suspension of work, there is little doubt the general inefficiency and unreasonableness of many of the employees was another factor taken into account when the big companies decided to suspend operations for a time. Developments at the several larger mines show that there continues to be an abundance of ore available, consequently preparations for still greater production were either in progress or authorized when the shut-down was decided upon. The small high-grade mines of the district have not been up to promise of earlier years. Work has been stopped for the winter in Franklin camp, on the north fork of Kettle river, where large bodies of ore have been located. Up the west fork of Kettle river small shipments of high-grade silver-gold ore were made but production will remain small until after railway transportation shall have been provided. At Camp McKinney, the old Cariboo-McKinney gold quartz mine was reopened but was not worked for many weeks.

Yale—The Stenwinder mine at Fairview, Okanagan, late in the year was reported to have made an important strike of gold-quartz ore at its 500-ft. level. In Hedley camp, lower Similkameen, operations were continued at the Nickel Plate gold mine, but no particulars of results have been received. In 1906 its production was about 35,000 tons of ore running about \$12 per ton.

Other Similkameen operations were as

follows: At Princeton the development of the coal measures of the Vermilion Forks Company was continued and a small production of coal made. No noteworthy progress was made on Copper Mountain claims. On Bear creek in the Tulameen section, developments were encouraging at both the group of claims under development by a Vancouver (B. C.) company, and those under bond to the Granby interests. Some interest was shown in the old placer gold creeks of the district, and there was talk of fresh efforts to produce platinum.

In the Nicola valley coal mining made a gratifying advance. At the Vancouver Coal and Coke Company's property two seams were opened, a plant installed, railway connection established, and the shipment of coal commenced. The Diamond Vale Company also made progress with the development of its property and installation of a plant.

Little calling for notice occurred in the several other interior divisions—Yale, Ashcroft, Kamloops and Vernon.

Coast—At the Britannia Copper Syndicate's Britannia mine on Howe sound much development and diamond drill work was done, with generally encouraging results. The mine camp was remodelled; a sawmill put in; a new 25-drill air compressor installed, driven by a Pelton water wheel and supplying the mine with compressed air through 18,000 ft. of 8-in. pipe; and the concentrating mill rearranged, the milling practice having been changed from a fine- to a coarse-crushing plant with a gradual reduction on intermediate jiggling operations on sized products.

Off the mainland the principal work was done at Mt. Sicker, Vancouver island, where the Tye mine continued work all the year, shipping its ore to Ladysmith. The Lenora, in the same camp, was reopened after having been unworked for several years and shipped ore to Ladysmith until the low price of copper considerably reduced profits, when shipping ceased for the time. The Richard III, adjoining the Tye, shipped between 3000 and 4000 tons of ore, also to Ladysmith. Claims were worked at Koksilah mountain, Sooke, and Bowen and Valdez islands, and from all these places more or less ore was sent to the Tye Copper Company's smelter for treatment. On the west coast of Vancouver island, the Indian Chief group at Sidney inlet was extensively prospected by a Seattle, Wash., company with very encouraging results in quantity of ore of good grade uncovered; while at Quatsino sound, the June group had the attention of some Pittsburg men, who are putting in half a dozen miles of railway between the property and tide water.

SUMMARY

General—Progress on the whole was substantial, though the serious decline in the price of copper arrested it in some districts toward the close of the year.

Eight mining companies declared dividends aggregating about \$2,500,000. Other companies and partnerships also made substantial profits, but amounts were not published. There was a decided revival of mining in Ainsworth and Slo-can districts, with numerous small mines either already shipping silver and lead ores or preparing to do so. The year's loss as compared with 1906 of nearly \$2,000,000 in value of metalliferous mineral production was more than compensated for in the increase in coal and coke. The prospects for the latter are decidedly favorable, with a very active demand, and new properties being opened on Vancouver island, in Nicola valley, and in the Crow's Nest Pass district. While both zinc and iron have remained practically unproductive, efforts are being made to utilize these mineral resources. A plant is being established at Nelson for the electric reduction of zinc ores, but its commercial success remains to be demonstrated. Under instructions from the Dominion department of mines Einar Lindeman, a Swedish iron expert, spent six months examining iron-ore occurrences on Vancouver and Texada islands. Of many showings visited he pronounces four promising—three on Vancouver island and one on Texada. Quality of ore is considered satisfactory, but extent remains to be proved. Mr. Lindeman's report will be awaited with much interest on the coast. Extensive building operations in coast cities greatly enlarged the demand for granite, sandstone, brick, and other building materials. Manufacture of portland cement was much larger owing chiefly to municipal requirements.

Ontario

BY THOS. W. GIBSON

The once current aphorism that there are no precious metals east of the Rocky mountains has been abundantly disproved by the Cobalt silver camp. Discovered in 1903, the development of the Cobalt camp has been rapid, the output of silver rising from 206,875 oz. in 1904, to 6,936,453 oz. for the nine months ending Sept. 30, 1907. Up to Dec. 14 the quantity of ore shipped out during 1907 was 13,954 tons, and the total for the 12 months will probably be about 14,500 tons, containing about 9,000,000 oz. silver. The aggregate production of the camp up to the end of 1907 will therefore be about 22,150 tons of ore, containing 17,100,000 oz. silver. Up to the end of 1906 the ore shipments averaged 1055 oz. silver per ton, a very high figure, but the average content fell during 1907 to about 625 oz. per ton. This reduction does not necessarily mean that the richness of the veins at the surface is

*Deputy Minister of Mines, Toronto, Ont.

lessening in depth, although this is probably to some extent the case, but rather that low-grade ores, instead of going to the dump as formerly, are now being sold and shipped. The installation of concentrating plants at a number of the mines will partly counteract this downward tendency and also obviate the necessity of paying freight charges to Denver or Perth Amboy on worthless rock matter.

The cobalt, nickel and arsenic which the ores of Cobalt carry, in addition to the silver, have so far proved of little advantage to the mine owners. The nickel is not an important constituent, but cobalt and arsenic are valuable, and when the refining stage is reached in Ontario these elements will form an important source of revenue. At present nickel and arsenic bring nothing and cobalt is only paid for when in excess of 6 per cent. None of the reduction plants so far projected or begun have yet started operations except that of the Orford Copper Company at Copper Cliff, which has treated since its erection a considerable proportion of the ore produced at Cobalt, particularly of the higher grades. At Deloro, the former seat of the arsenic industry in this province, the Deloro Mining and Reduction Company is at this moment starting its new works, where it intends treating the argentiferous ores of Cobalt as well as the auriferous mispickel of the Hastings district.

The chief producers of cobalt are the Nipissing, Coniagas, O'Brien, La Rose, Buffalo, Kerr Lake, Tretheway, Right of Way, Silver Queen, Drummond, McKinley-Darragh-Savage, Temiskaming & Hudson Bay, Temiscamingue, Foster, Nova Scotia, Townsite, Green-Meehan, Colonial, University and Standard. The Silver Leaf and Red Rock have also shipped some ore, and the Temiskaming, Cobalt and Imperial shipped a carload each of silver-free cobalt ore. The Temiskaming & Northern Ontario railway commission is building a spur line from Cobalt to Kerr Lake by way of the Gillies limit. The Government mine on the latter is being opened up, and shipments of ore will no doubt shortly begin.

The declining price of silver during the latter part of 1907, and the complexity of the ores, led the ore buyers, principally the American Smelting and Refining Company, the Balbach Smelting and Refining Company and the Orford Copper Company, to make their terms of purchase more stringent, and to impose severe penalties for excess of insoluble matter and other deleterious elements. When concentration becomes more general in the camp these difficulties may be eliminated, at least in part.

OTHER DISCOVERIES

In the fall of 1906 finds of ore similar in character to that of the Cobalt region were made on the Montreal river in and near the township of James, and this dis-

trict was pretty well prospected during 1907. The prevailing formation is quartzite with areas of diabase. In the latter a considerable number of veins have been located, some of them rich in silver, but as little sinking has yet been done, the value of the district is unproved. It is quite probable, however, that some payable mines may yet be opened up.

There was also some revival of activity in the silver region west of Port Arthur, where the old West End Silver Mountain and Beaver mines have been re-opened.

There was little gold produced in Ontario during 1907, but this metal has been found in several new areas, particularly at Larder lake, Lake Abitibi and Night Hawk lake in the northeastern portions of the province. The first-named district was overrun with prospectors during the fall and winter of 1906, and thousands of claims were staked out and recorded. The majority of these were worthless, but it is quite within the range of possibility that some of the veins or auriferous zones will prove rich enough to be worked with a profit. The principal showings of gold occur in silicified dolomite of Keewatin age where seamed with quartz stringers.

A shaft was sunk on one property at Abitibi to a depth of 75 ft., and good ore was constant to that depth. At Night Hawk little work was done. These several districts are widely separated so that the auriferous area of northeastern Ontario is likely to prove an extensive one.

NICKEL

The nickel mines of the Sudbury region are second only in interest, but scarcely even second in value of output, to the silver mines of Cobalt. The bessemer mattes produced at Copper Cliff and Victoria mines during the first nine months of 1907 contained 8087 tons of nickel and 5000 tons of copper respectively, and the production for the full year is likely to be much the same as that for 1906. The Canadian Copper Company remains the most active and largest producer of these ores, the principal output being from the well-known Creighton mine. The new smelting plant of this company at Copper Cliff is working smoothly and satisfactorily and is a model of convenience and completeness. Steam power is now only auxiliary in operating the mine and plant, electric power being generated at the High Falls of the Spanish river near Turbine station on the Canadian Pacific Railroad. The Mond Nickel Company continues to operate its mines and plant at Victoria Mines, and is developing a new deposit in the township of Garson. This company also contemplates the development of water power on the Vermilion river for the purpose of working its mines and plant. The Canadian Copper Company's mattes are exported to Constable Hook, N. J., for final treatment, and those of the Mond company to Clydach, Wales. From the former, in ad-

dition to nickel and copper, are extracted gold, silver, platinum and palladium.

Extensive deposits of nickel ore have long been known to exist in the Northern range, and now that railway accommodation has been provided in the Hutton branch of the Canadian Northern Railway, the company that has acquired an extensive interest in this region is likely to undertake development at an early date.

IRON ORE

The bulk of the iron ore raised in Ontario still comes from the Helen mine, Michipicoten, but the magnetite deposits of eastern and northern Ontario are coming strongly to the front. At Atikokan, west of Port Arthur, at Moose Mountain, north of Sudbury, at Bessemer, Hastings county, at Wilbur on the Kingston & Pembroke railway, and also at Radnor in Renfrew county, magnetite mines are producing ore freely. All of this ore is being charged into Canadian furnaces except that from Moose Mountain which is being stored at the mine preparatory to bringing it to deep water on Georgian bay for shipment to the United States; or it is being shipped by rail to Toronto, where Mackenzie & Mann, who are part owners of the mine, are proposing to erect blast furnaces on a large scale. There are now seven blast furnaces in Ontario, two additional stacks having been blown in during the year at Port Arthur and Hamilton respectively. The quantity of iron ore raised in Ontario during the first nine months of the year was 141,719 tons.

OTHER MINERALS

Of non-metallic substances, Ontario produces a varied list, including petroleum, natural gas, salt, mica, iron pyrites, graphite, feldspar, corundum and talc.

The petroleum and natural-gas fields both received important additions during the year. Formerly the Corniferous strata of Petrolia and Oil Springs contributed the entire output, but more recently the Onondaga, Guelph and Niagara formations in Tilbury East in Kent county yielded almost as much as the older areas. The adjoining township of Romney was also proved to contain a productive pool in the Corniferous formation, and both townships are yielding considerable quantities of natural gas. The Haldimand and Welland gas fields are also producing freely. The former furnishes gas to several of the cities and towns in southwestern Ontario, and the latter to Buffalo and Canadian points on or near the frontier. The Kent county wells supply the city of Chatham, and will probably send gas also to Windsor.

The iron pyrites resources of Ontario are extensive, deposits occurring in the eastern, northern and northwestern parts of the province. Hastings county, Rib lake, and Helen mine produced during the first nine months of 1907 about 13,218

tons. A sulphuric acid plant has been erected by the Nichols Chemical Company at Sulphide, Hastings county, convenient to local deposits. The contact process is employed.

Mica, corundum and feldspar are all products of eastern Ontario, and are produced in important quantities. The mica is mostly of the amber variety well adapted for electrical work. Grain corundum is turned out by two plants, one in Renfrew and the other in Hastings county. Orthoclase feldspar is quarried in Frontenac county by several concerns which export it to the potteries of East Liverpool, Ohio, and Newark, N. J.

South America

BY JOHN POWER HUTCHINS*

The past year was not a particularly notable one for the mining industry of South America, and this enormous area, almost equal as it is to North America, still lies undeveloped and awaiting exploitation. There are several good reasons for this condition, the principal ones being bad climate, poor transportation and unstable government. Bad transportation and unstable government are largely a result of bad climate. Parts of South America lying in the south temperate zone, and those sections located at such elevation in the tropic zone as to have temperate climates, are in a much more prosperous condition.

South America with the Cordilleras and their numerous ramifications is extremely mountainous. This makes transportation a serious problem, for mule-back freighting of mining machinery is costly and hazardous.

Tropic South America is largely a region of one-man operations. A fair example may be found in the mining operations of Dutch Guiana. Although there have been numerous attempts to exploit the placers and lodes on a large scale, embracing the use of dredges, pumps for straight hydraulicking, hydraulic elevators operated by gravity water, dredging pumps for elevating, and other devices, no success has yet attended these operations. The only operation carried on successfully by a merged interest was one in which no machinery at all was used. This was simply a number of one-man enterprises combined, and the fact that the ground mined was rich had much to do with its success.

PLACER MINING

The past year witnessed no great progress in placer mining. The placers of South America are credited with a total gold product since 1492 of nearly \$2,000,000,000. This large sum is about one-

*Consulting mining engineer, 52 Broadway, New York.

fifth of the total gold production of the world. The total annual gold production of South America is at present only about \$10,000,000, most of which comes from placers worked in a desultory way. Attempts to work on a large scale by hydraulicking or by dredging have generally been unsuccessful. All of the countries of South America which show large totals in gold production lie in the tropic zone, and hence the mining operations carried on there are subject to the effects of a hostile climate. These effects are very serious and they have had much to do with the failures which have been plentiful in mining in South America.

In the case of an interesting operation in tropic South America which failed largely on account of climatic conditions, a dredge operated unsuccessfully in ground containing nearly \$1 per cu.yd. It is true that the dredge was not well designed. The following factors contributed largely to the failure of the operation: The white men in charge were so shaken by malaria that the dredge was shut down partly to save their lives; fuel was difficult to obtain, for many of the trees were too hard or too twisted to be split into cord wood; vegetable matter in the water caused a rapid formation of scale in the boiler; labor was poor and unreliable; transportation was difficult and dredging among big stumps was slow; a considerable amount of gold was lost with the clay so commonly found in tropical alluvium.

There have been about 20 failures in dredging in tropical South America and not one success. Although the bad climate has had considerable to do with these failures, it is also true that a first-class modern dredge has never been operated in this region.

The question suggests itself as to the means by which the gold production of South America has been brought to such a large total during the history of the region. The answer is briefly as follows: In the early days the conquering Spaniards enslaved the natives and forced them to work in the placer mines. The food for these miners was raised and transported to them by other slaves. Labor cost was thus very small and it was possible to work very low-grade material. At present these low-grade placers could be exploited profitably only by hydraulicking or dredging on a large scale. These facts should be kept in mind by those who are considering mining investments in any country that has been exploited by slave labor.

It does not necessarily follow that because a region has a large total gold production that there are numerous opportunities for profitable mining with modern machinery and methods. On the other hand a country like Colombia, which is credited with a total gold production

of nearly \$900,000,000, probably has submerged auriferous ground that could not be worked by any device but the modern gold dredge. Those carrying on investigations of tropic South America at low altitudes should give ample weight to the extremely hostile environments usually found in tropical climates.

There are about 15 dredges in Tierra del Fuego, and of these about half are said to be failures. Conditions are not favorable for work of this kind on the extreme end of South America; the ground is rocky and it is necessary to import coal at a cost of more than \$5 per ton, and work may be prosecuted during about nine months of the year. Dredges operating in Colombia, Dutch Guiana, Ecuador, British Guiana and Brazil have generally not been profitable. This statement seems discouraging; but when it is recalled that most of these dredges would have been failures had they been installed under the so-called ideal conditions at Oroville, owing to faulty design and weak construction, the outlook is not without promise.

DRILL PROSPECTING

The continued search for ground suitable for exploitation by the dredging method resulted in more intensive investigation of the placer deposits of South American countries. Drill prospecting is carried on with particular vigor in Colombia, Dutch Guiana, Peru and Ecuador. A large volume of material which is said to have a maximum thickness of nearly 100 ft. and to carry gold in paying quantity, is located near Zaragoza, in the bed and on the banks of the Nechi, a tributary of the Magdalena river.

The placers of Peru are attracting considerable attention. It is thought that some of the large volumes of auriferous gravel can be exploited successfully by hydraulic mining. These deposits occur at an elevation of from 2000 to 4000 feet.

Some of the placers of Brazil carry both gold and diamonds. A dredge has been installed on the Jequitinhonha river to handle such material. The dredge was originally installed to save the gold in the usual way, and it was planned to deliver the material after its passage over the gold-saving tables to jigs and other diamond-saving devices on the shore by means of a centrifugal pump and an articulated pipe line. These plans have been changed, however, and the diamond-saving devices are now located on the dredge. Operations have not yet begun, though the dredge is about ready to start.

LODE MINING

Lode mining is being carried on in Peru, Colombia, Ecuador, British Guiana, Brazil, Venezuela, Chile, Uruguay, Argentine and Bolivia. Peru is the center of this industry, the chief products from its mines being copper, silver and lead, named

in the order of their importance. The recent drop in the prices of these metals has curtailed production, the cost of which is high, largely because of adverse transport conditions.

Colombia has a few profitable gold mines. The most notable of these is the Frontina Bolivia, near Remedios in the department of Antioquia. This mine was operated for several hundred years by Colombians. It has been worked during the past 50 years under English management with considerable profit.

The only lode mining in Ecuador is in Zaruma. Since the introduction of the cyanide process, about three years ago, operations in this locality are said to have been profitable. Only in the extreme northern and southern parts of Ecuador is any mining done, the intermediate section being covered by lava flows. The eastern slopes of the Andes which constitute the headwaters of the Amazon river are not so obscured and gold is mined from the placers by natives. This region is a vast unexplored wilderness, penetrated only by rubber hunters and traders. It is almost inaccessible and will probably remain unexploited for a long time.

But one lode mine of consequence, the Peters mine, is operated in British Guiana. This property is owned by American capitalists. High-grade ore makes it possible to operate successfully even though cost of mining is, on account of climatic conditions, high.

NITRATE

The nitrate beds located near the boundaries of Peru, Chile and Bolivia were extensively exploited. Recent labor troubles which resulted in a strike of about 8000 laborers, caused a diminution in output. Iodine, a by-product of saltpeter, was produced in Chile to a value of about \$1,500,000.

Mexico

BY A. VAN ZWALUWENBURG

Mining experienced a considerable reduction in activity in Mexico throughout the year, owing in the early months to the abnormally high cost of fuel and supplies and in the later months to the rapid fall in the prices of metals. During the first half of the year the congestion of traffic on the railroads rendered transportation difficulties so serious as to interfere with development and in many cases to cripple production. When later activity in the production of ore began to fall off, supplies began to move more freely, and at the beginning of the new year the railroads are able to handle normal tonnages promptly and without difficulty.

The stringency in the money market began to be felt earlier in Mexico than

in the United States. The prolonged drouth during the months which in normal seasons furnish rains for the growth of crops, transportation difficulties and uncertainty as to the Government's attitude in regard to freight rates on ore, all seemed to intensify the feeling of apprehension and to retard and to check the enormous development of which 1906 gave promise.

The end of the year finds the industry in a state of suspense. In a large proportion of the mines production has been curtailed if not stopped altogether, for at the present prices of copper, silver and lead, many of the large companies, which operate on a small margin at best, are unable to work at a profit. Among the stronger corporations energies are now directed toward improvement of equipment and getting ready for renewed activity when the expected turn in the market brings the normal demand. Several new smelting works are approaching completion; many mines are in condition to hoist a maximum tonnage of ore at short notice, and the return of prices which promise even a narrow margin would promptly stimulate the mineral production of Mexico to an output which has never been reached before.

GOLD

The production of gold experienced the steady growth which statisticians have learned to expect. For years the gold output of Mexico has been obtained chiefly as a by-product in the production of silver, copper and lead. Of late years there have been a greater number of operations carried on primarily for the gold content of the ore than in former years. Among the more notable gold producers were the mines of El Oro district and the Dolores. New discoveries were reported in western Chihuahua, Sonora, Oaxaca and other out of the way districts, but most of them will have to await improved transportation facilities before development on a large scale can be undertaken.

The proportion of gold in the ore which reached the large smelting centers experienced a normal increase, and it is possible that the reopening of the old Penoles mine near Mapimi will in 1908 add materially to the gold production of the country.

SILVER

Silver is still, as it has been for many years, the chief object of mining in Mexico. All the old camps—Pachuca, Guanajuato, Zacatecas, Parral and others—continued to produce freely, except during the last month when the mines dependent upon the custom smelting works for reduction of their ores almost ceased operations. Pachuca and Guanajuato, in which a large proportion of the ore is treated in local mills, suffered no apparent loss of activity, but in December Parral experienced an almost complete shut-down.

There were a number of new mines

which approached or reached the producing stage, during the year, notably several mines in the Taviche district in Oaxaca, and La Republica mine on the Kansas City, Mexico & Orient Railroad in Chihuahua. An increase was noted in the tonnage of silver-bearing ores received at the smelting works at Aguascalientes, but the district about Monterey barely held its own.

All of the silver-producing districts of Mexico will suffer greatly unless prices return promptly to a higher level. A large proportion of the smaller mines are dependent upon the custom smelting works for an outlet for their product, and the smelters were already working on a narrow margin when the slump came. This is especially true of the works at Aguascalientes, and if copper prices continue long at the present level, and also if radical changes in freight rates are put into effect, a serious reduction in the demand for smelting ores may be expected.

COPPER

The year opened with a promise of a considerably increased production of copper which was already second only to that of the United States; but the totals will probably show a marked decrease. Production continued at a high rate in all the great camps until well on toward the close of the year. Copper has become the chief collecting metal at the smelting works throughout the country, and some of the distinctly copper districts such as Cananea, Tepezala and Teziutlan, reached, if they did not exceed, expectations.

The development of new copper deposits proceeded at a great rate in all parts of the country until well past the middle of the year. Enormous bodies were opened in the Cananea district; also at Teziutlan and in the Ocotlan district, Oaxaca. Several of these properties were on the point of hoisting ore when the sag in copper came, and will be ready to begin production on a large scale as soon as a return of prices warrants a resumption of operations.

Other districts in Oaxaca, Jalisco and other states include extremely promising copper deposits, but most of these have not been systematically developed. When the many railroad construction projects now under way reach the operating stage, great areas now almost inaccessible will enjoy cheap supplies, and numerous copper deposits will be available to swell the production for many years to come.

LEAD

There were no new developments in lead mining. Mexico's supplies of lead ores are extremely limited. Although the search for new deposits for smelting with silver ores continued no important new mines were opened. Perhaps the most notable development is the deposit of the Penoles Mining Company which produces about 500 tons a day.

The Sierra Mojada district still ships a

small tonnage but the great days of that region when supplies for three smelting works were drawn from its mines is past.

The new railroad now being built from Gutierrez on the Mexican Central to run west through the State of Durango, will render available the lead ores of Sombrete; but these are sulphide ores valuable for silver rather than for lead. The San Pedro district near San Luis Potosi yielded a somewhat increased tonnage, but the ore is not of high grade and the supply is not large. Other districts in the Monterrey district and in Chihuahua continued to send regular supplies to the smelter, but the production was not sufficient to supply the smelting needs of the country.

It is not, however, to be supposed that lead as a collecting metal in smelting for the precious metals will ever be entirely replaced by copper in Mexico. There will always be a sufficient supply of plumbiferous ores to keep small local plants in operation and also enough to keep a few lead furnaces at the large smelting works in blast.

ZINC

Zinc properties in the Monterrey district and in Chihuahua attracted considerable attention during the year. The ores offered for sale at Monterrey were sufficient to maintain separate agencies of five different smelting companies during the greater part of the year, and shipments out of Chihuahua over the Mexican Central were regular until arrested by the freight congestion in the late summer. The zinc-mining industry was among the first to suffer when the decline of prices began to foreshadow the general contraction of business which was to follow. Conditions for the production of zinc ores are not favorable in Mexico at present, and the industry is likely to flourish only during prosperous times.

IRON

Iron mining presented no important change during the year. The deposits at Durango and the steel works at Monterrey continued to be the chief centers of interest. The iron and steel industry suffers from lack of cheap and suitable fuel. There is no lack of good hematite ores, but so long as the supply of coal and coke is no better, it will be difficult to compete with American products, even in flush times.

The abundance of available water power along both edges of the central plateau gives promise of developing an iron and steel industry, departing somewhat from conventional lines. With abundant ore, cheap electric current and excellent and inexpensive labor, the country seems to offer unusual advantages for the production of special steels by the electro-metallurgical method. Mexico is an excellent market for high-grade tool and drill steels.

COAL

While a number of new mines were opened during the year, still it is impossible to note any marked improvement in the supply of coal which Mexico so sorely needs. There was considerable activity in the State of Coahuila and along the Texas border, but Mexican coal failed to find its way into the interior in anything like sufficient quantities. There were no new discoveries of note, and the fuel problem of the country remains unsolved.

OIL

The most interesting developments in the fuel situation were found in the oil-fields along the gulf coast, which attracted increased attention. At present these fields offer greater promise of early furnishing an adequate fuel supply than the coalfields along the Texas border. The areas extending from Tampico down the coast show the same characteristic and possibilities as those of eastern Texas and Indian Territory, but it will require capital and patience to develop the resources by drilling.

Several companies are already in the field and operations are well under way. This source of fuel promises to revolutionize industrial Mexico, and, together with the development of water power, to remove the disadvantage of an inadequate coal supply.

WATER POWER

Mexico is wonderfully rich in streams which may be utilized for the production of electric energy to be distributed to mining districts. Guanajuato, Pachuca, El Oro, Ezzatlan, Ocotlan and Torreon are all within the radius of easy transmission from power stations on neighboring streams. Chihuahua is situated too completely upon the central plateau to offer much inducement for enterprise of this sort, but practically all the other mining States are potential producers of abundant water power. Many concessions for hydro-electric power production were granted during the year, and several are in process of development. Torreon is to be supplied from an installation on the Nazas river; Guanajuato and El Oro have already drawn power from transmission lines for months; and corporations have been formed to furnish electric current to the mines of Durango, Jalisco and Oaxaca.

This utilization of water power is destined to play an important part in the mining industry of Mexico. Streams descend from the central plateau to the low country along the coast at intervals along the western slope of the Sierra Madre, and at many points on the eastern edge of the table land.

At the close of the year labor was plentiful, the failure of crops having driven many agricultural laborers to the mines.

Coal Mining in the United States in 1907

Reviews of the General Mining Conditions in Many of the Important Centers of Anthracite and Bituminous Production

TOTAL PRODUCTION 468,543,334 TONS

Although at the close of 1907 the coal industry of the United States showed a considerable falling off in activity and output, especially in the bituminous department, however, the year will be known as one of great prosperity. December was the only dull month, and even at the present time of pessimism and gloom, the coal industry remains the bright spot in the business situation.

The demand for the smaller sizes of anthracite is still large, while the general hard-coal trade continues almost normal. The average price of coal at the mines in 1907 will show little change from 1906. Anthracite mining is becoming a business of general uniformity and is hardly affected by the severe fluctuations in other lines. Anthracite is being used almost entirely for domestic purposes, and the demand for it is growing much faster than the production.

The immensity of the bituminous industry is amazing. The production of soft coal has tripled during the last 15 years and within the next two years will probably attain a total of one-half billion tons annually. Pennsylvania, West Virginia and Illinois continue to furnish the greater part of the production, while Pennsylvania alone makes an output nearly equal to that of all the other States combined. Fair and profitable prices for bituminous coal and coke were maintained throughout 1907, but it is probable that some falling off will be experienced early in 1908.

The business depression affected the manufacture of coke more than any other branch of the coal industry. Several new plants were started during 1907, but the close of the year witnessed the complete suspension of coke manufacture at many mines in all parts of the country. In the western States, the coal that would ordinarily have been manufactured into coke for use at the smelters, was thrown upon the market and greatly helped to relieve the scarcity of fuel which would have been acute if business and mining operations had continued at the pace established during 1906.

At present there are about 548 coke manufacturing establishments in the United States, which is an increase of more than 250 since 1900. This shows that there is approximately one coking plant for about every 10 mines. Reports also show that for each active coke operation during 1907 there was on an average, 198 ovens in use.

Coal Mining in the United States in 1907

BY FLOYD W. PARSONS

The coal industry in the United States during 1907 was affected less by the scarcity of money and the recession of industrial activity in the last quarter than any other line of business. The year also was uneventful so far as serious labor troubles are concerned, the only difficulties being of a local nature. The Miners' Federation was, however, active throughout this period of quiet, and many new districts heretofore employing non-union labor were organized and brought into the union fold. This activity confined itself principally to western States, and in many instances, the mines are now not only employing union labor, but have submitted to the adoption of the check-off system which requires that the operating company shall itself deduct from each miner's pay the regular union dues, as well as all fines and similar charges. This check-off system is taken advantage of at many mines in such an undesirable manner that the plan is objectionable from every standpoint, and is sure eventually to cause friction and work further harm.

The scarcity of miners, which was so apparent during the first months of the year has now disappeared, and all coal plants throughout the country have a sufficient labor supply, which condition is sure to continue until the former activity in other lines of business is resumed.

FOREIGN vs. AMERICAN LABOR

The periodical exodus of foreign miners from our shores was greatly augmented by the recent financial panic. So important has this problem of alien labor become that the question is under consideration by the largest coal operators in America. Perhaps the greatest percentage of foreign labor is employed about the coke works in the Pittsburg region, and for this reason the operators in and about Connellsville are attempting to take the initiative in solving this labor problem. One of the plans suggested and largely favored is to do away with alien labor, even though the employment of native or naturalized American labor necessitates an increase in the wage scale. The records of the larger companies seem to show that the employment of this more intelligent labor at a higher cost leads to a larger

profit and does away with the annoyances and losses attendant upon the employment of ignorant foreigners.

The coke region of western Pennsylvania contains 40,667 ovens, of which the Frick company controls 50 per cent. With two men per oven, it is evident that the coke industry alone in this district requires 80,000 employees.

The coke industry in the Connellsville region is more a manufacturing than a mining enterprise, and is attended with large profits. To open about 1500 acres of Connellsville coking coal, the cost for each oven of a modern 800-oven plant will be about \$1100 per oven, which includes sinking the shaft, erecting the houses, etc. Some companies with modern equipment are producing coke for \$1.12 per ton, which insures a profit of not less than \$1.20 per ton, or if we consider that each acre will have a minimum production of 8000 tons of coke, the profit per acre will amount to more than \$9000. Is it any wonder that good Connellsville coking coal land is selling for \$1500 to \$2500 per acre?

CAR SHORTAGE

The cry of inadequate transportation facilities was heard in all parts of America, not only from coal-mining operators, but from shippers in other lines of business. In some aggravated cases the railroads may be to blame, but taking the situation as a whole the transportation companies are doing all in their power to handle the traffic originating on their lines, and where they fail, the manufacturer and the industrial shipper is usually as "hard hit" as the coal operator. Possibly those who know may point to some districts where discrimination is practised; however, the general facts remain that the growth of our country and its industries has been so rapid that railroads have been unable to keep pace with it. If those who are complaining would carefully study the reports of the various roads showing the great increase in tonnage hauled, as well as the additional locomotives and cars that have recently been added to the various lines, they would find the figures most enlightening.

The car situation in the Northwest was principally responsible last winter for the fuel famine which occurred in that territory. General conditions throughout Montana, Wyoming and Utah are not so acute this winter, although there is a considerable fuel shortage in many localities. The Northwest has plenty of undeveloped

coal, and when transportation facilities become adequate, fuel famines will no longer occur.

NEW OPERATIONS

The year 1907 brought few new coal-fields to our attention, although the area embraced in the old territories was largely extended. Great developments took place in practically all of the coal States. West Virginia and Illinois led in activity. The Western States furnish opportunities for new discoveries, and it is here that the future will show the greatest developments. What we desire most is a new supply of anthracite, but little hope seems to exist that we shall find a field to succeed the present district in Pennsylvania. With the completion of the Denver, Northwestern & Pacific Railroad through the Rockies, it is possible that some fairly good anthracite will be marketed, while the reports from Alaska and the State of Washington are somewhat reassuring. In the latter territory, near the city of Spokane, a coal is said to have been discovered equal to the best Eastern anthracite. The extent of the field is at present unknown.

EFFECT OF NEW LEGISLATION

Those interested in coal mining are at present much concerned as to what steps the different railway companies will take to comply with the "Hepburn law," which goes into effect May 1, 1908. This law requires that no railroad shall transport between States any coal, in the mining or sale of which, it is "directly or indirectly interested." The railroad company can ship coal to other States for its own use and can sell coal to local trade within the State borders.

The Union Pacific Railroad Company will probably use all the coal produced at its mines in Wyoming, to supply the fuel demands of its own lines, as well as those of the Southern Pacific and Oregon Short Line railroads. The "Gould roads" (Western Maryland, Wabash, Missouri Pacific and Denver & Rio Grande) may try to incorporate separate companies and turn over to them the coal lands now held by the various lines. It is possible that even such action as this will be considered as an evasion of the law, which will place the companies in an embarrassing position. One other difficulty now confronting the Gould lines in selling their coal holdings, or disposing of them to another company is the fact that most of the coal properties, valued at about \$55,000,000, are already pledged as security for bonds.

ANTHRACITE COMPANIES MAY FIGHT HEPBURN LAW

Some of the coal roads such as the Delaware, Lackawanna & Western, and the Delaware & Hudson Railroad Company, have old Pennsylvania State char-

ters, which specifically state that the railroad companies concerned may mine and sell anthracite coal. These roads may fight the present law, basing their defense on the "Dartmouth College Decision," which held that a company's charter was a contract with the State and could not be abrogated by any government, unless provision was made in the charter itself.

There is also a disposition on the part of some coal roads to let present conditions rest and throw upon the United States the obligation of enforcing the law. This method would place the Federal Government in the position of attacking property rights, and the corporations would so become defendants, and allege that the interests of security holders were threatened and put in jeopardy by the United States. The danger in this is that failure to observe the law would possibly mean heavy fines. President Baer has stated that the coal properties of the Philadelphia & Reading are completely divorced from the railroad company, the ownership being vested in the Reading Company, which is simply a holding corporation.

Several railroad companies have already anticipated the enforcement of the Hepburn law, and have prepared to meet its provisions in different ways. The Baltimore & Ohio Company has sold its stock in the Consolidation Coal Company of Baltimore to outside parties, while the Buffalo, Rochester & Pittsburg Company has transferred its coal shares to a new company, the stock of which was sold pro rata to the stockholders of the railroad company.

ADVANCES IN ENGINEERING PRACTICE

Many mining companies improved their systems of underground development by paying more attention to the preservation of room and barrier pillars, at the same time abolishing the uneconomical methods of driving all entries water level in order to prevent the initial expenditure that results from taking up bottom or grading a haulway. It is true, however, that practically no unusual advances were made in the systems of mining, nor were there any radical changes that point to more economical methods in the future.

The wasteful system of gobbing all bony coal in the anthracite mines continues, and this waste coal or bone, as it is improperly called, is still considered without commercial value, although its composition shows it to be superior, so far as heating efficiency is concerned, to many grades of Western coal now mined. Members of the technologic branch of the U. S. Geological Survey are now investigating the waste in coal mining, and they will, no doubt, give attention to this most important matter.

One of the most commendable advances recently made and which will undoubtedly result in much good, is the educational work being done by the Philadelphia &

Reading Coal Company, and many other large anthracite corporations. The coal department of the Young Men's Christian Association of Western Pennsylvania is also holding numerous meetings in various localities, and much benefit is resulting from the discussions and papers that are presented. The first-aid organizations which are also being encouraged by the anthracite companies are reaching a degree of efficiency that speaks well for the good they will do when serious accidents occur. Such work appeals to the coal miners themselves, and it is not difficult for any operating company to secure the enthusiastic cooperation of its employees in such humane work.

MINE TIMBERING

Among the many mining problems that were taken up in detail during 1907 is that of mine timbering. The reports made by the Forest Service of the U. S. Department of Agriculture were of such a nature that mine operators are becoming alarmed as to the future problem of mine supports.

During 1905 the anthracite mines of Pennsylvania consumed about 53,000,000 cu. ft. of round timber and nearly 122,000,000 board feet of sawed timber, costing approximately \$6,000,000. In the same year the bituminous mines of the United States used about \$7,000,000 worth of timber at an average cost of \$2170 for each bituminous mine, and \$20,524 for each anthracite mine.

It is estimated that during 1907 10 per cent. more timber was used than in 1905, and that the cost of this timber was at least 55 per cent. more than in 1905. Although the cost of other mine material has fluctuated, the price of timber has steadily increased. The work of reforestation has progressed so slowly that its results are not yet appreciable. Much publicity was given to the results obtained by the Forestry Department of the Government, in its experiments on mine timbers at several anthracite properties. The preservative methods devised are worthy of the attention of all mine operators.

STEEL SUPPORTS

The use of steel supports and props underground is no longer an experiment, for the mines of France, Germany and England have proved that it is eventually most economical, especially where timber is scarce. In those mines of America where steel supports are used, the results were successful beyond expectation. The Carnegie Steel Company is devoting much attention to this problem and has recently had an experienced colliery engineer design several styles of props for use in coal mines. The designs submitted permit of adjustability, and if carried out will make the steel prop almost as flexible as the wooden timbers now used. It is possible that the future will find steel used underground as largely as it now enters

into the construction of head-frames, etc., on the surface.

MINE EXPLOSIONS

The loss of life in mine explosions during December, 1907, was appalling. Coal mines are dangerous and always will be, but to hush up these matters and belittle the fact is almost a crime on the part of those who are in a position to know. Mine managers, State inspectors, legislators and engineers, deplore the losses of life resulting from these accidents; but all are waiting for others to provide a remedy. When the probable causes of an explosion are discussed, mining men seem to think it necessary to drop their voices to a whisper for fear someone will find out something tending to involve the company or perhaps show a weakness in the State mining laws. If an explosion is thought to be due to the derangement of an electric wire and the consequent ignition of dust or gas, many intelligent men will immediately caution great secrecy for fear of what they call hysterical legislation. Legislation concerning mines will be as sane as the evidence submitted to the men who make the laws, and if facts are hidden, the legislators are compelled to do considerable guessing and consequently are not to be blamed for prescribing harmful and useless laws.

Before a representative body of mining men, a speaker recently decried the work of investigation carried on by the United States Geological Survey, claiming that such matters should be left to the mine managers. How much light has been shed on the problems of dust explosions, gas explosions and other serious mine disasters by the investigations of our mining companies and State inspectors?

WORK OF THE FEDERAL GOVERNMENT

The Government decided to erect an experiment station where investigations to determine the explosive nature of the dust found in our different coal mines are to be carried on. These investigations will also include experiments with explosive gases and determinations as to the nature and efficiency of the different kinds of powder used in the mines. This plan met considerable opposition, but the majority of mine operators are anxious and willing to see improved conditions introduced that will tend to increase the safety of mining operations in general.

The example set by the management of the Fairmont Coal Company in giving absolute publicity to every detail of the terrible explosion at the Monongah mine, might be followed advantageously by other coal-mining companies. The officers of the company knew that they were complying with the mine laws and felt confident that the truth could not harm them. Out of 100 mines controlled by this company, none was more nearly ideal in its plan of development than the Monongah operations. The ventilating fans were modern

in design and threw large volumes of air through the entries and rooms of each mine, providing a system of ventilation second to none in the district. The recent explosions have not taught us new lessons, but have only emphasized with great force, the need of observing the many precautions that experience has already shown to be necessary.

In my last annual review, published in the JOURNAL, Jan. 5, 1906, I called attention to the dangers resulting from connecting the underground workings of two adjacent mines, and suggested the advisability of enacting laws to prohibit this practice. If this provision had been considered and enforced at the Monongah mines, the loss of life would have been only half as great. A long list of recent accidents might be cited as examples in corroboration of this statement.

PRESENT IGNORANCE

If the general public were to realize how little is known concerning the nature of gas and dust explosions and the phenomena which accompany them, it is most likely that a general demand would be made for some action to clean up the confusion of ideas now prevailing. Some practical men claim that the Monongah No. 8 mine was the seat of the recent explosion because the greatest damage was done in its workings; this very fact is one of the strongest proofs that the origin of the explosion was in the No. 6 mine. All dust explosions gather in force as they travel and do the least damage at the point of initial occurrence.

Evidence gathered from the many explosions in bituminous mines during recent years tends to show that dust has been the main factor in nearly all of these accidents. The trouble may have been started by a local gas explosion, a blow-out shot, the ignition of a cloud of dust by an open light or from the short-circuiting of a live wire and many other accidental causes. When an explosion occurs in an anthracite mine it is usually local, affecting one portion of the mine; nearly all explosions in our bituminous mines have practically extended through the entire underground workings and generally executed the greatest damage at the very mouth of the mine. Since anthracite dust does not contain much volatile matter while bituminous dust is high in volatile hydrocarbons, which make a dust dangerous, does this not tend to prove that the extension of explosions in soft-coal mines is caused by the dust present.

A COAL-DUST PHENOMENON

A better understanding of these matters and the greatest good must come from actual experiments and observation, and for this reason I wish to call attention to a part of an interesting paper read before the Midland Institute of Mi-

ning Engineers of England by Mr. Neil. The ignition of coal dust in one of the collieries was described as follows:

"The seam was dry and dust accumulated rapidly. Early in September a deputy had opened a safety lamp at a lamp station. A train of full cars drawn by ponies was passing and raised a considerable quantity of dust. Just before the train reached the last station, the deputy removed part of the burning 'snuff' from the wick of the lamp and it fell harmlessly to the floor. As soon as the train had passed he knocked away the remaining portion of the snuff and as this fell to the floor there was an ignition of the coal dust. The flame rose to the height of about 2 $\frac{3}{4}$ ft., and spreading over a width of 3 ft., followed the train with a peculiar rolling motion apparently corresponding with the excessive clouds of dust raised, making a peculiar hissing sound. The train was stopped about 45 ft. beyond the last station, and when the flame reached the last car it ascended to the roof, returned along the upper portion of the roadway and finally extinguished itself within 3 ft. of the point of ignition. The color of the flame was described as being similar to that of a candle or oil lamp."

Mr. Neil had thought that nothing short of an ignition or an explosion of gas or gas and dust could cause a coal-dust explosion, and that was his opinion until this incident occurred. Such observations as this are interesting, and when coupled with other phenomena such as the explosion and wrecking of a coal mine when no one is underground and no flame is present, proving almost conclusively that explosions may be due to the ignition of gas by a heavy fall of roof, a better understanding of the dangers ever present may result.

The Monongah explosion left 800 fatherless children to be provided for by the Fairmont Coal Company; adding all other costs resulting from the disaster, it is probable that the operating company here involved will eventually be compelled to spend \$200,000 as a direct result of the accident. There is no longer doubt in the minds of most operators that the cost of the eternal vigilance and precautionary safety measures is less in the long run than the disasters which they may prevent, and the passage and enforcement of sensible laws would be welcomed by all.

There is no longer any doubt as to the advisability of wetting our coal mines; in fact it is as necessary to remove dust and carefully sprinkle all entries and rooms in our bituminous mines as it is to provide a large circulation of air by an efficient fan. Remove the likelihood of a dust explosion and our mines will be 90 per cent safer than they are at present.

As to the work of investigation that should be carried on, there are many in-

interesting points to be determined. The positions of all men found in these explosions should be carefully examined. Why is it that some victims have not had time to rise from their seats or even move a muscle? I can recall one case in which a member of a rescue party had not even taken his hand from the saw with which he was cutting a board.

There are also many other points that should be discussed openly instead of passing them into history with a faint whisper and a knowing nod. Through the suggestion of State Inspector Paul, of West Virginia, I once before called attention to the advisability of securing careful analyses of the blood of those miners who have been overcome by afterdamp and in other ways perished in mine explosions. Such scientific investigations would be most enlightening.

If all those in America who from experience have obtained practical knowledge concerning mine explosions, would make their opinions public, the discussions that would follow would surely be of great benefit to the mining industry as a whole.

The Coal Market

No especial feature marked the production of anthracite coal during the year. There were no changes in the control and management of the trade. Perhaps the most marked feature was a decline in the activity manifested in the previous year in the prospecting and purchase of coal lands in the anthracite region by independent companies. Some large improvements were undertaken by several of the coal companies, which are referred to elsewhere. The production of anthracite in Pennsylvania was as follows, in long tons, shipments for December, 1907, being estimated:

	1906.	1907.	Changes.
Shipments.....	55,698,595	66,577,672	1. 10,879,077
Used and sold at mines.....	8,711,733	9,320,874	1. 609,141
Total.....	64,410,328	75,898,546	1. 11,488,218

The shipments were the largest in the history of the trade. The detailed statement, by companies, follows, for the 11 months ended Nov. 30:

	1906.		1907.		Changes.
	Tons.	Per Ct.	Tons.	Per Ct.	
Reading.....	10,271,242	20.2	12,877,557	21.0	
Lehigh Valley....	9,132,959	18.0	10,625,844	17.3	
N. J. Central.....	6,350,433	12.5	8,008,359	13.1	
Lackawanna.....	8,409,033	16.5	9,461,177	15.4	
Del. & Hudson....	4,886,130	9.6	6,062,097	9.9	
Pennsylvania....	4,421,287	8.7	5,219,871	8.5	
Erie.....	5,151,068	10.1	6,589,601	10.8	
N. Y., Ont. & W...	2,240,415	4.4	2,482,366	4.0	
Total.....	50,862,567	100.0	61,327,672	100.0	

All the companies showed increases, the larger proportional gains being on the Reading and the Erie. The Lehigh Valley figures now include the shipments of Coxe Brothers & Co., or the Delaware, Susquehanna & Schuylkill Railroad, purchased in 1906.

The New York, Ontario & Western re-

mained under control of the New York, New Haven & Hartford Company. During the year an option on the stock was given to the New York Central, but subsequently withdrawn.

Later in the year the New York, New Haven & Hartford Company announced that it would receive no more all-rail coal for New England points by way of Jersey City and the Harlem river terminal. All shipments must be routed by Reading or Easton and over the Poughkeepsie Bridge line. Whether this will be fully carried out is uncertain. The New Haven's facilities for handling coal were always defective, and the road has been perpetually in quarrels with its connections over car delays and charges.

In the anthracite trade the demand for the small steam sizes was remarkably strong throughout the year, except for two periods—July and November—and there was a shortage except at these times. The scarcity was brought about partly by the efforts, on the part of the producers, to reduce the production of these small sizes.

Prices remained constant until the last part of August when an advance of 25c. per ton was made on all the small sizes. This increase was maintained to the close of the year in spite of the falling off in trade which began in October.

Prepared sizes experienced a variable market. The demand was brisk at times and again the market was flat. Steady contract business took care of a large tonnage and the trade enjoyed a profitable year as a whole. Prices of prepared sizes through the year were on the basis of \$5 per ton at tidewater. The customary discount of 50c. per ton was made on April 1, decreasing by 10c. each month until the \$5 price was restored on Aug. 1. The year closed with a dull, heavy market, due chiefly to mild weather.

THE SEABOARD BITUMINOUS TRADE

Up to the time of the general business depression the bituminous trade along the Atlantic seaboard was characterized by a tremendous demand except during a portion of the summer months. The demand for coal in the far East was especially persistent and consumers clamored for supplies.

Early in the year shipments by rail were hampered by severe climatic conditions which caused coal to freeze in the cars and the delays in unloading at tide-water forced the railroads to decline embargoes at South Amboy. In March the main line roads increased through rates 5c. per ton, and shortly afterward prices began to advance on all grades. Southern West Virginia coals became scarce and the market was largely supplied from Pennsylvania districts, when the heavy demand began in August.

In October certain George's Creek coals which earlier had brought \$2.85@3.15, were advanced to \$3.55@3.70, and even at

these prices the demand exceeded the supply.

Consumption of coal in New England continued heavy all year and there was not the disposition to carry heavy stocks seen in former years.

In November factories began to shut down and the demand fell off sharply, which lowered prices accordingly. Good steam coals, offered at \$2.50 per ton New York harbor, proved unattractive and the market closed heavy.

The Sound enjoyed a prosperous year, but experienced the conditions felt elsewhere in the closing months.

COASTWISE TRADE

The demand for vessels, which supply most of the trade in eastern New York and New England points, was very active most of the year. At times the market was severely affected by shortage of vessels, and freight rates, which usually fall off in the summer months, were maintained at winter rates for practically the whole year. The demand from Maine ice-making ports set in earlier than usual and continued until navigation closed on account of increased activity in manufacturing. The general suspension of work took place after these points were supplied and should result in extra large stocks of coal in the hands of consumers.

Coastwise coal shipments for the 10 months ended Oct. 31—the latest date attainable—were as follows, in long tons:

	Anthracite.	Bitum.	Total.	PerCt.
New York....	13,830,297	9,701,396	23,531,693	64.4
Philadelphia	1,992,560	4,250,296	6,242,856	17.1
Baltimore....	208,764	3,158,265	3,367,029	9.2
Newp't News	.....	1,989,239	1,989,239	5.4
Norfolk.....	.....	1,412,923	1,412,923	3.9
Total.....	16,031,621	20,512,119	36,543,740	100.0
Total, 1906.	12,860,919	18,656,254	31,517,173	.....

New York includes all the New York harbor shipping ports. The total increase in these shipments in 1907 was 5,026,567 tons, or 16 per cent.

FOREIGN COAL TRADE

Exports of coal and coke from the United States for the 10 months ending Oct. 31, the latest complete figures, are reported as below by the Bureau of Statistics of the Department of Commerce and Labor:

	1906.	1907.	Changes.
Anthracite.....	1,851,466	2,336,304	1. 484,838
Bituminous.....	6,378,483	8,675,258	1. 2,296,775
Total coal.....	8,229,949	11,011,562	1. 2,781,613
Coke.....	642,931	761,568	1. 118,637
Total.....	8,872,880	11,773,130	1. 2,900,250

Coal bunkered, or supplied to steamships in foreign trade at United States ports for the 10 months was 5,034,315 long tons. Added to the imports given above, makes a total of 16,045,877 tons coal for consumption beyond the limits of the United States in 1907.

The coke exported went chiefly to Mexico and eastern Canada; the distribution of the coal was as follows:

	1906.	1907.	Changes.
Canada.....	6,216,261	8,352,010	I. 2,135,749
Mexico.....	936,837	930,486	D. 6,351
Cuba.....	557,962	631,002	I. 73,040
Other W. Indies.....	267,750	358,304	I. 90,554
Europe.....	76,338	201,428	I. 125,090
Other countries.....	174,801	538,332	I. 363,531
Total.....	8,229,949	11,011,562	I. 2,781,613

The increase in exports to Europe was in shipments to Italy, which took 130,509 tons last year. The exports to other countries were chiefly to South America. The exports to Canada—75.8 per cent. of the total in 1907—were, in detail, as follows:

	1906.	1907.	Changes.
Anthracite.....	1,819,586	2,296,958	I. 477,372
Bituminous.....	4,396,675	6,055,052	I. 1,658,377
Total.....	6,216,261	8,352,010	I. 2,135,749

The increase in anthracite was 26.2 per cent., and in bituminous 37.7; the total gain being 34.4 per cent.

Imports of coal and coke into the United States for the 10 months ending Oct. 31, were, in long tons, as follows:

	1906.	1907.	Changes.
Great Britain.....	97,844	33,985	D. 63,859
Canada.....	1,202,349	1,161,876	D. 40,473
Japan.....	10,812	102,358	I. 91,546
Australia.....	152,568	416,894	I. 264,326
Other countries.....	4,581	7,315	I. 2,734
Total coal.....	1,468,154	1,722,428	I. 254,274
Coke.....	112,363	108,298	D. 4,065
Total.....	1,580,517	1,830,726	I. 250,209

The decrease in imports from Canada into California was made up by larger receipts of Australian and Japanese coal. Some Nova Scotia coal comes to New England ports, but the bulk of the imports of coal is on the Pacific coast. The coke is chiefly from British Columbia, though a little comes from Germany.

The Chicago Coal Market

By E. MORRISON*

In certain respects the market of 1907 was the best that Chicago coal dealers have known. The consumption of steam coals for the first six months was so heavy as to remove all complaint about sacrifices due to demurrage rules. Prices were steady, though not high for Western coals, and there was no serious interruptions to shipments and sales through labor troubles. Transportation also was better than in previous years, to judge from the absence of general complaints. At the end of the year, however, the trade suffered from financial conditions and the lack of severe weather in December.

The mild weather of the winter of 1906-1907 caused light sales for domestic purposes in January and February, and by March weakness of prices began. By the end of March this trouble was removed by a general restriction or diversion of shipments, and comparative stability followed from the same causes. A cold and late spring aided sales of domestic coals greatly. The regulation of shipments to

*Special correspondent, Chicago, Ill.

Chicago is the great thing needed to insure steadiness. With large producing interests in Illinois and Indiana becoming more conscious of this need every year, and conscious of the fact that common benefit means individual benefit, regulation is more nearly approximated. Enduring regulation, however, can hardly be looked for while the productive area is so great and the number of producers is unrestricted.

Even in the summer period, when demurrage troubles are commonly expected, the Chicago market had little weakness, so far as Western coals were concerned. Eastern coals—the term including all from east of Indiana—were more irregular, but hardly suffered seriously from demurrage. Nor were sales of Eastern interfered with by lack of cars so seriously as in previous years.

Average car prices in Chicago were as follows, for Illinois and Indiana coals, which furnish about 60 per cent. of the total handled in the local market:

PRICES OF WESTERN COALS, CHICAGO.

Month.	Lump and Egg.	Run of Mine.	Screenings.
January.....	\$2.00@3.00	\$1.75@2.25	\$1.30@1.65
February.....	1.85@ 2.75	1.75@ 2.25	1.25@ 1.50
March.....	1.75@ 2.75	1.65@ 2.15	1.25@ 1.50
April.....	1.75@ 2.50	1.65@ 2.15	1.25@ 1.75
May.....	1.85@ 2.65	1.65@ 2.25	1.25@ 1.75
June.....	1.85@ 2.65	1.65@ 2.15	1.25@ 1.65
July.....	1.75@ 2.65	1.65@ 2.00	1.25@ 1.65
August.....	1.75@ 2.65	1.65@ 2.00	1.25@ 1.50
September.....	2.00@ 2.65	1.65@ 2.00	1.10@ 1.50
October.....	2.25@ 2.65	1.75@ 2.25	1.10@ 1.50
November.....	2.25@ 2.75	1.75@ 2.25	1.10@ 1.40
December.....	2.25@ 2.75	1.75@ 2.25	1.10@ 1.40

It is probable the total amount of coal received in Chicago, of all kinds, was 12,000,000 tons, against about 11,000,000 tons in the previous year. The proportions of coal remained about the same, about 65 per cent. bituminous from the Illinois and Indiana fields and the remainder from mines east of Indiana. Within the city much attention was paid to smoke consumption. Leading dealers sought to aid consumers of coal in preventing offensive smoking of chimneys, and so to popularize the less expensive coals, though it is not apparent that such efforts had much effect on the trade as a whole.

The use of Eastern coals was large, owing to general prosperity and heavy consumption, though in the closing months of the year these coals suffered more than Western. Smokeless ranged from \$3 to \$3.65 for Pocahontas and New River run-of-mine, the lowest prices being for December and the highest for early summer, though most sales were for \$3.25@3.40. Hocking Valley coal sold at \$2.75@3.50 for run-of-mine and was in good demand throughout the year. Other Eastern coals sold at about the same prices as in the previous year.

Anthracite sold at the same prices as in 1906—\$6.50 for egg, stove and chestnut and \$6.25 for grate, with No. 2 nut in large demand at \$4.50, for delivery after

Sept. 1. The graduated discount system was in use between April 1 and Sept. 1, giving 50c. off on April sales, 40c. on May, 30c. June, 20c. July, and 10c. on August sales. There was a scarcity of chestnut throughout the year, but no lack of other anthracite.

Pittsburg District Coal in 1907

By S. F. LUTY*

The last two months spoiled a most remarkable year in the coal industry in the Pittsburg district and western Pennsylvania. Production was greater than former years despite the fact that the output of the Pittsburg Coal Company, was fully 1,000,000 tons less than in 1906. Great gains were made by the Monongahela River Consolidated Coal and Coke Company as the rivers were navigable every month in the year for the first time in the history of the river trade.

There were no labor troubles of any consequence as the wage scale in force was arranged for two years and does not expire until Apr. 1, 1908. The only interruption due to a strike was at the Youghiogheny mines of the Pittsburg Coal Company, over 2000 miners going out on account of a dispute over the terms of the agreement. A serious strike was threatened owing to the introduction of the Pate dump at the majority of the mines, the objectionable feature being the ratchet sword attachment. A strike was averted by the companies on June 3, discontinuing the use of the dump.

Owing to the absence of official data on production for the last two months of the year it is impossible to give accurate figures on the total production, but John H. Jones, president of the Pittsburg-Buttalo Company, who has been successful in making estimates in former years, says he believes the total production for the Pittsburg district, including the Westmoreland field, will reach 52,000,000 tons. The output in round numbers in 1906 was 47,000,000 tons; 1905, 42,000,000 tons; 1904, 31,000,000 tons, and in 1897 the total production amounted to 18,000,000 tons.

The production of the Pittsburg Coal Company for the year with the last two months estimated was around 15,000,000 tons. The other large interest, the Monongahela River Consolidated Coal and Coke Company, produced in round numbers 7,500,000 tons, a gain of 1,500,000 tons compared with the previous year. Of this tonnage nearly 3,000,000 tons went to lower river ports. Other river coal interests produced about 3,000,000 tons, two-thirds of which was by the Vesta Coal Company, a subsidiary of the Jones & Laughlin Steel Company, none of

*Special correspondent, Pittsburg, Penn.

which went into the open market but was consumed at the plants of the company.

The lake shipping season opened early in April and the report of shipments for the season is expected to show a gain of probably 3,000,000 tons compared with the shipments of 1906, which were 9,200,000 tons. The lake freight rates to the Northwestern markets were increased 5c. a ton on April 15, making the new rate on cargo coal 88c. and on vessel fuel coal 98c. a ton. While the shipments to the Northwestern markets were greatly in excess of the previous year it is figured that contracts amounting to about 1,000,000 tons remained unfilled at the close of navigation.

ADVANCE IN PRICES

Prices were advanced at the opening of the year on all contracts, the increase amounting in most instances to 20 per cent., and prices ranging from \$1.15 to \$1.20 on the basis of mine-run coal f.o.b. mine. The general quotation to the trade was \$1.45 a ton. The advance was due to the higher price for mining. The operators had expected a reduction in the rate of 5c. a ton for mining coal over 1¼-in. screen, and 1906 contracts were made on that basis. Instead the mining rate was advanced to 90c. on April 1, 1906, for a two-year period. A number of important contracts were made in January and a lower rate was named in February. Prices fluctuated during the year and on Oct. 1, the large producers fixed the price on a basis of \$1.25 for mine-run coal at the mine. On Oct. 15, the rate was advanced to \$1.40, but the depression in the iron and steel industry which resulted in the closing of many mills caused a serious decline in the demand and on Dec. 2 prices were reduced to a basis of \$1.30 for mine run coal and a week later the rate was cut to \$1.15 a ton and even this low price was shaded. Slack which brought 85 to 90c. at the opening of the year could be had at 40c. in December and some sales were made at a lower figure.

Some important changes were made in the management of the two large interests. At a meeting of the stockholders of the Pittsburg Coal Company in Jersey City on Feb. 11, Francis L. Robbins, chairman of the board, retired and was succeeded by President M. H. Taylor. Mr. Robbins transferred his interests to the Monongahela River Consolidated Coal and Coke Company and was elected president of that corporation. The company had a most prosperous year and in November resumed the payment of dividends. The company in addition to its regular annual contracts booked a number of important new ones, including 250,000 tons for the Southern Pacific Railroad and Steamboat Company to be delivered at its wharves in New Orleans, and 200,000 tons for the St. Louis Gas

Company. A sudden storm early in July damaged a number of boats and coal tipples along the Monongahela river, the loss being about \$500,000. The March flood also caused a loss, but despite these losses the year was a most profitable one for the Monongahela company.

There were not many serious accidents compared with former years. The most disastrous was an explosion at the Naomi mine of the United Coal Company on Dec. 1. The mine was badly damaged and about 40 lives were lost. An explosion at the Darr mine of the Pittsburg Coal Company on Dec. 19 caused a loss of over 200 lives. On July 14 a fire broke out at the big Hazel mine, of the Pittsburg-Buffero Company, at Canonsburg, causing a serious loss. A fire at the Braznell mine of the Braznell Coal Company occurred at the same time and it was necessary to flood the mine.

A number of improvements were made at a number of mines throughout the district in order to facilitate production. The most important extension was made by the Pittsburg-Buffero Company which sank three shafts in the Washington county field to develop 14,000 acres of coal. Operations began at one of the shafts in November but shipments could not be made until the completion of a new branch railroad late in December. The company also proposes to build 1000 coke ovens.

CONNELLSVILLE COKE IN 1907

The year opened with prices abnormally high and production to capacity in the Conneltsville coke field and closed with most of the ovens idle and no demand for the product. Early in January furnace coke was quoted at \$3.40 to \$3.50 and foundry at \$4.10 to \$4.25, but in December \$2 to \$2.25 for furnace and \$2.50 to \$2.75 for foundry were the quotations, with some sales reported at lower prices.

The production of coke in the Conneltsville region, including the lower field, for the year with December estimated was about 18,000,000 tons, or nearly 1,000,000 tons less than the previous year. For the first 40 weeks the production was in excess of 400,000 tons weekly, and in the last 12 weeks the average production did not amount to 200,000 tons weekly.

On Feb. 18 the H. C. Friek Coke Company ordered an advance in wages for its 18,500 employees in the coke region ranging from 8 to 12½ per cent. effective March 1. This made the rate the highest in the history of the great coke field and increased the pay roll of the company for the year by \$1,500,000. All the other companies in the region adopted the new wage scale. In December three small concerns made a reduction in wages of 12½ per cent. but the other companies announced that no cut was contemplated and none would be made so far as known at the close of the year.

Coal and Coke in Alabama

BY L. W. FRIEDMAN*

Alabama's coal production will come near to all predictions for the year 1907. The great slump in iron and steel and other circles was not felt so extensively in the coalfields. All through the year—and the months of November and December are included—there was a steady demand made on the railroads to furnish cars. There was but little cessation of the development in the coalfields. The consumption fell off toward the end of the year, but apparently companies were behind in their deliveries of coal and the movement from the coalfields during the last two months of the year was active.

There was but little coal, comparatively speaking, accumulated for future use in the Alabama fields. The bins at furnaces and at other points were filled, but this coal is not of such great quantity that it will have any effect on activity when there is a revival in business. The price of coal in Alabama through the whole year was satisfactory.

COAL PRODUCTION

The estimates made just after the first half of the year was over, placed the aggregate for the year at 15,000,000 tons. At that time there was a strong demand for coal, and every mine was working hard. The depression that began in October had some effect, but the production of coal continued. The Southern Steel Company closed down two of its mines in November and one or two others were practically down at the same time. With this all considered, the production for the year approaches the estimate of 15,000,000 tons. The new mines put in operation more than made up for the mines which shut down. The State mine inspector's report shows the output in 1906 to have been 12,851,775 tons.

NEW COAL MINES

Development in the coalfields was pushed in the western part of Jefferson county and in Walker county by the Pratt Consolidated Coal Company; in the southeastern portion of Jefferson by H. F. deBardeleben and associates, in the Acton basin; in the southwestern part of Jefferson by the Birmingham Iron and Coal Company, or the Atlanta, Birmingham & Atlantic railroad; in the northeastern part of Jefferson and in St. Clair county by H. F. deBardeleben and associates; in other parts of the coalfields of the State.

THE COKE INDUSTRY

The coke industry suffered considerably during 1907, and the production was probably less than in 1906, when the official

*Special correspondent, Birmingham, Ala.

figures gave 3,217,068 tons. It is not believed that production in 1907 was above 3,000,000 tons.

Coal and coke production in Alabama since 1900 is reported by the State mine inspector as follows, in short tons:

Year.	Coal.	Coke.
1900.....	8,273,362	2,110,837
1901.....	8,970,617	2,148,911
1902.....	10,329,479	2,552,246
1903.....	11,700,753	2,693,497
1904.....	11,273,151	2,340,219
1905.....	11,900,153	2,576,786
1906.....	12,851,775	3,217,068
1907.....	14,100,000	2,250,000

The figures for 1907 are not given by the mine inspector, but are estimated on the basis of company reports.

Coal Mining in the Indian Territory in 1907

BY WILLIAM CAMERON*

The production of coal for the year ending Dec. 31, 1907, in that part of the state of Oklahoma which was formerly Indian Territory, will approximate closely to 3,450,000 tons. Owing to the increased value of slack during the past year the 232 coke ovens in the district named, have worked very little and irregularly. The total production for the year will be about 20,000 tons.

There are now operating in the Indian Territory some 64 companies and individuals, of greater or smaller capacity, there being 118 mines in operation, of which 31 are shafts, 85 are slopes and two are drifts. The different veins of coal operated in this district are the McAlester, the upper Hartshorne, the lower Hartshorne, the Secor, the upper Witteville, the lower Witteville, and the Panama, besides some seams on which there were scattered small operations which have no particular designation. It is possible that the upper and lower Witteville seams are separate portions of some other veins, very probably the upper and lower Hartshorne; but the coal having characteristics of its own, I have given it a separate name.

In addition to these principal beds there are operations on what are known as the Cavanal seam, the Arkansas and the Lehigh seams (which latter is no doubt a continuation of the McAlester bed, but having a character so changed as to show distinct individual characteristics). There has also been a considerable increase in the development of what is known as the Henryetta seam (which is supposed to be a continuation of the Kansas bed) in the Creek Nation, and there have also been some smaller operations. This Henryetta coal is coming rapidly into prominence as a desirable fuel for steam purposes especially. There are also some operations on an isolated seam which (not being sure

*United States mine inspector, So. McAlester, Okla.

of its connection with any principal bed) I have named the Blocker seam.

The total number of men and boys employed is as follows: over 16, underground, 6093; under 16, underground, 137; over 16, above ground, 1454; under 16, above ground, 26; total 7710.

The production of coal in 1907 is larger than for any previous year in the history of coal mining in the Indian Territory and the prospect is that it will still further increase. The actual capacity of the mines in operation is something like $4\frac{1}{2}$ to 5 million tons, if run full time. The chief obstacles to full development are the scarcity of railroad cars and a scarcity of labor. If there were abundant transportation facilities and labor was plentiful I have no doubt the maximum figures here given would be reached.

The differences between the operators and the men during 1907 were not of much magnitude and when they arose they were settled by representatives of each body in a satisfactory manner, without any serious delay in the operations of the mines.

Coal Mining in Montana

BY RICHARD LEE

Notwithstanding the lack of cars and scarcity of labor the coal-mining industry in Montana was prosperous in 1907. The greatest activity in new development work occurred in what is known as the Bear Creek field. The great difficulties attending coal operations in this district were due to inadequate transportation facilities. An independent line, known as the Yellowstone Park Railroad, has a branch running through the field and connecting with the Northern Pacific at Bridger. The Northern Pacific refused to transfer cars to the Yellowstone line, because of the latter's inability to make exchanges, having no equipment of its own. The matter has been taken up by the Interstate Commerce Commission, and it is hoped that some satisfactory solution of the problem will be found.

The vast coalfields of Montana have hardly been touched. The largest operators in the State are the Northern Pacific Railroad Company, with its mines at Red Lodge, the Amalgamated Copper Company, with its mines at Bear Creek and Belt, and the Great Northern Railroad Company, with its operations at Sandcoulee and Stockett.

Several new lines of railroad are being extended to various parts of the State and it is certain that the next few years will show great activity in the Montana coal-mining industry. The most important of the new developments will probably be along the line of the Burlington railway, which in building its line to the coast is opening several new and important fields.

Coal Mining in Colorado

BY JOHN D. JONES*

During the year 1907 unusual activity was manifested in Colorado in opening and developing new mines of which there are altogether 18; these are equipped for capacities ranging from 150 to 1500 tons daily. In addition to the opening of these new mines, a great many improvements were made in the old mines tending toward greater safety to life and property; new air-shafts were sunk and new ventilating fans of larger capacities were installed.

The relations between employer and employees was friendly, and few local disputes occurred, all of which were of short duration. The railroad car shortage was noticeable as usual in some parts of the State especially in the last three months. The scarcity of men in the coal camps retarded the production considerably, but during the closing months of the year the money stringency relieved the labor shortage. The mines are now able to operate with a full force of men.

While the demand for coal is not as active as it was previous to the disturbance in the money market, yet a comparison of the tonnage of November and December with that of the corresponding months in 1906 shows a decided increase in the output, and proves that the coal industry has so far suffered but little.

The general summary of Colorado's coal industry during 1907 follows:

Number of mines in operation.....	183
Number of new mines opened up....	18
Tons of lignite coal produced.....	2,076,246
Tons of semi-bituminous coal produced.....	916,909
Tons of bituminous coal produced.....	7,811,269
Tons of anthracite coal produced..	44,893
Tons of unclassified coal produced, estimated.....	70,000
Total tonnage of coal produced....	10,919,317
Increase of tonnage over 1906:....	610,896
Total tons of coke manufactured..	1,041,995
Total number of coke ovens.....	2,726
Number of employees in and about the mines.....	12,900
Number of employees at the coke ovens.....	960

Coal Mining in Indiana in 1907

SPECIAL CORRESPONDENCE

The coalfields of Indiana are included in the eastern interior field which underlies the greater part of western Kentucky and twenty counties in the southwestern part of Indiana.

The coal beds of Indiana have never been systematically and thoroughly studied. The proposed State Geological Survey and the work already done by it in coöperation with a Federal survey give promise that the knowledge of the coal beds of Indiana will doubtless, within another year, be made more exact. However, it is known that Indiana occupies the

*Chief mine inspector, Denver, Colo.

eastern edge of the basin which dips toward the center of the field in Illinois.

The first coal shipped by rail in Indiana was mined in Clay county and transported by the Vandalia Railroad. In the early '70s, a number of operators began developing the Block coal district of Clay county, and the demand was so great that other seams were found and developed. A few years subsequent, the counties of Greene and Sullivan were made to produce an excellent quality of coal. Railroads were built and the coal lands of these and adjacent counties were developed with remarkable rapidity. The Indiana coal has met with so much favor in the market, that it ranks with the so-called high-grade coals.

The remarkable growth of the coal-mining industry of Indiana can best be observed by the following figures:

In 1870 there were 1,106,490 tons of coal produced.
In 1884 there were 2,260,000 tons of coal produced.
In 1888 there were 3,140,979 tons of coal produced.
In 1893 there were 4,358,897 tons of coal produced.
In 1898 there were 5,146,920 tons of coal produced.
In 1902 there were 8,763,197 tons of coal produced.
In 1906 there were 11,422,027 tons of coal produced.

A review of the coal-mining industry for 1907 shows that Indiana Coal is not only holding its own in the home market, but is reaching out in adjoining and distant States, adding new territory in the face of a strong competition in the various markets. This fact is evidenced by a comparison of the output of the present year with that of 1906 and 1905. In 1906 there were 11,422,027 tons produced by the mines exclusive of the mines working ten or less men, an increase of 426,955 tons over that of 1905. The same mines during 1907 (the month of December estimated) produced 11,692,702 tons, an increase of 270,675 tons. Of this amount about one-half was consumed in Indiana and the other half shipped to other States. Prices have been better and steadier than for a number of years past, ranging from 90c. to \$3.25 for mine-run. Of the total production about 724,000 tons were block coal, a decrease of about 22,670 tons as compared with 1906. The average price at the mine being about \$2.40 for the year.

While a careful review of the mining industry in its many phases, viz., total production, wages paid, number of miners and workmen employed, etc., shows only a slight increase over the banner year of 1906, the following conditions are said to have contributed to the lack of a corresponding increase. The first and most potent was a continuous car shortage for at least two-thirds of the year; a shortage of miners in some localities and the refusal of miners to work during certain periods since Oct. 20, when currency could not be obtained to meet the wages.

The more stringent mining laws, the product of the last Legislature, were rigidly enforced, and, as a consequence, there have been fewer accidents resulting in fewer deaths and a less number injured. Of the ten strikes during the year

all were local and none lasted over fifteen days. In one instance the miners occasioned a shutdown, which under the agreement, licensed the operators to deduct \$1 a day from their wages for the time they were out. The miners reluctantly returned to work and have sued for the wages deducted by the operators. A test case in this matter will likely reach the Supreme Court.

The number of new mining companies organized and new mines opened during the year exceed the number of mines closed by 16. There has been a slight increase in machine mining and the mining properties generally improved.

The Indiana operators are inclined to be optimistic relative to the future coal-mine industry. They feel assured that the new steel city of Gary will soon be consuming hundreds of thousands of tons of Indiana coal, and that the iron ore of Indiana will in time become sufficiently developed to make a large demand upon the mines. They are also appreciative of the work of the Indiana Railroad Commission in the enforcement of a rule conducive to an equitable distribution of coal-carrying cars and equalization of rates.

Coal Mining in New Mexico

By J. E. SHERIDAN*

During the fiscal year ending June 30, 1907, the coal-mining industry of New Mexico made greater progress than in any preceding year, both as to percentage of increase of production, and by the installation of machinery and equipment of the latest and most improved type, of as great efficiency as is found in use upon any of the great coal-producing properties of the Eastern States or of Europe.

With the present equipment the coal mines of New Mexico can easily double the output of the past year, if a full quota of miners, and ample transportation facilities can be secured. The shortage of these two factors of production has restricted the output of the mines fully 50 per cent. during the past fiscal year, as the demand far exceeded the production of the mines, while the competition of purchasers demanding the product caused a rise of prices which guaranteed a very big profit to the operators, and induced them to use every effort to supply the demand, but without avail, hampered as they were by a dearth of miners and lack of transportation facilities, causing the shutting down of some of the principal mines from one to two days per week, which restricted the output fully 15 per cent. and probably more. In view of this shortage of cars in which to ship the product it is doubtful that the production could have been increased

*United States Mine Inspector, Silver City, New Mexico.

even if a full force of miners had been available.

The gross production of the coal mines of New Mexico for the fiscal year ended June 30, 1907, was 2,302,062 tons of 2000 lb.; amount used in operating the mines, 80,678 tons; leaving the net product shipped from the mines, 2,221,384 tons, an increase of net production over the preceding fiscal year of 494,646 tons; or a percentage of increase of net production, 28.64; as against 17.29 percentage of increase for the preceding fiscal year. The estimated production of coke was 203,437 tons, valued at \$3.50 per ton at the ovens.

It is safe to assume that the percentage of increase of coal production, shown above, has been maintained to the end of the calendar year 1907, as all of the coal mines have been flooded with orders for coal, and thus far have been unable to fully supply the demand. The domestic market of California would absorb fully double the production of the Gallup coal field, but there is always an unfilled demand from that quarter for New Mexico coals, especially the coal of the Gallup field, which maintains a preference for domestic uses both at home and in distant markets.

UNFAVORABLE OUTLOOK.

The outlook for demand for coke is not so favorable during the ensuing year, as the shutting down of many large copper furnaces in the Southwest has lessened the need of coke among those principal consumers. These copper-mining companies had very large stocks of coke on hand when the decrease in demand for copper came and caused shutting down of some of their furnaces. These stocks of coke are now being utilized, to some extent curtailing the demand for new product. But it is doubtful if the decreased demand will be materially felt by the coke producers of New Mexico as the entire production of New Mexico has not been a tithe of the demand upon them for coke; a great deal of the coke for the Southwestern markets having been shipped from Colorado, West Virginia, Pennsylvania, and even from Germany and Australia, via San Francisco.

It is probable that the present stagnation in the copper-mining industry may redound to the benefit of the New Mexico coal mines. Many of the men thus thrown out of employment are seeking work in the coal mines of this Territory, and the coal mines are nearer having a full complement of miners than at any time in the past four years.

During the past fiscal year there were 2966 men and 93 boys employed in the coal mines, an increase of 676 men and 29 boys over the number employed during the preceding fiscal year.

The year was an exceedingly unfortunate one on account of fatalities in the mines, 31 men being killed, a percentage of 1.04 of the men employed, as against

a percentage of 0.382 in the preceding year. Heretofore New Mexico has compared favorably with the large coal-mining districts of the world, as to the lives lost in the mines; but during the past fiscal year two extraordinary accidents increased the ratio of fatalities beyond the usual degree, one, an explosion at the Dutchman mine, whereby 10 men were killed, and the other a mine fire in which three men lost their lives.

Coal mining in New Mexico is starting the new year most auspiciously. A larger force of miners, and equipment of the most modern type and of sufficient capacity for greatly increased production would warrant the expectation of the most prosperous year thus far for the coal-mining industry in New Mexico.

Coal in Pennsylvania in 1907

By F. W. PARSONS

If the production of coal in Pennsylvania could have been maintained throughout 1907 at the rate recorded during the first half, the increase in production over all other years would have been enormous. As it was, the slackening in industrial activity and the mild winter caused a considerable curtailment in output. However, the year's production will still be found to greatly exceed that of any previous twelve months.

Present conditions have not existed without some redeeming features, and the decrease in tonnage of other kinds of freight has given the railroads a better chance to carry their coal to market before severe weather has set in. The anthracite production was affected less than the bituminous industry or probably any other line of business. The anthracite tonnage for the month of October was the largest in history for any one month, while the shipments of anthracite coal for the entire year were about 67,027,672 long tons, an increase of nearly 12,000,000 tons over the 1906 shipments.

An investigation of present conditions, shows that the tremendous shipments recorded did not entirely satisfy the market's demands; in fact much of the increase in production went to satisfy the Eastern trade, without taking into account the increased demand coming from the West. As a result of this condition, the lake shipments were not up to expectations and the mining companies are now engaged in a rush to fill orders for lake and Western inland markets. The anthracite coal passing through Sault Ste. Marie canal for the season up to Nov. 1 is reported as follows, in net tons:

	1906.	1907.	Changes.
Anthracite . . .	823,800	1,249,844	I. 426,044

Great activity prevailed among the anthracite and bituminous coal interests throughout all parts of the State, and as

a result, many new mines were opened. Several new mines began production during 1907. One of these newer operations owned by the Jones & Laughlin Steel Company, and known as Vesta No. 4 mine at California, Penn., is said to be the largest bituminous operation in the world. During the first month of the mine's existence, the 1400 miners produced 174,338 tons of coal. The largest output for a single day was 7225 tons. Twenty-eight electric locomotives are used to haul the coal to the surface.

MINE DISASTERS

Anthracite operators were busy fighting several mine fires, but as a whole, the year 1907 did not show any considerable loss of life or property in the anthracite districts. The bituminous mines were not so fortunate; the last month of the year brought two serious disasters, the first occurring Dec. 1 in the Naomi mines of the United Coal Company at Fayette City, Penn. This accident resulted in the death of 34 miners and was pronounced by the coroner's jury to be due to an explosion of gas and dust ignited by sparks from the electric wires, or by an open light at some point not definitely located. The jury which investigated and returned the verdict condemned the use of electric wires on return air currents, and also advised against the use of open lights in gaseous mines. The second explosion occurred at the Darr mine of the Pittsburg Coal Company near Jacob's Creek, Penn., and resulted in the loss of about 150 miners.

The frightful explosions which occurred near the close of the year directed the attention of the whole country to the localities afflicted. Much discussion was aroused, and considerable good may result from the agitations started. It is impossible entirely to eliminate mine accidents, but the removal of dust, the sprinkling of mines, the use of safety lights, the abolition or careful insulation of electric wires in gaseous mines, the better supervision of shot-firing, and the employment of flameless explosives should greatly reduce the number of mine explosions. The situation is one that deserves careful handling, and hasty, ill-advised legislation should have no place in the solution of the many problems involved. It will take time to inaugurate the many reforms necessary, and there is no doubt that all intelligent coal mine managers will heartily cooperate to better present conditions.

The anthracite companies are leading all other operators in inaugurating new reforms that will tend to place coal mining on a higher and safer basis. Nearly all companies have efficient first-aid corps, and several of the larger companies are carrying on lecture courses and institute meetings which are sure to prove beneficial to the miners by increasing their

understanding of the problems and dangers that accompany their work.

Several companies are using steel props to advantage and concrete barns and overcasts are common in many districts. Chemical fire engines designed to go underground are kept constantly ready for emergency use in case of mine fires. The larger companies also have a specially designed railroad car which is equipped with all modern appliances and such apparatus as is necessary for rescue or first-aid parties when entering a mine after an explosion or other serious accident. These cars contain safety helmets, some of them of American design. In several instances, these helmets have well proved their worth. Emergency cars of this sort are kept constantly ready at some convenient point, and immediately on the occurrence of an accident at any mine, the car is rushed to the property affected.

LEGISLATION

No great changes in the mine laws were made during the past year and practically no efforts were made to enforce radical reforms. The employment of children at some of the mines caused considerable discussion. The Supreme Court of Pennsylvania in a recent case against the Pittsburg Coal Mining Company held that the act of June 2, 1891, prohibiting the employment of any person under 15 years of age to oil machinery in a coal mine is a valid exercise of the police power, and that under this act the employer cannot set up as a defense contributory negligence. A boy employed in violation of the statute is not chargeable with having assumed the risk of employment in such occupation, and any employer who violates the act by engaging a boy under the statutory age does so at his own risk, and, if the boy is injured while engaged in the performance of the prohibited duties for which he was employed, his employer will be liable in damages for injuries thus sustained.

The Illinois Coal Output During 1907

By DAVID ROSS*

The total output of coal in Illinois for the fiscal year ended July 30, 1907, was 47,797,354 tons. This is an increase over the preceding year of 9,479,773 tons, or 24.2 per cent. In our report for the fiscal year ended June 30, 1907, which is not yet printed, we have collected the production of Illinois mines by months. From this it appears that the difference in the production during the first and second periods of the year is only 1.6 per cent. in favor of the last six months. Estim-

*Secretary, Illinois Bureau of Labor Statistics.

ated on this basis the production for the calendar year ending Dec. 31, 1907, will be 48,562,112 tons. The total number of mines is 933, of which 424 were shipping and 509 local mines, employing in all 65,423 men.

The most important feature in connection with the industry in 1907 is the remarkable increase in the output, 98 per cent. of which was the product of shipping mines operating but 195 days during the year. From this it appears that the mines of Illinois, with present equipment, running approximately full time, could easily produce 75,000,000 tons per annum.

Utah's Coal Industry

By F. W. PARSONS

The year 1907 was the most prosperous in Utah's coal-mining history. During the early part of the year, the great problem confronting the operators was the scarcity of miners; this trouble was corrected when the smelters and metal-mining companies shut down. For the first time in many years, the coal operators now have a sufficient and satisfactory supply of labor. The other serious problem with which Utah operators have always had to contend is the railroad or transportation question. Cars were more plentiful this winter than heretofore and notwithstanding the reduced demand for coal and coke for smelting and metal-mining interests, the season has been most successful.

The Utah Fuel Company produces nearly all the coal mined in the State and is extending and opening several new properties. The Denver & Rio Grande Railroad Company controls the Utah Fuel Company and coal operators are much interested to know what steps the railroad company will take to place itself in accord with the "Hepburn law," which goes into effect May 1. At some of the mines of the Utah Fuel Company all shot-firing underground is done electrically, and many Eastern companies would find it to their advantage to adopt this system so successfully used in Utah. The system of sprinkling the mine workings is also admirable and is far in advance of the methods generally used in Pennsylvania and West Virginia.

Utah probably employs a larger percentage of Americans in its coal mines than any other State; at least 50 per cent. of the miners are American born. Of the foreigners, the Austrians are in the majority, while Italians, Finns and Greeks are largely employed. During the past year, a considerable number of Japanese were brought in; results proved that they make successful miners.

Much of the coal mined by the Utah Fuel Company is made into coke and is shipped to neighboring smelters. One contract for daily shipments of coke was

with the Amalgamated Copper Company for its Montana smelting works. When the curtailment in the output of copper was enforced, the orders for coke from this source were discontinued and as a result, a large number of coke ovens in Utah are now idle. This curtailment in the coke production has permitted the coal companies to supply domestic trade with large quantities of coal that otherwise would not have been available. This has removed the probability of another coal famine in Utah.

Coal Mining in West Virginia

By F. W. PARSONS

The coal production of West Virginia during 1907 was greater than that recorded in any previous year. The different railroads extended branch lines into new fields, and a large number of new companies started production. The all-absorbing problem, relating to coal mining, was that of the cause and prevention of coal-mine explosions. Much discredit has fallen upon the operators and the mining methods employed in West Virginia, because of the apparent inability to reduce the number of accidents.

The most notable mine accidents in West Virginia during the year occurred at the following places and on the dates given:

	No. of deaths
Jan. 24—Florentz	11
Jan. 29—Stuart	91
Feb. 4—Elkins	38
May 2—Charleston	11
Dec. 6—Monongah	345

The Governor and the members of the State legislature have been thoroughly aroused by the enormous losses of life and property that have occurred, and it is certain that some action will be taken which will tend to improve conditions and make coal mining safer. In order to show how lacking is our knowledge of mine explosions in general, it is only necessary to state that after carefully studying the facts relative to the various accidents, the opinions of many competent coal-mine superintendents and engineers radically differ as to the causes accountable. One authority will state without hesitation that an explosion was due to dust, while from an equally competent source will come the opinion that gas was the primary and destructive factor. So long as such extreme differences of opinion exist, it is evident that our mining education is incomplete.

A JOINT RATE DECISION

One of the most important cases affecting the coal industry in West Virginia during the year was the conclusion of the fight between the Loup Creek Colliery Company and the Virginia Railway Company (formerly the Deepwater Railway Company) and the Chesapeake & Ohio

Railway Company. The case was submitted to the Interstate Commerce Commission June 18, and was decided November 6. The complainant located at Page, West Virginia, on the Virginia Railway, nine miles from its junction with the Chesapeake & Ohio, applied for the establishment of through routes and joint rates, with divisions thereof, for the transportation, in carloads, of coal and coke over the two roads, from Page to the destination on the Chesapeake & Ohio outside of West Virginia, such rates in no case to exceed those applied by the Chesapeake & Ohio from the junction point of the new road and from other points on the line of the last mentioned carrier in the same rate group. The commission, after a thorough investigation, concluded its report by saying, "We do not believe that the facts of this case justify the exercise of the authority invoked. The complaint will therefore be dismissed."

In the northern part of West Virginia, practically all of the mines are controlled by the Fairmont Coal Company; in the central and southern parts of the State the independent companies still continue to hold their own. In the New River field, the New River Company continued to expand and is by far the most important operator. The New River Smokeless Coal Company passed from the control of Wittenberg interests to the Guggenheims.

NEW DEVELOPMENTS

A mine which is advertised as the largest bituminous operation in the world, began production in November, and shipped coal from the new town called Dorothy. The company is known as The Big Coal Company of West Virginia, and controls about 65,000 acres of land in Raleigh county. Seven seams of coal underlie the greater part of this territory, and are said to contain a workable thickness of probably 40 ft. Geologists claim that the entire tract contains more than 4,000,000,000 tons. The Chesapeake & Ohio Railroad Company extended its Cabin Creek branch for a distance of 15 miles to this property and has completed its extension to the new mining town established by the company. The mine is equipped to produce 500,000 tons a year, but the company expects to open several other properties at an early date and thus increase its output so that the annual production will be about 7,000,000 tons.

Bromine

The production of bromine in the United States in 1907 was about 1,062,000 lb. against 1,229,000 lb. in 1906. The average value per pound in 1906 was 15c.; in 1907 it was 13c. The importation of German bromide into the United States in 1907 was large.

There was an increase in the production in West Virginia, but a large decrease in the production of Michigan.

Coal Mining in Wyoming in 1907

BY RICHARD LEE

Although 1907 was successful so far as the Wyoming coal industry was concerned, the operators were greatly handicapped by the scarcity of labor and inability of the railroads to furnish cars and transport the coal. The business depression has helped the labor problem and somewhat relieved the car situation.

Practically all of the coal mines in Wyoming are unionized and the companies have been forced to adopt the check-off system, whereby the company is obliged to deduct all union dues, fines, etc., from each miner's pay before any store bills or other settlements are made. The miners at the Union Pacific mine, near Rock Springs have been organized for the first time in 20 years. The utter impossibility of securing any kind of efficient labor prevented the company from opposing the union organizers.

In the northern part of the State, the Sheridan Coal Company experienced great trouble in securing a sufficient number of miners, while in southern Wyoming, the Union Pacific mines had the great difficulty in employing labor. The mines of the Amalgamated Copper Company at Diamondville, on the main line of the Union Pacific Railroad, shipped a large part of their output to the mines and smelters at Butte, Mont.; after the closing down of the metal mines at Butte, the Diamondville coal was shipped to other points for supplying the domestic fuel demand. The Kemmerer Coal Company and other operators stopped taking large winter orders as early as last August, having sufficient orders booked to keep them busy during the greater part of the winter.

Petroleum in California

The production of petroleum in California in 1907 is estimated at 40,000,000 bbl., valued at \$13,800,000, which is a great increase in quantity over 1906. The average value at the wells was 25c. per bbl. up to the end of May, when the price rose to 40c. per bbl., which continued during the remainder of the year.

Phosphate Rock

The total production of the United States is estimated at 1,917,000 long tons in 1907, against 2,052,742 in 1906. Up to the end of October the exports were well ahead of the previous year. Tennessee made a smaller output than in 1906 and the shipments from Florida and South Carolina also showed a decrease.

Coal and Coke Production in the United States

The following table has been compiled largely from data communicated by the several State mine inspectors, estimates having been made only where no such statistics were available, but in all cases upon the basis of good information.

PRODUCTION OF COAL IN THE UNITED STATES.		
States.	1906, Sh. Tons.	1907, Sh. Tons.
Bituminous:		
Alabama.....	12,851,775	14,100,000
Arkansas.....	1,164,268	2,400,729
California & Alaska.....	1,31,764	32,000
Colorado.....	10,293,528	10,874,424
Georgia & N. Carolina.....	332,910	335,146
Illinois.....	41,480,104	48,562,112
Indiana.....	11,422,027	11,622,702
Indian Territory.....	2,860,200	3,450,000
Iowa.....	7,257,383	7,401,618
Kansas.....	6,016,358	6,921,482
Kentucky.....	9,859,847	10,425,000
Maryland.....	5,435,453	5,500,000
Michigan.....	1,346,338	1,941,771
Missouri.....	3,563,294	3,895,579
Montana.....	1,829,921	2,100,000
New Mexico.....	1,807,416	2,350,000
North Dakota.....	805,689	375,200
Ohio.....	27,731,640	31,446,019
Oregon.....	79,731	80,100
Pennsylvania.....	129,293,206	147,790,223
Tennessee.....	6,259,275	7,000,000
Texas.....	1,312,873	1,500,000
Utah.....	1,772,551	2,050,000
Virginia.....	4,254,879	4,350,000
Washington.....	3,276,184	3,500,000
West Virginia.....	43,290,350	47,295,965
Wyoming.....	6,133,994	6,200,000
Total Bituminous.....	341,021,867	383,480,070
Anthracite:		
Colorado.....	41,268	44,893
New Mexico.....	15,000	12,000
Pennsylvania.....	71,282,411	85,006,371
Total Anthracite.....	71,338,679	85,063,264
Grand Total.....	412,360,546	468,543,334

PRODUCTION OF COKE IN THE UNITED STATES.		
Alabama.....	3,075,641	3,255,000
Colorado.....	980,303	1,041,995
Georgia & N. Carolina.....	75,000	70,000
Illinois.....	60,234	65,721
Indian Territory.....	275,900	287,000
Kentucky.....	85,096	100,000
Montana.....	49,045	48,000
New Mexico.....	159,107	183,437
Ohio.....	291,437	279,064
Pennsylvania.....	23,108,883	26,243,205
Tennessee.....	483,428	505,609
Utah.....	282,195	275,000
Virginia.....	1,572,000	1,606,097
Washington.....	45,642	50,000
West Virginia.....	3,746,091	4,270,542
Other States.....	1,750,000	1,810,000
Total.....	36,040,002	40,090,670

If the production of coal during 1908 shows as large an increase as in 1907, the long-predicted half-billion total will be reached. To satisfy our fuel demands during the last 12 months we have used up 69 square miles of our available coal lands.

Barytes

BY EDWARD K. JUDD*

The prevailing high prices on finished barytes throughout 1907 stimulated the output from all the established districts, led to the development of some not hitherto productive deposits, and caused plans to be drawn up for several new grinding plants. As in previous years Missouri produced more than any one other State, Tennessee, Virginia and North Carolina

*Mining engineer, New York.

following in the order named. Kentucky for the first time reported a substantial output.

The principal new developments occurred in Missouri, Kentucky and Nevada. In Missouri a new grinding plant was planned by local capitalists at De Soto, in the center of the producing district, but its erection was not begun at once. The same interests now have in full operation, at East Alton, Ill., a plant for the manufacture of barium salts and compounds, the crude material for which comes from the Missouri district. The De Soto company has acquired mining rights over a large territory and has arranged to consume the output of other smaller producers.

Considerable attention was devoted in 1907 to the well known but previously unexploited barytes deposits of central Kentucky. The Dix River Barytes Company began mining at a number of points around Danville, shipping its crude product to New York for grinding. The deposits in this locality are veins with well defined rock walls and certain parts of the deposits owned by the Dix River company yield appreciable amounts of strontium. At Nicholasville, south of Danville, the Jessamine Barytes Company opened deposits and erected a grinding mill.

A promising new deposit was developed in 1907 by New York capitalists near Blair, Nev. The barytes occurs in a vein of which galena is the only other constituent. The company intends to build a mill for separating the two minerals; the lead will then be sold to smelters and the barytes, already crushed and thoroughly cleaned by the jigging process, will be ground for market.

The Barium Production Company, of New York, in 1907 secured control of the Lake Ainslie barytes deposits on Cape Breton Island, and will establish a grinding plant in the vicinity of New York, with the intention later of going into the manufacture of barium salts and compounds. Another new concern is the Georgia Barytes Company of Asheville, N. C., which will develop deposits and erect a small mill in the South. Development of the barytes mines on Crowders mountain, Gaston county, N. C., was resumed in 1907 by the Clinch Valley Barytes Company of Virginia, and substantial shipments were made from the Lawton mine.

The year 1907 was an exceedingly active one in the paint trade, and this, coupled with the shortage of crude material during the previous year, caused prices on finished products to advance by at least 10 per cent. early in 1907. Prices ranged high throughout nearly the entire year, until a slight recession occurred in December. Quotations at the end of the year were about as follows: Foreign, first-class, water-floated, \$21.50; Domestic, first-class, water-floated, \$20.50; Domestic, first-class, dry-ground, \$18@20; Domestic, off-color, \$13.50@17.50 per short ton. Imports of finished barytes were greatly stimulated by the advancing prices.

The Petroleum Industry of the United States

Production of California, Texas, Louisiana, Lima, Illinois, Mid-Continental and Appalachian Fields. Developments in Various Districts

PRODUCTION 165,877,906 BARRELS

The production of petroleum in the various fields is treated in the following articles. The total production in 1906 shows a large increase over 1905. This was due especially to the California and Mid-Continental fields, and the remarkable development in Illinois. On the other hand, the falling off in the Lima field was equally remarkable.

The Appalachian Oilfields

BY HAROLD C. GEORGE*

The production of the Appalachian or high-grade oilfields declined to a very low point; it is with the greatest difficulty that it is maintained at about 70,000 bbl. a day. Desirable territory is becoming very scarce and only wells of small production are to be found by drilling. There was an earnest search for new pools, constantly going on, but every month showed a large percentage of dry holes and a constantly decreasing production.

West Virginia, the region which formerly furnished many large gushers, now seldom produces a large well, and those that are found are short-lived.

The obliteration of the color line in classifying high-grade petroleum, and the advance in price, over that of 1906, undoubtedly stimulated operations; and thus maintained the production nearly up to that of the two previous years. Conditions were very similar to those of 1906. No new pools of importance were discovered and the new wells drilled were widely scattered.

The accompanying table gives a summary of the operations in the Appalachian fields in 1907.

OPERATIONS IN THE APPALACHIAN OILFIELD IN 1907.

Field.	Number of Wells Drilled.	Daily Production.	Daily Production per Well Drilled.	Per Cent. Dry Holes.
Allegheny Field.		Bbl.	Bbl.	
New York State.	575	1,114	1.9	16.0
Pennsylvania.....	3,611	12,176	3.3	21.0
West Virginia.....	1,320	21,300	16.1	38.0
Southeast Ohio.....	1,335	6,793	5.9	39.5
Kentucky & Tennessee.....	212	2,006	9.4	32.0
Total.....	7,053	43,389	6.1	27.0

*Superintendent, Quincy Lead and Zinc Company, Platteville, Wis.

Pennsylvania ranks first in the number of wells completed, while West Virginia ranks first in production.

Both West Virginia and Southeast Ohio showed a very large percentage of dry holes, which helped greatly to reduce the average daily production per well drilled. The average daily production of the new wells in the Appalachian field was estimated on the daily average production of each for the first month after being drilled. The daily production of the new wells from the time they were drilled until Jan. 1, 1908, is doubtless much less, probably about 35,000 bbl. or half of the total daily production, including that from both new and old wells.

The total production of the Appalachian field in 1907 was 25,500,000 bbl. as compared with 27,345,600 bbl. in 1906 and 28,324,324 bbl. in 1905.

The average monthly price paid for the petroleum from this field was as follows:

AVERAGE MONTHLY PRICE PER BARREL OF PETROLEUM FOR 1907.

January.....	\$1.58	July.....	\$1.78
February.....	1.63	August.....	1.78
March.....	1.68	September.....	1.78
April.....	1.78	October.....	1.78
May.....	1.78	November.....	1.78
June.....	1.78	December.....	1.78

The Lima Field

BY HAROLD C. GEORGE

The Lima oil field, or more properly the oil fields of northwest Ohio and Indiana, experienced a great decrease in production for 1907. Large numbers of wells were abandoned, and the new wells did not produce as did the new wells of former years.

In 1907 there were 930 wells completed in northwest Ohio with a total daily production of 8100 bbl. or 8.7 bbl. per well drilled; 15 per cent. of the wells drilled were dry holes.

Indiana showed 682 wells completed with a total daily production of 5673 bbl. or 8.3 bbl. per well; 20 per cent. of the wells drilled were dry holes.

The total production of the Lima field for 1907 was 8,030,000 bbl. as compared with 25,680,000 bbl. in 1906. The average price paid for North Lima was 93½c. per bbl. and for South Lima and Indiana 88½c. per barrel.

Oil and Gas in the Mid-continental Field

BY ERASMUS HAWORTH*

During the year 1907 a very large development was produced in the Mid-Continental field. The oil development was confined almost entirely to the Indian Territory, now Oklahoma, but a large supply of gas was developed in Kansas. Likewise the total oil production in the Mid-Continental field was produced very largely by Oklahoma. It is impractical to quote figures for each State, as the statistics obtainable are gathered in such a way that no discrimination is made.

OIL

The Prairie Oil and Gas Company (Standard) was the principal consumer of oil, although other interests, such as independent pipe-line companies, independent refineries and dealers in fuel oil consumed a comparatively large amount. The accompanying table gives a summary of the monthly reports of the Prairie Oil and Gas Company, showing a total of 35,756,366.76 bbl. handled by this company. Much the greater part of this was used for refining purposes, so that only 10,762,333.34 bbl. were stored. This brings the total storage of the Prairie Oil and Gas Company at the close of 1907 up to the large sum of 33,703,367.74 bbl. To obtain the total production of the Mid-Continental field, we must add to these figures the consumption by the independent refineries, the consumption as fuel oil, and the runs by the independent pipe-line company.

Nine independent refineries were in operation during the year. The one at Paola was bought by the Standard Oil Company during the year; a few other smaller ones were operated irregularly and these, when in full operation, had a capacity of only a few hundred barrels per day. The largest refineries are at Humboldt and Chanute. A conservative estimate of the total consumption of the independent refineries plus the total crude oil used for fuel is 2,309,500 bbl.

The Gulf Pipeline Company completed a line from the Glenn pool to the Gulf of Mexico and began pumping oil about Oct. 1. This company began storing oil in January; before the pipe line was built it shipped largely by rail, and even yet ships small quantities by rail from wells

*State geologist and professor of geology, University of Kansas, Lawrence, Kan.

not yet connected with the pipe line. A fair estimate of the business done by this company during the year is 5,381,794 bbl., the output during the last half of December only being estimated. The Texas company also is shipping large quantities of oil from the Mid-Continental field. It began shipping by rail in March; by October the company had completed its pipe line as far south as Dallas and hopes that this will reach tidewater by the end of the year. The Texas company handled a total of 3,359,265 barrels.

The Haywood Company, of Texas, also is shipping extensively by rail, supplying fuel oil to various parts of Texas. It is not known definitely how much this company has produced, but presumably about 750,000 barrels. These added to the figures for the Prairie Oil and Gas Company, given above, make a total of 47,556,905.76 barrels.

abandoned. But the company that drilled the well soon began to acquire other leases; the suspicion of others was aroused and a miniature boom resulted. In a short time a number of different companies were drilling on different leases and a nice group of oil wells and gas wells were developed; the larger of the oil wells have a capacity of about 500 bbl. oil per day and the gas wells from 5,000,000 to 15,000,000 cu.ft. of gas.

During the first half of December what appears to be a possible repetition of the Glenn pool was developed in the north-east part of Osage reservation, only a few miles west of Dewey, the largest well being on lot 32. Previously, the Dewey-Copan field was limited on the west by a number of dry wells. These checked developments in a westward direction, but someone finally grew bold enough to go a few miles farther west, with the re-

companies are paying as high as 3c. per 1000 cu.ft. for gas delivered to them directly from the wells; a number of private producers are disposing of their gas in this way. Other producers have contracts at a less price. Kansas now has more than 125 towns and cities using natural gas; a great majority of these use meters and pay at the rate of 25c. per 1000 cu.ft., some even 30c. The Kansas Natural Gas Company is the largest retail dealer, but by no means the only one. The pipe line of this company goes as far north as St. Joseph, Mo., taking in the larger cities of St. Joseph, Atchison, Leavenworth, Lawrence, and Topeka, and also the smaller cities and towns between. A pipe line also reaches Kansas City, which has an aggregate population of nearly 400,000, about two-thirds of whom are now using natural gas. Another pipe line belonging to the Kansas Natural Gas Company is carried east from the gas fields by way of Parsons, Oswego, Columbus, Pittsburg, and into the entire zinc-mining district of southeastern Kansas and southwestern Missouri, where the company has an aggregate sale at retail price of close to \$15,000,000 per year. A portion of this is sold at the rate of 25c. per 1000 cu.ft., but a much larger portion, that used for generating power, is at the rate of 10c. per 1000 cu.ft. Another pipe line is carried westward to Wichita and beyond, connecting with all the intermediate towns. If we reckon this gas and that consumed by the cement plants, smelters, brick yards, and lesser manufacturing plants at 3c. per 1000 cu.ft., the total production from Kansas alone for 1907 will have a value of between \$5,000,000 and \$7,000,000. Should it be estimated at the actual retail price, the total value would be very much greater, but here again the complexity is so great that this has not been attempted. The pipe line companies make various rates to different factories from less than 10c. upward, depending on the size of the factory and the particular kind of a bargain that may be made. Were the entire consumption paid for at specific rates, difficulties would not be so great.

NATURAL GAS IN OKLAHOMA

But little gas has been marketed from Oklahoma except for local consumption. One small pipe line was laid across the State line near Caney and a large amount of gas is being conducted through it and delivered to the pipe lines of the Kansas Natural Gas Company. The Secretary of the Interior and the State of Oklahoma are making efforts to prevent any further transportation of gas out of the State. Early in the present session of the Oklahoma legislature a bill to that effect was passed and signed by the Governor, and is now a law. It is very stringent, providing, among other things, at least according to newspaper reports,

CRUDE OIL BOUGHT BY PRAIRIE OIL AND GAS COMPANY DURING 1907.

Month.	Total Runs, Bbl.	Daily Average, Bbl.	Deliveries, Bbl.	Stored, Bbl.
January.....	2,337,164.90	75,392.42	1,646,090.76	691,074.14
February.....	2,292,116.70	81,861.31	1,759,151.91	532,964.79
March.....	2,795,969.12	90,192.55	1,965,586.57	830,382.55
April.....	3,098,915.89	103,297.20	2,166,236.16	932,679.73
May.....	3,023,776.68	97,541.18	2,342,348.78	681,427.90
June.....	3,021,285.46	100,709.52	2,162,624.65	858,660.81
July.....	3,053,284.85	98,493.06	2,325,471.93	727,812.92
August.....	3,213,547.64	103,662.83	2,281,436.97	932,110.67
September.....	3,089,627.93	102,987.60	2,200,032.11	889,595.82
October.....	3,486,804.13	112,477.55	2,267,631.40	1,219,172.73
November.....	3,231,769.51	107,725.65	1,942,309.80	1,289,459.71
December.....	3,112,103.95	100,390.45	1,872,689.40	1,176,991.57
Total.....	35,756,366.76	.....	24,931,610.44	10,762,333.34

OIL PRODUCTION, MID-CONTINENTAL FIELD, DURING 1907.

Prairie Oil and Gas Company.....	35,756,366.76 bbl.
Independent Refineries and Fuel.....	2,309,500.00
The Gulf Pipe-line Company.....	5,381,794.00
The Texas Company.....	3,359,245.00
The Haywood Company.....	750,000.00
Total.....	47,556,905.76 bbl.

OIL DEVELOPMENTS

The most remarkable developments during 1907 were in the Glenn pool located about 10 miles south of Tulsa, Oklahoma. Here a number of wells with an initial capacity close to 2000 bbl. per day have been developed and also many others producing more than 1000 bbl. per day. The Glenn, therefore, is the most remarkable pool yet developed in the Mid-Continental field. How long it will continue to be so productive, of course, no one can tell, but it is certainly one of the greatest oil fields ever developed in America.

About the middle of the year considerable excitement was caused by finding oil near the new town of Morris, 30 miles south from the Glenn pool toward Ardmore; a few good wells were obtained, but not much drilling had been done before a number of dry wells were obtained, a fact which checked development.

A nice field has been developed along Hog Shooter creek, from 6 to 15 miles southeast of Bartlesville. Late in 1906 a well was drilled and plugged; then a report was given out that the well was

sults described. It is reported that one well has been obtained equal, if not greater, than the biggest well of the Glenn pool.

The districts, productive at the close of 1906, remained equally productive during 1907. The shallow field in the Alluwe-Chelsea district has sustained its production, although but few new wells have been brought in, especially since the middle of the year. This is also true with reference to the Dewey field, the Bartlesville field, and practically all the others. A good healthy activity prevails, but developments have been confined principally to pools already opened up.

A number of different rulings were given out by the Secretary of the Interior; some of these stimulated development, but the greater number had the opposite effect. During October a series of rulings were made regarding oil royalties, gas royalties, and the transfer of leases; these rulings were so objectionable to operators that development work was practically stopped. The royalties in many instances were increased and in some other ways restrictions were enforced which were very objectionable to the operators.

NATURAL GAS IN KANSAS

Every year it becomes more difficult to estimate the value of gas produced in Kansas. At the present time pipe-line

that no private individual shall pipe gas even within the State, the object being to make all pipe-line owners public corporations of record so that the authorities may the better cope with various attempts to get gas across the State line. Steps have already been taken to place the one pipe line, now crossing the State line, into the hands of a receiver, hoping thereby to close it. In Oklahoma, consumption is confined almost entirely to domestic uses in the various cities and towns, for but few factories are as yet established. At Bartlesville, two zinc smelters are in operation and a third one is building; these give to that town an extra consumption. At Dewey, four miles north, the portland cement plant has just begun operations.

The total value of gas in Oklahoma actually consumed in 1907 is approximately \$1,500,000, the estimate being based on a rate of 3c. per 1000 cu.ft. This statement, however, of itself would convey an extremely imperfect idea of the possibilities of gas production in Oklahoma. Probably no other place in the world, now or at any other time, ever had so much gas developed ready for immediate consumption as has Oklahoma today. Natural gas occurs everywhere throughout all the productive oilfields. Many wells range from 15,000,000 to 30,000,000 cu.ft. per day, while a few are reported to have a capacity close to 40,000,000 cu.ft. per day. The large amount of fuel now awaiting consumption is astonishing. And this, too, in face of the fact that all the development companies, with but few exceptions, have been trying to keep away from gas in their search for oil. What the result will be in the future when an intelligent search for gas is made, no one can state at the present time, but the value of the annual production certainly will reach several million dollars.

RECENT DEVELOPMENTS IN KANSAS AND OKLAHOMA

In Kansas, considerable search was made for gas, the difficulty of piping gas from Oklahoma having served as a strong incentive. The most remarkable individual field discovered is about six miles southwest of Chanute. Here, on the high land between the Neosho and Verdigris rivers, a field has been developed almost entirely within the past year; some wells of this district are so large as to compare favorably with the best of the wells drilled in Montgomery county two years ago. Wells ranging from 2,000,000 to 30,000,000 cu.ft. per day seem to be comparatively common.

Another commercially important field, developed within the past year, lies to the east of Fredonia. The wells here are not very large, ranging from 3,000,000 to 5,000,000 cu.ft., but the field is so situated that the flow is consumed by various nearby manufacturing industries. In a similar manner, considerable development has

been made to the northeast of Chanute, or southeast of Humboldt, near the southern line of Allen county; this field extends eastward more than half-way to Savenburg. The wells here, likewise, are comparatively small, but in the aggregate produce a large quantity of gas. Still another field of equal importance is just now being developed near Hale, in the northeast part of Chautauqua county. Wells from 3,000,000 to 5,000,000 cu.ft. per day are comparatively common.

An interesting small gasfield has been opened up near Elmdale, in the Cottonwood river valley, near Cottonwood falls. Here is a well marked anticlinal ridge. A member of the Kansas State Geological Survey suggested to certain citizens of Elmdale that it would be a good place to prospect for gas; accordingly a number of wells were drilled only a few hundred feet deep and a flow of shallow gas was obtained; the wells vary in flow from 500,000 to 1,000,000 cu.ft. per day. A similar condition exists to the southwest in the vicinity of Augusta, where shallow but good gas is obtained in a number of wells; the anticlinal ridge is not so fully marked there as at Elmdale. The now somewhat famous gas at Dexter is obtained from a similar anticlinal ridge, but the quality of the Dexter gas is so different from that at Elmdale and Augusta as to cause one to think that it comes from an independent pool.

The gasfield at Arkansas City continues to be very interesting; it is similar to the Augusta-Elmdale field. The gas is first-class in quality and is much greater in quantity than has as yet been developed at either of the other two places. A flow of gas has been developed sufficiently to supply Arkansas City and still leave a surplus. What future developments will bring forth, of course, is largely conjecture, but it looks as though important developments may be expected in this district near and between Elmdale and Arkansas City.

In Oklahoma, gas was found in many new wells along the ridge east of Bartlesville and north practically to the State line; a few large wells, in what appears to be the same field, developed across the line in Kansas. South, along the Hog Shooter, good gas wells are also found. Here the gas lies underneath the oil and frequently, when a well drilled for oil goes dry, it is carried deeper and a good gas well obtained. The same is true regarding the region east of Collinsville, where wells, having a capacity of from 5,000,000 to 12,000,000 cu.ft. per day, are obtained. Also a number of good gas wells have been obtained in the vicinity of Tulsa and West of Red Fork, in the district surrounding the Glenn oil pool, and also near Muskogee; the boundaries of this last field have approached closer to Muskogee than was the case a year ago.

While no distinctly new field was

opened up in Oklahoma during 1907, still gas was found in so many different places that the total possible production for the year was greatly increased.

GEOLOGY OF THE FIELD

The oil and gas produced in the Mid-Continental field, except that from the gas wells in the Elmdale-Arkansas City district and the Muskogee oilfield on the southeast, come mainly from Lower Carboniferous strata. In Oklahoma, the westward development seems to result in deeper wells, so that the productive horizon remains about the same. In Kansas, however, there is a slight modification of this and many of the oil wells and gas wells in the west part, near Longton and Howard, are not deeper than wells in the eastern part. This means that the productive horizon there is higher up geologically than in the heart of the field. Gas in the Elmdale-Arkansas City district is obtained fully 1000 ft. higher geologically than the gas about Iola, Chanute and Independence. The mouths of these wells are in the Permian, but the productive sandstones are in the uppermost part of the Carboniferous. Some oil has been obtained at Muskogee from sandstones evidently below the Mississippian. Few attempts have been made elsewhere to penetrate the formations below the Mississippian except in the vicinity of Chelsea, Miami, and a few other points, outside of the productive fields to the east. All of these wells, except those in the immediate vicinity of Muskogee, have been barren of oil and gas.

Petroleum Developments in Texas and Louisiana

SPECIAL CORRESPONDENCE

The prominent feature of the year was the unusually high price obtained for crude petroleum compared with the selling prices in other States of petroleum of a much higher specific gravity. Field operations produced nothing beyond the normal until November when the first gusher in the Anse Le Butte district in Louisiana was drilled in, too late in the year, however, to have any great influence on 1907 production. The 1907 production, as might be expected under prevailing conditions, shows a decline when compared with that of 1906, although the decrease is occasioned entirely by the reduced output of the Jennings district of the coastal field. The old Texas districts in this field as a rule maintained and in some cases increased their output, mainly by development is proved territory stimulated by the high prices paid for crude oil.

The production of petroleum in Texas in 1906 was 12,724,000 bbl. of which 11,600,000 bbl. came from the Gulf coastal field. The Louisiana output in 1906 was

7,110,000 and the total output of the Gulf coastal field, 19,834,000 bbl. These figures do not exactly agree with those published by the United States Geological Survey, whose figures are derived from the combined pipe-line shipments for the year, partly drawn from oil stored in the field by producers during previous years. The 1907 production of Texas is, as closely as it can be ascertained, approximately 13,250,000 bbl., of which the North Texas fields produced about 1,000,000 bbl.; the Louisiana production, 4,925,000 bbl., making a total for the Gulf coastal field of 17,175,000. The Louisiana figures may vary 100,000 bbl. or more during December, for it is difficult to predict the output of the Anse Le Butte district.

The figures given indicate a reduction of 2,185,000 bbl. in Louisiana, an increase of 524,000 bbl. in Texas and a decrease of 1,570,000 bbl. in the coastal field as compared with 1906. The producers, however, will receive about \$13,500,000 for their petroleum, a sum \$3,500,000 more than the value of the 1906 output, and probably in excess of what California will receive for a production nearly double in quantity.

The year up to Dec. 1 developed no new big field in Texas, and while the old districts were actively prospected by deepening old wells and drilling new ones in proved territory, fewer wildcats were drilled, mainly because operators preferred to take a chance in Indian Territory. The percentage of completed producers of fair capacity in the coastal field was high. According to the *Oil Investors' Journal* the number of wells completed in 11 months to Dec. 1, 1907, was 915, of which 681 are classed as oil producers and 21 as gassers. This record compares favorably with the 1906 data which showed 503 producers out of 728 completed wells. The Jennings district was the largest producer in the coastal field with an output of approximately 4,700,000 bbl., over 2,000,000 bbl. less than in the previous year. The output of the other leading districts is as follows: Humble, 3,095,000; Sour Lake, 2,589,000; Batson, 2,510,000; Saratoga, 2,338,000; Spindletop, 1,564,000 barrels.

COMMERCIAL CONDITIONS

The average price paid producers in 1906 was 46c. per bbl.; the Texas coastal producers averaging 50c., while the Jennings producer received only 39c. Taking the posted pipe-line credit balance prices as a basis of the prices paid for crude in 1907, it shows that quotations on Jan. 1, 1907, ranged from 55½c. for Batson heavy to 76c. for Sour Lake light. Under a strong market prices steadily advanced until on Aug. 1, the posted prices ranged from 85c. for Batson heavy to 95c. for Spindletop and Humble, and some oil was sold on contracts for more than \$1 per bbl. The market was weaker in September with prices unchanged and when the monthly report showed a surplus, prices

promptly slumped several cents and the decline continued in October and November until on Dec. 1, prices ranged from 67c. for Dayton to 80c. for Spindletop, and 75c. for Jennings. Further reductions at that time appear to be almost certain and indications were that prices might reach the level they had on Dec. 31, 1906. The average price for 1907 received by coastal field producers will be between 75c. and 80c. per barrel. The causes contributing to end the era of abnormally high prices, as compared with other fields, for crude petroleum of the gravity produced in Texas and Louisiana are: (1.) The refinery consumption of Mid-Continent crude displacing about 20,000 bbl. daily of Texas crude; (2.) The restricted consumption for fuel caused by the high price and to a small extent the use for fuel of the heavier grades of Mid-Continent crude shipped to Texas users by tank car; (3.) The general opinion that the Anse Le Butte district will be a large producer.

The petroleum stocks on Dec. 31, 1906, amounted to 8,150,000 bbl. and in every month up to and including August the consumption exceeded the output until on Sept. 1 the oil stocks were estimated at 5,450,000 bbl. In September for the first time in two years the output of the wells exceeded the consumption and the months of October and November added a surplus to the stored oil. There is every reason to assume that December will increase stocks at least 200,000 bbl. so that they will aggregate about 6,100,000 bbl., a decrease of 2,400,000 bbl. during 1907.

In order to obtain an adequate supply of crude suitable for refining at a lower price both the Texas Company and the Gulf Refining Company, who operate refineries at Port Arthur, constructed pipe lines to the Glenn pool of the Mid-Continent field. The Gulf pipe line runs north from Sour Lake to Tulsa, a distance of about 415 miles, and was completed in six months. It is 8 in. in diameter and has an estimated capacity of about 25,000 bbl. daily. From Sour Lake to Port Arthur the company has two 6-in. lines. The completed pipe line has only been in operation since September, but rail shipments of Mid-Continent crude were made as early as February, 1907, and increased in succeeding months.

The Texas Company pipe line runs from the Glenn field *via* Dallas to Humble where it connects with a pipe line to Port Arthur. While not in operation yet for its entire length the portion from Dallas north has been in use since July and the crude piped to Dallas has been stored or shipped south by tank cars.

Practically none of the Texas refineries now utilize coastal crude, and since April, 1907, the Standard Oil Company has made no shipments of crude by water to eastern ports.

LEGISLATIVE AND JUDICIAL PROCEEDINGS

During the year the State has vigorously

prosecuted the Standard Oil Company or its alleged subsidiary or affiliated corporations. The Waters Pierce Oil Company was convicted of violating the anti-trust law of Texas, fined \$1,549,500 and placed in the hands of a receiver appointed by the State courts. The Security Oil Company, Union Tank Line and other corporations were sued in November and an injunction was issued forbidding the removal of any of the defendants' property from the jurisdiction of the court. This order restrained the shipment, by water from Sabine, of refined oil and other products made at the large Beaumont refinery of the Security Oil Company. It also prevented the return of empty tank cars to the Glenn field and the Union Tank Line naturally refused to allow any more loaded cars to cross the Texas border. No modification of the injunction could be secured and having taken up its gathering lines in Texas the Security company was forced to close its plant.

In view of these actions which were directed almost entirely against the refining and distributing interests, it should be noted that there are, and have been for several years, large independent refineries at Port Arthur and other places which have been operated steadily and apparently successfully in competition with the Standard Oil Company. With regard to the market for crude it is well to quote the findings of Commissioner of Corporations Herbert Knox Smith, who in his report states "that in the coastal oil field the price of crude seems to be determined by genuine competition and regulated solely by the law of supply and demand." That this finding is just and accurate is undoubted, so that there is at least one large oil field in which the Standard Oil Company does not dictate crude oil prices.

While the officials grappled with anti-trust violators the State legislature introduced various enactments directed against producers and dealers in petroleum. The most drastic of these, "The Gross Receipts Tax Bill," threatened the very existence of the oil industry by the imposition of a heavy cumulative tax on every step necessary in the production and marketing of petroleum. This bill was vigorously fought and only passed after its exactions were greatly modified. It remains, however, one of the most conspicuous burdens imposed on any legitimate industry in the United States.

LOUISIANA DISTRICTS

The Anse Le Butte district is at present the only one that calls for special attention. It is near Breaux Bridge in St. Martin's parish. As long ago as 1900, Capt. A. F. Lucas, of Spindletop fame, drilled some shallow wells almost on the location of the new gusher, showing indications of oil and gas. Other persons, especially the Heywood Bros. and Robert Martin, obtained extensive interests in

the district and numerous wells have been drilled, some of which are small producers, for the reported output in 1906 was 24,000 bbl.

The Lake Oil Company began operations in 1905, sinking seven wells. The No. 7 well of this company was brought in on Nov. 14 last at a depth of 1850 ft., and while not properly cleaned out, its capacity was between 3000 and 4000 bbl. daily. The crude is a heavy fuel oil of 22.5 deg. B., very similar to that of Jennings, and the oil sand strata are said to be very thick. Other wells are going down and several strong corporations are in control so that the district will be promptly and efficiently developed. The district is favorably situated for oil shipments by rail, it already has a pipe line to Breaux Bridge, and the pipe line of the Evangeline Oil Company, between Jennings and the Atchafalaya river, passes less than half a mile distant from the new gusher.

The Jennings field output in 1907 varied from 276,000 bbl. in May to 495,000 bbl. in September. The proved territory was extended slightly to the southeast. The comparatively few wells are the largest average producers in Texas and Louisiana.

The Caddo district produced some gas wells of immense pressure and volume, but the production of oil failed to fulfil expectations, although the output increased from 4650 bbl. in 1906 to about 80,000 in 1907. A portion of the gas is piped to Shreveport and other pipe lines are contemplated. The Welsh district was another disappointment; its output remains small. Many operators, however, hold the opinion that it is only a question of time when both Welsh and Caddo will be large producers. Wildcat wells were sunk in several Louisiana parishes, but nothing of any commercial importance resulted.

TEXAS DISTRICTS

Wildcat operations, while not as numerous as in the previous year, were conducted in many counties too numerous to specify, especially as they did not open up any extensive new field. In Duval county some small rail shipments have been made from Piedras Pintas and in the San Antonio Mission field, ten miles south of San Antonio, several small wells were successfully brought in. While operations were active in the old gusher fields, nearly all the new wells were in proved territory. Humble led in field work, followed in order by Batson, Sour Lake and Saratoga. The findings of a new sand at a depth of 1170 ft. in Humble field enabled it to again lead the Texas districts in production, although its output was 500,000 bbl. less than in 1906.

The outlook for an increased production in Texas remains practically as it was in December, 1906. There are cer-

tainly large undiscovered oil deposits in the coastal field and eventually they will be located, but when no one can foretell. Regarding crude prices it is reasonable to believe that they will decline, when the enormous stocks and low prices prevailing in the Mid-Continent region are taken into consideration.

The Illinois Petroleum Fields in 1907

By H. FOSTER BAIN*

The year just closed was a very prosperous one in the petroleum fields of Illinois. The area was extended rapidly to the southeast, many gaps were filled in, new and lower sands were tapped, additional pipe lines were laid, a new refinery was built and the output was phenomenal.

At the close of 1906 the number of producing wells was estimated at 4185, and 532 dry holes were known to have been drilled. The total number of producing wells may now be estimated at approximately 9275, with perhaps 1300 dry holes. At this rate 86 per cent. of the holes put down have proved productive despite the fact that the outlines of the field are at many points yet to be determined. The new production for the year may be estimated at 130,000 bbl. daily. The detailed figures for the first 11 months of the year are given in the accompanying table, being derived from the careful monthly records of the *Oil City Derrick*.

WELLS DRILLED IN ILLINOIS, 1907.

Month.	Completed.	Production, Bbl.	Average Initial Production, Bbl.	Dry Holes.
January.....	253	9,439	44	41
February.....	356	9,842	32	55
March.....	351	10,392	35	60
April.....	387	11,083	32	40
May.....	493	13,329	31	64
June.....	639	18,807	33	75
July.....	521	17,375	38	72
August.....	461	11,240	27	45
September.....	400	10,967	32	62
October.....	363	8,157	25	82
November.....	430	9,780	28	80

The first oil was shipped from this field in June, 1905, and the shipments for that year, all of which went out in tank cars, amounted to 156,502 bbl. In 1906 a pipe line was extended into the territory, and the shipments were as follows:

OIL SHIPMENT FROM ILLINOIS IN 1906.

January.....	55,680 bbl.
February.....	65,209
March.....	19,352
April.....	102,862
May.....	267,746
June.....	410,654
July.....	610,401
August.....	778,463
September.....	722,168
October.....	463,819
November.....	350,985
December.....	549,711
Total.....	4,397,050 bbl.

*Director, State Geological Survey, Urbana, Ill.

There are now collecting mains extending from north to south throughout the field and four 8-in. lines (or an equivalent) from Martinsville, the central pumping plant, eastward across Indiana. A new line is nearly ready for service running westward to a large refinery built this year near Alton, Ill., by the Standard Oil Company.

The pipe-line runs for 1907, given through the courtesy of the Ohio Oil Company, were as follows:

PIPE-LINE RUNS FROM ILLINOIS, 1907.

January.....	752,670 bbl.
February.....	918,620
March.....	1,494,598
April.....	1,823,024
May.....	2,094,194
June.....	1,850,633
July.....	2,376,281
August.....	2,398,895
September.....	2,560,592
October.....	2,818,952
November.....	2,464,980
December.....	2,500,000 estimated
Total.....	24,032,439 bbl.

To these figures must be added something for the fuel oil shipped by cars from Duncanville, the oil used by the local refinery at Robinson, and the tank car shipments of the Pure, Sun, Cornplanter and other independent companies. It is probably safe to estimate the total production for the year at 25,000,000 bbl. or more. The oil, in the main grades 32 deg. or better, and sold at the standard price of 68c. per bbl. Only a limited amount was lower and sold at 60c. Of the year's production 12,128,676 bbl. are stored in the field by the Ohio Oil Company and a large amount is in producers' tanks.

NATURAL GAS

The situation as relates to natural gas did not change materially in 1907. Gas is found somewhat generally with the oil in Clark and Crawford counties. The wells, while showing good pressure and fair initial capacity, have usually proved short lived and so far the gas has been of local value only. In 1906 gas to the value of \$186,000 was utilized according to the U. S. Geological Survey. Probably not more than \$250,000 worth was sold in 1907. The southern part of the field in Lawrence county has yielded practically no gas. Late in December two wells were brought in here which yielded respectively 3,000,000 and 6,000,000 cu.ft. per day from a depth of 1500 ft. Considerable confidence in their probable life is felt and it is possible that an important gasfield is about to be brought in. A gas main is being laid to Vincennes, Ind., the largest nearby town.

COMMERCIAL CONDITIONS

This enormous development was accomplished in a thoroughly business-like and quiet manner. Leases are selling at very good prices and a bonus of \$150 to \$200 an acre with a royalty of one-eighth is not uncommonly demanded in the productive district. At the same time there was little speculation by those not familiar with the oil business and its risks. Prac-

tically none of the usual stock-peddling companies were organized, and there is a strong sentiment against them.

Experienced men have found this field an unusually profitable one despite the high bonus asked and certain other drawbacks. One conservative operator estimates that three out of four will make money. It is by no means unusual for a well to flow enough oil to pay for itself by the time it is connected up, and initial productions of 1000 bbl. are not uncommon. So far the wells have stood up well under pumping. The most northerly, or Westfield pool, is the only one which is even approximately drilled in. It was here that oil was first found and the shallow depth, 350 to 400 ft., has made its exploitation rapid. In October a careful estimate showed that the wells of this pool were yielding an average of about 6 bbl. daily and many of them had been pumped more than two years. The Crawford county wells were at the same time estimated to be yielding 20 bbl., while those of Lawrence county were yielding 40 bbl.

OCCURRENCE

The oil occurs in a number of isolated pools which, however, are being brought closer together by drilling. It is not improbable that they will eventually be found to overlap. To the north they are higher stratigraphically and also shallower in depth. The Westfield pool is in the upper coal measures. Most of the oil in Crawford county seems to come from the lower coal measures, well down toward the base. In Lawrence county there are two sands, the main production being from the Buchanow sand at 1300 ft. This probably represents the Mansfield sandstone of the Indiana geologists, an approximate equivalent of the Pottsville strata of the east. The Kirkwood sand at 1600 ft. may also be Pottsville, though this is as yet uncertain. Farther south in the Princeton, Ind., field, a still lower horizon in the Chester group is productive.

THE YEAR'S DEVELOPMENTS

In general the year's work resulted in extending the field to the south and in connecting up intervening territory. Wildcatting was active in other parts of the State, but so far without much result. Some gas has been found near Medora and one or two oil wells have been brought in at Sparta, but as yet too little has been done to test thoroughly any considerable portion of the field.

Topographic surveys have been made over much of the eastern Illinois field, and the maps are now being drawn, preparatory to field use by the geologist.

It is said that 1 lb. of zirconium will supply 50,000 filaments for Professor Wedding's zirconium lamp. The life of the lamp is calculated at 700 to 1000 hours.

Production of Petroleum

The production of petroleum in the United States in 1906 and 1907 is summarized in the following table:

PRODUCTION OF CRUDE PETROLEUM IN THE UNITED STATES.

		(In barrels of 42 gal.)	
Field.		1906.	1907.
Gulf	California	(a) 30,538,000	40,000,000
	Colorado	(e) 600,000	(e) 350,000
	Texas	12,666,000	13,250,000
	Louisiana	7,100,000	4,925,000
	Illinois	4,900,000	25,000,000
Lima	Indiana	25,680,000	8,030,000
	Ohio		
Mid-Continental (c)		21,929,905	47,556,906
Ken.-Tennessee		1,000,000	(e) 1,250,000
Appalachian (d)		27,345,600	25,500,000
Wyoming		(b) 13,000	(e) 13,000
Others		(b) 4,000	(e) 3,000
Total		131,771,505	165,877,906

(a) Reported by the California Producers' Association. (c) Kansas and Oklahoma. (d) Pennsylvania, New York, West Virginia and Eastern Ohio. (e) Estimated.

Artificial Graphite

The production of artificial graphite by the International Acheson Graphite Company, of Niagara Falls, N. Y., in 1907 was 6,924,000 lb., valued at \$483,717, against 4,868,000 lb., valued at \$312,764, in 1906. These statistics show plainly the great increase in the demand for this product. It is finding use for electrodes, as a filler for dry batteries, as a pigment, as a polisher in electrotyping and as a lubricant.

A highly interesting development is the production of deflocculated graphite, which is prepared by reducing a highly unctuous graphite to a fineness that is practically molecular. When mixed with oil or water it remains permanently suspended. One of the useful field of application for this graphite is in mixing with oil that is to be fed through an oil cup. Test have shown that the introduction of a fraction of 1 per cent. will greatly reduce the consumption of oil, while when used with cylinder oil it increases the compression and improves the lubrication.

White Lead in 1907

The demand for white lead, as well as for the oxides, during 1907, was in excess of that of the preceding year, and the plants of the consolidated interests and also those of the independent corrodors were employed to almost their full capacity. Prices which were advanced, just prior to our last review, to a basis of 6½c. for dry white lead and 7¼c. for lead in oil, were maintained on this basis until September 1907, with concessions of ⅛ to ¼c., here and there, as the result of aggressive competition. As a whole, however, the demand so far kept pace with the supply that there was no necessity for breaking prices, and the concessions referred to resulted chiefly from energetic competition at certain local

points and were not general. Early in September there was a reduction of ¼c. on all pigments, following a decline of \$25 per ton in pig lead which began with a break of \$5 in June followed by two further reductions of \$10 within the next 60 days. The steady shrinkage in the value of pig lead since then, amounting to fully \$20 per ton, was met by a further reduction of ¼c. in the prices of white lead and the oxides on Dec. 16. Manufacturers are still providing from the higher cost metal, but the present disparity between the metal and its products is too wide to admit of much firmness in the latter and still greater concessions are reported to have been made privately, with every probability of another reduction in the publicly quoted price, early in 1908.

The demand for oxides was especially active throughout 1907, and red lead was relatively stronger than any of the other pigments, by reason of its heavy consumption as a structural paint, as well as in the industries where it is employed for other purposes. Litharge was freely used in all of the ordinary channels of consumption, and even the demand for electrical purposes showed no appreciable shrinkage until near the close of the year, in spite of the reported curtailment of activity in that industry.

By reason of contracts entered into on the basis of prices prevailing before the advance in December, 1906, manufacturers of paints obtained a large share of their supplies at figures which gave them a better margin of profit than the difference in the card prices of dry lead and lead in oil would have afforded. Beyond the nominal narrowness of this margin, there has been nothing in the course of the market to justify the apprehension referred to in this review last year as to the policy of the combined smelting and corroding interests toward the paint manufacturers who, although large consumers of lead, are using other pigments in still larger quantities in the manufacture of competing paints. It would appear that each branch of the merged interests is being operated with reference to its own profits, and in view of the competition which the smelting as well as the corroding branch has to face, there is nothing to encourage fear of a more complete or more aggressive monopoly in the near future than exists today.

One of the most interesting features of the present situation is the uncertainty as to the effect which the reduced cost of lead will have upon oxide of zinc, the prominence of which, as a competitor of white lead in the manufacture of mixed paints, has been gained through a wider difference than there is at present in the cost of the two pigments.

Although France has many extensive deposits of bauxite, much of it is of quality unsuited to the manufacture of aluminum and so it is employed for making fire-proof ware.

Production of Other Metals and Minerals

Aluminum—Antimony—Bismuth—Cadmium—Quicksilver—Tin—
Statistics of Production—Commercial Conditions

INCREASED PRODUCTION OF ALUMINUM

The production of aluminum, in the United States was highly profitable, but antimony mining received a great set-back by the spectacular decline in the price, and quicksilver mining also declined. Tin mining again failed to develop into an industry of any consequence.

Aluminum

Owing to the unwillingness of the only producer of this metal in the United States to make a report, we are unable to give precise statistics of the production in 1907. We estimate, however, on the basis of information received from good authorities, that the American and Canadian production was about 36,000,000 lb. against 20,350,000 lb. in 1906. The American production in 1907 was about 25,000,000 lb., against 14,350,000 lb. in 1906. The estimates for 1907 are based on the assumption that the producing plants averaged a total consumption of 50,000 h.p. during the year.

The price of aluminum at the beginning of the year was 36c. per lb. In April it rose to 50c. per lb. During the autumn it declined along with the other metals and closed the year at 38c. per lb. In Europe the price was 3s. per kg. It is reported that this is to be reduced to 2s. per kg. beginning Jan. 1, 1908.

In the early part of 1907, and during the summer months the producing plants were making use of every horse-power available. The demands for aluminum were very heavy. Toward the end of the year the demand fell off, owing to the general industrial depression, and particularly because of the relaxation in the demand from the automobile manufacturing and electrical industries. The general set-back was so serious that the Aluminum Company of America in November shut down temporarily its Shawinegan and Massena plants and half of its Niagara plant. Of course, it is morally certain that this set-back to aluminum manufacture is only temporary, and when industrial conditions improve the production of aluminum will proceed with former vigor. In connection with the general status of the industry, we may best reproduce portions of an editorial which appeared in the JOURNAL of Nov. 30, 1907, as follows:

The production of aluminum is forging rapidly ahead and the vision of the prophets that this metal in the comparatively near future will become of common

industrial importance is growing clearer and clearer. Several companies are preparing for the aluminum business in the United States, and when the Bradley patents expire in February, 1909, there will be a battle royal between the Aluminum Company of America and its new competitors. The older company will occupy the superior position because of its prestige, experience and large capacity for production, but the price for the metal will inevitably come down. An expert in the aluminum industry, in whom we have great confidence, foresees that aluminum will be produced eventually by the hundreds of thousands of tons yearly and considers that a large figure may be expected in the not very distant future. Indeed, the one hundred thousand ton mark may be passed inside of five years.

If we consider the statistics of production in 1906 this estimate does not appear unduly extravagant. In that year the production of the United States and Canada was considerably upward of 7000 metric tons; the production of the world was 18,325 metric tons, which was more than twice as great as in 1904. The production has been, indeed, increasing by leaps and bounds. The Aluminum Company of America undertook the installation of new equipment and plant in 1905 which was only partially completed in 1906. It was pointed out in "The Mineral Industry," Vol. XV, however, that on this account the increase in production in 1907 and 1908 will be very marked, and by the end of 1908 the production of aluminum in the United States will make a significant comparison with the production of copper, taking into consideration the relative bulks of the two metals.

In the meanwhile a great expansion in production is going on in Europe. Since the Héroult patents expired, four new aluminum plants have been started in Europe. The Aluminum Corporation has just been formed in England and will have its works going by the end of this year. This company expects to have 12,000 h.p. available for use in 1909. The new works of the British Aluminum Company, at Loch Leven, are being rapidly pushed forward. This company originally started works on the Caledonian canal, using the water that came down the celebrated Fall of Foyers. The demand for aluminum has made it necessary to provide a much greater source of supply. The new works are on the borders of Argyll and Inverness. On the continent of Europe there is a similar exhibition

of interest in the production of aluminum.

However, although there is so strong promise of a remarkable increase in the output during the next five years, and although it is inevitable that the price for the metal will eventually come down to lower figures, there is no reason to anticipate a decline in the very near future, the present demand being so largely in excess of the supply in spite of the large increase in the latter which has already materialized.

Antimony

The only antimony smelter that ran continuously in this country in 1907 was that of Mathison & Co., at Chelsea, Staten Island. The smelter at San Francisco ran for only a short time when prices were very high, but for the last 10 months of the year it remained shut down. The production of antimonial lead by the lead refiners was 9474 tons, against 10,120 tons in 1906.

The antimony market opened in 1907 at about 24c. per lb. with a good demand and a moderate quantity booked ahead. At that time the statistical position was apparently very good. The high prices, while they brought out a fair supply of antimony, apparently did not bring out too much for the world's needs. There had been a severe falling off in the production of antimonial lead, and this very much increased the consumption of pure antimony.

The market continued steady for the first three or four months and then gradually commenced to sag. As it has since developed this decline was due to a variety of causes. The market for needle antimony had to a large extent been artificially sustained by a considerable proportion of China's output being held in strong hands on the continent. With the appearance of larger quantities of ore from northern Africa, Turkey and Australia, the holders became afraid and needle antimony was allowed to drop.

From that time onward there was a steady and rapid decline, accelerated by the financial depression in this country and a consequent diminution of demand. At the same time it is believed this country's consumption for 1907 will prove to have been considerably greater than for any previous year.

At the end of 1907 it was reported that there were large stocks of antimony

ore held in Europe which were mined to be sold on the basis of about 20c. per lb. for the metal, and if this is so it is hard to see how there can be an increase in price for some time to come. The market to-day for the lowest grades is about 7.85@8c. per lb. duty paid and nothing but good times or serious curtailment of ore production can help it.

Within the last few years Japan has ceased to be a factor in the antimony market and very little ore is mined there now. It is the opinion in the trade that the United States is not likely to be a producer of any importance. The deposits are too far from the market to be available at ordinary prices. If antimony stayed over 20c. per lb. this country could turn out several hundred tons of ore a year, but at prices like the present it cannot hope to do any mining. Time will prove whether this forecast be correct. The Utah Antimony Company of Garfield county, Utah, has just completed a concentrating mill, which after a protracted testing run has demonstrated that the ores of the mine can be successfully concentrated. The company states that it has a large supply of low-grade ore on the dumps, besides having considerable quantities of stibnite which is found in bunches. The test run has proved that a concentrate containing 65 per cent. antimony can be successfully produced from ore containing 11 per cent. antimony. The mill is capable of producing 10 tons of concentrate per day.

Nova Scotia has produced several hundred tons of ore during the last 18 months or two years, but according to the same opinion quoted above, mining in Nova Scotia is as impossible as in this country at present. Australia is supposed to be in position to furnish a steady supply at low prices. South America at high prices can contribute a little, but on today's market is probably not a producer. Continental Europe has a very elastic production. At high prices its mines can turn out large quantities of ore. At low prices the output is very much reduced. The most likely producer of ore for some time to come is Australia.

AVERAGE PRICES OF ANTIMONY.
(In cents per pound)

	1906.			1907.		
	Cookson's.	Hallett's.	Ordinaries.	Cookson's.	Hallett's.	Ordinaries.
January.....	15.0	14.0	13.5	25.906	25.219	24.156
February....	16.0	15.0	14.25	25.062	24.062	23.437
March.....	17.5	16.5	16.15	24.900	23.750	23.025
April.....	21.31	20.81	20.25	24.125	21.344	20.875
May.....	25.25	24.38	23.31	21.937	18.562	17.750
June.....	26.0	25.0	24.0	15.750	13.812	12.650
July.....	25.25	24.25	23.19	11.875	10.500	10.125
August.....	25.0	24.0	22.75	10.906	9.687	9.375
September..	24.5	24.0	22.25	10.750	10.000	9.650
October....	25.2	24.81	23.63	11.750	10.406	10.047
November..	26.14	25.25	24.50	11.000	9.937	8.906
December...	26.25	25.24	24.70	9.662	9.050	8.088
Year.....	22.78	21.94	21.73	16.969	15.527	14.840

Bismuth

The price of bismuth, which is established at London, experienced only one change in 1907. Up to July 4 it was 5s. per lb. On that date it was changed to 6s. 6d. per lb., which continued during the remainder of the year.

Cadmium

The manufacture of cadmium was begun, for the first time in the United States, in 1907 by the Grasselli Chemical Company at Cleveland, O. The process employed is fractional distillation in iron retorts. The production was small, the demand for the metal being small. It is used principally by the manufacturers of silverware; also there is a small consumption for the manufacture of cadmium yellow pigment; also for the manufacture of several alloys and an amalgam. Heretofore, the domestic consumption of cadmium has been supplied from Upper Silesia.

The manufacturers of silverware find that the addition of 0.5 per cent. of cadmium imparts malleability to the alloy and prevents to a certain extent the formation of blisters. Sterling silver manufacturers now use cadmium in making sterling for rolling or for sand or plaster casting.

The Grasselli Chemical Company casts its cadmium in sticks 12 in. long and ¼ in. in diameter, weighing about ¼ lb. each. The present price for 100-lb. lots is \$1.25 per lb. f.o.b. Cleveland.

Tin

The statistics of the production of tin are necessarily compiled largely from the reports of exports and imports of the various producing companies. The larger part of the metal comes from countries where no accurate statistics are kept, and it is only from the quantities which enter into commerce, and so become subject to record, that we can estimate the world's production.

The figures on this basis, for the 12 months ended Nov. 30, 1907, compare with those for 1906 as follows. They are in long tons:

	1906.	1907.	Changes.
Cornwall.....	4,522	4,400	D. 122
Straits.....	58,438	55,570	D. 2,868
Banka and Billiton.....	11,250	13,490	I. 2,240
Australia.....	6,888	7,330	I. 442
China.....	4,000	3,000	D. 1,000
Bolivia.....	16,394	15,500	D. 894
Miscellaneous.....	400	500	I. 100
Total.....	101,892	99,790	D. 2,102

The Straits production—which includes that of the whole Malay Peninsula—quite possibly did not decrease last year, since it is reported that considerable quantities of metal were held back by the

large Chinese operators during the second half of the year. The same cause operated to reduce the exports from China. In the table the exports alone are given for China; there is a considerable production in that country, but the actual quantity is entirely a matter of conjecture. In the Banka and Billiton output, which is controlled by the Dutch Government, there was a substantial gain; but the Cornwall production declined a little, as did that of Bolivia. No new sources of tin supply of any importance were developed during the year.

Deliveries for the 12 months ended Nov. 30, 1907, are estimated as follows, in long tons:

	Tons.	Per Ct.
United States.....	40,100	40.2
Great Britain.....	29,300	29.4
European Continent.....	24,670	24.8
India & China, from Straits..	1,700	1.7
Japan.....	2,400	2.4
Australia consumption.....	350	0.4
Miscellaneous.....	1,150	1.1
Total.....	99,670	100.0

The consumption here shown was practically the same as the production. There was no accumulation of stocks, except possibly some in the Straits Settlements, as reported above.

The tin-mining industry in Alaska, South Dakota, and elsewhere in the United States, made no material progress in 1907. It is to be hoped that the smeltery at Bayonne may be put in operation sooner or later on foreign ores, for which it was originally intended, so that the United States will at least smelt part of the large amount of tin which it annually consumes. There were the usual reports in 1907 of rich tin discoveries in Mexico, but, as we have repeatedly emphasized, these are only small pockets of the rich *guijilos* that occur in rhyolite tuff, and there is slight prospect that Mexico will ever be a tin producer of any consequence, at least not from the rhyolite-tuff formation, which predominates in Durango and Zacatecas.

The Tin Market in 1907

The New York market for tin during the year 1907 has been characterized by an almost total absence of large available supplies and a hesitancy on the part of the rank and file of consumers to anticipate their requirements. The larger part of the transactions that took place in tin covered the immediate requirements of buyers only; and while in almost each and every case premiums had to be paid for spot delivery tin, this did not deter consumers from pursuing their conservative policy in obtaining their supplies. As far as can be ascertained, the production of tin throughout the world did not vary much from that of previous years, and the expectation of larger shipments from some of the producing centers, among these especially Bolivia, were not fulfilled.

In sympathy with all other metals and general industrial and financial conditions which developed during the year 1907, tin values have found a much lower level, and the following will give an outline of the price movements of tin during 1907:

AVERAGE PRICE OF TIN AT NEW YORK

Month.	1906.	1907.	Month.	1906.	1907.
January	36,390	41,548	July	37,275	41,091
February	36,403	42,102	August	40,606	37,667
March	36,662	41,313	September	40,516	36,689
April	38,900	40,938	October	42,852	32,620
May	43,313	43,149	November	42,906	30,833
June	39,260	42,120	December	42,750	27,925
			Average year..	39,819	38,167

Prices are in cents per pound.

Until the end of April, prices remained on about an even level, fluctuating to the extent of not more than 1 or 2c., the lowest price reached being about 40c., and the highest about 42c. per lb. At the beginning of May, a large advance in the London market made those interested in tin remember the same month of the year previous, when spot material reached the price of 50c. per lb., and served to advance prices here to 45c. This advance was greatly helped by the strike among the longshoremen, which not only made the unloading of tin from import vessels almost an impossibility, but even compelled some of the steamers to take back to Europe the cargo that was destined for our market. With the improvement in the strike situation, and larger arrivals of tin from Europe, the heavy premium which was exacted for spot tin disappeared for the time being, and resulted in a decline of almost 4c. per pound toward the middle of June. When the statistics for June were published, it developed that the supplies had decreased to the extent of 1400 tons, in consequence of which a violent speculative movement took place in the London market at the beginning of July, which served to advance quotations for spot tin about £8 per ton, this market being quoted in New York at about 43c. per lb. This was followed very quickly by a total collapse in the speculative situation, and at the end of July prices had declined almost £20 per ton from the high level.

The month of August witnessed a further serious decline, both in the London and this market, prices touching here at one time 36½c., but being at the end of the month somewhat steadier at 37¾c. per pound.

During the month of September, the market remained around 37c., but it experienced a further sharp decline during the month of October, at the close of which spot tin was selling at about 31c. While at the beginning of November prices hardened somewhat, touching 32c. per lb., this firmer tone could not be maintained, and in sympathy with the continuing sagging market in London, declined to 30c. at the end of that month.

The middle of December brought the lowest prices of the year, 26c. being quoted in this market for spot material. The better feeling and greater confidence which developed in all metal markets, did not fail to make itself felt in the tin market, which improved considerably in tone and closed at the end at 27c. per pound.

Quicksilver

The production of quicksilver in the United States decreased largely in 1907, each of the districts showing a falling-off. Our reports of the production are incomplete, but the following estimates for 1907 are approximately correct. The comparative figures (in flasks of 75 lb.) for 1906 and 1907 are as follows:

State.	1906.	1907.
California.....	19,516	16,500
Texas.....	4,517	3,000
Utah.....	1,276	400
Total.....	25,309	19,900

The decrease in the California production is explained in the following article. In Utah the only producer, the Sacramento mine, closed down. No production has yet been made in Arizona and Oregon.

The average monthly prices of quicksilver are given in the following table:

AVERAGE MONTHLY PRICE OF QUICKSILVER.

• (In dollars per flask of 75 lb.)

	1906.			1907.		
	New York.	SAN FRANCISCO.		New York.	SAN FRANCISCO.	
		Domestic.	Export.		Domestic.	Export.
January	\$40.25	\$39.13	\$37.73	\$41.25	\$39.50	\$37.50
February	41.00	39.50	38.00	41.25	39.00	37.37
March	41.00	39.10	38.00	41.00	38.50	37.25
April	41.00	39.50	38.00	41.00	38.50	37.25
May	41.00	39.50	38.00	41.00	38.50	37.25
June	41.00	39.50	38.00	41.00	38.50	37.25
July	41.00	39.50	38.00	41.00	38.50	37.25
August	41.00	39.50	38.00	40.00	38.00	36.75
September	41.00	39.50	38.00	40.00	38.05	36.70
October	41.00	39.50	38.00	40.50	38.19	36.50
November	40.75	39.50	37.50	45.00	45.00	43.50
December	40.75	39.50	37.50	45.00	45.00	43.50
Year	\$40.90	\$39.47	\$37.89	\$41.10	\$39.60	\$38.17

Quicksilver in California

BY CHARLES G. YALE

The condition of the quicksilver-mining industry in California is not at all encouraging for the opening of new mines, or increased development upon old ones, unless the deposits have been proved. The output is lessening year by year. In nearly all the old mines the ore is diminish-

ing in quantity and grade, showing a virtual exhaustion of the profitable deposits. A number of properties have been closed down, and hardly any are coming into productiveness to take their places. Of course in mining these deposits there is always the chance that good ore may be met again, so this encourages the operators to keep on work even though little profit is being made. There is in this feature also some encouragement for men to open new prospects and test their ores with small benches of retorts. But unless the grade of ore is reasonably good there is little money in quicksilver mining under present conditions, with the exception of those cases where extensive reduction works are already built to handle ores carrying below 1 per cent. of metal.

In 1905 California produced 24,655 flasks of quicksilver, worth \$886,081. In 1906 the yield of the State was 19,516 flasks valued at \$712,334. A still further reduction is apparent for 1907, which will probably amount to some 3000 flasks. When the full figures are obtainable it is expected that the total yield for 1907 will not exceed 16,500 flasks, which will be the lowest output for many years. Indeed some persons interested in the business predict even a less amount than this estimate.

The most productive mine in the State, the New Idria of San Benito county, has been increasing its output since September, another new furnace having been put in commission. The product is about 800 flasks per month. This mine and the Napa Consolidated, under the same management and ownership, yielded 12,000 flasks in 1907. The Napa produced at the rate of 200 flasks per month, which is better than in 1906. The New Idria also materially increased its output as compared with 1906. Most of the other mines of the State showed rather a marked falling off in yield, though a few held their own.

Aside from these about the only mine in the State which shows improvement worthy of note is the Helen, of Lake county. This mine has been worked for some years in a small way, but has never made much production. Of late, however, owing to vigorous and intelligent development, it has been turned from a good prospect into a good mine, and is expected to cut quite a figure in the market in 1908. A good furnace has been erected at the mine.

A good many quicksilver deposits have of late been found in Nevada, but generally speaking the grade of the ore is low. Some ore has lately been found in southwestern Nevada, and also in northwestern Nevada, the latter in a sort of clay. In Arizona the cinnabar mines near Ehrenberg have not yet become productive, though a furnace has been built and some quicksilver will be produced in 1908.

Zinc Mining in Wisconsin in 1907

By J. E. KENNEDY.*

Under conditions which prevailed during 1906 the zinc-ore production of the Tri-State District would have shown an increase in 1907 of at least 50 per cent. The output for the first six months of 1907 (24,954 tons) exceeded that of the corresponding period of 1906 by 8,137 tons. The 20 new concentrators which went into commission during the early summer, together with those already operating, ought to have scored an equal gain over the figures for the latter half of 1906 (25,312 tons). The slump in the ore market, however, reduced the output for the last six months so materially that the total shipment of zinc ore in 1907 exceeds that of 1906 only about 7000 tons. However, upward of 3000 tons of zinc concentrate remained unsold in the bins at the end of the year.

LABOR SITUATION.

The adverse market conditions which set in about the middle of August did not particularly affect new work until late in the fall. The unprecedented activity developed a big demand for labor, which could not be supplied locally, and though several companies imported from outside, the supply during the summer was nowhere sufficient. Such a condition not only affected the wage scale but reduced the efficiency of the average working force. Though unorganized the labor element was practically in control of the situation. Insufficient competent labor was a severe drawback to many companies during the summer months.

NEW CAMPS—INVESTMENTS.

During 1907 Galena and Dubuque again became producers of lead and zinc ores, and both witnessed a large amount of new work during the year. Resembling Joplin ore in character, containing but little iron, the zinc ore mined in the Dubuque camp produces a raw concentrate assaying above 55 per cent metallic zinc.

While the excitement which prevailed a year or more ago has diminished, and stocks have by no means been as active as heretofore, large investments have nevertheless been witnessed at every camp. New properties have been opened up by companies formed to develop certain lands without the aid of the stock broker and public flotations of stock. Big capitalists and corporations quietly secured leasehold rights or fee to land, sunk shafts and are opening up new mines.

PRICES OF ZINC ORE.

The price of zinc ore trended down-

ward after the month of April, when the top price in this district for the year, \$47 for 60 per cent. ore was recorded. By October the price had fallen to \$40, and it continued on downward to \$39. About the middle of October there was a rally, and in the week ending Oct. 26, the top price of \$44 was recorded on a market of \$42 for 60 per cent. zinc. The downward slide immediately set in again. Curtailment in purchases on the part of buyers was the most disastrous feature of the slump; buyers of low and intermediate grades practically withdrew from the market during November and caused many mines to shut down sooner than they would otherwise have done, merely on account of low prices.

NEW DEVELOPMENTS.

Fifty concentrators and some 200 power and sinking plants were erected during 1907. About one-half the number of mills built are single-jig, 50-ton plants; the others are mostly 75- and 100-ton plants, with rougher, cleaner and sand jigs. Sludge tables are coming into more general usage; the Wilfley seems to be the favorite, although the Pinder and Overstrom are also adopted. Five roasting and magnetic separating plants were built during 1907, which makes 25 now in the district; of this number 20 are of the slow-roast Galena type, which so far has been the only one successful in this field.

Prospect drilling was not as active as during the preceding year, although good discoveries were made during the summer months.

While several dividend payers were added to the list during 1907, results in some quarters were not what was anticipated. Such was due to several causes. In the first place the bulk of new companies were not supplied with sufficient funds to make full and proper machinery equipment. The milling stage was too often reached with a big debit balance. The grade of concentrates was invariably overrated in advance, and it was only after the first car of concentrates was sampled for sale that the necessity of a roaster was duly impressed upon the minds of over-enthusiastic stockholders. Without having made provision at the start, in the case of stock companies especially, the profits derived from the sale of raw concentrates were depended upon to clear off indebtedness and purchase a roaster. This process in many cases was a slow one, hampered as it was by the decline in prices and tight market for low-grade or sulphury blends.

While some of the new properties experienced unforeseen difficulties, the older paying mines continued making a consistent record, and by their lasting qualities have proved beyond the shadow of a doubt the permanency of the ore-bearing ranges of the Tri-State district.

Over a million dollars was spent in new

machinery equipment alone in 1907, and there is still a crying need of more capital. There are many new prospects to develop and better and more complete equipment is needed by companies now operating. It has been practically demonstrated that it is profitable to convert low-grade raw concentrates into a 60 per cent. product by the process of roasting and magnetic separation, and unless other methods are proved more efficient, a large number of roasters or calciners will be built next year.

BETTER METHODS.

The year just closed made a beginning and 1908 will record a general adoption of more scientific methods in mining and a more economical policy in business management. While the contract system may not be universally adopted, cost keeping at least will be more generally pursued. Up to this time mine superintendents, as a rule, have been left to set and maintain their own easy pace, without sufficient pressure from the business management to conform to a cost sheet figured out in the company's office. That a mine superintendent or manager must needs possess special qualifications to fill his position successfully has been duly learned by stockholders, and hereafter merit alone is more apt to be the prime consideration in selecting the person to fill such position. Greater saving in concentration by the aid of sludge tables and sand jigs is being effected, and in almost every new plant provision is made for the installation of tables. The work of the mill man is watched more closely and less zinc is being lost in tailings than heretofore by too hasty or careless jigging. The Mining Trade School to be opened at Platteville early in January will aim to provide an intelligent class of mine superintendents who will combine both technical and practical knowledge.

The results attained by the Blake-Morscher electrostatic separator, in course of installation at Platteville, will be watched with much interest. The company building this plant will buy low-grade concentrates from independent mines and make the separation between marcasite (or pyrite) and blende, whereby the iron is saved as a by-product. If successful this company will enlarge the market for low-grade sulphury blende.

Cotunnite, a mineral found in the products of all Vesuvian eruptions, and containing lead, but no appreciable quantity of uranium, has a radio-activity equal to about 1.1 times that of pure crystallized uranium nitrate. The mineral projected from the crater in 1872 is found to be as active as that from the eruption of April, 1906. A specimen of galena from the latter eruption is much more strongly radio-active than the cotunnite.

*Special correspondent, Platteville, Wis.

Zinc and Lead in the Joplin District in 1907

By JESSE A. ZOOK*

The year 1907 opened auspiciously upon a scene of satisfactory conditions in zinc-lead mining in the Joplin district, with prices of both minerals at a high point, and this condition continued so evenly until the end of June that the expectation

during the first seven months. The zenith was attained in the third week in March, at \$435,846. Three weeks of that month exceeded \$400,000 per week, and the weekly average for the month was only a shade under that figure. It was thought safe to predict, from the average weekly value of seven months as noted above, that the year would mark an increase of values over 1906 of \$3,250,861. Panicky developments at the end of the year wiped out this prophecy so rapidly that 1907 ends

November only 3940 tons were produced, while additional mills were being closed down every week.

PRODUCTION BY LOCALITIES

The accompanying tabulation shows the shipments for 11 months of 1906 and a like period of 1907, ending with November. The first section of the table embraces the "sheet ground" area, extending from Oronogo on the north to Duenweg on the south. The second section embraces all territory west and south of Oronogo-Duenweg sheet ground to the State line. The third section is from the sheet ground to the east line of Jasper county. The fourth section embraces the Lawrence, Green and Morgan county production. The fifth section is the producing area of Cherokee county, Kansas. The sixth section the producing lands of Ottawa county, Oklahoma.

REVIEWING THE TABULATION

The Oronogo-Duenweg "sheet ground" section increased its production of zinc ore by 21,700 tons, while increases in all other sections of the district totaled only 5590 tons, to offset which all other points give an aggregate decrease of 14,380 tons. Aside from Alba-Neck and Galena, the decrease in the lead production was scarcely perceptible. Galena gives an increase in zinc ore shipments, while Alba-Neck has a decrease of zinc ore also.

Joplin's large decrease of zinc ore production indicates the working out of the older levels in the Chitwood group. Its increase in lead ore comes from all sides of the camp. The Webb City-Carterville increase comes wholly from the new developments north of those towns, a large proportion of which is in the corporate limits of Oronogo. Oronogo's increase comes from deeper levels and improved machinery. The Prosperity increase comes from new mines south and east toward the Porto Rico group in the Richland valley, and in the further development of the divide from Prosperity to Duenweg.

PERCENTAGE OF INCREASES

Without including the camps making first shipments, Carl Junction leads with an increase of 1878 per cent., Sarcoux follows with 564 per cent., Reeds with 340 per cent., Playter 272 per cent., Prosperity 90.60 per cent., Spurgeon 30.37 per cent., Webb City-Carterville 24.87 per cent.

The Carl Junction shipment is from the old Lehigh mines, which have been abandoned numerous times on account of periodical overflows from Center creek. The increase from Sarcoux is practically all from new mines, and the same may be said of Reeds. The increase from Spurgeon is from new and shallow mines, the zinc ore production being about 50 per cent. silicate and carbonate.

INCREASE DUE TO HIGH PRICES

The larger tonnage of increased production coming from the "sheet ground"

PRODUCTION OF ZINC AND LEAD ORE IN THE JOPLIN DISTRICT.

	ZINC ORE (SHORT TONS).				LEAD ORE (SHORT TONS).			
	1906.	1907.	Inc.	Dec.	1906.	1907.	Inc.	Dec.
Oronogo.....	7,948	9,945	1,997	.....	293	506	213	.....
Webb City-Carterville.....	58,780	74,030	15,250	.....	15,624	17,482	1,857	.....
Prosperity.....	3,928	7,487	3,559	.....	2,465	2,912	447	.....
Duenweg.....	16,873	17,767	894	.....	3,502	3,436	.....	66
Totals.....	87,529	109,229	21,700	.....	21,885	24,336	2,517	66
			21,700				2,451	
Carl Junction.....	46	910	864	.....	.....	98	98	.....
Sherwood.....	2,154	1,147	.....	1,007	275	267	.....	8
Zincite.....	1,440	1,765	325	.....	32	72	40	.....
Cave Springs.....	929	940	11	.....	12	15	3	.....
Joplin.....	61,620	56,344	.....	5,316	6,080	7,108	1,028	.....
Spurgeon.....	5,089	6,635	1,546	.....	743	1,509	766	.....
Diamond.....	44	38	.....	6	.....	.....	.....	.....
Granby.....	13,149	11,413	.....	1,736	843	1,345	502	.....
Totals.....	84,511	79,192	2,746	8,065	7,985	10,414	2,437	8
			320	5,319			2,429	
Alba-Neck.....	22,509	22,438	.....	71	325	157	.....	168
Carthage.....	3,325	2,227	.....	1,098	61	4	.....	57
Reeds.....	87	383	296	.....	.....	.....	.....	.....
Sarcoux.....	203	1,349	1,146	.....	.....	.....	.....	.....
Wentworth.....	344	391	47	.....	.....	.....	.....	.....
Totals.....	26,468	26,788	1,489	1,169	386	161	.....	225
			320					225
Stott City.....	1,092	817	.....	275	20	.....	.....	20
Amora.....	13,880	12,302	.....	1,578	296	337	41	.....
Ash Grove.....	.....	.....	.....	.....	.....	33	33	.....
Springfield.....	282	193	.....	89	.....	227	227	.....
Morgan County.....	135	.....	.....	135	.....	.....	.....	.....
Totals.....	15,389	13,312	.....	2,077	316	597	301	20
				2,077			281	
Galena.....	25,770	26,542	772	.....	3,907	3,393	.....	514
Playter.....	80	398	218	.....	4	17	13	.....
Badger.....	14,100	11,421	.....	2,679	40	45	5	.....
Lawton.....	.....	27	27	.....	.....	.....	.....	.....
Totals.....	39,950	38,288	1,017	2,679	3,951	3,455	18	514
			1,662					496
Quapaw-Baxter.....	2,710	2,320	.....	390	595	640	45	.....
Peoria.....	.....	278	278	.....	.....	.....	.....	.....
Miami.....	.....	60	60	.....	.....	16	16	.....
Totals.....	2,710	2,658	338	390	595	656	61	.....
			52				61	
District.....	256,557	269,467	27,290	14,380	35,118	39,619	5,334	833
			12,910				4,501	

that 1907 would so far exceed 1906 as to eclipse all previous records of increase was fully justified. During July and August prices dropped slightly, but no realization of a 50 per cent. reduction in the price of lead concentrate and 40 per cent. reduction in the price of zinc concentrate could be conjectured from what was believed at that time to be only the lowering of prices on account of the large reserve stock of concentrate then in the bins. Values preserved an average of \$353,443 per week

*Special correspondent, Joplin, Mo.

less than a half million dollars ahead of 1906 in values. Even with this showing the production of both minerals places 1907 ahead of all previous years.

The financial storm that broke with such fury in October overwhelmed the ore market, and both zinc and lead concentrate slumped so seriously in November that many mines and mills were closed down. From an average production of 5997 tons per week during the first seven months the average at the end of 11 months shrank to 5639, and the last week in No-

mines of Oronogo, Webb City, Carterville, Prosperity and Duenweg, substantiates a statement made last year that this production could not be maintained under an average of \$45 per ton for zinc ore. It may be added this year that a price of \$60 per ton for lead is an additional necessity. This is not a rule applicable individually to the sheet ground mines, but including all of them in an average. These prices for zinc and lead ore will not put all of the sheet ground mines opened during 1907 on a paying basis.

PROSPECTIVE NEW PRODUCTION IN 1908

Prospecting during 1907 indicates that the new production of 1908 will come from the sheet ground discoveries on the divide between Turkey and Short creeks, at the head of Chitwood and Leadville hollows, west of Joplin, from all the camps showing a large percentage of increase for 1907, from points along Spring river between Alba and Carthage, and northeast from Alba. The further development of lower levels at Granby promises to restore that camp to the ranks of those showing an increased zinc production.

SHIPMENTS AND VALUES

The total shipment of zinc concentrate for 1907 was 278,306 tons, at a value of \$12,587,551; the total shipment of lead concentrate was 42,291 tons at a value of \$2,906,813; the total shipment of both zinc and lead concentrate was 320,597 tons at a value of \$15,494,364.

The following table embraces the shipments of zinc and lead concentrate in short tons and their combined values for each of 14 years:

	Zinc Ore, Tons.	Lead Ore, Tons.	Total Value.
1907.....	278,306	42,291	\$15,494,364
1906.....	278,930	39,189	15,128,175
1905.....	252,435	31,679	13,302,800
1904.....	267,240	34,362	11,487,350
1903.....	294,773	28,656	9,477,395
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	31,204	3,775,929
1894.....	147,310	32,190	3,535,736
Total.....	3,195,730	443,996	\$124,009,226

HIGH AND AVERAGE PRICES

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

	ZINC ORE.		LEAD ORE.	
	High.	Avg.	High.	Avg.
1907.....	\$53.50	\$45.23	\$88.50	\$68.73
1906.....	54.00	43.30	87.00	77.78
1905.....	60.00	44.88	80.00	62.12
1904.....	53.00	35.92	62.00	54.80
1903.....	42.00	33.72	60.50	54.12
1902.....	42.00	30.33	50.00	46.10
1901.....	34.00	24.21	47.50	45.99
1900.....	38.50	26.50	56.50	48.32
1899.....	55.00	36.61	55.00	51.34

ZINC-ORE PRICES

Zinc concentrate sold as high as \$50 per ton during the first week of 1907, advancing 50c. each of the following two weeks and closing the month at \$51. February opened with \$52.50 and closed at \$53.50, holding at this until the last week in March, when it closed at \$52.50. Back

to \$53.50 at the opening of April it dropped to \$53, and then \$52 in the last fortnight. May started at \$51 and ended at \$49. Through June the price was \$51, but in July it dropped to \$50, then resting until the second week in August when it went down to \$49, then to \$48 and \$47, closing the month at \$46. During the first two weeks of September it was \$45 and the last two weeks \$43. October marked a reaction to \$44, \$45.50, \$46.50, closing at \$46. November opened at \$43.50, dropping to \$42.50, \$41.50, \$40, \$38, and in December to \$36.

The highest price paid for first-grade zinc concentrate was \$53.50 in the last two weeks in February, all of March and one week in April. The base price for 60 per cent. zinc at this time was \$48 to \$51. The lowest base price was in December, \$28 to \$34 per ton. The average base price of the year ranged approximately from \$40 to \$42.

PRODUCTION BY STATES

An accompanying tabulation gives the zinc- and lead-ore production for 11 months of 1906 compared with 11 months of 1907, of Missouri separately by counties and the State total. The Kansas production is all from Cherokee county and the Oklahoma production from Ottawa county.

	ZINC (SHORT TONS).				LEAD (SHORT TONS).			
	1906.	1907.	Inc.	Dec.	1906.	1907.	Inc.	Dec.
Jasper County.....	179,882	196,732	16,850	.....	28,670	32,057	3,387	.....
Newton County.....	18,626	18,477	.....	149	1,586	2,854	1,268	.....
Lawrence County.....	14,972	13,119	.....	1,853	316	337	21	.....
Green County.....	282	193	.....	89	.....	260	.....
Morgan County.....	135	.....	.....	135	.....	.....	.....
Missouri.....	213,897	228,521	14,624	.....	30,572	35,508	4,936	.....
Kansas.....	39,950	38,288	.....	1,662	3,951	3,455	496	.....
Oklahoma.....	2,710	2,658	.....	52	595	656	61	.....
District.....	256,557	268,467	12,910	.....	35,118	39,619	4,501	.....

The above production of zinc concentrate, reduced to an approximate in spelter gives the following result: Missouri, 130,380 tons; Kansas, 19,750 tons; Oklahoma, 1370 tons.

LEAD-ORE PRICES

In the first two weeks of January the price was \$87, the next week \$87.50, then two weeks at \$88, then \$88.50, \$88.25, back to \$88, then \$86, \$85 for four weeks, \$84 one week, \$82 for five weeks, then \$83 the last week of May and \$83.50 the first week of June, and the remainder of the month teetered up and down, \$75.50, \$78, \$74, and closing at \$76. The first week in July it was cut \$20 per ton, opening the month at \$56, up to \$58, \$62 and closing July at \$64. The first week of August it was \$62, then \$64.50, \$65, dropping to \$62 the last two weeks. September opened at \$61, and the next three weeks it was \$54. All of October the price rested very steadily at \$55, dropping the first week of November to \$51.50, the next week to \$51, then \$48, \$46, \$44, opening December at \$42 and dropping to \$36.

Garnet in New York

By D. H. NEWLAND*

The abrasive garnet industry in the Adirondacks contributed an increase of about 1000 tons in 1907 above the output for the preceding year which was 4729 tons. During the first six months the production was proportionately larger than in the latter half of the year, as the demand slackened with the general business depression and operations were curtailed to some extent. The garnet trade of the country is now concentrated more than ever in this region, since the mines elsewhere have not kept pace with its progress in recent years. In the last decade the output from the Adirondacks has enlarged by about 300 per cent., while the total for the country has grown from 2261 tons in 1897 to 5404 tons in 1906, or about 150 per cent.

The garnet is obtained from four localities. The North River Garnet Company operates on Thirteenth lake, Warren county, where an immense body of garnet rock, affording a quarry face 142 ft. high, has been opened. The material is crushed and concentrated mechanically. The company has added another unit to its separating plant and is in position to

turn out from 8000 to 9000 tons of crystal garnet yearly if the trade should warrant it.

The Gore Mountain and Garnet Peak deposits near North river are worked by H. H. Barton & Son Company, and the American Glue Company. The garnet is separated by hand cobbing and operations are carried on only during the open months of the year.

In the northern part of Essex county a deposit has been under development recently and made shipments in 1907. Most of the product is of the massive variety. The property is owned by G. W. Smith, of Keeseville.

The export trade in garnet is relatively small, but it has prospective importance.

The Creusot Works of France has begun the construction of a big wharf at Corral, Chile. This company has decided to establish the headquarters of its South American iron industry in southern Chile.

*Assistant State geologist, Albany, N. Y.

THE MINING INDEX.

The editors of this paper read all the important publications of the world that relate to mining and the treatment of minerals. This index is published as a reference for all interested and to make it impossible for readers of the **ENGINEERING AND MINING JOURNAL** to miss any important article published anywhere.

We will undertake to furnish a copy of any article (if in print) in the original language, for the price quoted. Where no price is quoted the cost is unknown. These papers are not kept in stock, but must be ordered from the publisher; hence there will be some delay for foreign papers.

No accounts can be opened for these small amounts, but remittance must be sent with order. For the convenience of those making small but frequent remittances, coupons are furnished at the following prices: 20 cents each, six for \$1.00, thirty-three for \$5.00 and one hundred for \$15.00. This arrangement will be especially appreciated by foreign readers and men in distant mining camps. Where remittances are made in even dollars we will return the excess over an order in coupons upon request.

ABRASIVES

5082—**PRODUCTION of Abrasive Materials in 1906.** D. B. Sterrett. (Advance Chapter from Mineral Resources of the U. S., Calendar Year 1906; 16 pp.) Report on the commercial position, technology and production of the following abrasive substances: Buhstones and millstones, corundum and emery, crystalline quartz and feldspar, garnet, grindstones, infusorial earth and tripoli, oilstones and scythes, pumice, and artificial abrasives.

ALUMINUM

5083—**ELECTRIC CONDUCTORS—Aluminum as a Substitute for Electrical Transmission Purposes.** J. B. Sparks. (Elec. Rev., Nov. 15 and 22, 1907; 4 pp.) Investigates the conditions under which it is more economical to substitute aluminum for copper in electric conductors and derives curves showing relative costs of cores of cables and of insulation, lead covering and labor in the cases of both these metals. 60c.

5084—**METALLURGICAL PROCESSES—État actuel de l'Industrie de l'Aluminium.** R. Pitaval. (Génie Civ., Nov. 16 and 23, 1907; 6 pp.) General historical outline of the discovery of aluminum, the first methods of producing it and the furnaces and apparatus used therein, followed by a description of modern processes, the raw material, the production of alumina and the obtaining of aluminum therefrom. Also considers the future prospects of the industry throughout the world. 80c.

ANTIMONY

5085—**PRODUCTION of Antimony in 1906.** F. L. Hess. (Advance Chapter from Mineral Resources of the U. S., Calendar Year 1906; 5½ pp.) Reviews the course of the antimony mining industry in the United States during 1906 and gives statistics of export, imports and consumption of this metal and also a review of market conditions.

ARSENIC

5086—**ANALYTICAL METHOD—The Quantitative Determination of Arsenic by the Gutzzeit Method.** C. R. Sanger and O. F. Black. (Journ. Soc. of Chem. Ind., Nov. 15, 1907; 9½ pp.) Very detailed account of the procedure and necessary precautions to be taken in using this method of detecting very small quantities of arsenic in organic substances. The method depends on the use of specially prepared sensitized mercuric chloride paper which is discolored by evolved arsenic. 80c.

5087—**PRODUCTION of Arsenic in 1906.** F. L. Hess. (Advance Chapter from Mineral Resources of the U. S., Calendar Year 1906; 3½ pp.) Reviews the course of the arsenic industry in the U. S. during 1906, giving statistics of production and imports, foreign production, prices, etc.

BARYTES

5088—**VIRGINIA—Geology of the Virginia Barite Deposits.** T. L. Watson. (Paper read before the A. I. M. E., July, 1907; 23½ pp.) Groups the barytes deposits into various productive areas and describes the general geological conditions in each area, the mode of occurrence of the baryte mineral, the associated rocks and mentions the more important mines of each district. 40c.

BISMUTH

5089—**PRODUCTION of Bismuth in 1906.** F. L. Hess. (Advance Chapter from the Mineral Resources of the U. S., Calendar Year 1906; 1 p.) Brief review of the production of bismuth during 1906.

BORAX

5090—**PRODUCTION of Borax in 1906.** C. G. Yale. (Advance Chapter from Mineral Resources of the U. S., Calendar Year 1906; 5 pp.) Short review of the condition of the borax industry during 1906, with statistics of production and imports of borax into the United States for a series of years.

CADMIUM

5091—**TECHNOLOGY AND USES—Ueber der metallische Cadmium.** P. Speier. (Oest. Zeit. f. B. u. H., Nov. 30, 1907; 2 pp.) Notes on the sources, uses, methods of extraction and value of this metal. 40c.

CEMENT

5092—**MANUFACTURE of Portland Cement.** R. K. Meade. (Ores and Metals, Dec. 5, 1907; 2½ pp.) Deals with the excavation of the raw material, its preparation for the kiln, the burning and grinding of the clinker. 20c.

5093—**THEORY OF HARDENING—The Hardening Process of Hydraulic Cements.** W. M. Michaels, Sr. (Translated by W. Michaels, Jr., Cement & Eng. News, 1907; 28 pp.) An inquiry into the nature of the hardening and setting process which takes place with hydraulic and puzzolan cements; also the application of the facts thus established to the manufacture of cement blocks. 60c.

COAL AND COKE

5094—**ACCIDENTS—Coal Mine Accidents: Their Causes and Prevention.** C. Hall and W. O. Snelling. (Introduction by J. A. Holmes. (U. S. Geol. Surv., Bull. No. 333; 20 pp.) A statistical inquiry into the causes, frequency and severity of coal mine explosions in the United States. Regulations of foreign countries in regard to the question are given in condensed form, and by comparison with them the high death rate in the United States is brought out.

5095—**ALABAMA—Extensive Operations of the Pratt Consolidated Coal Co., Birmingham, Ala.** (Elec. Mh., Nov., 1907; 14½ pp.) Descriptions of the mines, surface plant and general equipment of this company which makes very extensive use of electrical power in operating its mine and hoisting plant. 20c.

5096—**CLEANING COAL—Sur la Possibilité d'Abaisser par Voie électromagnétique la Teneur en Cendres des Houilles.** E. Frost. (Rev. univ. des Mines, Sept., 1907; 14½ pp.) Interesting experimental results of an attempt to improve the grade of coal by magnetic treatment. Many valuable tabulated results of tests are given, but the general conclusion seems to be that this process is too expensive in its present development to supersede washing. \$1.00.

5097—**COAL HANDLING—Coal Shipping at Durban Port Natal.** (Iron and Coal Tr. Rev., Dec. 6, 1907; 1½ pp.) Description of the shipping and handling apparatus at Durban, Port Natal, which, by reducing the cost and increasing the speed of loading has enabled Natal to become a serious competitor of England in coaling ships. 40c.

5098—**COKE DRAWING MACHINES and Other Machinery for Use at the Ovens in**

the Manufacture of Coke. W. W. Macfarren. (Proc. Eng. Soc. W. Penn., Nov., 1907; 65 pp.) Traces the history of coke making and particularly the evolution in design and use of mechanical devices for drawing and leveling coke. All the principal machines of this character are described at length and their limitations and advantages are considered in detail. 40c.

5099—**COKE OVENS—The Ernst Coal Charging Machine.** (Iron Age, Dec. 12, 1907; 1 p.) Description of the essential features of this machine which is adapted to use on by-product ovens, also the rectangular Belgian ovens. With this machine coal is introduced through the side of the oven and no leveling is necessary. 20c.

5100—**COKE OVEN—The Koppers Coke Ovens.** (Iron Age, Dec. 12, 1907; 4½ pp.) This type of by-product coke oven has been in successful operation for some time in Europe and recently has been installed at a plant at Joliet, Ill. A complete description of the construction and performance of the oven is given. 20c.

5101—**COLORADO—Coal Mining and Coke Making in the Trinidad, Colorado, District.** (Eng. Rec., Dec. 14, 1907; 2½ pp.) An outline of the plant, equipment and operating methods of the Colorado Fuel and Iron Company, which is the largest operator in this district. 20c.

5102—**DUST—Sur les Dangers que Peuvent Présenter les Lampes de Sureté Munies de Rallumeurs a Amores Fulminantes.** G. Chesneau. (Ann. des Mines, T. XII, 8 livr. of 1907; 29 pp.) Exhaustive report by the Dust Commission as to the possibilities of igniting explosive dust mixtures by safety lamps and appliances used to light fuses or explosive detonators. The history of the experimental work is very fully outlined.

5103—**DUST—Watering of Dust in Welsh Coal Mines.** W. N. Atkinson. (Eng. and Min. Journ., Dec. 7, 1907; ½ p.) Shows how watering coal dust is a useless and expensive operation as generally carried out and makes the claim that greater care and intelligence in watering may produce good results. 20c.

5104—**EXPLOSION—Disaster at Monongah Coal Mines No. 6 and 8.** F. W. Parsons. (Eng. and Min. Journ., Dec. 14, 1907; 2½ pp.) Results of an investigation into the cause of this catastrophe, which appears to have been a dust explosion started by an electric spark from a trolley wire, which was broken by a loaded trip of cars at the bottom of the slope. 20c.

5105—**EXPLOSIVES—The New British Explosives Order.** E. B. Wilsop. (Mines and Minerals, Dec., 1907; 1 p.) Quotes the regulations issued by the Secretary of State of Great Britain which went into effect on Mar. 1, 1907. These regulations abolished all previous ones bearing on the use of permitted explosives and are based on accidents which have recently occurred. 20c.

5106—**INDIANA—The Indiana Southern Coal Company's Mines.** R. S. Moss. (Min. Wid., Dec. 21, 1907; 2 pp.) Describes briefly the mines of this company, which comprise eight complete plants, and gives details of the methods of preparing the coal for the market. 20c.

5107—**ITALY—Ueber die fossilen Brennmaterialien Italiens und die Braunkohlenwerke Ribolla und Casteau in der Provinz Grosseto.** K. Stegl. (Oest. Zeit. f. B. u. H., Nov. 9 and 16, 1907; 6 pp.) Conclusion of article which was previously mentioned in this Index. 60c.

5108—**JAPAN—The Coal Mines of Kyushu, Japan.** (Min. Journ., Nov. 23, 1907; 1 p.) Short general history of coal mining in this country followed by a description of the various coal mining centers on the island of Kyushu, their situation, area, out-

put, labor conditions, etc. To be continued. 20c.

5109—LIGNITE IN RUMANIA—Note sur l'Exploitation du Lignite en Roumanie, Margineanca. V. Alimanestiano. (Rev. univ. des Mines, Oct., 1907; 16 pp.) General survey of the lignite industry of Rumania, followed by notes on methods of exploitation, organization of working corps, and the utilization of the lignite in gas producers. \$1.00.

5110—MICHIGAN—Mining the Coal Measures of Michigan. Lee Fraser. (Eng. and Min. Journ., Nov. 30, 1907; 3½ pp.) Brief account of methods of working adopted at the Bay City seam where the undulations of the strata prohibit straight entries and work is done chiefly with pick and shovel. 20c.

5111—MINE FILLING—Le Remblayage hydraulique. A. Wildiers. (Rev. univ. des Mines, Sept. and Oct., 1907; 72 pp.) Continuation of this article which has previously been mentioned in this Index. The present articles deal with and describe surface plants for mixing waste and culm with water preparatory to flushing into the workings, and compares this system with plants entirely underground and systems part of which are on the surface and part below. \$2.00.

5112—MONTANA—The Operation of Coal Mines in Montana. F. W. Parsons. (Eng. and Min. Journ., Dec. 7, 1907; 4 pp.) Gives a résumé of present day coal mining practice in this State as exemplified in several of the more important producing mines. 20c.

5113—PENNSYLVANIA—Mining Anthracite Coal in the Wyoming Valley. M. S. Hachita. (Eng. and Min. Journ., Dec. 21, 1907; 4 pp.) A general account of the working methods in this anthracite field where steel beams are used as roof supports. The cost of these props appears to be justified by their many advantages. 20c.

5114—PULVERIZED COAL and Its Industrial Applications. W. D. Ennis. (Eng. Mag., Dec., 1907; 14 pp.) Critical examination into the value of burning very fine coal, which is blown into the furnace by a definite admixture of air. Many types of apparatus for grinding, pulverizing and drying coal are described in some detail. 40c.

5115—RESCUE WORK—Einrichtungen für Grubenrettungswesen. (Glückauf, Nov. 30, 1907; 6 pp.) Descriptions of various installations of rescue apparatus in some of the more important German coal mines. 40c.

5116—WAGE SCALE—Ueber Lohnstarfe im britischen und rheinisch-westfälischen Steinkohlenbergbau. Hilgenstock. (Glückauf, Dec. 7, 1907; 14 pp.) Lengthy discussion and comparison of wage scales and general economic conditions in British coal mines and those of the Rhenish-Westphalian district. 40c.

5117—WATER SUPPLY—An Emergency Water Supply for a Coal Breaker. J. H. Haerter. (Eng. and Min. Journ., Dec. 14, 1907; 1½ pp.) Describes the effect of the way coal beds are laid down upon the subsequent washing processes and discusses the necessity of an abundance of water to keep a mine and washery in operation. An emergency system for storing water to tide over a dry season is explained. 20c.

COPPER

5118—CALIFORNIA—The Copper Belt of California—III. Herbert Lang. (Eng. and Min. Journ., Nov. 30, 1907; 4½ pp.) Traces the early attempts at smelting by mining companies in this belt and their failures. Later attempts at smelting are mentioned and several successful ventures are described. Concludes with notes on the smelting practice at the more important mines. 20c.

5119—CHILE—The Braden Copper Mines in Chile. Wm. Braden. (Eng. and Min. Journ., Dec. 7, 1907; 3½ pp.) Describes the ore occurrence at these Andes mines, mining methods and systems, the concentrating mill, and general equipment for producing and shipping copper. 20c.

5120—CUPRIFEROUS PYRITE CINDER—Abrüstung und Extraktion von kupferhaltigen Kiesabbränden ohne Chlorierende Röstung. K. Millberg. (Chem. Zeit., Nov. 16, 1907; 2 pp.) Notes on attempts to extract copper from pyrite cinder without a chlorinating roast; giving information as to handling insufficiently roasted cinder, and the removal of iron and other foreign metals from the copper solution. 40c.

5121—ELECTRIC SMELTING of Copper Ores. J. W. Richards. (Electrochem. and Met. Ind., Dec., 1907; 1½ pp.) Sample calculations of electric copper smelting methods, in which are determined a balance sheet of materials entering and leaving the furnace; a balance sheet of heat development and its distribution in the furnace, etc. 40c.

5122—HISTORICAL FACTS—Chemie und

Archäologie. B. Neumann. (Zeit. f. ange. Chem., Nov. 22, 1907; 7 pp.) Traces the history of metallurgical chemistry by means of archaeology, especially with reference to copper smelting in very early times; the production of alloys, their composition and uses. 40c.

5122a—NEW ZEALAND—Mount Radlant, a New Zealand Copper Discovery. Sydney Fry. (Eng. and Min. Journ., Dec. 28, 1907; ½ p.) A short geological discussion of an enormous low-grade copper deposit recently discovered. Contains maps showing location and section of deposit. Sets forth advantages of district for mining operations. 20c.

5123—QUEENSLAND—Cloncurry Copper Mining District. L. C. Ball. (Queens. Gov. Min. Journ., Oct., 1907; 10½ pp.) Continuation of lengthy geological report on the above district, which has been previously mentioned in this Index. 60c.

5124—REFINED COPPER—Ueber Sauerstoffgehalte, Eutektika, Dichtigkeit, Gasabsorptionsvermögen verschiedener Kupfer im späteren Verlauf des Raffinerieprozesses, sowie über Zusammensetzung, Qualitätswerte der fertigen Raffinade. W. Stahl. (Metallurgie, Nov. 22, 1907; 10½ pp.) Gives an account of the results of a detailed investigation into the quality of copper in the last stages of the refining process, particularly in regard to oxygen content, density, solution of gases, etc. 40c.

5125—REFINING COPPER—Notes on Copper—XI. A. H. Sexton. (Mechan. Engr., Nov. 23, 1907; 3 pp.) Continuation of a series of articles dealing with the metallurgy of copper, this instalment consisting of notes on various processes of refining and preparing blister copper for market. 20c.

5126—SMELTER—Mammoth Smelter Enlargement. (Mineral Wealth, Nov. 1, 1907; 1½ pp.) Description of the improvements being made in Mammoth smelter of the U. S. Mining, Smelting and Refining Company, at Kennet, Cal. 20c.

5127—SMELTING PLANT—Washoe Reduction Works at Anaconda, Mont. (Mines and Minerals, Dec., 1907; 3½ pp.) Continuation of an article previously mentioned in this Index. This instalment describes the operations of briquetting ore and the machinery used therein, the converting and refining process, and the power generating equipment. 20c.

DIAMONDS

5128—MINING METHODS—Diamond Mining. H. Leffmann. (Journ. Franklin Inst., Dec., 1907; 6 pp.) Abstract of a lecture on this subject, giving general statements as to methods of sinking in and mining the blue ground and recovering the stones therefrom. 60c.

GOLD AND SILVER

5129—BRITISH COLUMBIA—Some Placer Deposits of British Columbia. A. Lakes. (Ores and Metals, Nov. 20, 1907; 1 p.) Short description of the placer deposits of the Tulameen and Similkameen river districts and the probabilities of their successful exploitation. 20c.

5130—CHEMICAL PROPERTIES—Contributions to the Chemistry of Gold. F. H. Campbell. (Trans. Faraday Soc., Oct., 1907; 11 pp.) Applies physical chemistry to the determination of the properties of gold and the halogen compounds of this metal; the properties of aurous chloride, the preparation of aurous oxide and other compounds are discussed.

5131—COLORADO—Geologic Atlas of the United States. Ouray Folio. W. Cross, E. Howe, J. D. Irving. (U. S. Geological Survey, 1907; 26 pp.) Contains full and definite information as to the topography, structural, historical and economic geology of the Ouray district, with minute descriptions of all the rock series, the character and structure of the metalliferous veins, their importance and origin. 40c.

5132—CYANIDATION of Ore Containing Both Coarse and Fine Gold. P. Argall. (Min. and Sci. Press, Dec. 7, 1907; 1 p.) The author replies to the following question: "When cyaniding ore containing some coarse gold, as well as gold finely divided, what steps should be taken to save the coarse gold, which otherwise will escape in cyanide?" 20c.

5133—CYANIDATION—Sliming Ore for Cyanidation. M. R. Lamb. (Min. and Sci. Press, Nov. 23, 1907; ½ p.) Some notes on the sliming of ore and the relation of fineness to filtering and agitation, showing the varying behavior of different ores. 20c.

5134—CYANIDATION—The Cyanide Process—A Review. F. W. Traphagen. (West. Chem. and Met., Nov., 1907; 6 pp.) Brief review of the cyanide process in regard to the various claimants to the discovery of

this method of dissolving gold; including extracts from the claims of the first patent granted on this process. 60c.

5135—CYANIDATION with the Brown Vat. F. Narvaez. (Min. and Sci. Press, Nov. 30, 1907; 1 p.) Gives short notes on the use of this type of cyaniding vat, sometimes known as the Pachuca agitating tank. Results of working tests, descriptions of operation and working drawings are given. 20c.

5136—CYANIDE FILTER—The Burt Rapid Cyanide Filter. E. Burt. (Min. and Sci. Press, Dec. 7, 1907; 2 pp.) Gives details of the construction, operation, cost, extraction, etc., of the Burt filter press, which is of the cylinder type and which makes partial use of gravity pressure. 20c.

5137—CYANIDE PRACTICE—Hendryx Methods of Cyaniding. L. D. Bishop. (West. Chem. and Met., Nov., 1907; 6½ pp.) Deals with the possibility of increasing cyanide extraction by improvement in the mechanical conditions of the process. 60c.

5138—FILTER-PRESSING. C. Nardin. (Proc., Sydney Univ. Eng. Soc., Vol. XI., 1906; 12½ pp.) General dissertation on filter-press practice in Australia, describing the ordinary operations of the process, the construction of the press and general considerations of the process as a whole.

5139—GOLD IN SEA WATER—The Presence of Gold and Silver in Deep-Sea Dredgings. L. Wagoner. (Paper read before the A. I. M. E., April, 1907; 1½ pp.) Gives several assays of deep-sea dredgings and shows the amount of gold and silver which can be extracted by cyanide treatment. 40c.

5140—HISTORY of Gold and Silver. James W. Malcolmson. (Eng. and Min. Journ., Nov. 30, 1907; 2½ pp.) Paper read before the Am. Min. Congress, Nov., 1907. A summary of the ancient and modern uses of the precious metals, the sources of supply and the effect of supply on values. 20c.

5141—MEXICO—The Mines of Bolanos, Old Mexico. E. E. Behr. (Cal. Journ. of Tech., Nov., 1907; 4 pp.) Interesting historical account of the discovery of this old silver mine and the various attempts which have been made at working it. 20c.

5142—NEVADA—Rapid Development of Fairview, Nevada. Robt. B. Todd. (Eng. and Min. Journ., Dec. 21, 1907; ½ p.) Notes on the mines and general conditions which now exist in this new gold camp. 20c.

5143—ORIGIN of GOLD in the Rand Banket. J. W. Gregory. (Instn. of Min. and Met., Bull. 38, Nov. 14, 1907; 32 pp.) Discussion by various members of the Institution of the above paper, which has been previously mentioned in this Index, together with the author's reply.

5144—PLACER PROSPECTING—A-B-C of Steam Percussion Drill Practice. J. P. Hutchins. (Eng. and Min. Journ., Dec. 14, 1907; 5 pp.) Practical suggestions for unloading, moving and setting up Keystone drills used in testing placer ground in California. 20c.

5144a—PLACER PROSPECTING—Notes on Churn Drill, Placer Prospecting. J. P. Hutchins. (Eng. and Min. Journ., Dec. 28, 1907; 5 pp.) Sets forth advantages and disadvantages of different types of drills and contains valuable suggestions regarding the care of the drill and its accessories; discusses handling of core material and best procedure, under various conditions, for prospecting and determining the value of deposits. 20c.

5145—PLACER PROSPECTING—Testing Placer Ground with the Keystone Drill. J. P. Hutchins. (Eng. and Min. Journ., Dec. 21, 1907; 6 pp.) Very detailed directions for testing placer ground with a percussion drill, with descriptions of many of the ordinary difficulties met with, the means of avoiding and remedying them; also notes on pumping the holes so as to secure representative samples. 20c.

5146—PRODUCTION of GOLD—The Increased Production of Gold and Its Effect Upon the Cost of Living. F. Lynwood Garrison. (Journ. Frank. Inst., Dec., 1907; 6½ pp.) Analysis of the effect of recent increased gold production upon the cost of living, tracing the ratio of increase to increased production of food-stuffs, and tending to show that in the future the rate of increase of gold production must decrease. 60c.

5147—TUBE MILLS—A Spiral Feeder for Tube Mills. W. H. Fox. (Eng. and Min. Journ., Dec. 14, 1907; ½ p.) Describes this feeding device which was successful in reducing trouble from wear of packing around the tube-mill trunnion. 20c.

GRAPHITE

5148—DEFLOCCULATED GRAPHITE. E. G. Acheson. (Am. Machinist, Nov. 21, 1907; 1 p.) Paper read before the Am. Electrochem. Soc. General description of

the process of making artificial amorphous graphite and of the discovery of defloculating graphite by the use of tannin extracts. Tests of this substance as a lubricant are given. 20c.

GYPSUM

5149—MICHIGAN—The Gypsum Industry at Grand Rapids, Mich. L. A. Palmer. (Eng. and Min. Journ., Nov. 30, 1907; ½ p.) Notes on the origin of the gypsum deposits of this locality, the method of treating the raw material and the calcining process. 20c.

IRON AND STEEL

5150—ANALYTICAL METHODS—Assay of Iron. Symbol Fe. Atomic Weight 56. E. W. Buskett. (Mines and Minerals, Dec., 1907; ½ p.) Comparison of the permanganate and bichromate methods of iron determinations, giving the reactions which take place in each case. 20c.

5151—ANALYTICAL METHODS—Metals and Alloys. (Min. Journ., Nov. 23, 1907; 1 p.; Abstracted from *Rassegna Mineraria*.) Gives analytical procedures which have been corrected and modified by long experience in chemical laboratories of iron establishments. Among some of the substances dealt with are aluminum, metallic tungsten and ferrotungsten, ferro-chromium, ferro-manganese, ferro-silicon, etc. 20c.

5152—AUSTRIA—Neues in österreichischen Eisenhüttenwerken. T. Naske. (Stahl u. Eisen, Nov. 13, 27 and 30, 1907; 23 pp.) Describes improved methods, appliances and practices now in use in modern Austrian steel works and iron smelters. Gives also a description of the equipment and operation of the Klado iron works, which are served by the iron ore deposits of Nutschitz. 80c.

5153—AUSTRIA-HUNGARY—The Witkowitz Company, Moravia, Austria-Hungary. G. B. Waterhouse. (Iron Age, Dec. 5, 1907; 3½ pp.) A history of the Witkowitz Company of Moravia and a description of the works at its Sopha smelter. This company is said to be a model of Continental enterprise and to exemplify the best European practice in iron and steel smelting. 20c.

5154—BLAST FURNACE GAS—Installations pour l'Épuration des Gaz de hauts fourneaux, système Zschocke. M. Wolf. (Génie Civ., Nov. 16, 1907; 5 pp.) Description of the Zschocke system of purifying blast furnace gas previous to its utilization. This system involves intense cooling followed by two or three successive purifying processes. 40c.

5155—CAST IRON—A Volumetric Study of Cast Iron. H. M. Lane. (Proc. A. S. M. E., Mid-Nov., 1907; 9 pp.) Points out the effect of relative volumes of the usual impurities in cast iron upon its strength, and shows how a consideration of these volumes explains eccentricities in the behavior of cast iron which chemical analysis will not account for.

5156—CAST IRON PIPE, The Manufacture of. W. B. Robinson. (Iron Tr. Rev., Dec. 5, 1907; 7½ pp.) Interesting illustrated description of this large factory, where a continuous process of making cast iron pipe is used. The pit method is generally in use, but a feature is the use of large revolving tables for flasks, so as to allow successive molding, drying, casting and shaking out. 20c.

5157—CASTINGS—Converter vs. Small Open-hearth—II. W. M. Carr. (Foundry, Dec., 1907; 1 p.) Continuation of an article previously mentioned in this Index. In this instalment there is a discussion of the advantages and disadvantages of the converter in steel casting work and notes on the benefits of introducing continuous operations by using more than one converter. 20c.

5158—DUPLEX STEEL PROCESS. B. C. Lauth. (Electrician, Nov. 21, 1907; 2½ pp.) Describes the advantages of this process of steel making which is claimed to eliminate the evils of both blast furnace and open-hearth steel by combining the best features of converter and open-hearth practice. 20c.

5159—ELASTICITY OF STEEL—Die elastischen Eigenschaften von Stahl und die Abhängigkeit derselben von der chemischen Zusammensetzung und der thermischen Behandlung des Materials. Wawrzynik. (Metallurgie, Dec. 8, 1907; 6 pp.) Supplements an article by William Campbell on "The Heat Treatment of a High-carbon Steel," and inquires into the effect of the thermal treatment and chemical composition of a steel upon its elasticity. 40c.

5160—ELECTRIC SMELTING—Qualitative Arbeit in der Stahlerzeugung und elektrisches Schmelzverfahren. O. Thallner. (Stahl u. Eisen, Nov. 20 and 27, 1907; 13½ pp.) Long inquiry into the possibility of attaining much improved quality in steel and in methods of electrical production. The

effects of the various elements in steel are considered and the parts played by them in the different methods of steel production are discussed. 60c.

5161—ELECTRO-METALLURGY—Electro-thermic Production of Iron and Steel. J. W. Richards. (Journ. Franklin Inst., Dec. 1907; 16 pp.) A history of the invention of various types of electric furnaces which are now in active operation for reducing iron ore or producing steel. The description of each furnace is accompanied by a calculation to determine the thermal efficiency of the furnace in question. 60c.

5162—FOUNDING PRACTICE—Melting Iron for Foundry Purposes—III. E. L. Rhead. (Mechan. Engr., Nov. 16, 1907; 2½ pp.) Gives in this instalment notes on air pressure and its relation to the melting of the iron; also ratios of coke and iron to use under different conditions. Practice in melting different charges in the same cupola and collecting metal in ladles is described. 20c.

5163—FOUNDRY DESIGN and Equipment. A. R. Beilamy. (Mechan. Engr., Nov. 16, 1907; 6 pp.) A consideration of the factors which determine the economy of having a foundry as a supplement to a manufacturing business; takes up the resultant decrease in cost of castings, improvements in quality obtainable, selection of site, design of buildings, equipment, etc. 60c.

5164—FOUNDRY PRACTICE—Some Limitations on the Molding Machine. E. H. Mumford. (Proc. A. S. M. E., Mid-Nov., 1907; 10 pp.) Enumerates the various steps in the ramming of sand, withdrawal of molds, etc., which are not adapted to being carried out by molding machines and points out the many opportunities for new inventions in this field.

5165—GARY, INDIANA—Features of the City of Gary, Indiana. (Iron Tr. Rev., Nov. 21, 1907; 6 pp.) Deals mainly with progress in the construction of the town of Gary which is being erected to accommodate the workers of the new steel plant of the U. S. Steel Corporation on Lake Michigan. Describes also the water, gas, sewerage and lighting systems. 20c.

5166—HISTORY OF SMELTING—Das Eisenhüttenwesen im Altertum. F. Freise. (Stahl u. Eisen, Nov. 13 and 30, 1907; 4 pp.) Continuation of article describing ancient methods of producing blast, the smelting process and operation of the primitive furnaces; also contains a description of the various products of these early furnaces. 60c.

5167—LOSS IN SHIPMENTS—Pig Iron and Coke Shortages. (Iron Age, Nov. 7, 1907; 3 pp.) Summary of the report of a committee of the New England Foundrymen's Association which investigated the causes of loss of pig iron and coke in transit, the railroad's method of weighing cars, and attitude towards shortage claims. The weighing and checking systems in use by several large concerns are outlined in an interesting manner. 20c.

5168—MALLEABLE CAST IRON. Bradley Stoughton. (School of Mines Quar., Nov., 1907; 9 pp.) Observations on the nature of this form of cast iron, its structure, composition, qualities, uses, method of production and furnace practice while producing it. 60c.

5169—MILD STEEL—The Effect of Work and Time on the Properties of Mild Steel and Iron. (Iron and Coal Tr. Rev., Dec. 6, 1907; ½ p.) An account of tests made on old steel taken from ships, boilers and building structures, showing the excellent quality of mild steel of the Siemens-Martin and open-hearth type. 40c.

5170—OPEN-HEARTH FURNACES—The Blair Port and Bulkhead. (Iron Age, Nov. 7, 1907; 1 p.) Gives several illustrations and a description of these two devices which have been successfully applied to the open-hearth furnaces of the Lackawanna Steel Company at Buffalo, N. Y., and which have resulted in a considerable saving in repairs and maintenance, and lengthened the life of the port. 20c.

5171—RAIL MILL—The Illinois Steel Company's New Rail Mill. (Iron Age, Nov. 28, 1907; 4 pp.) Describes the various features of this new rail mill, including notes on rail heating furnaces, rolls, hot saws and handling equipment. 20c.

5172—SCANDINAVIAN IRON ORES, The Geological Relations of the. H. Sjögren. (Paper read before the A. I. M. E., July, 1907; 70 pp.) Lengthy paper on the character, relations, origin and rock associations of the iron ores of the Scandinavian peninsula. The discussion is very detailed, and each group of deposits is considered by itself. Its classification depending on its probable origin or source.

5173—SEGREGATION IN INGOTS, A Further Study of. Henry M. Howe. (Eng. and Min. Journ., Nov. 30, 1907; 5 pp.) An

attempt to combine and analyse a mass of experimental data in regard to segregation in steel ingots, considering the influence of size and shape of ingot, rate of cooling, the location of the most enriched and most impoverished spots, effect of sulphur and phosphorus on carbon segregation, etc. 20c.

5174—SHOP MANAGEMENT. W. W. Bird. (Iron Tr. Rev., Nov. 28, 1907; 1½ pp.) Explains the system adopted by the Worcester Polytechnic Institute in teaching the principles of management and business administration of machine shops and similar plants, by having the students take charge of a shop which meets open outside competition in marketing its product. 20c.

5175—SWEDEN—Der Schwedische Staat und die lappländischen Eisenerzgruben. (Stahl u. Eisen, Nov. 27, 1907; 2 pp.) Notes on the possibilities of working the iron ore deposits of Lapland; also the influence which the attitude the Swedish government has adopted will have on their development. 40c.

5176—TEMPERING FURNACES—Ueber Temperofen. G. Rietkötter. (Stahl u. Eisen, Nov. 13, 1907; 2½ pp.) Gives a few general considerations and principles of firing and regulating furnaces for steel tempering. Some constructions and modifications of furnaces adapted to gas firing are described. 40c.

5176a—TENSILE STRESS OF STEEL—Measuring the Extension of Test-pieces under Tensile Stress. W. J. Lambert. (Brit. Instn. Civ. Eng., Paper No. 3694, 1907; 2½ pp.) Describes an optical method for determining the extensions of steel under test for tensile stress, the advantages of which are simplicity, extreme accuracy and the absence of mechanical contrivances attached to and working from the specimen.

5177—TRANSVAAL—Iron and Steel in the Transvaal. A. Adair. (South African Mines, Nov. 9, 1907; 1 p.) Brief notes on conditions under which an iron industry in South Africa would have to operate. 20c.

5178—WYOMING—The Iron Ores and System of Mining at Sunrise Mine, Wyoming. B. W. Vallat. (Min. Rep., Nov. 28, 1907; 1½ pp.) Explains the ore formation at this mine, where two varieties of iron ore occur in the same ore body, and outlines the system of mining used. The property is owned and worked by the Colorado Fuel and Iron Company. 20c.

LEAD

5179—CHRONOLOGY OF LEAD MINING in the United States. W. R. Ingalls. (Paper read before the A. I. M. E., July, 1907; 12 pp.) Presents in brief form the history of lead mining and smelting in the United States. 40c.

5180—PRODUCTION of Lead in 1906. J. M. Boutwell. (Advance Chapter from Mineral Resources of the U. S., Calendar Year 1906; 23 pp.) The usual government report on progress in the lead mining and smelting industry. The general condition of the industry is reviewed, and figures of production, consumption and trade are given.

5181—HUNGARY—Vergangenheit und Gegenwart der konigl. Metallhütte in Zalatra. S. Kurovsky. (Oest. Zelt. f. B. u. H., Nov. 30, 1907; 3½ pp.) Deals with the heap roasting of the lead regulus and the following roasting processes. 40c.

5182—REDUCTION PROCESS—The Electrolytic Treatment of Galena. E. F. Kern and H. S. Auerbach. (School of Mines Quar., Nov., 1907; 19 pp.) Outlines the course of an experimental investigation into the possibility of producing lead from galena by electrolysis; shows the advantages to be gained by this process and tabulates many facts as to conductivity, current density, resistance of electrolyte, etc. 60c.

5183—SMELTING PRACTICE—Lead Smelting in Utah. R. B. Brinsmade. (Mines and Minerals, Dec., 1907; 3½ pp.) Descriptions of the smelting methods and equipment of the lead smelting plants at Bingham Junction and Murray, Utah, including sampling, bedding, roasting and blast furnaces, and deals briefly with the smoke problem. 20c.

MAGNESITE

5184—PRODUCTION of Magnesite in 1906. C. G. Yale. (Advance Chapter from Mineral Resources of the U. S., Calendar Year 1906; 4 pp.) Notes on production of magnesite in California, selling prices, trade conditions, annual output and figures of import.

NICKEL

5185—NEW CALEDONIA—Die Aufschliessung der Nickelergänzungsstätten in Neukaledonien. G. Dieterich. (Zelt. des Vereines

deutscher Ingenieur, Nov. 16 and 23, 1907; 20 pp.) Long article on working and exploiting the nickel deposits of New Caledonia. Deals in part with geological information but concerns itself chiefly with the handling equipment, means of transporting ore to tide-water, storing, loading on ship, etc.

PETROLEUM AND NATURAL GAS

5186—FUEL OILS—Technical Aspects of Oil as Fuel—III. F. E. Junge. (Power, Dec., 1907; 5½ pp.) Deals with the use of coal-tar oils in engines of the Diesel and similar types. The characteristics of tar oils as fuels and their behavior at high temperatures and pressures are discussed. 20c.

5187—JAPAN—The Petroleum Industry of Japan. K. Ito. (Petrol. Rev., Dec. 7, 1907; 2½ pp.) Very brief history of the petroleum industry in this country, dealing mostly with the operations and industrial position of the Nippon Oil Company. 40c.

5188—NATURAL GAS PRODUCTION IN 1906. B. Hill. (Advance Chapter from the Mineral Resources of the U. S., Calendar Year 1906; 20 pp.) Reviews the progress of natural gas industries in 1907 by States, with notes on value of the product, its consumption and acreage controlled by natural gas companies.

5189—RUMANIA—Note sur l'Exploitation du Pétrole en Roumanie, Campina-Bustenari. T. Ficinesco and V. Dessila. (Rev. univ. des Mines, Sept., 1907; 18 pp.) Describes briefly geological conditions in the three producing districts and gives a short history of early methods of exploitation. The methods of exploitation actually in use now are outlined, also the refining processes. \$1.00.

PHOSPHATE ROCK

5190—GEOLOGICAL INVESTIGATIONS—Phosphates in Western United States. (Am. Fertilizer, Nov., 1907; 6½ pp.) A compilation of the important parts of several investigations made by the U. S. Geological Survey into the phosphate rock deposits of Idaho, Wyoming and Utah. 20c.

PRECIOUS STONES

5191—BURMA RUBIES—Beitrag zur Kenntnis der Rubinlagerstätte von Nanya-zeik. J. J. Tanatar. (Zeit. f. prak. Geol., Oct., 1907; 4½ pp.) Summary of the present state of knowledge as to the geology of the ruby deposits of the district around Nanya-zeik, with extensive notes on the character and composition of the rock formations which are associated with the rubies. 40c.

QUICKSILVER

5192—ANALYTICAL METHOD—Bestimmung des Quecksilbers durch Reduktion des Quecksilberschlorids zu Chlorür mit Wasserstoffperoxyd. A. Kolb and A. Feldhofen. (Zeit. f. ange. Chem., Nov. 15, 1907; 3 pp.) Gives some general observations on this method of determining quicksilver by reduction to mercurous chloride by hydrogen peroxide. The actual results of using this procedure in the presence of a number of interfering substances are given. 40c.

5193—PRODUCTION of Quicksilver in 1906. J. M. Boutwell. (Advance Chapter from Mineral Resources of the U. S., Calendar Year 1906; 13 pp.) U. S. Geological Survey report on the production of quicksilver in the United States, and in the world, resources of the producing States and recent developments therein, together with a review of trade conditions and a list of exports, imports and prices.

RARE METALS

5194—CERIUM PREPARATION—La Préparation du Cérium et les Déchoués des Terres rares. L. Pierron. (Rev. de Chim. Ind., Nov., 1907; 6½ pp.) Notes on the mineral sources of cerium, methods of preparing cerium salts; basic nitrate methods. Wyruboff and Verneuil process, permanganate method, etc.

5195—SELENIUM—Production of Selenium in 1906. F. L. Hess. (Advance Chapter from Mineral Resources of the U. S., Calendar Year 1906; ½ p.) Very brief notes on the uses and production of this element.

STONE

5196—NEVADA—Marble in Nevada. (Am. Min. Rev., Nov. 30, 1907; 1½ pp.) An account of the marble industry of this State near White Pine, where there is a

large occurrence of ornamental and structural stone. 20c.

SULPHUR AND PYRITES

5197—LOUISIANA—The Sulphur Mines of Louisiana. Day Allen Wiley. (Eng. and Min. Journ., Dec. 14, 1907; 2½ pp.) Short notes on the Frasch process of extracting sulphur in melted form from great depth through wells and the methods of handling the product when it has cooled. 20c.

5198—PRODUCTION of Sulphur and Pyrite in 1906. Prepared under the direction of D. T. Day. (Advance Chapter from the Mineral Resources of the U. S., Calendar Year 1906; 10 pp.) Summary of figures relating to the production, exports and imports of sulphur and pyrite; also world's production of these substances.

TIN

5199—ELMORE VACUUM PROCESS at Dolcoath. Edw. Walker. (Eng. and Min. Journ., Dec. 14, 1907; 3 pp.) Description of the Dolcoath plant and its appliances, the installation of the flotation apparatus, tests of the process and an account of the results accomplished by it in successfully separating a complex tin-copper-tungsten ore. 20c.

5200—TINNING PROCESS—Special Report on Dangerous or Injurious Processes in the Coating of Metal with Lead or a Mixture of Lead and Tin. A. M. Anderson and T. M. Legge, together with a Report on An Experimental Investigation into the Conditions of Work in Tinning Workshops, by G. E. Duckering. (London, 1907; Wyman and Sons, Ltd.; 42 pp.) Exposition of the details of processes of coating metals with protective tin coverings, with definitions of technical terms, and statistics of lead poisoning among workers. 40c.

ZINC

5201—ELECTROLYTIC DETERMINATION—Qualitativer Nachweis Kleiner Zinkmengen auf Elektrochemischen Wege. W. Neumann. (Zeit. f. Elektrochem., Nov. 22, 1907; 1 p.) Describes a method for the qualitative detection of very small quantities of zinc from an alkaline solution by precipitation on a copper cathode. 20c.

5202—GALVANIZING PROCESS—Old and New Methods of Galvanizing. A. Sang. (Proc. Eng. Soc. W. Penn., Nov., 1907; 25½ pp.) Gives general reviews of the principles and theories of galvanizing processes, describing hot galvanizing, cold electro-galvanizing, sherardizing, and vapor galvanizing. Chapters on pickling iron and the properties and use of zinc dust are included. 40c.

5203—JOPLIN DISTRICT—Historical Sketch of Mining in the Missouri-Kansas District. J. A. Zook. (Lead and Zinc News, Dec. 2, 1907; 5 pp.) A general outline of the zinc mining industry in this district from its beginning to the present day. The relative importance of Joplin as a zinc producer is indicated by statistics and a few notes on methods of bidding for and selling ore are given. 20c.

5204—JOPLIN DISTRICT—The Relation of Ores to Mining in the Joplin District. O. Ruhl. (Min. Rep., Nov. 28, 1907; 1½ pp.) Classifies the various forms of ore occurrence in this zinc district and indicates the effect of typical ore formations on mining methods. 20c.

5205—ROYALTIES—Sliding Scale Royalties. L. D. Huntoon. (L. & Z. News, Nov. 18, 1907; 2 pp.) Explains the three methods of leasing zinc ground in the Joplin district and shows how each system works out in practice. Tabular statements of net returns from different leasing propositions under various market conditions and grades of ore are given. 20c.

5206—SHEET GROUND MINING in the Joplin District. Doss Brittain. (Eng. and Min. Journ., Dec. 14, 1907; 2 pp.) Gives details of mining sheet ground in the Joplin district with regard to drifting and stopping methods, breaking and handling the ore, labor conditions and wage scale. 20c.

5207—SMELTING—Zinc Smelting Told by Photographs. (Mines and Minerals, Dec., 1907; 2 pp.) Outlines the methods of ore treatment of the American Zinc, Lead and Smelting Company at its plant at Caney, Kansas. The text is brief and supplemented by several illustrations. 20c.

5208—ZINC WHITE—Supériorité du pouvoir Courant de la Céruse sur Célui du Blanc de Zinc, dans la Peinture à l'Huile. E. Lenoble. (Bull. de la Soc. Ind. du Nord de la France, 35 Année, No. 138, 1907; 9 pp.) Article inquiring into the relative merits of zinc-white and white lead as a pigment. Among the points considered are economies

of use, resistance to atmospheric agents, covering power, ease of use, etc.

ECONOMIC GEOLOGY—GENERAL

5209—CALCITE CRYSTALS—Some New Crystallographic Combinations of Calcite from West Paterson, N. J. H. P. Whitlock. (Am. Journ. Sci., Nov., 1907; 2½ pp.) Reports on some new types of crystal combinations of calcite found in New Jersey, giving a representation of some of the forms and a list of the angles noted. 60c.

5210—GERMANY—Ueber die Genesis der Eisen- und Manganerzvorkommen bei Oberrosbach im Taunus. Bodifée. (Zeit. f. prak. Geol., Oct., 1907; 7 pp.) Describes the characteristic modes of occurrence of the iron and manganese ore deposits in the Taunus mountains of Germany and investigates them with reference to the probable method of their genesis. 40c.

5211—LEADVILLE DISTRICT—Structural Geology at Leadville. F. L. Barker. (Mines and Minerals, Dec., 1907; 2½ pp.) Gives an idea of the structural geology of this camp as shown by the Western Mining Company and allied concerns. Some of the problems met with in sinking the Coronado and Hilschle shafts of this company are explained. 20c.

5212—MINERALOGY—The Gnomonic Projection from a Graphical Standpoint. A. F. Rogers. (School of Mines Quar., Nov., 1907; 7 pp.) Describes the principles upon which gnomonic projection of the faces and angles of crystal forms is based, and points out the advantage of this method over the stereographic. 60c.

5213—U. S. GEOLOGICAL SURVEY, The Work of the. George Otis Smith. (Eng. and Min. Journ., Nov. 30, 1907; 2 pp.) Paper read before the Am. Min. Congress, Nov., 1907. Story of the past and present work of the U. S. Geological Survey, how it has aided the mineral industry, and discussing plans and opportunities for the future. 20c.

5214—UNITED STATES GEOLOGICAL SURVEY, Twenty-eighth Annual Report of the Director of the United States Geological Survey to the Secretary of the Interior for the Fiscal Year Ended June 30, 1907. George Otis Smith, Director. (Washington, 1907; Government Printing Office; 80 pp.) A detailed report of the work of the various branches and divisions of the Survey during the above-mentioned period.

5215—WESTERN AUSTRALIA—The Distribution and Occurrence of the Base Metals in Western Australia. E. S. Simpson and C. G. Gibson. (Geol. Surv. of W. A., Bull. No. 30, 1907; 129 pp.) Notes on the distribution and occurrences of copper, tin, lead, zinc, antimony and bismuth, iron, nickel, aluminum, tantalum, tungsten and molybdenum.

MINING—GENERAL

5216—AIR-PIPES—Underground Air Pipes: Sizes and Capacities. (South African Mines, Nov. 2 and 9, 1907; 2 pp.) Notes on the best size of air pipe for carrying compressed air underground with minimum loss of pressure. D'Arcy's formulae are used and the improvements needed in pipe lines on the Rand are discussed. 40c.

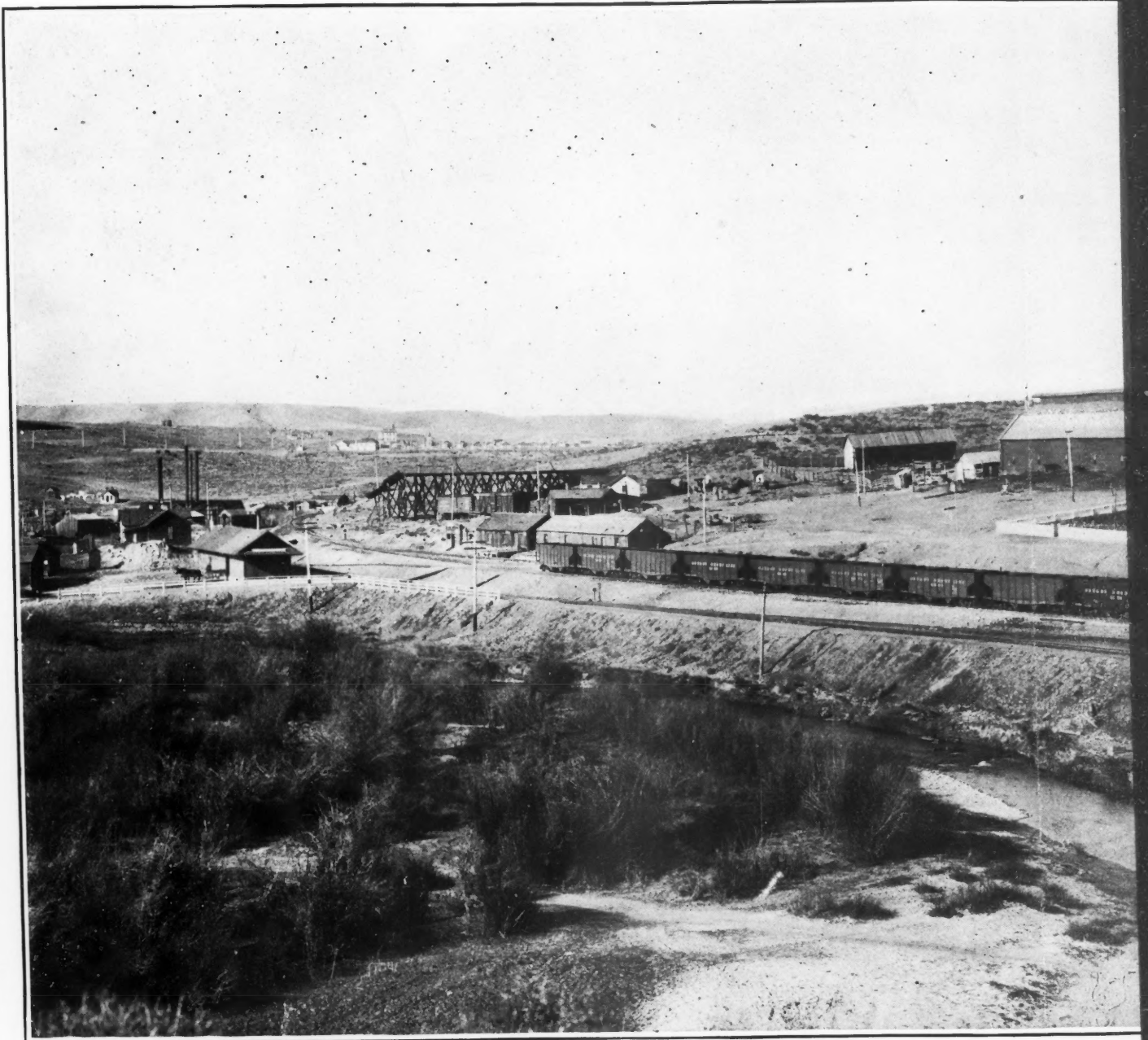
5217—ANCIENT MINING—Las minas en la antigüedad. (Geología y Minas, Aug. and Sept., 1907; 10 pp.) Interesting account of old time mining operations by the Greeks at Laurium, the mines of the Harz in the 15th century, slavery in early mining operations, etc.

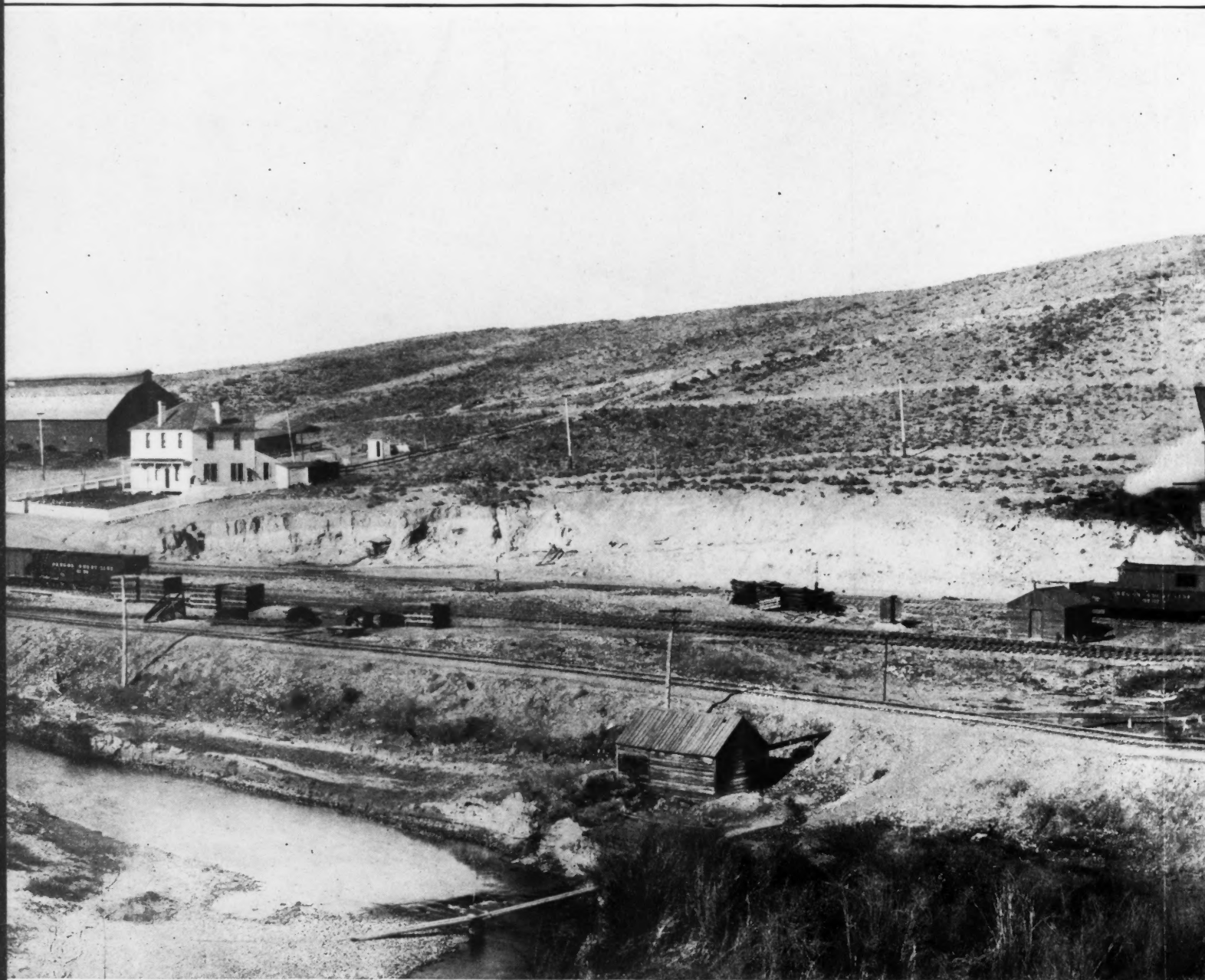
5218—AUSTRALASIA—Mining in Australasia. H. L. Wilkinson. (Min. and Sci. Press, Nov. 16, 1907; 2½ pp.) Reviews the mining industry of the various states of this country, dealing mostly with gold mining. 20c.

5219—BLASTING IN GASEOUS MINES—Note sur l'Amélioration de la Sécurité dans les Mines grisouteuses par Emploi d'un nouveau Dispositif d'Armorage de Explosifs. M. Lheaur. (Ann. des Mines, T. XII, 8 livr., 1907; 26 pp.) Account of a proposed method of securing greater safety while blasting in dusty mines. The improvement consists in not having the detonator of the blasting concentrated in one point, but spread throughout the entire length of the blasting medium.

5220—BRITISH COLUMBIA—Mining in the Rossland District, British Columbia. R. Stokes. (Min. Wld., Dec. 21, 1907; 2 pp.) Brief general notes on present mining conditions in the above district. 20c.

5221—BRITISH COLUMBIA—Mining in Western Canada. H. Mortimer Lamb. (Mines and Minerals, Dec., 1907; 2½ pp.) An outline of present running conditions in the Yukon and Coast districts and other regions of British Columbia. 20c.





The Largest of the Amalgamated Copper Comp

Supplement to The Engineering and Mi



Company's Mines at Diamondville, Wyoming

and Mining Journal, January 11, 1908

