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**THE ENGINEERING AND  
MINING JOURNAL**

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VOLUME LXXXI.

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JANUARY TO JUNE

1906

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THE ENGINEERING AND MINING JOURNAL  
INCORPORATED  
505 Pearl Street, NEW YORK



# The Engineering and Mining Journal

VOL. LXXXI.

NEW YORK, JAN. 6, 1906.

NO. 1.

Published Weekly at  
505 PEARL STREET, NEW YORK

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

To Foreign Countries, including postage, \$8.00 or its equivalent, 33 shillings; 32 marks; or 40 francs.

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

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

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

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THE ENGINEERING AND MINING JOURNAL.

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

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## Gold and Silver.

BY FREDERICK HOBART.

The great gold output of 1904 in the United States was again surpassed in 1905, and a new record was established. The figures collected by the Director of the Mint, which are given in the accompanying table, show a total for 1905 of \$86,337,700, an increase of \$5,614,300, or 6.95%, as compared with the corrected statement for 1904. The total for the year just closed was not only the largest ever reported for this country; it was within \$15,000,000 of the total production of the world only 20 years ago, in 1885.

In order to make a clearer comparison, we give herewith a supplementary table, showing the production of the nine more important producing States in 1904 and 1905:

	1904.	1905.	Changes.
Colorado.....	\$24,395,800	\$25,333,300	I. \$ 937,500
California.....	19,109,600	17,502,600	D. 1,607,000
Alaska.....	9,304,200	14,650,100	I. 5,345,900
S. Dakota.....	7,024,600	6,951,600	D. 73,000
Montana.....	5,097,800	5,064,600	D. 33,200
Nevada.....	4,307,800	4,700,000	I. 392,200
Utah.....	4,215,000	4,651,200	I. 436,200
Arizona.....	3,343,900	3,500,000	I. 156,100
Idaho.....	1,503,700	1,550,400	I. 46,700

In 1905 these nine States and territories produced 99.5% of the total gold; the output of the remaining 12 States included in the list being comparatively insignificant in amount. Three of the States named produced less gold than in 1904, the only important changes being in California. The other six made gains, nearly all of them important in amount and proportion.

### PRELIMINARY ESTIMATES OF THE PRODUCTION OF GOLD AND SILVER BY THE MINES OF THE UNITED STATES DURING THE CALENDAR YEAR 1905.

States.	Gold.		Silver	
	Fine ounces.	Value.	Fine ounces.	Commercial value. at 61c.
Alabama.....	2,195	\$ 46,500	387	\$ 236
Alaska.....	708,700	14,650,100	236,578	144,313
Arizona.....	169,313	3,500,000	3,400,000	2,074,000
California.....	846,688	17,502,600	879,511	535,441
Colorado.....	1,225,500	25,333,300	12,704,919	7,750,000
Georgia.....	2,441	50,500	205	125
Idaho.....	75,000	1,550,400	9,000,000	5,490,000
Maryland.....	281	17,000	39	24
Michigan.....			127,800	77,958
Montana.....	245,000	5,064,600	13,500,000	8,235,000
Nevada.....	227,363	4,700,000	6,000,000	3,660,000
N. Mexico.....	20,000	413,400	250,000	152,500
N. Carolina.....	3,694	76,400	2,547	1,554
Oregon.....	63,853	1,320,200	81,560	49,752
S. Carolina.....	4,915	101,600	223	136
S. Dakota.....	336,285	6,951,600	138,409	84,430
Tennessee.....	359	7,400	27,733	16,917
Texas.....	110	2,300	469,600	286,456
Utah.....	225,000	4,651,200	12,000,000	7,320,000
Virginia.....	19	400	4	2
Washing'n.....	17,842	368,800	115,412	70,401
Wyoming.....	1,485	20,700	3,528	2,152
	4,178,592	\$86,337,700	58,938,355	\$35,952,397

By courtesy of the Director of the U. S. Mint.

Colorado remains the largest producer; its increase of nearly a million still leaves the total \$3,135,200 below that of 1902, the record year; but steady progress is being made, and there is every reason to believe that a still higher point will be

The printers' strike, which began Jan. 2, has delayed us somewhat in the publication of this issue.

Several important reviews have necessarily had to be omitted from this issue, but will appear in our next and subsequent numbers.

The statistics which we have collected show a remarkable growth in the production of the most important metals in 1905. Iron, copper, lead, spelter, gold and silver have all increased over 1904, and with the exception of silver, the increases have been very large ones, and the productions of 1905 have been the highest on record. The fact that these great productions have been made at very high prices for the metals, indicates the extraordinary prosperity which has characterized the mining and metallurgical industry of America in 1905.

As in previous years, we present in this issue, the first of the new year, statistics of production of the most important ores, minerals and metals during the preceding year, with a few noteworthy exceptions. These statistics are necessarily estimates to a large extent, but they are estimates made by authorities in each branch and on much substantial data. In many cases they are compiled from reports of all, or nearly all, the producers, who have themselves estimated their probable output during the closing days of December. In the cases of lead and spelter, for example, we received reports from all producers, except one smelter of lead and one of spelter, whose outputs in 1904 were very small. In other cases we received reports from every producer. Our statistics may be considered therefore as giving a close approximation to the actual production of many of the important mineral and metallic substances in 1904, and the promptness of the publication will be appreciated.

Mineral and Metal Production for the United States.

Non-metallic:	CUSTOMARY MEASURE	1904			1905			CHANGES IN QUANTITIES
		QUANTITY	VALUE		QUANTITY	VALUE		
			TOTAL	PER UNIT		TOTAL	PER UNIT	
Arsenic, white . . .	Sh.T.	498	\$ 29,504	\$ 59.25	875	\$ 52,481	\$-60.00	I. 377
Bauxite . . . . .	L. T.	48,012	166,121	3.46	47,173	200,485	4.25	D. 839
Bromine . . . . .	LB.	879,312	245,431	0.28	896,500	313,775	(g) 0.55	I. 17,188
Carborundum . . .	LB.	7,060,380	706,038	0.10	3,940,000	394,000	0.10	D. 3,120,380
Cement, natural hydraulic	BBL.(a)	4,866,331	2,450,150	0.50	4,500,000	2,250,000	0.50	D. 366,331
Cement, portland	BBL.(b)	26,505,881	23,355,119	0.88	31,000,000	32,000,000	1.03	I. 4,494,119
Cement, slag . . .	BBL.(b)	303,045	226,651	0.75	300,000	210,000	0.70	D. 3,045
Coal, anthracite . .	Sh.T.	73,674,480	162,151,898	2.21	75,501,503	181,257,909	2.40	I. 1,827,023
Coal, bituminous(c)	Sh.T.	277,065,582	311,667,680	1.12	297,706,453	366,178,937	1.23	I. 20,640,871
Coke . . . . .	Sh.T.	22,035,292	54,178,015	2.46	26,219,071	79,968,166	3.05	I. 4,183,779
Copper sulphate.(a)	LB.	63,234,557	3,161,728	0.05	52,405,009	2,751,263	0.05½	D. 10,829,548
Copperas (f)	Sh.T.	16,956	118,692	7.00	20,392	142,744	7.00	I. 3,436
Crushed steel . . .	LB.	790,000	55,300	0.07	812,000	56,840	0.07	I. 22,000
Fluorspar . . . . .	Sh.T.	36,452	234,755	6.44	49,600	295,650	5.96	I. 13,148
Garnet . . . . .	Sh.T.	2,952	89,636	30.36	3,694	114,625	31.03	I. 742
Graphite, artificial	LB.	3,248,000	217,790	0.07	4,439,700	303,162	0.07	I. 1,191,700
Graphite, crystalline	LB.	4,357,927	162,332	0.04	4,260,656	170,426	0.04	D. 97,271
Iron Ore . . . . .	L.T.	29,462,839	51,559,868	1.75	44,054,197	79,372,155	1.80	I. 14,591,358
Lead, white . . . . .	Sh.T.	126,336	13,899,915	110.00	130,192	15,874,384	121.93	I. 3,856
Lead, red . . . . .	Sh.T.	13,938	1,672,569	120.00	14,635	1,858,645	127.00	I. 697
Lead, orange mineral	Sh.T.	1,125	168,681	149.94	1,181	203,132	172.00	I. 56
Limestone and dolomite flux	L.T.	10,657,038	4,702,768	0.44	11,435,900	5,146,155	0.45	I. 778,862
Litharge . . . . .	Sh.T.	12,487	1,248,691	100.00	13,111	1,573,320	120.00	I. 624
Pyrite . . . . .	L.T.	173,221	669,124	3.86	189,201	650,412	3.44	I. 15,980
Sulphur . . . . .	L. T.	193,492	3,869,840	20.00	.....	.....	.....	.....
Zinc-lead . . . . .	Sh.T.	6,781	474,670	70.00	7,200	540,000	75.00	I. 419
Zinc oxide . . . . .	Sh.T.	57,613	4,524,031	78.52	65,403	5,232,240	80.00	I. 7,790
Zinc ore, exported	Sh.T.	35,911	905,782	25.22	26,597	738,532	27.80	D. 9,314
Total non-metallic	.....	.....	\$ 642,912,777	.....	.....	\$ 777,849,418	.....	.....
Metallic :								
Copper (e) . . . . .	L.B.	817,715,005	106,302,950	0.130	925,267,840	145,257,798	0.157	I. 107,552,835
Gold (fine) . . . . .	Troy oz.	3,904,986	80,723,200	20.67	4,178,592	86,337,700	20.67	I. 273,606
Iron (pig) . . . . .	L.T.	16,276,641	225,268,711	13.84	23,010,625	382,666,694	16.63	I. 6,733,984
Lead . . . . .	Sh.T.	302,204	26,043,941	86.18	322,587	30,368,340	94.14	I. 20,383
Quicksilver . . . . .	Flasks(d)	35,258	1,489,716	42.25	30,256	1,173,932	38.80	D. 5,002
Silver (fine) . . . . .	Troy oz.	57,786,100	33,515,938	0.58	58,938,355	37,437,643	0.635	I. 1,152,255
Zinc . . . . .	Sh.T.	181,803	18,543,906	102.00	199,964	23,523,765	117.64	I. 18,161
Total metallic	.....	.....	\$ 491,888,362	.....	.....	\$ 706,765,872	.....	.....

(a) Barrels of 300 lb. (b) Barrels of 380 lbs. (c) Includes cannell. (d) Flasks of 75 lb. (e) Value computed on average of Lake copper at New York. (f) Only that marketed as copperas. (g) An arbitrary value since over half the bromine reported was contained in bromides.

reached this year. Cripple Creek remains the chief producing district, with a total of about \$16,800,000 for the year; but Leadville, Ouray, Telluride and other camps have been active producers. California, holding the second place, showed a decrease in 1905 which was largely the results of a year of light rainfall. The many mines of the Mother Lode and of nearly all the mountain region were obliged for several months to reduce their activity—in some cases to shut down entirely—on account of lack of water for mills and lack of power at the large number which use water-power. The dredging for gold, which has grown to be an important industry in this State, continued to increase in extent. Several of the larger companies were consolidated under one management, and arrangements

were made to extend the field of operations on a large scale.

Alaska holds the third place, with an increase of 57.5%, largely due to the opening and operation of the Tanana and some minor districts. The output of the Tanana country in 1905 was \$5,107,000. The Nome district remains a large producer, having turned out \$4,557,000 during the year. These, with the steady work of the great mines of Douglas Island, and the output of the American Yukon, have brought Alaska up to its present rank as a gold producer.

Nevada shows the effect of the new discoveries in Tonopah and the neighboring districts in a substantial gain.

The story of the year for the chief gold producing States is briefly told in the special articles which follow. In the

main it is a repetition of that of the several previous years: Some new discoveries; improvements in ore treatment which have made possible the treatment of low-grade ores on a large scale, and have also made possible the re-opening of many old mines formerly abandoned as unprofitable; and, generally, the placing of the gold-mining industry on a more practical basis than has ever before been attained. If we except the opening of the far North, the gains in gold production in the last decade have been quite as much the result of advances in knowledge and practice as of new discoveries.

Silver production in the United States in 1905 reached a total of 58,938,355 oz. an increase of 1,152,255 oz., or 2% over that of 1904. Montana was the leading

producer, followed closely by Colorado and Utah, and at longer intervals by Idaho, Nevada and Arizona. As has frequently been said, silver is now largely a by-product, obtained from ores the chief value of which is in other metals. Our chief silver producers last year were the great copper mines of Montana and Arizona, and the silver-lead mines of Colorado Utah and Idaho. Production, therefore, will continue on a large scale, with little regard to the demand for silver, or its price.

In 1905 the demand for silver was very good. A prosperous season in India, combined with heavy expenditures in China, on war accounts and otherwise, to make the requirements of the Far East—always a chief factor in the market—very large. Prosperity at home and in Europe made a larger demand for the metal for use in the arts than had been known for a long time. The price of silver therefore was well maintained through the year, and in the last quarter it rose to a point higher than had been known for five years. The moderate increase in production was readily absorbed, and the conditions were most favorable to the producers, who begin the new year with excellent prospects.

**Gold Production of the World.**

By FREDERICK HOBART.

The gold production of the world in 1905 not only maintained the high level which had been reached in several previous years, but also showed a substantial increase. So far as can be ascertained at this early date, the total for the year was \$375,465,810, an increase of \$28,198,746, or 7.5% over the output of 1904. With the exception of the Transvaal this increase was fairly well distributed.

OUTPUT OF THE LEADING GOLD-PRODUCING COUNTRIES OF THE WORLD.

	1904.	1905.	Changes.
Australia.....	\$ 87,100,852	\$ 85,522,125	D. \$ 1,578,727
British India	11,602,464	11,634,400	I. 31,936
Canada .....	16,400,000	14,429,000	D. 1,971,000
Mexico .....	12,605,300	13,500,000	I. 894,700
Russia.....	25,075,358	24,000,000	D. 1,075,358
Rhodesia.....	4,820,223	7,429,625	I. 2,609,402
Transvaal....	78,122,701	101,295,960	I. 23,173,259
United States	80,723,200	86,337,700	I. 5,614,500
All others....	30,816,966	31,317,000	I. 500,034
Total .....	\$347,267,064	\$375,465,810	I. \$28,198,746

In the table given herewith, according to our usual custom, we have given the production of the more important countries in 1905, with an estimate for the minor countries, comparison being made with the corrected figures for the previous year. In most cases it is possible to do this with a very close approximation to the actual result. The monthly report from the South African Chamber of Mines and those furnished by the different states of Australia make it necessary to estimate only the month of December. In some of the important countries the mint and other reports are available for this purpose. In Russia alone has it been impossible to ob-

tain definite figures. In previous years we have received from the Imperial Mint, at the first of the year, dispatches giving its total receipts; but the present condition of affairs has made it impossible to secure this information. Undoubtedly there was some decrease in the gold production in that country, but it was less than has been generally supposed. In the Ural there was a cessation of working to a large extent, but in Siberia, from which by far the greater part of the Russian gold is obtained, the war made little difference. The great placers of the Trans-Baikal and of the upper tributaries of the Lena were entirely out of the track of all operations connected with the war, and mining, according to our best information, went on without interruption, the people engaged being hardly aware that the contest was going on. The only interruption was in the district along the Amoor, of which Blagoviestchenk is the center, and even then there was not much interference with actual mining.

As will be seen from the table, the largest increase of the year was made in the Transvaal and indeed, that country and the United States furnished almost the whole gain. The great mines of South Africa have resumed fully the position which they had reached previous to the outbreak of the Boer war. The introduction of Chinese into the mines has made up the needed supply of labor, and has been to that extent an advantage, whatever may be the final economic results of this large alien immigration. This is now a matter of exciting debate, but can hardly be considered here. The newer deep level mines on the Rand which are now beginning to produce, have made up for any decrease caused by the working out of some of the earlier outcrop mines, and this will probably continue to be the case for some years.

Canada again shows a decrease in gold production in 1905. There was an improvement in British Columbia, and the comparatively small production of Ontario and Nova Scotia was practically unchanged. In the Yukon, however, there was a large decrease, due to the same causes as were noted a year ago. The first riches of the Yukon placers have been largely exhausted, and the country is now in a state of transition between the period of first exploitation and that of systematic working on a large scale by hydraulicking, dredging and similar methods, which is surely coming, but has not yet fairly begun. This will very possibly continue for several years. A promising development is found in the Cobalt and Timiskaming regions of Northern Ontario and in the Abitibi region of Quebec, but it will take several years to bring about the full exploration and development of those districts.

The United States has been referred to at length in the first part of this article.

Of the other countries, Mexico shows the same steady growth that has been apparent for several years. The Kolar district of India remains one of the steadiest producers in the world. Rhodesia has had a considerable increase, the result of the opening of several new mines.

Australia alone among the important countries show a decrease, and this change, we think, is fully explained in the letter of our Australian correspondent, which is given in another column.

The total production of gold is not only the largest ever recorded; it has reached an amount nearly four times as great as that made in 1885, only 20 years ago. There is every probability also that the end of this increase is not yet in sight.

The statistics of the commercial movement of gold during 1905 show that about one-third of the year's production became immediately available in an economic sense. That is, the increase in the known bank reserves of the world was about one-third of the gold production; making allowance for certain reports which cannot be obtained, and for bullion retained in private hands, it is probable that between 45 and 50% of the gold won last year is now in use for trade purposes. It must also be remembered that the consumption of gold in the arts undoubtedly reached a very high point as is always the case in periods of great prosperity. Russia is the only important country which has suffered from war and internal disturbances. In our own country and through the greater part of the commercial world, business and profits have been excellent. It is one of those periods of which it may be said that the whole world had money in its pocket and wanted to spend it—and it is in such periods that the precious metals find large use outside of coinage and currency.

**Commercial Movement of Gold and Silver in 1905.**

By A. SELWYN-BROWN.

The commercial movement of gold and silver in the United States in 1905 was noteworthy in several respects. The production of both metals was stimulated to an extraordinary degree during the year.

*Gold*—For the eleven months, ending Nov. 30, the United States gold exports amounted to \$44,125,935; as compared with \$107,709,000 in 1904. Imports amounted to \$46,514,475 against \$81,467,050 in the previous year. The excess of exports in 1905 amounted to \$2,388,540 as compared with \$26,241,950 in 1904.

In the fall, some important exports of gold were made to Mexico. The Mexican Government, taking advantage of the high price and keen demand for silver in the Orient, sold several million Mexican silver dollars in New York for export to China. In return for gold.

The table below indicates the gold in the banks of the principal commercial countries at the end of the year.

	Dec. 29, 1904.	Dec. 28, 1905.
New York Associated	\$ 203,684,000	\$ 170,212,800
England	149,636,360	142,657,255
France	531,724,630	575,666,510
Germany	173,825,000	166,300,000
Russia	511,580,000	576,215,000
Austria-Hungary	242,115,000	224,325,000
Spain	74,485,000	75,115,000
Italy	110,850,000	134,345,000
Netherlands	28,116,500	33,019,500
Belgium	16,843,335	16,233,335
Total	2,042,359,825	2,111,083,400

It will be noticed, that while most countries in the past year increased their gold reserves, those in the American banks were largely depleted.

**Silver.**—Silver imports were mostly from Central and South American States and Mexico, for refining, or for export to London or the Orient. The movement of silver in the United States, for the eleven months ending Nov. 30, was as follows: exports \$49,316,953; imports \$30,930,532; excess of exports \$18,386,421, as against \$22,186,497 in 1904.

The most remarkable movement was the large export of Mexican silver dollars to China in the fall. In the last three months of the year, the Mexican government sold about \$5,000,000 (of the \$10,000,000 silver reserve which the Currency Commission had stored in the Treasury awaiting a favorable opportunity for exchanging for gold.) The profit made by the government by this recent conversion is estimated at 7%, which was received in gold. Arrangements are in progress for the re-minting of the gold in Mexican coin

#### SILVER.

Month.	New York.		London.	
	1904.	1905.	1904.	1905.
January	57.005	60.690	26.423	27.930
February	57.592	61.023	26.665	28.047
March	56.741	58.046	26.164	26.794
April	54.202	56.600	24.974	26.108
May	55.430	57.832	25.578	26.664
June	55.673	58.428	25.644	26.910
July	58.095	58.915	26.760	27.168
August	57.806	60.289	26.591	27.822
September	57.120	61.695	26.349	28.528
October	57.923	62.084	26.760	28.637
November	58.453	63.849	26.952	29.493
December	60.563	64.850	27.930	29.977
Year	57.221	60.352	26.399	27.839

The New York prices are in cents per fine ounce; the London quotation is in pence per standard ounce, .925 fine.

The principal Oriental countries during the past few years have experienced prosperous seasons. As a consequence business is brisk in India, China, and the neighboring states; while prospects in Japan are excellent. As a result of these conditions, there is a large demand for silver which is expected to continue well into the new year. Shipments of silver from London to the East for the year to Dec. 14 were as follows:

	1904.	1905.	Changes.
India	£9,273,218	£6,584,921	D. £2,688,297
China	465,857	883,590	I. 417,733
Straits	79,268	38,299	D. 40,969
Totals	£9,808,343	£7,506,810	D. £2,301,533

Including silver valued at \$7,499,808 exported from San Francisco, the silver exported to the Orient during the year was valued at about \$45,000,000. Allowance must be made for shipments from Australia and Russia, for which figures are not yet at hand. During the war, Russia incurred large debts in Manchuria and other parts of China which are to be paid in silver. To meet these liabilities, large shipments of silver are being made by way of Siberia. For the same purpose, Japan is shipping silver to China every month.

Some trouble has been experienced by the Philippine authorities in protecting the local silver coins. During the past two or three years large numbers of Philippine dollars were coined in the San Francisco mint and sent to the islands. At present the Philippine dollar is worth a little more than 50c—its currency value. As a result, large quantities are reduced to bars and exported to China, notwithstanding the penalty consequent on such actions.

In addition to the Oriental demand for silver, the general revival in trade throughout the world has stimulated a call for the use of silver in the arts. The sales of bar silver to manufacturers have been unusually large lately. Owing to these causes, and to the small increase in silver production, the price of silver has advanced to a higher figure than has prevailed for nine years.

#### Copper.

BY FREDERICK HOBART.

The main features in the history of copper in 1904 were a moderate increase in production and a heavy demand from abroad. In 1905 conditions were somewhat changed, there was a larger increase in production than has been the case for many years; the home consumption was beyond all precedent, while the foreign demand showed a considerable falling off. The output of the metal showed the effect of the extension in mining which began three and four years ago. In the Lake Superior region, in Arizona and in Montana the production of the older mines increased and a number of new mines in which work has been in progress entered the producing list.

In the following table we have given an estimate by States of the production for the full year 1905, comparisons being made with the statement in "The Mineral Industry" for the year 1904. The figures are in long tons:

	1904.	1905.	Changes.
Montana	133,181	150,893	I. 17,712
Arizona	85,536	102,678	I. 17,142
Michigan	93,003	101,563	I. 8,560
Utah	21,009	25,566	I. 4,557
All Other States	32,322	32,366	I. 44
Total	365,051	413,066	I. 48,015

The total increase in production here shown is 13.2%. For a number of years previous to 1904 the average gain each year has not exceeded 8%. Taking the

table in detail, we find that Montana shows an increase slightly above the average, the gain being 13.3%. In the Butte district several new mines assisted in swelling the output; the old mines all kept up their production well, and there was less interference with the operations by litigation than in previous years; Arizona shows the largest gain, and for the first time it takes the second place, the increase of 20.1% making its total slightly higher than that of Michigan. The old mines, such as those of the Copper Queen Consolidated, The United Verde and the Arizona Copper Company, all increased their production considerably. The new mines of the Bisbee district are becoming important factors, and many smaller mines added to the total. In the Lake district the increase in production was larger than for several years; the greater part of it coming from the newer south range mines. In Utah the large low-grade mines of the Bingham district are showing the effect of the work which has been done in the past two years. The production of the other States was practically the same in 1905 as in the previous year; this was largely the result of a decrease in the California copper, which is, we think, only temporary. In Tennessee there was a fair advance, and the same may be said of Colorado and Idaho. Alaska appeared as a producer for the first time.

The imports of copper for the year were large, as is shown in the tables given below; the greater part of these came from Mexico in the form of blister copper, copper bullion and matte to be refined here. There was also a considerable amount from Canada and some was received from South America, the quantity of the last named imports being on the increase. Exports to European countries fell off decidedly. A demand for some 30,000 tons from China was not quite sufficient to bring the total up to that of the preceding year.

In the following table we have shown the extent of the copper supplies during the year and the disposition made of them. The imports and exports for December are necessarily estimated; the figures are given in long tons of 2,240 pounds:

Production	413,066
Net imports	92,600
Stocks, Jan. 1.	93,025
Total Supply	598,691
Exports	245,500
Approximate consumption	294,200
Total deduction	539,700
Stocks, Dec. 31	58,991

The consumption given above is, we believe, a very close approximation to that which will be shown by the completed statistics; as was said above, it is far in excess of anything known in this country before, the average being between 52,000,000 and 53,000,000 pounds

per month. All the mills manufacturing sheet, wire, and other finished forms of copper; all the brass mills and all the manufacturers of locomotive engines and other machinery into which copper and brass enter in part, were extremely busy throughout the year. The great extension of electric work of all kinds, the construction of new electric roads and the application of electricity on existing railroads have been largely responsible for the demand, which shows every sign of continuance through the opening year.

The stocks shown, it must be remembered, do not indicate that at the close of the year there were 59,000 tons of copper available for immediate delivery. As production is reported from the mines, and periods varying from 20 to 60 days for different districts are required to refine the copper, to transport it to the points where it is sold and generally to put it in marketable form, there must necessarily be from 50,000 to 60,000 tons of copper nominally included in the stocks, irrespective of any quantities which may remain unsold. As a matter of fact, the most careful inquiry has made it evident that the unsold stock of copper in marketable form at the close of the year was practically nil.

Production in foreign countries has shown its greatest development on the North American continent and Mexico decidedly takes the lead; the large mines of the Cananea, the Nacozari and others in Sonora are becoming very important producers, while many new mines are being opened, and the operations of the Boleo Company continue large. In Canada also production has increased steadily; the greater part coming from the large mines of the Boundary district of British Columbia, and from the Coast and Vancouver Island in the same province. In Eastern Canada also, there has been a revival of copper mining; the old Eustis and Massey mines in Ontario are doing well and there have been some promising developments near Sherbrooke in Quebec. In Europe there has been little change, the more important mines, like the Rio Tinto in Spain, the Mansfield in Germany, and others, have kept up a steady production. In South Africa one of the old mines of the Cape Copper Company is approaching exhaustion, and no extensive new discoveries have been made to replace it. The reported deposits of copper in Rhodesia have not yet been developed to any extent. In Australia production has been good, but without any material change. The output in Japan has been fully maintained, and now that the war is over the large proportion of its copper which has been used in the manufacture of cartridges and similar appliances will be eventually diverted to the supply of industry.

*Exports and Imports.*—Exports of metallic copper from the United States for

the 11 months ending Nov. 30 are reported as below by the Bureau of Statistics of the Department of Commerce and Labor; the figures being in long tons of 2,240 lb.:

	1904.	1905.	Changes.
Great Britain.....	45,554	25,188	D. 20,366
Belgium.....	3,640	2,107	D. 1,497
France.....	40,202	28,761	D. 11,441
Italy.....	6,168	6,465	I. 297
Germany & Holland.....	104,822	95,648	D. 9,174
Russia.....	8,968	8,013	D. 955
Other Europe.....	11,846	10,555	D. 291
Canada.....	1,430	1,172	D. 258
China.....	3,570	35,088	I. 31,578
Other Countries.....	344	7,286	I. 6,942
Total.....	226,508	220,253	D. 6,255

In addition to the exports of metal were 16,324 tons of ore and matte exported in 1904; and 34,470 tons in 1905; an increase of 18,146 tons. Estimating the copper contents of this material, chiefly on the basis of values, we find that the total exports were equal to 230,879 tons of copper in 1904, and 225,061 tons in 1905; a decrease of 5,818 tons. The increase in exports to China was 31,518 tons; there was, therefore, a decrease in the exports to all other countries of 37,336 tons.

Imports of copper and copper materials into the United States for the 11 months ending Nov. 30 are reported as follows, with re-exports of foreign material; the figures giving the equivalent of all material in long tons of fine copper:

	Metal.	In Ore, etc.	Total.
Mexico.....	42,230	11,971	54,201
Canada.....	9,501	5,863	15,364
Great Britain.....	10,830	21	10,851
Other countries.....	3,214	2,077	5,291
Total.....	65,775	19,932	85,707
Re-exports.....	692	.....	692
Net imports.....	65,083	19,932	85,015

In 1904 the total net imports were 72,844 tons, so that there was an increase of 12,171 tons in 1905. The total net imports for the 11 months were 140,046 tons less than the exports given above. The imports of ores and matte from Canada and Newfoundland were 153,720 tons, with a copper content of 11,971 tons. The imports from Mexico include a large proportion of matte. The imports from Great Britain were largely bars sent here to be refined. Imports from other countries were chiefly from South America.

### Copper in Arizona in 1905.

BY JAMES DOUGLAS.

The copper interests in Southern Arizona have been very active during 1905. The large smelter of the Copper Queen Company at Douglas, equipped as custom works, has been put into more effective working condition, and an increase in size of about 50% has been planned and is nearly completed. This increase however, is intended more as a safeguard against temporary interruption than as a means of increasing the capacity of the works to a proportionate extent. The output of these works, which was 40,488 tons in 1905, will probably be slightly increased

during the coming year. The total output for the year 1905 of the Copper Queen mines themselves, exclusive of what has been put into stock, but including 5,500,000 lb of Copper Queen copper in the form of sulphide ore, shipped to Globe, was 38,500 tons of copper.

The greatest activity, however, has prevailed in the mines known as the Bonanza groups, an activity which exhibits itself in the greater production of the Calumet & Arizona smelter, which reduces the ores of that company, and is being enlarged to handle the production of ores from the other mines of the allied corporations. The production of the Calumet & Arizona smelter in 1905 was approximately 17,000 tons, and it may safely be assumed that this figure will be exceeded in 1906. Railway switches from the El Paso & Southwestern R. R. have been built to the Irish Mag and the Oliver shafts of the Calumet & Arizona Co., to the shaft of the Calumet & Pittsburg, and to one of the shafts of the Lake Superior & Pittsburg, all of which mines are now producing or prepared to produce. This is also true of the Junction.

The Clifton District has slightly declined in its production, not due to any failure in the ore supply, but to interruption through floods. But the Arizona Copper Co. and the Detroit Mining Co. will nevertheless, unless interrupted by misfortune, turn out slightly more copper in 1906 than in any year previously, as the former company is building a new mill and the latter is doubling the capacity of its existing concentrator, and both improvements should be in operation before 1906 closes.

Globe also shows a large increase. As pointed out last year, the importation of sulphides from Bisbee and elsewhere enabled the Old Dominion to inaugurate matte smelting and bessemerizing with considerable economy over the old method of direct production of copper from oxidized ores. The output from the Globe smelter has reached about 28,500,000 lb. for 1905, but as the company has been importing sulphides and is treating large quantities of local custom ores, this large production does not come exclusively from the Old Dominion Mine. The company's mines however, will themselves probably be more productive as the concentrator, which was started in August last, will enable a much larger quantity of low-grade ores to be utilized than heretofore—and it is hoped soon to reach some rich productive ore-bodies, which have been inaccessible on account of the water. The United Mines have been shipping to both the Old Dominion smelter and likewise to the Douglas smelter, and a neighboring property, the Arizona Commercial, is likewise marketing its ores. The Black Warrior and other mines in the Pinal District are yielding more than ever heretofore, and

therefore the whole Globe District may be expected during the coming year to contribute 40,000,000 to 50,000,000 lb. of copper. The Imperial mine has been a steady producer, shipping its ores to the Copper Queen smelter at Douglas; the smaller mines in the Dragoon Mountains and the Santa Ritas have added to the sum total; and Yavapai county has contributed though less than it will in 1906, when the smelting works upon the Agua Fria will have yielded a year's production. The United Verde smelter has run continuously, but improvements are being made which will probably enable this very productive mine to increase its output.

Until accurate returns of the whole year's production have been made after the close of the year, statistics must be a matter of speculation, but it is fair to assume that the total output of the territory for 1905 has been about 230,000,000 lb., and that this will be increased during the year 1906 to approximately 250,000,000 pounds.

### The Lake Superior Copper District.

BY C. E. L. THOMAS.

In a great many respects, the year 1905 has been one of the most remarkable in the history of the Lake Superior copper mining industry. Certainly, never before since the inception of regular mining operations in 1843, have the profits been so large, with more men employed and prosperity more general. Many new enterprises have been launched, which give promise of bearing fruitful results, and several of the older companies are giving attention to their undeveloped lands. Producing properties are reaping large profits as a result of the increased price of the metal, and dividends next year will probably exceed those of any previous year. The disbursements in 1905 have been very large, and more companies are returning a portion of their profits to their shareholders than ever before in the history of the district. Nor has the prosperity been confined to the corporations; the laboring men have been paid high wages and in general have shown satisfaction with existing conditions. There were some differences at certain mines, but as a class, the men have shown good judgment, and wherever there were strikes, they have been settled amicably and the ill feeling usually engendered has been wholly lacking.

Production has been the largest ever secured. While the labor strikes at some of the mines reduced the length of the operating year, and consequently curtailed production, the output of the entire district has shown a gratifying growth. The production is given in detail in the accompanying table. The figures for 1904 are exact, except where otherwise noted. Those for 1905 are necessarily approximate; they are in pounds. The estimates may be relied upon, however, and will

vary only to a slight degree from future official reports:

Mine.	1904.	1905.
Calumet & Hecla....	80,341,019	85,000,000
Quincy.....	18,343,160	20,750,000
Osceola.....	20,472,429	19,500,000
Champion.....	12,212,954	16,750,000
Tamarack.....	14,961,885	15,500,000
Baltic.....	12,177,729	14,000,000
Trimountain.....	10,211,230	11,250,000
Mohawk.....	8,149,515	10,000,000
Wolverine.....	9,764,455	10,000,000
Franklin.....	4,771,050	5,050,000
Atlantic.....	5,321,859	3,850,000
Michigan.....	2,746,127	3,000,000
Isle Royale.....	2,442,905	2,800,000
Mass.....	2,182,931	2,700,000
Adventure.....	1,380,480	2,000,000
Ahmeek.....	e350,000	1,600,000
Centennial.....	641,294	1,500,000
Allouez.....	.....	1,250,000
Phoenix.....	1,162,201	600,000
Winona.....	646,025	50,000
Miscellaneous.....	50,000	100,000
Total.....	208,329,248	227,250,000

This shows a total increase of 18,920,752 lb., or 9.1% for the year.

Production in 1905 showed a gain of 9% over that of the preceding year. Had it not been for labor strikes and accidents the increase would have been considerably larger. The largest individual gain was made by the Calumet & Hecla. This company is shipping regularly from its Osceola mine now, operating three shafts, and results from that branch of the property are satisfactory. The workings on the Calumet conglomerate are furnishing practically the same production as formerly. The new mine on the Kearsarge amygdaloid belt is a shipper to a small extent, but production from this source promises to become larger as the openings are extended. All three Copper Range Consolidated mines — Champion, Baltic and Trimountain — showed increased production, despite the labor difficulties which curtailed operations. Osceola's decrease was due to labor strikes and the explosion at the North Kearsarge branch, which caused a suspension of work there for some time. Allouez was the only new producer during the year. It started shipping rock to the Centennial stamp-mill in the summer. While its tonnage of rock shipments was not large, the richness of its product enabled it to make a favorable showing.

The output during the last ten years is shown in the following table:

Lb. Copper.	Lb. Copper.
1896..... 142,067,500	1901..... 155,716,848
1897..... 142,702,586	1902..... 170,325,598
1898..... 147,905,738	1903..... 192,299,191
1899..... 146,350,338	1904..... 206,329,248
1900..... 142,151,571	1905..... 227,250,000

It is extremely difficult to forecast with any degree of accuracy the output for 1906. Production is subject to labor strikes, accidents and many uncertainties, so that estimates based on conditions existing today may be worthless tomorrow. It is safe to say, however, that the growth next year will be fully as large as in 1905. Several of the newer mines will turn out more copper. The Champion, Trimountain and Baltic are certain to increase their production under normal conditions. The Mohawk is compounding its stamp and will make a gain of 50% as soon as its mill is remodeled throughout.

Centennial and Ahmeek, two Kearsarge lode properties, are just in their infancy and their production will grow as development work advances and openings underground are extended. Among the old mines there is also promise of increased yield. The Calumet & Hecla Company's activity in opening the Kearsarge and Osceola amygdaloid beds where they traverse its main property at Calumet will in time furnish an important source of production. With the completion of the heavy equipment at No. 8 shaft on the Mesnard property of the Quincy Mining Company, a much larger volume of rock shipments will be possible. Atlantic's output last year was curtailed, owing to the management confining part of its work to the introduction of a new system of operations. When this system is in use throughout the mine the production will be larger than ever before. The Osceola Consolidated should make a better showing next year. The old Osceola mine and the South Kearsarge branches are furnishing a fairly good grade of rock, and a large tonnage is shipped from the North Kearsarge openings. The milling capacity has been enlarged by changing the heads from the simple to the compound type.

As the product of the mines is disposed of in various manners—some companies selling ahead, while others get a better price because of peculiar qualities of their copper—it is a hard matter to determine the actual returns. Valued at the average selling price of the metal, Lake Superior mines received nearly \$37,000,000 for their copper last year.

According to the annual reports of the mining inspectors of Houghton, Keweenaw and Octonagon counties, where all the copper mines are located, the working force last year was the largest in the history of the district. In the mines, stamp mills and smelting plants alone, nearly 18,000 men were employed.

Beginning at the extreme northeast, in Keweenaw county, and ending in Ontonagon county, the present status of the mines, briefly stated, is as follows:

At the Ashbed a few men are employed sinking below the old tunnel level. Some copper has been exposed. The consolidation of this property with the Arnold and Meadow, which are under the same management, is talked of, and undoubtedly would be to advantage.

The Keweenaw Copper Company, which was formed this year by Charles A. Wright, of Hancock, who was the original promoter of the Copper Range enterprise, is doing diamond drilling on one of its properties, the Mandan-Medora. The Montreal River lode has been located, and the core showed strong mineralization. The Keweenaw Company has built the Keweenaw Central railway from Lac La Belle, and next spring will push it on to Calumet. Thomas F. Cole, president of the Oliver Mining Company, and John



D. Ryan, managing director of the Amalgamated Copper Company, and associates, have purchased controlling interest in the Keweenaw Copper Company, and its subsidiary concern, the Keweenaw Central railway. Important developments are likely to result from the aggressive work which is projected for next season.

The Resolute, comprising 1,120 acres and located between the Mandan-Medora and the Delaware, has been purchased by the Cole-Ryan interests. Development work will likely be started next summer, the Kearsarge and Montreal River beds traversing the property.

At the Delaware, now owned by the Calumet & Hecla, an old pit on the Montreal River lode was cleaned out and converted into a shaft. Sinking has progressed to a depth of 150 ft., with a remarkably good showing of copper. Diamond drilling to determine the strike and incline of the lode is under way. Some diamond drilling was done on the Clark mine, located at Copper Harbor, in the summer.

The Phoenix was closed down in the middle of the year, as the St. Clair vein became too narrow to permit encouraging results. Much of the machinery and supplies have been sold and a resumption of activity is not expected.

Diamond drill work on the Cliff, owned by the Tamarack Mining Company, has located the Kearsarge amygdaloid bed. Whether extensive work will be started next year is not known. The Miskwabik discontinued sinking and drifting in its shaft, and rigged up a diamond drill to determine more fully the identity of the lode upon which all work has been done. Drill work was carried to a depth of 500 ft., but the core revealed a poor copper showing.

In the eastern series, the Bohemian Range pool explored a tract of land in the Bohemian range. It abandoned work, however, as soon as its fund was exhausted.

The Mohawk is now returning better results than for some time past, and the outlook for 1906 is very bright. Better ground is being opened in the old shafts at increased depth, and the new No. 5 is in a nice run of ground. The installation of the fourth head at the stamp-mill marks the completion of its milling facilities as originally planned. The new head is of the steeple-compound type and it has been decided to change the other stamps to this form. When completed, the change will permit an annual production of rising 18,000,000 lb. copper yearly. The Mohawk has declared its first dividend, \$2 a share, and thus places Keweenaw county back in the paying list.

Ahmeek is more than paying expenses, besides developing its mine in a thorough manner. Its rock is being shipped to the Tamarack stamp-mill and averages considerably better than the Osceola's North

Kearsarge mine, next south. Permanent equipment is being installed and the Ahmeek eventually will become one of the best mines in the district. Its copper values are good in the bottom of its two shafts. All production is from rock taken out in opening the shaft and drift stopes.

Allouez's record will probably stand for some time in the annals of lake copper mining. The rapid and successful manner in which the Kearsarge lode has been opened and the property put on a paying basis is a great credit to Capt. James Chynoweth, the superintendent. Since opening the lode, at a depth of 1,500 ft., five levels have been opened. Production started in the middle of 1905, rock being shipped to the Centennial mill. Allouez's No. 2 shaft will be sunk as rapidly as possible, and should be bottomed in the lode and on a producing basis in two years.

Wolverine goes along from year to year, making the lowest-cost copper on Lake Superior, and paying excellent dividends. Its production will continue about 10,000,000 lb. per annum for 20 years or more, as no increase is contemplated. The mine and mill plant are kept in a fine state of repair, the only construction cost being for maintenance and renewals.

The Osceola suffered from accidents last year, but barring unforeseen conditions should make a good record this year. The outlook at the old Osceola branch is better than for some time past. Work is confined to two shafts with good results. The South Kearsarge branch is yielding an excellent grade of rock. North Kearsarge openings are not as good as they were expected to be, based on results north and south of the property. There is room for considerable exploration northward toward the Allouez and Ahmeek, and better ground may be opened there.

Centennial's energies are being devoted mainly to the opening of new ground, money for that purpose having been obtained from the stockholders. No. 1 shaft is bottomed in what is believed to be the continuation of the upper limits of the rich copper-bearing shoot which makes southward from the Wolverine on the Kearsarge lode. The Centennial's north drifts are penetrating the same character of ground and the outlook is better than ever before. Until development work has advanced sufficiently, no attempt will be made to make a big showing in production.

Small forces are employed at the Old Colony and Mayflower properties, eastward, exploring for copper-bearing lodes of promise. Work at both properties is at considerable depth, and results at one are of importance to the other, as they carry many of the same lodes.

At the Calumet & Hecla much energy is being devoted to the development of virgin ground. Gradually work is being resumed in all the Osceola lode shafts, Nos. 13, 14 and 16 now operating. The remodeling of

the stamp-mills still progresses and will be completed in 1907. The portion of the mills under repair are being fitted to treat amygdaloid rock, which indicates that it is planned to carry the Osceola and Kearsarge lode work forward permanently. The shaft started on the extreme southeastern portion of the property has struck the Kearsarge lode with encouraging results. Permanent equipment is being installed. The two Kearsarge shafts farther north are being opened steadily. Provisions for substituting electricity for steam as an operative power are progressing steadily, and will be completed in 1906. A great saving should result, as there are countless small engines, pumps, etc., and in piping the steam much power is lost. The Calumet & Hecla has acquired extensive holdings of promising mineral lands in Keweenaw county, and organized two subsidiary corporations to develop them. An interest in the Superior has been purchased, and if the outlook is sufficiently favorable, control of the property will be taken.

Tamarack's production is improving. The Osceola lode is supplying rock, it being reached by crosscuts in No. 1 shaft. The other shafts are furnishing a large tonnage from the Calumet conglomerate, improved conditions being noted in No. 5 and No. 3 shafts.

Diamond drilling located the Kearsarge lode on the Laurium lands, but nothing further resulted. Tecumseh became active in 1905. Two shafts have been opened on the Kearsarge amygdaloid, which was located with the diamond drill, and the outlook contains promise.

Attracted by the success of its neighbors, the Rhode Island has started diamond drilling for the Kearsarge amygdaloid bed, and the situation offers encouragement. Work on the Pewabic amygdaloid continues through No. 2 shaft, the lode showing considerable copper in spots.

The Franklin has successfully opened the Kearsarge amygdaloid bed with diamond drills. A crosscut will be extended from the workings on the conglomerate to test the copper values of the formation. One of the most important developments in recent years by the Franklin is the striking of rich ground in the bottom of No. 1, the rock being better than anything heretofore opened. The old Franklin property is still active.

Arcadian has started a shaft upon a lode located with the diamond drill a few years ago. Much of the extensive surface plant was sold, but there is enough machinery left to suffice for the temporary work now under way.

Quincy's outlook is improved by virtue of the approach of No. 8 shaft to the producing stage. This shaft is on the Mesnard branch, being separated from the old mine on surface by the Franklin, but connections will be established between the two properties under the Franklin workings.

Isle Royale has started work on the Baltic amygdaloid bed, which has furnished excellent mines to the southward. A shaft is being sunk upon the outcrop. The shaft on section 2, which is developing the Isle Royale lode, is opening favorable ground and furnishes considerable rock for the mill. Operations in the active shaft at the north end of the mine continue and some exploratory work has been done on the Grand Portage lode.

The Superior Copper Company, which is opening a mine on the Baltic lode in section 15, has passed into the hands of the Calumet & Hecla Company. The latter is furnishing money for operations, taking stock in payment, and if the outlook is good, will purchase control.

Atlantic is developing the Baltic lode on its section 16 tract. A shaft was started from surface and a drift is being extended on the vein from the Baltic workings at the sixth level. The outlook is good. Work of altering the system of mining in the old mine progresses. Lower costs will result.

Baltic is equipping and developing its No. 2 shaft, which should enter the producing list next summer, enabling the mine to make a better record. The cost of making Baltic copper now compares favorably with the best mines in the district. At the stamp-mills the simple stamps have been changed to the steeple-compound type.

Trimountain is developing new ground and making a creditable product. Its heads at the stamp-mill are being compounded and the milling capacity thereby enlarged. Champion's development work is progressing steadily. The mine shows no lessening of values as depth increases.

A portion of the Globe property, immediately south of the Champion, is under option to the Copper Range Consolidated Company. Difficulty was experienced in sinking the first shaft and it was abandoned; the second is a success and should encounter the lode 250 ft. from surface. Openings south from the Champion indicate that the Globe contains good copper ground.

Drifting on what is believed to be the Baltic lode is being pushed by the St. Mary's Mineral Land Company at its Challenge mine. Some copper is exposed and the situation is not without promise. If the bed contains paying values the property will make an immense mine.

The Erie-Ontario Development Company, a new concern, is exploring for the Baltic lode at a point about half-way between the Challenge and Winona mines. A bed is being opened by drifts and it is believed to be identical with the Baltic.

Elm River is sinking its No. 1 shaft. During the late part of last year the rock showed more encouraging conditions, but little copper has been found. Wyandot is exploring its property, but nothing of permanent value has been developed.

Winona's openings, particularly in the

lowest level of No. 3 shaft, are improving. The management is confining its efforts to a thorough exploration of the property, and the stamp-mill question will not be considered until the underground openings are large and plenty of paying rock has been opened.

South of Winona, the St. Mary's Mineral Land Company and other property owners have united in organizing the King Phillip Mining Company to develop lands traversed by the Winona lode. Diamond drill cores and results at the Winona have led the management to plan for permanent work, the property not being classed as a prospect.

No. 4 shaft, started by the Adventure the latter part of last year, is promising and there are still hopes of making a paying mine. Work on the Evergreen lode failed to reveal anything of lasting value. The Aztec and Algomah properties have been taken under option. They adjoin the Adventure and carry the lodes of the Evergreen range.

The Michigan takes first rank among the Ontonagon county properties. Its showing on the Branch vein is excellent and a good-sized product is turned out between the rock stamped at the Mass mill and the yield of heavy copper. The Mass Consolidated has extended railroad facilities to C shaft, which will become a producer shortly. The outlook at the new shaft is good and the old shafts are encouraging. The old Belt property has been taken over by the Lake Copper Company, and will be explored. Victoria's stamp mill and other surface work is rapidly nearing the time when the property will be enabled to start producing. The Copper Crown Mining Company is exploring the Norwich by means of a tunnel driven into the base of a bluff on the property.

#### The Copper Market During 1905.

The year 1905 must be classed as a record year for the copper-producing industries of the world, not only as regards the production—the increase of which over that of the previous year is estimated at about 10%—but also as far as the demand is concerned, which far exceeded available supplies. This naturally affected values considerably, so that toward the end of the year, a price level was reached unknown since the time of the notorious copper corner of 1888, or the summer of 1899, when the agents of the Amalgamated Copper Company tried to keep copper at arbitrary prices. In these two previous instances, values of copper were artificially raised. This time there were no such manipulations; on the contrary, for a long time, the principal producers tried as hard as they possibly could to supply the market at reasonable prices, until the copper in stock or in sight was gone. Then they found themselves helpless, and thus manufacturers who had not supplied themselves in good time were entirely at the mercy of

those who still had small quantities for sale. While usually consumers follow the policy of not buying ahead when the value of commodities is considered above the average, circumstances were now reversed and they put forth efforts to procure the necessary supplies; and during the last few months of the year there was a scramble to purchase copper for three, four and even five months ahead, in the fear that waiting would result in still higher prices. First of all slowly, and then by leaps and bounds, refined copper toward the end of the year went to 18.75c. per lb., with first hands sold out for a considerable time ahead, so that it appears almost safe to predict high values throughout next year, and certainly during the first few months.

At the time of writing, it does not appear that the high prices asked have caused any falling off in the consumption. It must be borne in mind that the uses for copper continue to spread and—as we have now seen—the demand has outstripped the production, in spite of the increase in the latter. Production is likely to be further increased in 1906, but the demand also promises to increase. By far the larger proportion of the consumption is for electrical purposes, and while so far, the electrification of railroads has been confined to secondary roads, there are numerous signs that within a comparatively short time, the trunk roads one after another will replace steam locomotion by electric motive power. This in itself will create an enormous demand for copper, while an increase for practically all other purposes may be looked for. The axiom pronounced a few years ago that electricity is only in its infancy, appears to have been justified in the fullest sense.

There is no doubt that, especially in the earlier part of 1905, large quantities of copper were used for military purposes, due to the Russo-Japanese war, and it is more than likely that in this direction also there will be a large consumption for a considerable time to come; first of all with a view to replacing the large quantities of ammunition used during the war, besides new accouterments, etc., as well as for construction in the navies, not only of the two Powers named, but also of those of the other great Powers of the world.

In addition to fairly large exports to Europe in 1905, there was a large extra demand from the Orient, and there was seldom a month in which the large quantity of 20,000 tons for export was not reached. There was no doubt also a considerable extra consumption on account of new copper coinage in China. How long this will last is somewhat difficult to foresee. During the first half of the year, home consumers covered their wants from hand to mouth only, but when, during the summer, they found more or less difficulty in providing for their requirements, they changed their policy in the way already described. Under the cir-

cumstances, it was more a blessing than a calamity that during the latter half of the year exports decreased to a certain extent.

In scrutinizing in detail the movements of the copper market during the past year, we find that up to the end of July the market ruled quiet, but with a very firm undertone, prices keeping on about a level, with an occasional spurt of activity brought about by an increasing demand from abroad.

The year opened with prices for lake and electrolytic copper at about 15c. per lb., and 14½c. per lb. for casting. These prices, with occasional fluctuations of ¼ to ⅜c. in an upward direction, remained stationary up to the end of April. Then the demand for the metal from consumers here, as well as abroad, ceased almost entirely, and the few comparatively small lots of copper which were pressed for sale had the effect of lowering prices to the extent of about ½c. per lb.

This condition lasted until the beginning of July, when buyers became alive to the fact that copper for near-by delivery was becoming exceedingly scarce and that premiums were asked and paid for such deliveries. This fact prompted them to change their "hand-to-mouth" policy, and to provide for their supplies up to the end of the year. Such action naturally benefited values to a considerable extent.

The conclusion of peace between Japan and Russia, with its expected era of renewed industrial activity in both countries, also helped matters along, so that by the middle of September 16¼c. per lb. for lake, 16c. for electrolytic, and 15¾c. for casting copper was reached.

A slight set-back to the firmness and activity in the market was caused by rumors of intended re-sales by Chinese dealers of large quantities of copper previously contracted for. A thorough investigation, however, into these reports revealed the fact that they were unfounded, and values continued in their upward climb. Large orders were placed by consumers, both here and abroad, during the latter part of November, for delivery well into next year, with the result that at the end of November lake copper was quoted 17½c. per lb., electrolytic 17¼c., and casting copper 17c.

After the placing of these large orders the market became quieter again, but assumed further strength and activity during the first half of December, with large transactions for both lake and electrolytic at from 18¾ to 19c. per lb. Near-by copper remained exceedingly scarce, and fancy prices were realized for small lots that were wanted immediately. The latter half of the month saw a further increase in strength and activity, but toward the close business became rather dull through the natural relaxation of the demand during the holiday season.

COPPER.

	NEW YORK.				LONDON.	
	Electrolytic.		Lake.		1904.	1905.
	1904.	1905.	1904.	1905.		
Jan....	12.410	15.008	12.553	15.128	57.500	68.262
Feb....	12.063	15.011	12.245	15.186	56.500	67.963
March...	12.299	15.125	12.551	15.250	57.321	68.174
April...	12.923	14.920	13.120	15.045	58.247	67.017
May....	12.758	14.627	13.000	14.820	57.321	64.875
June...	12.269	14.673	12.399	14.813	56.398	65.881
July....	12.380	14.888	12.505	15.005	57.256	66.887
Aug....	12.343	15.664	12.468	15.725	56.952	69.830
Sept....	12.495	15.965	12.620	15.978	57.645	69.667
Oct....	12.993	16.279	13.118	16.332	60.012	71.406
Nov....	14.284	16.599	14.456	16.758	65.085	74.727
Dec....	14.661	18.328	14.849	18.398	66.384	78.993
Year..	12.823	15.590	12.990	15.699	58.587	69.465

New York prices are in cents per pound. Electrolytic quotations are for cakes, ingots or wire bars. The London prices are in pounds sterling, per long ton of 2,240 lb., standard copper.

Lead.

BY W. R. INGALLS.

The year which has just closed was characterized by further consolidations of producing interests, all tending to increase the hold which the American Smelting and Refining Co. has upon the industry. That company, through the American Smelters' Securities Co., absorbed the Guggenheim Exploration Company and its various interests, together with certain other interests that were outside of it. The American Smelting and Refining Co., through the American Smelters' Securities Co., now controls all of the lead smelting and refining plants on the Pacific Coast, including the famous old Selby works, near San Francisco. It also controls the Federal Mining and Smelting Co., which is one of the largest producers of silver-lead ore in the Coeur d'Alene. That company controls the Sullivan Group Mining Co., which has a mine and smelter at Marysville, B. C., the bullion from which is shipped to Everett, Wash., for refining. Through the Federal Lead Co. it controls a large smelting works at Alton, Ill. The Federal Lead Co. further increased its interest in the Flat River district, Missouri, by the purchase of the Central mine, and by contracts with other mining companies for the smelting of their ore.

At the present time there are only four large producers of refined lead in the United States; namely, the American Smelting and Refining Co., through itself and its allied interests, the Balbach Smelting and Refining Co., the St. Joseph Lead Co. and the St. Louis Smelting and Refining Company, the last being one of the subsidiary companies of the National Lead Co. It is even probable that there will be a further consolidation of interests, since during the latter portion of the year there was a good deal of talk as to the eventual consolidation of the United Lead Co. (American Smelting and Refining Co.) and the National Lead Co., a combination which has been under consideration for several years. The great rise which occurred in the common stock of the Na-

tional Lead Company is considered to indicate buying for control, and it is commonly believed that some plan for the consolidation of these companies will be effected during 1906.

Of the outside smelting interests, the United States Mining Co., which has a plant near Salt Lake City, is now the most important. This company derives its ore partly from its own mines in the Bingham district, and partly from small mines in other districts. During 1905 this company secured a controlling interest in the old Richmond and Eureka mines at Eureka, Nev., which it is proposed to reopen.

The United States Mining Co. produces base bullion, but does not refine it. Other producers of base bullion are the Ohio and Colorado Smelting Co., which has a plant at Salida, Col.; and various small works in different parts of the country, which treat chiefly the ores from a single group of mines. Among such plants are those of the Luna Lead Co., at Deming, N. M., the Mowry Mines Co., at Patagonia, Ariz., and the Pen d'Oreille Smelting Co., at Sandpoint, Ida., which were constructed during 1905.

The chief lead districts of the United States are the Coeur d'Alene, Idaho, Flat River and Bonnetterre, Mo., Joplin, Mo., Park City, Utah, and Leadville, Col. Developments in the Missouri and Idaho districts are described in excellent articles by Messrs. Wheeler, Zook and Easton, which are published elsewhere in this issue. Southeastern Missouri and the Coeur d'Alene both show important increases in output during 1905, and there is no evidence that either of these important districts is yet anywhere near its maximum productive capacity. In Colorado, Utah and other States of the Rocky Mountains the production of lead is being helped by the production of zinc ore, for which at present there is a great demand. In the mines of those States zinc and lead are commonly associated, wherefore a strong demand for one kind of ore will naturally increase the production of the other.

In the metallurgy of lead the great development of 1905 was the introduction of the Huntington-Heberlein process in the plants of the American Smelting and Refining Co. This process has already been introduced at Pueblo, Col., Salt Lake City, Utah, and East Helena, Mont., and it is understood to be the intention of the operating committee of the company to install it in all the plants of the company. The process was previously introduced at Mapimi, Mex., and at Marysville, B. C. Installations of the process are also being made at Nelson, B. C., by the Hall Mining and Smelting Co., and at Trail, B. C., by the Canadian Smelting Works.

The Huntington-Heberlein process is analogous to the Carmichael-Bradford and Savelsberg processes, which have been

designated by the generic name of "lime-roasting of galena." In these processes the sulphide ore, mixed with a certain proportion of limestone and silicious flux, is charged into a large, hemispherical cast-iron pot, usually of capacity for eight to ten tons of charge. Air is introduced at the bottom of the pot and is blown through the charge at low pressure.

An exothermic reaction takes place, the charge becoming red hot, and sulphur dioxide coming off. At the end of the reaction, this extending up to sixteen hours, desulphurization is almost completely effected. The charge is then dumped out of the pot, by inverting the latter, dropping out as a solid, red hot cake. This is then broken up by wedging and sledging to size suitable for the blast-furnace, to which it is directly delivered. Owing to its excellent physical characteristics the speed of the blast-furnace is greatly increased, the blast-furnace can be operated at lower wind pressure and the production of matte is greatly reduced. These advantages combine to effect a very important saving in the treatment of such ore, besides which the loss of silver and lead is greatly reduced, the desulphurization in the converters being effected at a temperature so comparatively low that volatilization of lead and silver is insignificant.

The essential difference among the three processes mentioned above is as follows: In the Huntington-Heberlein the ore is first partially roasted; that is to say, it is burned down to a content of 10% to 11% sulphur, and is then charged into the converter; in the Savelsberg process the ore mixed with the proper proportion of limestone and quartzose material is charged directly into the converter, there being no preliminary roasting; in the Carmichael-Bradford process the ore is mixed with a proportion of gypsum, and is then charged directly into the converter. These processes have been described in a series of articles which appeared in the JOURNAL during 1905.

Although the operation of these processes and their results are now well known the precise nature of the reactions which operate in them is by no means understood as yet, and both the experience with them and the data concerning them which have been published are still too meagre to lead to a thorough discussion of the subject. One thing, however, is clear: These processes constitute one of the most important improvements in the metallurgy of lead during the last fifty years.

The Huntington-Heberlein process was introduced extensively in Europe, in Australia and in Tasmania, before it was tried in the United States. In those countries it has already displaced to a large extent the old reverberatory roasting furnace,

and also in Silesia it has displaced the old roast-reaction method of lead smelting.

The right to the use of the Huntington-Heberlein process in the United States is controlled exclusively by the American Smelting and Refining Company.

#### PRODUCTION OF LEAD.

Reports have been received from every producer of refined lead in the United States of its output in 1905 (the probable output during the last half of December being estimated) with the exception of one small producer whose output for the year we have estimated at 2,500 tons. These reports show a total production of 402,799 short tons, against 401,134 tons in 1904. Of the output in 1905, the refiners report that 80,212 tons was derived from foreign ores and bullions, against 98,930 tons in 1904. The lead of domestic origin was divided according to class as follows:

Class.	1904.	1905.	Changes.
Desilverized.....	200,858	205,989	I. 5,131
Soft.....	90,470	105,561	I. 15,091
Antimonial.....	10,876	11,037	I. 161
Total.....	302,204	342,587	I. 20,383

The statistics of imports and exports are available only for the first 10 months of the year. Comparing with the corresponding period of 1904, these show the following movement.

	1904.	1905.
Imports of refined lead.....	7,992	3,503
Exports of foreign lead.....	74,194	52,112
Lead in bond, Jan. 1.....	10,694	11,481
Lead in bond, Oct. 31.....	9,725	8,840

In the absence of statistics as to the imports and exports of lead during the last two months of the year, it is impossible to estimate accurately the domestic consumption. However, the consumption undoubtedly increased materially during the year, inasmuch as the exports of foreign origin showed a large falling off during the first 10 months, and stocks of lead in the hands of refiners, which, at the beginning of the year were small, at the end of the year were practically nil.

The statistics show a decrease in the production of lead of foreign origin, and a large increase in the production of domestic origin. This increase was chiefly in the output of the smelters of the Mississippi Valley which derive their ore supply principally from Southeastern Missouri. The prospect is for a further important increase in the production of lead from this source during 1906.

#### THE LEAD MARKET DURING 1905.

In a line with nearly all other staple metals, lead has seen great prosperity during the year under review. Not many changes are to be reported in the production, which will probably not show any large increase, except in the Idaho district, where great activity was displayed, which was interrupted only for a short

time early in the year, owing to a scarcity in the water supply for the concentrating mills.

On the whole, the industry remains dominated by the American Smelting & Refining Company and its allied interests. One independent smelter started in the spring, in Utah, and has been a regular producer. The output in the southeast Missouri district was also very large, and will probably amount to a record figure.

Consumption throughout the year was extremely heavy. There was a heavy drain on the light stocks in existence, which exhausted them completely, with the result that toward the end of the year fancy prices had to be paid by belated manufacturers and consumers, who had not covered their requirements in due time.

Thus, we see two of the most important metals, lead and copper, in practically the same position; that is to say, the demand has been larger than the current production, including available supplies. On former occasions, efforts were made to prevent the importation of foreign lead whenever market conditions reached a point where such transactions might be profitable. At this time, however, importations were welcome, as otherwise the scarcity here would have been such as seriously to hamper the trade, and as long as home producers could market every pound of what they were able to produce, there was no longer any necessity of shutting out supplies from other quarters.

Naturally, conditions such as these will not continue for any length of time; in fact, we shall see that the home production will soon catch up and that prices, which are abnormally high, will come down to a more reasonable level than the present.

At the beginning of the year, the American Smelting & Refining Company's prices for refined lead were 4.60c. New York, and 4.52½c. St. Louis, but more or less unexpectedly, these quotations were reduced, on January 23, to 4.45 and 4.37½c., respectively. With very slight variations, these figures remained for several months, and it was not until the end of July, that the opening prices of the year were again established. From then, prices advanced rather quickly, without putting any damper on the demand, which on the contrary became stronger and stronger as the year advanced, at the close of which prices are 5.60c. New York, and 5.52½c. St. Louis.

#### LEAD IN NEW YORK.

Month.	1904.	1905.	Month.	1904.	1905.
Jan.....	4.347	4.552	July.....	4.192	4.524
Feb.....	4.375	4.450	Aug.....	4.111	4.665
March.....	4.475	4.470	Sept.....	4.200	4.850
April.....	4.475	4.500	Oct.....	4.200	4.850
May.....	4.423	4.500	Nov.....	4.200	5.200
June.....	4.496	4.500	Dec.....	4.600	5.422
			Av. year.	4.309	4.707

Prices are in cents per pound.

### The Coeur D'Alene in 1905.

BY STANLEY A. EASTON.\*

The yield of the mines of this district during 1905 was greater than that of any previous year.

The work of most importance has been the exploration and exploitation of the deepest levels from which all of the older mines are now producing wholly. These levels are scarcely to be considered deep, as modern "deep mining" is now accounted; but they are deep in comparison with the work done heretofore. Particular reference is had, to the orebodies disclosed by the deepest workings of the Federal Mining & Smelting Co.'s Mace mine (the consolidation of the old Standard and Mammoth mines); to the deep development on the Morning at Mullan; to that in the Bunker Hill & Sullivan at Wardner; and to that in the Hecla mine at Burke.

Not alone are these finds of ore in the deepest known portions of the mines important to the properties themselves; they are, in a broad sense, important to the entire district. They show that the ore-bearing depths of these wonderfully productive Coeur d'Alene quartzites are not yet sounded, and that the work is now entering a horizon really yielding an ore of higher grade than that from the upper levels. This excludes, of course, those extreme upper portions, enriched by secondary agencies, where were found the very high-grade orebodies worked in the early days of Wardner; of such enrichment, the upper portions of the Hercules mine near Burke form a notable example. There were great masses of "secondary" carbonate and sulphate of lead, with a little lead phosphate, yielding, in large shipments, at the rate of 60% lead and 100 oz. of silver per ton. Those surface orebodies have disappeared completely from all the older mines. The present and the future depend upon the "primary" galena; this is being mined in the bottom levels, as clean from foreign sulphides, as fruitful in silver, and as high in lead, as the best has ever yielded. It is from this that the wealth of the district comes.

In the Bunker Hill & Sullivan, at Wardner, what is possibly the finest body of galena ever found in this or any other section, is being worked, with other valuable orebodies, 2,100 ft. below the surface and 3,000 ft. from the apex of the vein along its dip; while equally great depths are reached by the workings of the orebodies at Mace, Gem and Mullan.

Development work upon prospects and unproductive properties has been conducted with the greatest activity, but no new producer of considerable tonnage has been found. The increase in yield over former years comes solely from the old mines. The number of small producers which have shipped during the year gives hope

\*Manager, Bunker Hill & Sullivan Mining & Concentrating Co., Kellogg, Idaho.

that several will, in time, reach a productive stage that will rank them with the old and well-known mines. Among properties in the development and shipping stage, are found the Chesapeake & Tamarack; 16 to 1 mine; and California, on Nine Mile creek; the Senator Stewart, at Wardner, which seems to be the link on the Wardner vein between the mines at Wardner and those on Government Gulch; two or more properties tributary to Murray and now without the transportation facilities to ship either regularly or economically; also on Pine creek, below Wardner, much prospecting and investigating has been done.

The production of *zinc* has begun, in a very small way to be sure, and there is little probability that it will ever compare with the lead production; it will probably figure somewhat as a by-product in both mining and ore-dressing. The Hercules has sent out a small shipment of hand-sorted zinc-blende encountered in its regular mine work; a concentrator, planned to produce both zinc and lead product from the ores of the Granite mine on Nine Mile creek, has recently been started by the Success Company.

Copper production has gone on regularly from the Snowstorm mine, near Mullan; this has shipped its silicious copper and silver-bearing ores to most of the copper smelters tributary to this country. The leaching plant, erected by the lessors of a portion of this property, has recently been completed, but has not yet handled any considerable tonnage of the low-grade ore for the treatment of which it was intended.

The sale of the Morning mine, by Messrs. Larson and Greenough, to the Federal Mining & Smelting Co., for \$3,000,000, is the biggest deal of the year. Thos. L. Greenough and associates have purchased the control of the Snowstorm copper mine, and a bond has been given by its owners for a fifteen thirty-second interest on their holdings in the Hercules to Duluth people. In addition to these transactions, there are many other minor transactions, in the aggregate amounting to no small sum.

Water for power has been scarce throughout the year; and for this reason there has been a regularly increased use of the electric power transmitted from Spokane Falls, for general mine- and mill-work. All the mines are now drawing on the system consuming about 2,800 horsepower.

A high class of efficient labor is employed. There are 2,500 engaged directly in the mine- and mill-work alone. Industry and order have dominated the district; the prosperity of the year now closing presages still better things for the most important lead-producing section of the country.

The production of the Coeur d'Alenes for 1905 was approximately 247,660,000 lb. of lead; and 6,690,000 oz. of silver.

### The Southeast-Missouri Lead District.

BY H. A. WHEELER.\*

The output of the southeastern Missouri lead district in 1905 approximated 82,000 short tons; of this, St. Francois county (or the Bonne Terre and the Flat River districts) produced about 90%; Madison county (or the Fredericktown district), including Mine La Motte, produced about 7%; and the numerous small mines scattered throughout the adjoining Washington, Jefferson and Franklin counties produced about 3%. This is by far the largest output in the history of this district; it exceeds the production of 1904, the previous high-water mark, by nearly 12%. The price realized for the lead was also the highest since the Civil War; pig lead has ranged from \$4.25 to \$5.50 per pound in the St. Louis market. The year was also free from labor troubles, although the Miners' Union threatened to start another strike in the Flat River district last summer, which was fortunately averted by concessions on both sides.

Under the stimulus of this great prosperity, prospecting has been inaugurated on a scale never before attempted. Hitherto, from five to ten diamond drills were to be found scattered throughout the district or on the frontier, searching for new orebodies. These drills were usually operated by prospecting companies; they rarely gave the land a fair trial, as usually only a few random holes were put down, and much ground was hastily condemned on meager and insufficient data. This year it is the old companies that are vigorously carrying on a search for new orebodies and attempting to extend the area of the lead belt. Over 30 diamond drills are prospecting, and on lands that are beyond the known limits of the recognized lead belt.

An innovation in prospecting this year has been the payment of \$3 per acre for the privilege of "optioning" the land for a year while carrying on the diamond drilling. Hitherto a large advance payment on the price for the land was exacted on a spot-cash basis for giving a drilling option for 6 to 12 months; but now the land-owners are practically renting their land for double their former rentable value as farms, while the option is held on the land, besides getting a large advance over a quick-sale valuation. The minimum price that is asked for lands that are miles beyond the known lead belt is \$100 per acre; while more favorably situated lands that are nearer known developments are being held at \$200 to \$400 per acre. These prices are not regarded as high; for if a good orebody is found, the lead-bearing ground is liable to produce from \$50,000 to \$500,000 worth of lead per acre.

This vigorous prospecting is sure to open up new orebodies, though it will be

\*Mining engineer, St. Louis.

two or three years before the new discoveries can be developed and equipped into large producers.

An important event of the last year was the further concentration of New York interests in this district by the sale of the Central Lead Co.'s property to the Guggenheim interests. This was one of the few southeastern Missouri lead properties owned by the St. Louis parties. Since its re-organization and development as a modern enterprise, some twelve years ago, under the able management of the mining engineer, Arthur Thacher, it has been successful, and has returned, in dividends and advance on the sale, an average return of 5% a month for this twelve-year period. The new management will consolidate it with their adjoining properties—the Derby and Federal mines; it is one of the finest properties in the district. A central power and milling plant is to be erected, from which the three mines will be operated; new shafts are to be sunk on the Central property; the old Central mine, which was flooded by strikers two years ago, is to be pumped out.

The Columbia mine, at Flat River, is shut down and, through internal dissensions and lawsuits, is liable to remain non-productive for some time.

The Mine la Motte property, in Madison county, has been taken out of the hands of the promoters, who sold its watered stock at high and unwarranted figures; the stockholders are now becoming acquainted with the real merits, and demerits, of their property. It is unfortunate that such a successful and historic property, which has been producing lead for about two centuries, should have fallen into the hands of the stock-market manipulator. The property has been bonded for \$300,000; the proceeds from the sale of the bonds are to be devoted to improving its lead-producing capacity, instead of to the alluring sale of stock, under fantastic promises of a prodigious output of nickel. For, while it has always produced some nickel and cobalt, these have occurred on a small scale as by-products; no deposits have thus far been found on the property that would justify the nickel flood promised by the promoters.

The St. Joe Lead Company, of Bonne Terre, has materially increased its plant and output during 1905; it is sinking a new shaft, No. 14, on its Bonne Terre land. The company absorbed its closely allied offspring, the Bonne Terre Farming & Cattle Company, last summer; a beautiful stone library was erected by the St. Joe Lead Company, at Bonne Terre, as a memorial to J. Wyman Jones, its successful president for so many years. This company has large acreage of unprospected land under option, on which it is operating 20 diamond-drills.

The National Lead Company, at Flat River, installed a couple of electrically-operated four-stage centrifugal pumps in one of its mines; this is an innovation in

this district, where the water has hitherto been handled by steam pumps of improved design.

The Doe Run Lead Company, at Flat River, installed a central electric power plant at its Flat River property last summer, and made considerable improvements in its mill at Doe Run. A large amount of prospecting is being conducted by this company, especially in the outlying districts.

The Desloge Lead Company, at Desloge, had an active, prosperous year; this is the last of the large companies operating in this district, controlled by St. Louis interests.

The Madison Lead Company, at Fredericktown, made improvements in its mill and mine during the year, and sunk a new shaft. The North American Lead Company, also at Fredericktown, had a busy year, and proposes to increase its output materially in 1906. This and the Madison property are controlled by Ohio interests.

The Union, Manhattan, Penicaut, and Elizabeth properties in St. Francois county have not yet been put on a productive basis; their absorption by a new company is said to be contemplated, as they have considerable merit, and could be made important producers if equipped with modern machinery. The Irondale lead mine, at Irondale, is still full of water; the Renault property, in Washington county, since the death of its manager, has been operated on only a limited scale.

### Zinc.

BY W. R. INGALLS.

The zinc industry of the United States in 1905 was characterized by a large production, a high range of prices for spelter and a shortage in ore supply, which caused the market for raw material to hold at a very high level, but left only a small margin to the smelter, notwithstanding the strong market for the metal. The year was, therefore, extremely prosperous to the producers of ore, but not so prosperous to the smelters. Some of the latter were, indeed, obliged at certain times to put a portion of their furnaces under dead fire.

The production of the Joplin district showed no significant change from the output of several years previous. However, it was a little smaller than in 1904. It appears to be recognized that this district is now affording as large an output of ore as can reasonably be expected from it, and further supplies must be looked for in other quarters. Indeed, if it had not been for the prominent position which the zinc ore of Colorado and other Western States has assumed in the market, there is no doubt that disaster would have overtaken the domestic zinc industry. The delivery of large supplies of ore from the Rocky Mountains, however, has enabled several smelters of Kansas to withdraw

from the Joplin district. There are now a good many large plants which run exclusively on ore from the Rocky Mountains.

Zinc ore was shipped in 1905 to the Joplin district from Colorado, New Mexico, Arizona, Utah, Nevada, Idaho and Montana. Important supplies were obtained also from British Columbia, and to a larger extent from Mexico, where in the vicinity of Monterey, large deposits of carbonate ore have been worked. The ability to ship these comparatively low-grade ores from points so remote from the smelting centres is due to the very low rates on such traffic which have been made by the railways. If the freight rates were reduced to the ton-mile basis they would figure out perhaps as low as on any commodity traffic on this Continent.

The extensive importation of zinc ore of British Columbia, and especially from Mexico, led to a dispute between the domestic producers of ore on the one hand and the smelters who were making the importations on the other hand as to the proper construction of the Dingley Act with respect to such importations. There was never any doubt as to the importation of calamine, since that ore is explicitly put on the free list in the Dingley tariff. There was a question, however, as to whether blende should be assessed at the rate of 20% ad valorem under the clause in the tariff which establishes that rate on ores and minerals unenumerated, or whether it should come in free under another paragraph of the Act. It was finally decided by the Treasury Department that zinc ore should be admitted free of duty, under paragraph 614 of the Dingley tariff, which provides for the free entry of minerals, crude, or not advanced in value or condition by refining or grinding. Lead-bearing ores of all kinds are dutiable, however, under paragraph 181 of the same act, at the rate of 1½c. per pound on the lead contained therein.

Colorado and New Mexico in 1905 very largely increased their output. The shipments from the other Western States mentioned above were practically new developments in 1905, since although they afforded scattered lots of ore previous to that year, no regular output could be depended upon from them.

The most important zinc producing centre in New Mexico is Kelly, where are situated the well-known Kelly and Graphic mines. In Utah zinc ore was shipped from Park City, and from the Horn Silver mine in Beaver county. In Idaho zinc ore was produced by one property in the Wood River district, and by one property in the Coeur d'Alene. Leadville, Col., continued to be, however, the largest producer of zinc ore outside of the Joplin district. Its output in 1905 will, without doubt, considerably exceed 100,000 tons.

A very important feature of the year was the increased extent to which some

of the zinc smelting companies invested in mining property. Several of these companies have had agents in the field for two years or more in the search for desirable zinc mines, and during 1905 several purchases of such property were made. This new policy is directed toward the assurance of ore supply under the control of the smelting company itself. This will tend to give the industry more stability.

East of the Mississippi there was a good deal of activity in the Wisconsin field, where the production undoubtedly increased, although no complete statistics are yet available to show how much. The work done in that field, however, was largely of a preliminary character, and will show the results in 1906 and following years, rather than in the year which has just closed. It has been found that the separation of the blende and the marcasite, which is the common ore of the district, can be economically and efficiently accomplished magnetically and otherwise. Various plants have been erected for that purpose, and more may be expected to follow. Some of the large zinc producing companies made extensive investments in the Wisconsin field, and there is a general confidence that this will prove to be an important source of zinc. Geographically it is more advantageously situated than any of the zinc producing districts west of the Alleghenies.

Some developments were made in the Holston River district of Tennessee, with encouraging results, it is claimed. The deep mining which has been inaugurated in that district is a new feature. In New Jersey the development of the great mine at Franklin has been continued on the same lines as in previous years, and it has made the usual large output. Progress in zinc mining in Tennessee and Virginia is described in an article by Mr. Van Mater elsewhere in this issue. Kentucky made its usual small output.

There was no important increase in the smelting capacity in the United States during 1905. Several of the smelters completed new blocks of furnaces, and two new plants are now under construction, but there was no new plant that went into operation in 1905. The new plants now under construction are those of the Mineral Point Zinc Co., at Depue, Ill., and of Hegeler Bros., at Danville, Ill. These plants will go into operation during 1906. It is particularly noteworthy that both of them, the only new plants now under construction, are established in the Illinois coal field, rather than in the Kansas gas field. The old smelting works at Weno, Ill., were closed early in 1905.

Metallurgically, there was a good deal of experimentation in 1905, and some steady improvements in the practice, but nothing of a remarkable nature. Experiments were made with the Lungwitz process of smelting zinc ore in the blast furnace at Warren, N. H., on a rather elab-

orate scale. Although nothing has yet been published with respect to their results, it is surmised that they were not so successful as was hoped. However, the experiments at Warren will probably be resumed next Spring. At Vancouver, B. C., experiments were made with an electric furnace invented by F. T. Snyder, but this process also is only in the experimental stage. At Denver, Col., a considerable quantity of ore was actually treated by the Dewey process, which consists substantially in obtaining a solution of the zinc of the ore in the form of sulphate, evaporating the sulphate to dryness and calcining it for the production of oxide. During the autumn the plant was partially destroyed by fire, but it is the intention to rebuild it this winter.

In the standard practice of smelting, experiments were directed toward the production of a more durable retort, and the invention of some satisfactory method of mechanical charging for the retorts. It has been found that the addition of a certain proportion of carborundum to the batch for the manufacture of the retorts is highly beneficial. However, the high cost of carborundum is temporarily prohibitive of its use in that way. It is considered likely, however, that the difficulty can be overcome by using it as a lining for the retort made by hydraulic pressure in the standard manner.

With respect to spelter, the old class of "prime Western" has practically disappeared, since most of the smelters of Kansas now use ore from Colorado and elsewhere in the Rocky Mountains. Some of the smelters use it exclusively. The ordinary brands of Western spelter that are now on the market consist, therefore, chiefly of Colorado metal, which goes, however, under the name of "prime Western." The Colorado metal is, nevertheless, substantially as good for all practical purposes, inasmuch as at the temperature at which the ore is distilled no excessive quantity of lead is driven over; while if the ore be distilled at a high temperature, driving over a considerable percentage of lead, the excess can be removed by a simple process of refining. Spelter made from the Colorado ore need not contain more than about one per cent. of lead. A few of the smelters which used only selected ores from the Joplin district produce a higher grade of metal, which commands more or less premium. It is the practice also of nearly all the smelters to reserve the first draw of metal for marketing as special brands, these commanding usually a premium of 10c. @15c. per 100 pounds. This metal comes over during the first part of the distillation, before the temperature of the furnace attains the maximum, wherefore it is lower in lead than the average, but on the other hand is higher in cadmium. There has been a good deal of discussion among the smel-

ters and brass makers as to the effect of a high cadmium content on spelter. Some of the specials produced in Kansas assay as high as 0.4% in cadmium. No definite conclusion has yet been reached as to the effect of this impurity. The consensus of opinion appears to be, however, that it is ordinarily not injurious, but if it exceeds 0.5%, which is not often the case, it may detract from the value of the spelter for certain uses.

Zinc in Europe in 1905 commanded prices nearly as high as in the United States. For a considerable time during the latter half of the year the London price was close to the parity at which exports could be made from the United States, and at one time crossed the mark, enabling several thousands of tons of Kansas spelter to be sold for export. This had the effect of cleaning out the last of the stocks of metals in the hands of American smelters, and at the close of the year the domestic market is believed to be bare of stocks.

The high price for spelter in Europe in 1905 is understood to be due to deficiency in the smelting capacity, in comparison with the increase in the industrial demands, rather than to any shortage of ore. Large supplies of ore of inferior character have been obtainable from Australia. That continent appears to be destined to take an important position in the zinc industry of the world. There is no other place where there is so much zinc ore literally in sight as in the great tailing piles at Broken Hill. The mines continue to show large reserves of mixed sulphide ore, and every year make large additions to the accumulations on the surface. Although the separation of this ore is a difficult problem, the magnetic separation and flotation processes have succeeded in making out of it a marketable grade of zinc ore. During the latter portion of 1905 a large number of the great dumps at Broken Hill were purchased by the Zinc Corporation, Ltd., a British company, which is planning to go into the zinc business on a very large scale.

Complete statistics of the zinc production of Europe in 1905 are not yet available. The statistical report for Upper Silesia, which is the largest zinc producing district, shows, however, that during the first nine months of the year the spelter production of that district was 96,097 metric tons of crude spelter, against 91,840 tons in 1904. There was also produced in 1905 zinc dust to the amount of 2,115 tons. The production of calamine in the first nine months of 1905 was 167,156 tons, against 159,224 tons in the corresponding period of 1904; the production of blende was 291,598 tons, against 276,096 tons. These figures certainly do not indicate any falling off in the productive capacity of this important district, the largest producer of Europe.

The production of spelter in 1905 was 199,964 short tons, against, 181,803 in 1904. The production in 1905 was therefore the largest on record. The increase occurred chiefly in the production of the Western smelters, and inasmuch as the output of the Joplin district in 1905 was a little less than in 1904, the origin of the increase in spelter production in 1905 was entirely in outside districts, chiefly in those west of the Rocky Mountains, including British Columbia and Mexico. A small portion of the production was from the resmelting of galvanizers' wastes.

Our statistics for 1905 are based on reports from every producer except one small producer whose output has been estimated at the same figures as reported in 1904. The consumption of spelter in the United States increased in 1905, practically as much as the production since, although a small quantity of western metal was exported to Europe, the stock on hand among the smelters were diminished to a great extent. At the end of the year the stocks are believed to be practically nil.

#### SPELTER MARKET FOR 1905.

The violent fluctuations to which the spelter market is always being subjected have again played an important part in the history of this year's business. While in a general way the level of prices was quite satisfactory, still the smelting industry has not profited largely, because the price of the raw material was most of the time relatively higher than that of the refined metal. This applies particularly to the Joplin orefield, where it would seem that the maximum production has been reached, while the demand for this class of ore had increased right along, owing to the growing consumption of high-grade spelter for brass and rolling mill purposes.

The necessity for finding other sources of supply for the smelters has become more and more imminent, and the improvement in the methods of concentration, as well as the high prices have stimulated mining activity in the West, so that the supply from that quarter has become heavier. During the last few months a good tonnage of ore has been coming in from Mexico and British Columbia.

The consumption of spelter throughout the year has been very satisfactory, and stocks which existed last January disappeared during subsequent months. Some exports were made this fall, amounting to about 4,000 tons, but it was not the question so much of a surplus of metal, as the fact that the European markets had reached the parity of the American market, and the scarcity of spelter abroad necessitated imports from here.

At the close of the year the outlook is a good one for a continued heavy demand, galvanizers and brass manufacturers being very busy.

Prices at the beginning of 1905 were quoted at 6.05c. St. Louis and 6.20c. New York, and remained on this level during January. Ore prices in Joplin became somewhat softer at the beginning of February, in consequence of which spelter quotations receded 0.05c. per lb. and remained steady thereat during that month.

The first half of March brought a large inquiry from consumers, so that prices hardened again. As soon as this demand was satisfied, however, the market again gave way, and as no support was forthcoming, declined gradually to 5c. St. Louis and 5.15c. New York, which level was reached the beginning of June.

These low prices attracted a good many buyers, who received further encouragement by quite an improvement in the galvanizing industry. Quotations at the end of July had reached 5.35c. St. Louis, and 5.50c. New York. A further impetus was given the market at the beginning of August by reports from Joplin of a falling off in the ore supply, which necessitated the dead-firing of a number of furnaces. The month closed at 5.60c. St. Louis, and 5.75c. New York.

The firmness of the metal was maintained during September and prices at the end of that month had advanced to 5.80c. St. Louis, and 5.95c. New York. In October considerable sales for export to Europe, where spelter had become so scarce that prices there were upon a parity with ours here, were made, which cleared out almost all of the stocks that were held by the smelters. Quotations were established at 6.05c. St. Louis, and 6.20c. New York.

Our market here, in consequence of the close proximity to London, became naturally dependent on the same, and as prices over there receded somewhat through the exports from this side, November brought us lower quotations and closed at 5.95c. St. Louis, and 6.10c. New York.

At the beginning of December the demand from both the brass and galvanizing trade became much more active, and the comparatively small stocks which had accumulated in the hands of the smelters were gradually absorbed. In consequence of this, the year closes with a very firm market, prices being quoted at 6.50c. St. Louis, and 6.65c. New York.

#### SPELTER.

Month.	New York.		St. Louis.		L'nd'n
	1904.	1905.	1904.	1905.	
January.....	4.863	6.190	4.673	6.082	25.063
February.....	4.916	6.139	4.717	5.989	24.594
March.....	5.057	6.067	4.841	5.917	23.825
April.....	5.219	5.817	5.038	5.687	23.813
May.....	5.031	5.434	4.853	5.284	23.594
June.....	4.760	5.190	4.596	5.040	23.875
July.....	4.873	5.396	4.723	5.247	23.938
August.....	4.866	5.706	4.716	5.556	24.675
September.....	5.046	5.887	4.896	5.737	26.375
October.....	5.181	6.067	5.033	5.934	28.225
November.....	5.513	6.145	5.363	5.984	28.500
December.....	5.872	6.522	5.720	6.374	28.719
Year.....	5.100	5.882	4.931	5.730	25.433

New York and St. Louis prices are in cents per pound. The London prices are in pounds sterling per long ton (2,240 lb.) good ordinary brands.

### The Joplin District.

BY JESSE A. ZOOK.

The year 1905 stands far in the lead of all previous years in point of the value of the zinc and lead ores marketed in the Joplin district. It exceeded 1904 by approximately \$2,000,000; it was \$3,000,000 greater than the boom year of 1899; and was nearly \$7,000,000 greater than the average of the eleven years preceding.

This year sees the highest price ever paid in America for sulphide of zinc concentrate; \$60 per ton, a price \$5 per ton higher than the previous record of \$55 in 1899; and the highest price paid for sulphide of lead concentrate since the period immediately following the Civil War, was \$74 per ton, in the last week of November just passed.

**Zinc Prices.**—Zinc concentrate sold for \$55 per ton the first week of 1905, advancing to \$58 the next week. The next two succeeding weeks recorded the highest price ever paid for zinc, namely, \$60 per ton. In the first week of February, \$2 was taken off; in the second week, an additional \$1.50; during the last half of that month, \$56 was paid. March begun with zinc at \$54.50, dropping to \$45 at the end of the month; through April there was a steady advance to \$48 at the close, and to \$48.50 for the first week in May. Then the pendulum again swung backward, continuing until it reached \$43.50 in the third week in June. From this, the lowest point of the year, prices advanced \$1 to \$3 per week, until the highest price came in the second week in August, \$59 per ton, and within \$1 of the January record-breaking price. During the succeeding three weeks the price declined \$10 per ton, regaining an upward tendency the second week in September, and continuing upward to \$55 in the first week of October, then down two weeks, touching \$51.50, and returning to \$55 in another two weeks, where it remained throughout November.

The highest price paid for first-grade zinc concentrate was \$60 per ton in January; the lowest price for this grade was \$43.50 in June. The average price for all grades of sulphide and silicate ores during eleven months of the year was \$44.90 per ton.

**Lead Prices.**—Lead concentrate began the year 1905 at \$60 per ton, advanced the following week to \$63, from which it declined to \$57 on the first of February; then up to \$59 at the end of the month; \$58 the first half of March, continuing upward to \$61.50 in the first half of May; down to \$57 on the first of June; up to \$60 on the first of July; to \$61.50 on the first of August, and to \$64 at the end of that month. Throughout September the price was uniform at \$63.50, but increased through October until on the first of November \$66 was paid. The next week



it was \$70; the third week \$71.50; and the last week of November \$74 per ton was paid for choicest grades.

The highest price paid during 1905 for lead concentrate was \$74 per ton in November; the lowest price was \$57 per ton at three periods of the year, occurring one week each in February, May and June. The average for all grades of sulphide and silicate ores for eleven months of the year was \$60.50 per ton. Lead Concentrate sold as high as \$78 per ton in December.

The following table embodies the highest and the average prices of zinc and lead for each of the past seven years:

	Zinc—		Lead—	
	Highest.	Average.	Highest.	Average.
1905.....	\$60.00	\$44.90	\$74.00	\$60.50
1904.....	53.00	35.92	62.00	54.80
1903.....	42.00	33.72	60.50	54.12
1902.....	42.00	30.83	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

**Shipments and Values.**—The total zinc shipment for 1905 (estimating December), was 255,855 tons, at a value of \$11,494,055. The total lead shipment for 1905 (estimating December), was 31,662 tons, at a value of \$1,924,870. The total shipment of both ores (estimating December) was 287,517 tons, at a total value of \$13,418,925.

**Comparison with 1904.**—The shipment of zinc was 11,385 tons less than for 1904, but the value was \$1,832,855 greater. The shipment of lead was 2,700 tons less than for 1904, but the value was \$38,720 greater. The combined value of both ores exceeded 1904 by \$1,931,575, an increase of 16 4-5 per cent.

The year 1905 ranks below 1904, 1902 and 1901 in the tonnage of both zinc and lead marketed.

The following table embodies the shipments of zinc and lead, and their combined values for each of the last 12 years:

	Zinc, Tons.	Lead, Tons.	Values.
1905.....	255,855	31,662	\$13,418,925
1904.....	267,240	34,362	11,487,850
1903.....	234,873	28,056	9,471,395
1902.....	262,545	31,025	9,430,690
1901.....	258,306	35,177	7,971,651
1900.....	248,446	29,182	7,992,105
1899.....	255,088	23,888	10,715,307
1898.....	234,455	26,687	7,719,867
1897.....	177,976	30,105	4,726,302
1896.....	155,333	27,721	3,857,355
1895.....	144,487	31,294	3,775,929
1894.....	147,310	32,190	3,535,736
12 years.....	2 641,914	362,299	\$93,502,812

The cause of the smaller output in 1905 was directly attributable to an extraordinary precipitation, amounting to 50 inches of rainfall. In January and February the district was enveloped in the coldest weather known in the district since the discovery of ore; during that time there occurred a succession of snow and cold rain storms that settled into a mantle of ice 6 to 8 in. in thickness for a continuous period of six weeks. What ore was mined during this period was frozen solid in the bins, and for shipment had to be blasted out. The spring was rainy and cold, and the mines had but fairly recovered from an unusual winter and spring when July floods sent an inflow of water into them.

August followed with heavy rains, and the mines had barely recovered after a comparatively dry September when October brought additional heavy rains and came near inundating many mines again. For the first time in the year the output conditions assumed a normal basis in the latter part of October; after this, conditions remained favorable, until labor troubles at the end of November upset the prospects for a clear finish of the year. The United States Supreme Court handed down a decision during the month sustaining the constitutionality of the 8-hour labor law, enacted by the State legislative session of 1900-1, making a day for miners 8 hours, and providing a penalty for its infraction. It developed, during the controversy arising over the adjustment of this law to the local situation, that the last legislative session had enacted a further law embracing all workmen about a mine under the 8-hour system. Ground men had been working 8 hours, mill men 10 hours and engineers 12 hours. Owing to high ore prices (an average of \$9 per ton for zinc and \$6 for lead above last year, and no advance in the general wage scale), employees began demanding full pay for the 8 hours' work. Temporary adjustments were made in most of the cases between the mine-owner and his employees; but agitators are at work trying to stir up strife, and it is not known to what extreme this may yet lead.

The introduction of electrical energy from a central water-power generating station, and the piping of natural gas to the mines of the western part of the district during 1905, are inaugurating an era of improvement and economy in mining. It is producing a pronounced evolution in the mine and mill motive-power equipment of the district. In the construction of new mills during the latter half of this year, electric motors or gas engines have been installed, or provision made for later installation. At some mines boilers and steam-engines have been removed or are unused, giving place to one or the other of the cheaper powers. At other mines, having comparatively good steam appliances, gas is piped under the boilers for generating steam. Supplied at 10c. per 1,000 cu. ft., even thus extravagantly used, it is proving an economical fuel, compared with Kansas bituminous coal.

**Reduction in Cost of Mining.**—The inauguration of electrical energy and the installation of natural-gas engines, together with the use of natural gas as boiler fuel, will reduce the operating expense of mining. This has been accomplished only here and there in the last year, and the aggregate results obtained are so small that it reduced the whole year's cost very little. Another year, however, should show a marked reduction in cost per ton of concentrate. This will prove true unless the demands of labor should absorb the saving thus made.

All labor trouble has been amicably adjusted without union organization, and no further dissatisfaction is heard. Analysis of the Supreme Court ruling on the 8-hour law makes it clear that the later legislative action, embracing top workmen under the 8-hour law, would be held unconstitutional, leaving the effective 8-hour law applicable only to men working underground.

The average value of the zinc-ore output in 1905, and the total value, were the largest on record.

### Virginia Lead and Zinc Mining in 1905.

BY J. A. VAN MATER.\*

A strong metal market, with high prices, has tended to stimulate prospecting; old locations are being re-examined and some new ones investigated; nothing new, however of importance has yet resulted from this work.

The two most promising properties are that of the Albermarle Zinc and Lead Company at Fabers, Nelson county, and the Cedar Springs Zinc Mine and Development Company, near Rural Retreat in Wythe county; at both of these places mills are being equipped to concentrate mineral.

At the former mine, the blende and galena occur, with fluor-spar and quartz, in mica-schist. Air jigs are being tested for the separation, but no mineral has been shipped. At the Cedar Springs property, a shaft has been sunk some fifty ft., and some other development work has been done, which encourages the owners to believe that they are warranted in erecting a mill. The ore should prove an easy milling proposition, if it occurs in sufficient quantity, as the blende is distributed through the brecciated rock in fairly coarse form; but, even if the property opens up well, it will be some time before it can be counted a producer. There has likewise been some prospecting for lead in the Rye Valley district in Smyth county; but no deposits of importance have been disclosed.

The only zinc and lead produced in this State during the year has been by The Bertha Mineral Company, from the old Wythe Lead and Zinc Mine property, at Austinville in Wythe county. The mines have been worked more or less continuously, since about 1750 (when they were opened for lead); but it was not until about twenty years ago that any attention was paid to the zinc, which occurs as silicate and carbonate, near the surface between chimneys of limestone. In the early days, when lead was the only mineral sought, large quantities of these surface ores were wasted; but in

\*General manager, the Bertha Mineral Co., Pulaski, Virginia.

later years they have been carefully saved. This property, next to the Bertha Mines, has been the most important producer in the State, and is now the only one shipping any zinc ore. The output this year from this property has been 651 tons of zinc concentrate, and 89 tons of lead concentrate; beside 348 tons of lower grade zinc oxide, recovered from the mill tailing on the Bertha property, this oxide being turned into spelter. The output was much curtailed by the burning of the oxide plant in June, and by the breaking away of part of the dam in the river, which necessitated extensive repairs, entailing a shut down of all power for four months. While the output of soft ore from this property is likely to be small in the future, there has been considerable development work done in the rock underlying the soft-ore deposit, in the hopes that sulphide ores of sufficient importance would be found to make a new mine of this property. This work has been vigorously prosecuted throughout the year and has shown results, which on the whole are encouraging; but it will take considerable more work before the future of this mine can be determined.

The Bertha Mines (likewise owned by The Bertha Mineral Company), which were abandoned some eight years ago as a zinc property, have been producing limonite iron ore, which overlies the deposits of soft zinc ore. There was a hope that after the stripping of a considerable portion by the mining of the iron ores, other deposits of zinc ore would be uncovered; but such has not proven to be the case, with one exception, where a small basin was encountered, but of no particular importance.

### Zinc Mining in Wisconsin in 1905.

BY E. W. MOORE.

After nearly 50 years of mining, more or less active, the Platteville zinc and lead district, as the southwest Wisconsin zinc and lead fields are locally called, is enjoying a period of prosperity. Today there are some 20 to 30 large dividend-paying mines and innumerable smaller propositions, as against two or three a little over a year ago. The chief cause, of course, has been the high prices that have prevailed for the past year, but even the prices paid for zinc ore alone would have been inadequate to bring the majority of the mines to a dividend-paying basis. Had it not been for the perfected system of magnetic separation, many valuable properties would to-day have been lying idle.

Some five years ago it was generally thought that it was only a question of a short period before the mines would be a thing of the past, as the richer veins continued to carry more and more pyrite, locally called sulphur, which cut the price

of zinc ore down below a profitable point. The late Richard Kennedy, one of the best known local zinc men at that time in the district, returning from the Joplin district, was imbued with the idea that if the Joplin operators could make money on 4 and 5% propositions, the operators in the Platteville district surely could on 15 and 20 and even as high in some instances as 50% ore, provided proper methods and modern machinery were employed.

The first concentrating plant was built three years ago, on the Oldenburg property by Mr. Kennedy and his associates. Since that time the Kennedy companies alone have had installed some 10 different concentrating plants and separators, all of which today are paying dividends. Owing to the fact that the ore buyers heavily penalized the pyritic zinc ores, many of the propositions never paid a dollar in dividends until after installing a roasting and magnetic separating plant.

The first plant of this kind was installed at Meeker's Grove camp, on the Trego property. The results were so satisfactory that the builders of the plant were more than pleased, but not altogether satisfied as to values saved. The latest Galena type of roaster, in connection with the Cleveland-Knowles separator, as now generally installed, shows an efficiency of 90% and produces a product, of which the heads assay as high as 65.4% Zn and 0.9% Fe, with only 2.05% Zn in the magnetic tailings, from an original product wherein the assay was 19.2% Zn and 29.0% Fe. Of course, the above is the result of the best single test, the average result being in the neighborhood of 60% Zn and 2.9% Fe finished heads; from an original concentrate assaying 40.2% Zn and 16% Fe.

Another interesting innovation has been the change from gasoline to steam power and the installation of central electric power plants. One of the most serious drawbacks has been the lack of competent labor, but this difficulty is fast being overcome, both through education and importation.

Few mining districts can boast of as many mines that have been paying dividends for as long a time and as continuously as a great number in the Platteville district; the time of active operation of many runs from one to 50 years.

It has only been within the last 18 months that the Illinois Zinc Company first began to buy up all the producing properties it could secure, and by merging operations it has eliminated considerable expense.

There are today in active operation 47 concentrating plants and 12 separators, two of which obtain ore merely by buying from producers.

One of the most important additions to the interests of the district was the completion of the Mineral Point railroad, connecting with the Chicago, Milwaukee & St. Paul and Chicago & Northwestern and

entering the three principal camps in the northern part of the district—Highland, Linden and Mifflin. The Chicago & Northwestern has built spurs to all the principal mines along its line, as also has the Chicago, Milwaukee & St. Paul.

The Illinois Zinc Company, in addition to the purchasing of certain producing mines, has enlarged its oxide works, spending some \$500,000, and is at the present time adding quite extensively to its acid plant. It also installed a battery of Galena type roasters and Cleveland-Knowles separators. It is expected that the Depue zinc works will be completed the coming spring.

The demand for zinc ore, as well as lead, has exceeded the demand. There is not a pound of surplus ore in the bins. Local capital reaps the benefits of its confidence in the mines. Differing from most mining propositions, the Platteville district was almost wholly developed by home money. More attention has been paid of late by outside capital, but the majority are men who have had experience in the West and Southwest, and who are being attracted by the comparatively small outlay necessary to prove up a property.

During the last two months an inter-urban electric freight and passenger line has been proposed and the right of way is now being surveyed. This electric line will give shipping facilities to a great number of the mines that have been depending altogether on team and wagon, the hauls running from 5 to 15 miles. The foundries at Galena and Platteville have increased their capacity, to take care of the increased business, which is quite an item to the operator. The towns all through the district have felt the prosperity enjoyed by the miner.

The past year has seen more improved methods and modern machinery introduced into the district than ever before. In nearly all instances the ore found has been below the old water levels. What the future will bring is hard to tell, but judging from the past and what each day shows, the Platteville district will become quite a factor in the zinc market. The output for the last six months has more than equaled that of the entire twelve months previous, and it is safe to say that in the next year the output will be more than doubled. One machinery company alone has put in over \$350,000 worth of mining machinery. Some 150 prospect drilling outfits have been sold, and prospectors are waiting for new ones that are being shipped in each day. The coming year promises to be a record-breaker in the way of output and installation of machinery.

Generally speaking, the past year has been extremely satisfactory to all concerned, and with the exception of one or two incipient labor difficulties and only two fatalities, there have been no drawbacks at all.

### The Klondike in 1905.

BY J. P. HUTCHINS.\*

The gold production of Klondike was about \$7,000,000, or 30 per cent. less than that of 1904. This large decrease is surprising and disappointing; it is the result of a combination of conditions. Some beautiful romances have been woven about Klondike; the rapid exhaustion of its auriferous deposits and its consequent decline can be viewed only with regret by those who have read them or have experienced the delight of mining in the unique and enjoyable environment of the far north.

**Causes of Lessened Product.**—Klondike is a placer district, no paying quartz mines being in operation, and, as a gold producer, it has passed its zenith and is rapidly losing its rank. The past year has been in the main unfavorable for large production. There was a light snowfall abnormally late, and the resultant condition of the winter trails interfered somewhat with hauling wood to the claims. The rapid thaw was not conducive to best results in sluicing the winter dumps. However, little loss resulted by freshets washing away material dumped in the creek bottoms or by flooding open cuts.

The stampede to Tanana during the summer and autumn of 1904 included many of the men who usually winter in Klondike, and work winter "lays" for want of something better to do. Considerable low-grade ground (unworkable during the summer by reason of thawing, and not profitable unless the lower scale of winter wages 30c., per hour and board, is in force), is ordinarily mined. Last winter few "laymen" mined, and a material part of the increase is attributable to this cause. Lay percentage, that is the share to the "laymen", was higher, and varied from 60 to 80% of the total output. The mining population numbered only about 3,000; six years ago it was more than 20,000. In a normal year labor would have been scarce, but the dry spring and summer made fewer miners necessary. Labor was scarce during the fall when heavy rains furnished ample water for mining purposes. The rapid thaw and dry spring prevented working during the spring and summer, by ground sluicing of "muck" and other overburden from creek, hillside and bench claims for work later, during the summer and fall.

The advent of cold weather, and the cessation of mining operations, were normal. Less ground was reserved for exploitation by the hydraulic method, the extreme popularity of this means of working alluvion having been followed by a slight reaction; the product was not materially affected in this way.

**Gold Production of the Canadian Yukon.**—This includes not only Klondike

dike proper, but several other camps, as Stewart River, Atlin, etc.

Klondike is the main producer. The following tabulation shows the gold production of Yukon territory:

Year.	Amount.
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

Casual examination of these figures reveals an abnormal rate of decrease during 1905. The unfavorable climatic conditions primarily and the Tanana excitement secondarily, were almost entirely responsible for this, though exhaustion is partly responsible.

**Mining Methods.**—A remarkable variety of methods for mining the placers of Klondike has always been noticeable. During the early days when nearly every one of the self-reliant men constituting its population was evolving his own method for combating obstacles of great magnitude, practice was as varied as nationality. To be sure, there were a few experienced placer miners; but they, too, were not familiar with handling frozen material. Some devices of startling ingenuity were used, and temperament frequently dictated where judgment should have prevailed. Surviving devices, the offspring of some of the numerous mechanical mistakes, are still in existence. In the methods of mining, due particularly to the frozen condition of alluvion—the unique feature of the far north—there is a generally accepted notion. Thus in drifting, there are well defined procedures; but in stripping of overburden and in transporting pay dirt to sluices—both problems in earth work—there is a striking diversity of practice. Overburden in creek bottom is stripped by ground sluicing, steam scraping, horse scraping, steam shoveling or hand shoveling. Steam scraping (a method possessing many advantages and which may be well used in other placer districts) is still the favorite method.<sup>1</sup>

Larger and more powerful scrapers, engines and boilers were used in this work, and with better results during 1905. The means of transporting pay material to the sluices were more varied than ever. Shoveling to platforms, thence to sluices; shoveling into wheelbarrows, wheeling to bucket, raising on inclined cableway to sluices; steam shoveling direct into sluices; shoveling into skips, hoisting by derrick to sluices; shoveling into cars, hauling on inclined track to sluices, were the most common. Shoveling into wheelbarrows, wheeling to bucket and hoisting on inclined cableway; this last is still the most generally practiced method of transporting pay-dirt.

<sup>1</sup> "Methods and Costs of Placer Mining in Alaska," U. S. Geol. Survey Bulletin, No. 263, p. 61.

**New Methods.**—One innovation was the use of a steam shovel to load a skip, in conjunction with a Lidgerwood cableway system, to transport material to a trommel and to gold-saving devices. This arrangement has won numerous advocates who claim for it many advantages in ground which is not workable by the floating dredge. Any definite conclusion regarding a superiority of this method over that including steam scraping as a way of transporting material at present must be considered premature. This is particularly true of frozen area; the removal of thawed material in successive layers is best accomplished by scraping. Variety and novelty in mining mechanism and method are always liable to have an impressionable following; Klondikers are more than usually inclined to welcome and laud such processes.

After all, it is largely a matter of climate; the same spirit which produced wonderful hydraulic installations for mining and power in California, now prevails in the far north; and it will surely make new engineering history.

**Dredging.**—Mechanical excavators of still larger capacity were more generally used. Three dredges were installed and results were satisfactory. The expansion in dredging operation is due to a more thorough appreciation of the advantages of this method when applied to area thawed or but slightly frozen, and to a more general realization of its ability to excavate sufficiently most of the schist and shale bottoms.

A unique installation was that on the Klondike river. An electric dredge, with 7-ft. close-connected buckets, was built and ready for operation in 43 days. A steam turbine was used to generate electric power with the object of economizing in fuel and permitting more deckroom. This took care of sudden loads of 100 h. p. without difficulty, and was found to be entirely satisfactory. The ordinary steam dredge is wasteful of fuel and has little deckroom. The possibilities for similar installations elsewhere in dredging districts are numerous.

**Mining Frozen Ground.**—In open-cutting (except where mechanical excavators such as steam shovels and dredges are used) little thawing is required, the overburden being scraped and the "pay-dirt" handled as they thaw by exposure to sun and air. No new device for thawing frozen alluvion has been used. A more general realization of the futility of attempting to handle material when frozen was noticeable. It is possible to excavate frozen gravel if large and powerful steam shovels with small dippers are used; but the impossibility of a satisfactory gold extraction from gravel which is not completely thawed makes such procedure bad practice. Thawing cost has not varied materially; when steam is used on an economical scale, an allowance of about 40c. per cubic yard is made.

\*Mining engineer, New York.

**Hydraulic Mining.**—The year was not favorable for hydraulic mining; the early, warm and dry spring, the rapid thaw, and the dry summer, caused a shortage of water. The copious fall rains were too late to be of the best advantage. Yet in spite of the bad season about 1,500,000 cu. yd. (50% more than in 1904) was washed. This was due to the conservation of water in reservoirs, and the utilization of more of the flood-water, formerly wasted during the spring thaw, in installations completed during 1904. There was no material modification of hydraulic mining methods. There was less ditch construction than in 1904; the largest ditch excavated in 1905 is 7 miles long, with a capacity of 10 sec. ft. A dam, to be 50 ft. high, forming a reservoir with capacity of 60,000,000 gal. was begun. The significance of these figures is patent as demonstrating the lack of favorable reservoir sites in Klondike.

No great difficulty was experienced with dams built during 1904, although some was anticipated. All earthwork is hampered by the frozen condition of material. Cost of hydraulicking, including amortization, etc., has not fluctuated greatly; 20c. per cu. yd. is proper for well managed operation. A duty of 5 cu. yd. per miners' inch was attained in several authentic instances. Considerable difficulty, due to conflicting water grants, issued under faulty mining regulation, was experienced during 1905. Few applications and fewer grants were recorded in 1905, those of previous years having covered practically all available water. Hydraulicking with pumped water was still carried on by the same operators with results similar to those of 1904. This method is very costly and is seldom profitable.

**Water Supply.**—The physiography of Klondike is such that an ample and constant supply of water is not attainable without long ditches, flumes and inverted siphons. Climatic conditions are extremely adverse to the construction and maintenance of such water ways. In addition to the high cost due to costly labor, materials and transportation, and particularly resultant from hostile climate, good ditching or fluming ground is seldom encountered, and maintenance expense is extremely large. Water has been obtained from limited areas, topographic isolation preventing other procedure. This circumstance has been a tremendous handicap, making slow and costly methods necessary, where an ample water supply would have allowed rapid and cheap exploitation. During 1905, the Canadian Government has had a party in the field investigating the possibility of obtaining a constant supply. No actual ditching to bring a large supply of water from a considerable distance has yet been undertaken.

**Developments.**—There were no developments of new or rich alluvial deposits during 1905. The genealogy of these placer

deposits and their simplicity of occurrence are such that no discoveries of "deep" or "back" channels is likely. The existence of peneplains of the "White Channel" occurring as secondary benches and terraces, though none have been found, is likely. This "White Channel" is what is left of the ancient creek-beds; it has a course approximately parallel to, and an elevation of 150 to 300 ft. above, the present creeks. Where it has not been eroded it appears as a bench deposit with one rim completely removed. There are no paying quartz mines in Klondike, though some prospecting for payable veins was carried on in 1905. The notion of a "mother lode" still attracts many prospectors whose conception of geologic history and appreciation of the colossal erosion is deficient. The wonderfully concentrated deposits of Klondike (where lateral and vertical dissemination is so seldom found) are the results of the corrosion of prodigious volumes of what was probably low-grade material.

The development of more so-called "worked out" ground during the past year has been gratifying. Early methods contemplated working only the richer spots and were crude and wasteful; with improved exploitation, much ground formerly thought to be "worked out" has become valuable. No unusually rich ground, such as was common in the early days, was mined.

**Labor.**—As noted above, the supply of labor has not been ample. Wages are still high—40c. per hour and board in summer, 30c. per hour and board in winter, being the ruling rates. There are no unions and no strikes have occurred. An unusually high class of labor is available, the tremendously stimulating climate having developed a remarkable body of men.

**Fuel.**—Wood hauled on runners cost from \$10 to \$12.50 per cord; for that delivered on wheels, \$14 to \$22 per cord was paid. It was usually delivered in 16 ft. lengths. The cost of fuel in Klondike is materially affected by length of haul and the rapid denudation of adjacent hills; besides preventing conservation of water, it has caused a yearly increase in fuel expenses. Experience with local coal has not been encouraging; as during 1904, it was found to be of low calorific value and is only used where peculiar conditions make its cost per ton less than that of wood per cord. A ton of coal was found to be about equal to a cord of wood in steam-producing qualities. A line of river steamers used about 6,000 tons of coal from a mine about 200 miles from Dawson on the upper Yukon River.

**Transportation.**—New wagon roads and trails have been built in Stewart river and Miller creek districts. The excellent roads already constructed have been well maintained; large loads (20 cwt. per animal) are hauled on them. Alaska mining camps, still notoriously deficient in this respect, can profit by this example. The con-

struction of a narrow gauge steam railway from Dawson to Grand Forks, 12 miles distant, has been begun. Transportation cost for supplies from the outside (southern ports of British Columbia and northern ports of the United States) has not varied materially; about \$60 per ton is charged. Passenger rates for railway, river-steamer and stage travel are about as formerly, 20c., 11c., and 25c. per mile being the respective average charges.

**Mining Laws and Regulations.**—The law still requires \$200 worth of work per annum on each claim or fractional claim; this is called "representation work." Title cannot be obtained, but claims are leased by the Crown to licensed "free miners" from year to year, as long as the rules are followed. The regulation passed in 1904 to allow holders of water rights to sell surplus water because of the dry season, was of little benefit during 1905. What little water was sold commanded the high price of \$1 per ten-hour miners' inch. No new regulations as to concessions were passed. No new concessions were granted, and little work was done on those already existing.

In preparing this sketch I am much indebted to Mr. J. Moore Elmer, the dredging pioneer of Klondike; and to Mr. Geo. T. Coffey, the hydraulic expert of Klondike, for helpful data.

### Gold in Japan.

The Japanese Department of Agriculture and Commerce states that the country's output of precious metals has, this year, exceeded previous records. Production for the last five years has been, in troy ounces:

	Gold.	Silver.
1901.....	113,731	1,760,025
1902.....	143,982	1,853,133
1903.....	139,612	1,884,021
1904.....	142,378	1,993,197
1905 (January to July).....	98,285	1,399,838
1905 (estimated).....	161,344	2,411,767

The above statistics include the output of Formosa.

### Coal in Austria.

The official statement, recently published, gives the production of fuel for the full year as follows:

	1903.	1904.	Changes.
Coal.....	5,749,056	5,934,122	I. 185,066
Brown coal.....	11,078,760	10,993,825	D. 84,935
Total mined..	16,827,816	16,927,947	I. 100,131
Coke made.....	584,132	641,236	I. 57,104
Briquettes made	79,567	100,926	I. 21,359

The output of iron ore was 859,609 tons in 1903, and 857,991 tons in 1904; a decrease of 1,618 tons last year.

New York, Pennsylvania, Maryland, Ohio and Illinois have a large number of natural cement plants, built between 1818 and 1838. These were constructed to manufacture cement for the canal work which was being extensively carried on at that time.

## The Mining Industries of California.

BY CHARLES G. YALE.

The mining industry of California continues in a thriving condition and each succeeding year shows a marked increase in value of product. This increase has been about on an average of two million dollars per annum for the past eight years, but in 1904 the increase was over \$6,000,000 beyond that of the preceding year. The reasons for this are easily found in the utilization of mineral substances formerly neglected, as well as in the enlarged developments occurring in quartz and gravel mining operations for gold, and in the petroleum fields of the State.

Naturally gold mining continues to be of the first importance, some nineteen million dollars a year coming from gold properties as against twenty-four and a half million from all the other mining industries combined. The value of the entire mineral product of the State in 1904 was nearly \$44,000,000, and a conservative estimate for the year 1905 places it at between forty-five and forty-six million. No special increase in gold output is expected, when the final figures for 1905 are completed, since the State has had an exceptionally long "dry season." During the later fall months a large proportion of the more important quartz mills and mines were compelled to close down owing to lack of water for power; and the hydraulic mines were unable to start working for many weeks beyond the usual time when a water supply is available. All this must have its effect upon the total gold output of the State for the year; though no very great falling off in yield is anticipated, as the dredgers are expected to make up by their increased output any deficiencies in the other branches of gold mining.

No developments of note have occurred in the quartz mines of California during 1905. In the older districts work has continued as usual with the exception of this period already noted, when the lack of water compelled the companies to stop their mills, necessitating, of course, a reduction of working force in the mines themselves. In some cases the mills were idle for two months or more, and in other instances for shorter periods. At certain points the large companies have provided auxiliary steam power plants to be used under just such circumstances, and, after the experience of this year, it is probable that numbers of other companies will follow the example. While most of the larger plants are run usually by water or electrical power, when these sources fail owing to lack of water, steam power becomes a necessity if a shut-down is to be avoided, even for a few weeks each year.

It is hardly possible in a brief review to single out special instances in the many districts of the State where noteworthy advances have been made. It may be said,

however, speaking generally, that the southeastern portion of the State is now attracting more attention from prospectors than other portions. This is largely due to the success achieved in the "desert" camps of southwestern Nevada, where very rich gold ores have been found in situations hitherto considered unlikely. The conditions attracted some thousands of men to the various camps and many of them continuing southward have come over the boundary line into California from Nevada, prospecting the mountainous and desert regions of Inyo county and thereabouts.

As a result not only have many new finds been made, but old and practically abandoned districts have been resuscitated. Twenty-five and thirty years ago there were numerous camps established in those sections, but owing to high costs, lack of transportation facilities, distance from reduction works, etc., most of them proved costly failures. General conditions have changed materially since then, and ores which could not be worked profitably then are now of value. Moreover the experience on the deserts of Nevada has shown what may be done under adverse circumstances where the properties have real merit, and numbers of mines discovered a quarter of a century ago, worked for a time and then practically abandoned, are being re-opened. Inyo, Mono, Kern and San Bernardino counties are all large ones, and their developed mineral resources are incommensurate with their extent. The Funeral range in Inyo county alone has this year shown prospects of a surprising nature; and mines for years worth practically nothing in such old camps as Panamint, Cerro Gordo, and others, have suddenly become of value.

In the northwestern counties of the State also, Shasta, Trinity, Siskiyou, etc., renewed activity is apparent both in quartz and gravel mines, and considerable new development is under way, especially in quartz properties. In Shasta, new smelters have been blown in and others are in course of construction. These are intended for particular mines, but their purchase of fluxing ores give opportunity for many, working in a small way, to dispose of their low grade ores, and thus conduct their mining operations without the necessity of individual reduction works. In Siskiyou and Trinity more attention is being paid than hitherto to quartz mining, these being considered generally gravel-mining counties. Siskiyou is now producing more from her hydraulic properties than any other county in the State. These counties are free from the incubus of the Caminetti law, and do not come under the supervision of the California Debris Commission; they may hydraulic as they please without having to impound the debris.

In the older central and Mother Lode counties, increased developments are to be noted in the more important and larger

properties. That is, not only are the depths in shafts being greatly increased, from year to year, but the reduction facilities for ores are being materially enlarged as underground developments warrant. Some few properties have been closed down as unprofitable, as happens every year, but, to offset this, many new ones are started up, some of which bid fair to become of permanent importance. The mining field of the State extends over such a large area that there is still an immense territory in which original prospecting may be done.

It is worthy of note that California, which has fairly earned its cognomen, "The Golden State," has been for some years slowly increasing its gold output annually until it has now again reached upward of \$19,000,000, after having fallen at one time as low as \$12,000,000, and the increase is likely to continue for some time to come. Last year the increase over the previous one was nearly \$3,000,000, which was due primarily to enlarged operations in the quartz mines, and secondarily to increased output of the dredges. In fact the hydraulic, drift, and surface placers also showed some slight additional output, thus proving the generally improved condition of the gold mining industry in the State.

Just at present the dredging operations are probably attracting more attention than any other form of gold mining in California, from their comparative novelty and rapid increase in numbers. The main feature of interest may be said to be their capacity for working auriferous deposits hitherto unworkable with a profit by other known methods. It is an absurd error, though somewhat prevalent, to suppose that these machines may work either hydraulic or drift properties as these are understood in California. The hydraulic gravel banks are usually of a depth or height, and of a grade in value far beyond the limitations of any dredge yet devised. The usual "drift" mines have their available gravel buried under several hundred feet of hard lava which can not be handled except by means of long tunnels and drifts. Dredging machines can not manage the gravel now worked by either of these systems. But there are auriferous deposits, shallow, and with no available fall or dumps, hitherto unworked, for which the dredges are admirably adapted.

Indeed such deposits can be worked profitably by no other system than dredging. No reservoir, ditch system, pipe-lines, or water under high pressure are needed for the dredges. If the bedrock is not rough and hard and the deposits do not exceed say 65 ft. in depth, the overlying gravel may be readily handled with a profit, provided the average values are sufficient. Moreover ground which has already been once mined may be again handled by the dredge system as at Oroville, where only the underlying de-

posits near bedrock, were once partly mined by drifting before the dredge was invented. Again, ground covered with debris from former hydraulic mining operation as on the Yuba river near Marysville and useless for any thing else by reason of lack of fall and water supply, can be dredged. But as stated there are limitations to the dredge mining system. Comparatively shallow gravels, with an excess of water, and with soft bedrock, form ideal places for dredges to work. The costs per cubic yard vary from 2.36 and 3c. to 8.5c., and the material thus far handled on a large scale varies from 10 to 25c. in value, a general average being about 17c. The capacities of the machines run from 3,000 to 4,500 cu. yd. per day according to size and power supplied. No blasting is required as is the case generally in hydraulic and drift mines. Generally speaking any gravel that may be picked may be dug by the dredge, without the use of powder.

There are at present somewhat less than 50 dredges in operation in California, but more are under construction or contemplation. The area of available dredging ground at present known or prospected is somewhat less than 50,000 acres. The principal seats of dredging operations are at Oroville, Butte county, between Smartsville and Marysville in Yuba county, and near Folsom, Sacramento county; but there are dredges at work in other counties. The average gross output per dredge, taking large and small together is a little less than \$55,000.

Taking the total gold output of the State since 1848, the average annual yield for the 57 years has been \$25,250,000 and California is shown to have yielded 52.44% of all the gold mined in the United States since 1792. That a state with such a remarkable record should at this late day be able gradually to increase its gold output yearly, from its lowest point, should be a matter of encouragement, to gold miners throughout the world. The placer deposits were not worked out years ago as supposed, for the invention of new appliances and systems has shown that it was only lack of knowledge, and not exhaustion of the deposits that caused the falling off of output from these sources. And the annual increase of yield from the quartz mines proves also that improved and cheapened systems of mining and metallurgy were all that were required to make successful mines out of what were failures under the antiquated methods so long in use.

When the gold in California was first discovered and men went in thousands to seek it, there was no idea among them that anything else of interest to miners was to be found. Indeed for many years this idea prevailed. But now there are 45 mineral substances utilized in the State, and many of these are making wonderful progress. Who could have supposed, for instance, ten years ago, that California

would become the largest producer of petroleum in the United States; yet this has happened and the output is increasing. The State is now yielding nearly 30,000,000 barrels a year, worth between eight and nine million dollars, and new wells are being constantly opened in both old and new districts. The copper mines for a long time neglected are yielding about \$4,000,000 a year in value and more large ones are being opened.

The metallic substances now mined, including gold, silver, pyrites, quicksilver, copper, lead, manganese, platinum and chrome, are worth over \$25,000,000 a year. The non-metallic substances such as borax, coal, mineral waters, infusorial earth, gypsum, magnesite, mineral paint, lithia-mica, fullers earth, mica, soda, tourmaline, kunzite and other gems are worth considerably over \$2,000,000. The hydrocarbons, including asphalt, bituminous rock, natural gas, petroleum, are worth between nine and ten millions a year. The structural materials, such as brick and pottery clays, Portland cement, lime and limestone, macadam, granite, serpentine, slate, glass sand and soapstone, bring values between seven and eight million annually.

For the oldest mining State in the Union outside of those of the Appalachian region, this general record should be a matter of congratulation to all persons engaged in the mining industry. The gradual settlement of the country has caused its mineral resources to be investigated, developed and brought to a profitable stage. And the best of it is that "the end is not yet." It is only within the past few years that the possibilities of gem mining became known, for example, and in the southern part of the State this is a rapidly enlarging industry. Up to a few years ago petroleum was only known in one county. Now eight counties are producing it. Gold is being mined in 34 counties. Out of the 57 counties of the State all except three made some mineral product last year. Some single counties produce as many as fifteen mineral substances each year.

There are more producing gold mines, quartz and gravel, in operation in California to-day than in any other State; and these are annually increasing in number. The gold-producing area is wonderful in extent for one State. For a distance of 775 miles in length, and a width of 148 to 235 miles, in a total area of 156,931 square miles, gold is found in almost every portion. In the tier of counties extending from one end of the State to the other there is not one without its gold deposits in one form or another. In some places 13,000 ft. above sea level, gold mining is carried on, and in other places 200 ft. below sea level gold is found and mined.

But as shown, gold mining is no longer the only form of mining carried on in California. With all the other substances

being utilized the record of annual output in value is rapidly increasing and will continue to do so for some years as new deposits of mineral substances are developed and utilized.

### Mining in Idaho in 1905.

BY ROBERT N. BELL.\*

The mining developments of the past year, in Idaho, outside of the Cœur d'Alene district, a review of which will be found in another column, have been interesting and important in certain localities.

At Orogrande, near the old placer camp of Elk City, in Idaho county, the Crooked River Mining & Milling Co., has equipped its property, locally called the Hogan mine, with a 300-ton cyanide plant which was recently put into successful operation. This property carries a remarkably interesting gold deposit. It is locally called a dike, but is simply a sheeted and shattered zone of excessive fissuring in the ordinary country rock, which is a coarse gneiss which has been compressed and its feldspars and micas considerably changed. Subsequent to fissuring it was evidently permeated by a gold-bearing iron solution, giving it the appearance of a rusty, shattered, granitic gangue. The zone is 500 ft. wide, stands nearly on end, and carries an average value of better than \$3 per ton in gold. It has been developed by crosscuts, one of which is connected to the surface with big raises, and the material has been mined by the "glory hole" method. The property was equipped with a 20-stamp mill several years ago, and a good many test runs have been made. It was found that the gold was exceedingly fine and that only about 30% of it could be saved by amalgamation, but the material was well adapted for cyaniding, with the result of the present equipment.

Under the management of William Hogan, this property has established a low record of mining and milling costs; it has been operated for months at a time at a total cost of 60c. per ton for mining and milling, including all costs properly chargeable to operation. The present cyanide equipment is the first instalment of a more extensive plant which will follow if a successful treatment of the ore is established. The brown, oxidized, condition of the zone changes at about 150 ft. below the surface to a blue, unaltered, sulphide condition, with an even dissemination of fine-grained iron pyrites, but there are no objectionable sulphides apparent, and it is said that the sulphide horizon carries equally strong gold values, and yields quite readily to cyanide solutions.

The property gives evidence of becoming a producer of the "Treadwell" class, as the deposit apparently has a lineal extent of several thousand feet, and its great

\*State Mine Inspector, Boise, Idaho.

width warrants the anticipation of an enormous tonnage. It parallels the valley of Crooked river, extending from 100 to 500 ft. above the river bed. The company owns a fine water power, and has abundance of timber; the elevation is only 4,500 ft., and the natural facilities for an economical operation on an extensive scale, with the exception of railway transportation, are exceptionally good. The nearest railway point is Stites, 65 miles distant, the terminus of the Clearwater branch of the Northern Pacific, which, however, could be extended into this district with very little difficulty, with an easy grade all the way.

There are several other deposits of the same class as the Hogan mine, in the Elk City basin, that are worthy of extensive development. This is one of the old placer districts of Idaho and carries some important gold-quartz fissures, besides big zone deposits like the above described. One of these, known as the Buster mine, half a mile north of Elk City, carries a well-defined fissure vein, traceable for over 1,000 ft., with a width of 5 to 20 ft.; its principal ore-shoot was recently opened in the lower tunnel, nearly 200 ft. deep,

of about 40 men, at this time. The mill has remained idle since spring.

The Dewey mine, on the opposite side of Thunder mountain summit, still remains the only property in the district that has produced any gold at a profit. This is equipped with a 10-stamp mill, which was shut down, during the summer months, undergoing repairs. It is now being operated, and is said to be yielding a good profit and making a saving of over 80% with simple plate amalgamation on an \$8 ore.

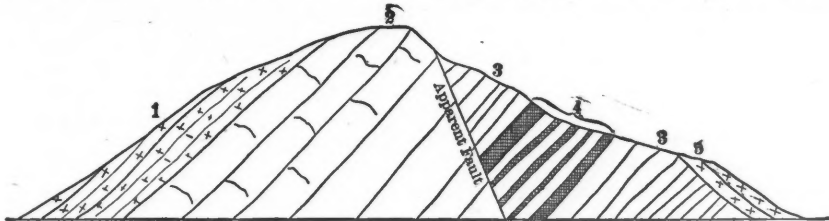
The Big Creek district, 30 to 40 miles north of Thunder mountain, has also experienced a quiet season, although its many promising properties have been kept alive and well represented; a new State wagon road is under construction there, and already, two-thirds of it have been completed. This will open the district to wagon transportation, by way of the Pacific & Idaho Northern railway from the terminus at Council, and from there *via* the old placer camp of Warrens. Big Creek has some immense fissure veins and dikes of gold-bearing quartz and porphyritic rock that carry very fair average values in gold, and it is likely to develop

and carries a pay-streak averaging 2 ft. wide, which has been proved by a succession of adit tunnels to a depth of 400 ft. and a length of 500 ft. This pay-streak is remarkably clean and well defined and averages 2 oz. gold and about 20% copper. It is a massive, chalcopryite, ore, and is remarkably clean and continuous for such high-grade mineral. The rest of this large vein is low-grade, running about 3% copper and \$5 to \$7 gold. The property has recently been equipped with a smelting plant of 100 tons daily capacity, intended to use the hot-blast pyritic process.

The old mines of Owyhee county, in the vicinity of Silver City and De Lamar, deposits of Nevada type, yielding high-grade, silicious, milling ores, continue to show very handsome results. In fact, the production of the Trade Dollar, this year, has been increased, and the mine seems good for a long lease of life, in spite of the fact that it has been operated continuously for over twelve years, and has produced \$12,000,000. The chief feature of its development is a drain tunnel over two miles in length and a face depth of 1,700 ft. The De Lamar mill has been undergoing re-construction for several months past with a view of reducing costs and increasing the saving. A large force has been kept on the mine at development work with very satisfactory results, and this old property continues on fine physical condition with a bright future ahead of it, and its ninth \$1,000,000 of production in sight. The combined product of these two mines for 1905 will approximate \$800,000, of which about two-thirds will be silver and one-third gold. This old district has some remarkably promising undeveloped properties, and is likely to continue a big producer for a long time.

At the Gilmore, in Lemhi county, near the famous old Viola, which made such a great record of lead production in the 80's, a handsome deposit of high-grade lead carbonate ore, contained in a nearly vertical fissure in blue limestone, was operated successfully during the last summer; 2,500 tons of ore were shipped, mostly crude mineral, just as it came from the stopes, that averaged about 50% lead and 20 oz. of silver. This property is situated in a very extensive lead-bearing district that compares closely in ores and formations with the Tintic district in Utah. It is attracting a great deal of attention at the present time, and several new development enterprises have been started there. It is, unfortunately, 75 miles from a railroad, the nearest point being Dubois on the Oregon Short Line railway, but the distance is covered over a smooth, hard, desert road, at a wagon-haul charge of \$10 per ton for the ore.

An important development of the year was the opening of some seams of bituminous coal in Fremont county, 26 miles east of the terminus of the St. Anthony branch railway, which leaves the Mon-



1. RHYOLITE 800 FT. 2. MASSIVE BLUE LIMESTONE AND QUARTZOSE SANDSTONE BEDS 2,000 FT. 3. SOFT SANDSTONE AND THIN SHALE BEDS 5,000 FT. 4. COAL SEAMS. 5. RHYOLITE 500 FT. GEOLOGICAL CONDITIONS AT FREMONT CO. COAL FIELDS.

where it is said to carry an average value of \$30 per ton for 10 ft. of width, together with smaller pay-streaks and patches of \$100- to \$200-ore. This property has recently passed into the hands of a San Francisco company which is actively developing it at present. A number of other operations are in progress in the Elk City basin, and some important developments may be anticipated within another year.

The Thunder Mountain district around Roosevelt has experienced a rather poor year. The Sunnyside mine, on which such a large amount of capital has been expended, with high expectations, seems to have been sadly overestimated. This company completed a 40-stamp mill on the property early last spring. The mill was run for something like two months on ore that was supposed to be worth \$10 to \$30, according to mine samples, but the results obtained are reported, on good authority, to have been insufficient to cover the cost of a milling operation. The owners of this property are, principally, wealthy Pittsburg capitalists, who are still displaying faith in the property and trying to find pay ore; they are developing the mine with a crew

an important and productive district in time.

A new electric power plant and dam are being constructed at the upper end of Garden valley, on the south fork of the Payette river, for the purpose of supplying electric power to the dredges of Boisé basin. This enterprise is expected to be in running order in time for the placer season of 1906. There are four large dredges in the Boisé basin; two of them are of modern design and construction, and two more will be built next season, according to definite plans already under way. This famous old placer district has some very extensive tracts of flat bottomland, ideal for dredging; it has been extensively tested and found to contain average values of 15 to 30c. per cubic yard, and it is likely to afford an important increase in the gold production of Idaho, beginning with next season.

At Loon creek, in Custer county, one of the most important ore developments of the year has been made. This is at the property of the Lost Packer Mining Co., owned by some prominent Butte and Salt Lake capitalists. The Lost Packer carries a nearly vertical fissure in granite and rhyolite formations. It is 10 to 15 ft. wide

tana division of the Oregon Short Line at Idaho Falls. The new coalfield carries a series of seams that vary from 2 to 20 ft. thick. They strike a little west of north and dip 45° to the southwest. The enclosing formations are Cretaceous sandstones and shales, full of characteristic Cretaceous fossils. The development is limited, as yet, but sufficient to indicate an important resource of available, high-grade fuel.

Two of the seams, one 10 ft. and another 5.5 ft. wide, have been traced by surface pits and shallow tunnels at short intervals, for three miles along their strike. The 10-ft. seam has a blue shale roof, and has been opened by a tunnel 500 ft. long. This roof has proved hard to hold at the shallow depth of 50 ft. The walls of the 5.5 ft. vein, however, are of sandstone, and very hard, which admits of cheap mining. This vein is producing 300 to 400 tons per month for local consumption, and there is a market for several times that amount, as the surrounding country is one of the richest agricultural sections in the State, and thickly settled. The analyses of some of the principal openings on this property show a very superior quality of fuel. Some of the smaller veins show coking qualities in laboratory tests, giving a product that analyzes very closely to the Pocahontas coke; of course, no practical oven tests have yet been made.

No.	Width.	Moist-ure.	Vol. Car.	F. Car.	Ash.
1	10 ft.	1.8	39.6	55.7	2.9
2	5½ ft.	1.8	40.1	55.8	2.3
3	3 ft.	1.9	41.5	53.1	3.5
4	4 ft.	2.5	38.8	54.4	4.3
5 (Laboratory Coke)		0.8	0.6	90.1	8.5

These samples were all taken less than 40 ft. below the outcrops; and with the exception of a 6-inch clay band in the 10-ft. seam and a 4-inch clay band in the 5½-ft. seam, represent the full width of each seam. The sulphur contents have never exceeded 0.7%.

This field is, doubtless, a continuation of the Uintah formations, in which the Wyoming coals of Kemmerer, Cumberland and Diamondville occur. It occupies an important geographical position, being nearly 200 miles nearer the Montana markets than are the Wyoming mines, from which it is estimated that 2,000,000 tons of coal per year are shipped to supply the Montana mines and smelters.

The property now being operated carries an aggregate width of 40 ft. of workable coal seams, in a closely parallel series that should contain 2,000,000 tons of fuel, for every 100 ft. of depth, if their present size is maintained on the dip. There is evidence of a pronounced north-and-south fault running nearly parallel with the outcrops at some distance to the west, but it is unlikely that this fault plane would be encountered in following the veins down their dip at less than half a mile. The accompanying diagram will illustrate the interesting geological conditions in these coal deposits.

The gold output of Idaho for 1905 was reduced by the extremely short water season with the placer miners, who still pro-

duce 45% of the total gold yield of the State. The silver output was largely increased, due, principally, to the remarkable production of the Cœur d'Alene mines; 1905 will break all records for lead, and copper will also show a marked increase, also due to a Cœur d'Alene property. Zinc entered the list of metal production in Idaho, for the first time in 1905, with an output of several thousand tons of zinc ore, principally from the Wood River district. On the whole, the metal yield of the State was largely increased by the remarkable production of the Cœur d'Alenes.

### New Mexico in 1905.

BY CHARLES R. KEYES.\*

The mining industry in New Mexico has shown noticeable advancement. There are several reasons for this encouraging progress. In the first place, the Spanish land-grant cases have all been finally settled by the special court established by Congress, and thus good titles are now to be had to all of these lands. These enormous land-grants cover most of the best mineral land in the region. Secondly, the water question has not proved to be so serious a factor as had long been fancied. Thirdly, the labor problem has proved favorable, in the light of the serious troubles in Colorado. A fourth factor has been the systematic character of the prospecting and exploration of the past few years. A fifth, and an important, feature is the large increase in railroad mileage; this has brought many large mineral districts within reach of good markets. All these conditions give a promising outlook. The effects are already felt in the capital that is being invested in New Mexican properties.

**Coal.**—Of all the mineral wealth of this State, coal stands first in so far as present production is concerned. Activity in coal mining continues in full vigor in the old Raton field. To the west, in the Raton range, the new Dawson field is now in full operation. A railroad 120 mi. in length has been built into the field (from Tucumcari, on the Rock Island line); the coal now supplies the Phelps-Dodge railway and smelting. The coalfield of Hagan, near Albuquerque, has been opened, and the mines are among the promising ones of the region. In the northwest, in the San Juan valley, large coal deposits are being developed. The Denver & Rio Grande railway has already built a line to tap this field; the Southern Pacific railroad is now surveyed through the district. These roads will reach a large number of private interests. A number of other fields have been discovered and are being developed. In the course of a few years they will also be furnishing the southwest markets with large supplies of good fuel. Some of these new coals are coking coals.

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

The coal industry of New Mexico must surely experience rapid expansion during the next few years.

**Zinc.**—Of the metals, zinc now takes the lead. The ores are chiefly carbonates and sulphides which are shipped East. There are some silicate ores, some rare combinations with copper, and also with manganese. Zinc mining has only begun in New Mexico. The ores are abundantly and widely distributed, chiefly west of the Rio Grande. Socorro county is the principal producer, its output promises a rapid increase. Grant county comes second in production.

New Mexico may soon be one of the largest zinc producers in the Union. The development now going on in the Magdalena district will within a year make two of the mines the largest of the kind in the United States. Zinc ores are now being shipped from several counties; and a number of other counties will soon be in the list of active producers.

**Gold.**—Though gold was mined by Europeans in New Mexico before it was anywhere else in the United States, and though some of the most extensive and richest placers on the continent occur in this region, yet the insufficient water was long a drawback to the exploitation of these valuable gravels. The dredge at least has solved the most difficult of the problems; in a number of localities these machines are in operation, and with large profit. There are hundreds of localities where similar operations may be carried on, with large returns on the outlay. Near some of the best placers, the solid and unweathered rock carries over \$1 in gold to the cubic yard.

Lode mining has received more systematic attention than for a long time previous. The general outlook for a considerable increase of output is promising. In the western part of Socorro county, important mines are being developed, but the distance (100 miles) from railroads is a serious hindrance to extensive operations at this time.

**Silver.**—At the present, silver mining offers attractions for investment that have not occurred during a dozen years previous. With improved methods of treatment, and with better transportation facilities, New Mexico should soon get back much of the old-time prestige she had before the metal was demonetized.

Many of the silver and gold ores are complex, and heretofore have defied profitable treatment. Since satisfactory methods have recently been put into operation, a large amount of ore (which up to this time could not be shipped) can now find a market.

**Copper.**—Western and southwestern New Mexico is rapidly becoming a copper producer. A number of important developments have been made. As yet, the most important copper districts are at considerable distances from railway facilities.



Lines of railroad have been located here during the past year; these tap a number of these camps. The Santa Rita mines continue to be good producers. In the Mogollon region, bornite ores (which occur in large deposits) are finding their way to the market in spite of transportation drawbacks.

The low-grade copper ores of the great "Red Bed" belt have received attention. This formation covers large areas in New Mexico; nearly everywhere it carries more or less copper. In a small way, copper has already been extracted from the Red Beds. It is with much interest that large projected developments are being conducted.

*Iron.*—This has shown more activity than during the previous year. Fierro continues to be the largest producing camp; much of this output goes to Pueblo, Colorado. Important new bodies of iron ore have been lately discovered. The project of large rolling mills in New Mexico has not reached the stage where actual operation has begun. The past year has shown that iron is a much more important resource of the region than has hitherto been suspected.

*Lead.*—The mining of this metal has increased. The smelter at Deming has stimulated the local mining of lead. From the Granite Gap district, in Grant county, new developments have been made; the camp is now becoming an important producer. Another locality coming into prominence as a lead-sulphide camp is in the Caballos district, in Sierra county. The ore occurs in well-defined veins. At the present, a large concentrating plant is being installed and a smelter is being provided. The camps in the Organ mountains and in the Black range have shown increased activity. In the Magdalena camp (which for the last 20 years has been a lead-carbonate producer, and which has been recently so overshadowed by zinc), immense sulphide bodies have been developed. The sulphide ores are a mixture of lead and zinc. A concentrator will soon make a rough separation of the former, which will be smelted on the spot; the ores containing zinc and a little lead at present are shipped to Joplin and Coffeyville. New lead stopes have also been found at the top of the range; they promise important developments.

The search for the rare metals has made progress. Uranium in the form of the mineral torbernite has been found in Socorro county. New localities for tungsten have been found in Grant county. Molybdenite has been opened up in Santa Fe county.

Altogether the last year has been the most encouraging during the past decade.

The purest graphite designed for commercial purposes seldom exceeds 99% in carbon. What is termed "commercially pure" graphite contains about 95% of carbon; such material is used to a large extent as a lubricant.

### South Dakota Mining in 1905.

BY J. V. N. DORR.\*

The year in the Black Hills has seen considerable progress along conservative lines, with eight companies operating their own reduction plants continuously, and several others shipping to custom mills and the smelters outside the Hills.

The overproduction of mining stocks, from which the Hills suffered several years ago, has left some of the more speculative propositions apparently stranded, but the producing properties have, as a rule, operated steadily with diminishing working costs.

The formation of the Con. Power & Light Company has taken over the lighting plants of Deadwood and Lead, the latter of which was already supplying power to two cyanide mills, and is now installing a modern steam-turbine powerhouse of several thousand horse-power capacity; this company will reduce the power costs at the mines and mills in the northern Hills materially, and will assist greatly the development of properties not on the railroad. The investment of such a large sum of money as this company will expend shows confidence in the permanency of the mining industry in the Hills.

The Homestake Co. has increased its tonnage milled considerably over last year; the last annual report showed an increased recovery per ton milled. Early in the year the dividend rate was doubled, and it is believed that the present rate will be maintained, although the company has improvements under way that will require the expenditure of more than \$500,000 in less than a year. These improvements comprise the erection of a filter-press plant to treat the 1,300 tons of slime now being discharged without being cyanided; the installation of a power plant to generate 500 h. p. from the water supply for the mills; and the substitution of compressed air for animal haulage underground.

The Homestake is the only steady producer in the free-milling district at present. The Clover Leaf Co. (which has been operating for the last few years against great difficulties from large amounts of water) has shut down to secure additional capital; the numerous companies floated on the "extensions" of the Homestake, have not yet passed the development stage.

Most of the companies operating in the "silicious ore" district have done well this year. Both the Wasp No. 2 and the Golden Reward Co. have increased the capacity of their mills; the Puritan Co. is putting up a wet-crushing mill to handle quartzite, similar to that crushed dry in the Wasp.

The burning of the big mill of the Horseshoe Co., in May, shut down the largest producer; but the mines have been

\*General manager, Buxton & Big Bonanza Mines, Terry, S. D.

operated steadily since then, shipping high-grade ore to the smelters and a lower-grade ore to a custom mill. The reorganization of the company, now about completed, will result probably in the changing of their old dry-crushing plant at Pluma into a 300-ton wet-crushing mill.

The purchase of the McGovern ground in the Portland district by the Imperial Co., at the end of 1904, has proved a good investment; that company has supplied its mill with good ore from that property during the whole year. It is interesting to note that the purchase price (over \$100,000) was paid before any ore was developed in the mine, and entirely on account of the orebodies that had been worked up to the lines.

There has been considerable activity in the Limestone district. The Spearfish has run steadily all the year, and has put in another set of rolls in order to grind finer; the Victoria and Eleventh Hour companies are each completing a 200-ton mill similar to that of the Spearfish Company.

The only new company to start milling during the year in the northern Hills was the Gilt-Edge-Maid Co., which is treating about 130 tons of porphyry ore daily.

In the southern Hills a number of properties are being developed. The Golden West Co. ran its mill at Rochford until the shortage of water for power purposes in the Fall shut it down.

No estimate of the total production for the year is obtainable now; but it will be much larger than in 1904, and there is every prospect of a still greater increase next year.

### Mining Progress in Utah in 1905.

BY L. H. BEASON.

Utah's contribution from its metal mines during the year 1905, according to confidential reports received from each of the smelters in the State and from shippers of ore and bullion out of the State, had an estimated value of \$29,810,815, comprising the following items:

Gold, 347,353 oz. @ \$20.67.....	\$7,180,786
Silver, 14,412,928 oz. @ 59.76c....	8,613,166
Copper, 57,267,706 lb. @ 15.341c..	8,785,559
Lead, 96,661,605 lb. @ \$4.551 per	
100 lb.....	4,399,070
Zinc, 13,476,129 lb. @ 5.528c....	784,984
Quicksilver, 1,050 flasks @ \$45....	47,250

Total.....\$29,810,815

The year's showing is a very gratifying one, as will be seen by comparison with the metal output of 1904, which had a total value of \$21,861,288, comprising: Gold, 202,476 oz.; silver, 12,210,527 oz.; copper, 44,012,203 lb.; lead, 116,350,974 lb.; quicksilver, 700 flasks.

It will be seen that there has been an increase in output of all the metals except lead, and the falling off in that metal can be accounted for by the fact that the Ontario tunnel disaster at Park City cut down the output of the Ontario and other lead mines in that camp. Then there has been

a shortage in tonnage from Stockton, where operators have been devoting their energies to the development of their properties pending the completion of the Honerine drain tunnel, through which in the future they will send their ore to the surface. The lead output of Tintic shows some increase, but it is not enough to make up the deficiency from the camps mentioned.

While the increase in the output of gold and silver has been decidedly interesting, the greatest strides have been made by the copper mines, and they have supplied over 13,000,000 lb. more metal this year than they did last. It will be noted that another factor has entered into the mining industry. For the first time, the mining of zinc ore has been carried on profitably in this State and the mine owners have realized therefrom a material increase of income. It has been well known for a good many years that there is an abundance of zinc ore in the mountains of Utah; but wherever it has appeared, it was looked upon as a detriment rather than an advantage to a property. Park City, Tintic, Stockton, American Fork cañon and Alta all have some big tonnages of zinc ore; so has the Horn Silver mine at Frisco, Beaver county, which sent close to 15,000 tons to the smelters at Iola, Kansas, for treatment under a favorable contract.

Steps are under way for the construction of reduction works to handle zinc ores in Utah. A syndicate of local and eastern capitalists has already secured a site, with necessary water rights, at a point along the tracks of the Oregon Short Line and the Southern Pacific railroads, near Bonneville, in Boxelder county, 12 miles north of Ogden. It is proposed to build a plant that will be as important as any of the Kansas smelters.

One of the gratifying features of the year's achievements is the steady headway that has been made by the older camps. Some that have been producing for more than a quarter of a century show no signs of giving out, but on the contrary are surprising even the most optimistic.

During 1905 the mines of Utah paid in dividends \$3,963,000, or \$205,500 less than was credited to them in 1904.

The distributors were:

Silver King, Park City.....	\$1,300,000
Utah Consolidated, Bingham.....	1,050,000
United States, Bingham and Tintic.....	750,000
Daly West, Park City.....	432,000
Gemini, Tintic.....	100,000
Consolidated Mercur, Mercur.....	75,000
Grand Central, Tintic.....	75,000
Horn Silver, Beaver county.....	80,000
Yankee Consolidated, Tintic.....	25,000
Uncle Sam Consolidated, Tintic.....	20,000
Victoria, Tintic.....	25,000
Sacramento, Mercur.....	10,000
Utah, Fish Springs.....	6,000
Swansea, Tintic.....	5,000
Beck Tunnel Consolidated.....	10,000

Total for the year.....\$3,963,000

The shining example is Bingham, now recognized as one of the greatest copper camps. Developments here have been so rapid during the past year or two that

the smelters have not been able to keep pace and have found it necessary to call a halt on producers by asking them to curtail their output temporarily. To make things worse, a disastrous fire at the Pleasant Valley Coal Company's mines at Sunnyside, Utah, destroyed the coke-making facilities of that corporation. For several weeks it was unable to supply the smelters with fuel, and the plants in the Salt Lake valley came dangerously near a complete shut-down; while the trouble lasted some of the shippers were asked to cease sending their ores altogether.

The success of the Utah Copper Company, operating in the copper-bearing porphyries of Bingham, has settled the commercial possibilities of those low-grade ores, and has encouraged others to develop in that zone. Most conspicuous among them was the Boston Consolidated, which began last March to develop the porphyries within its own territory. In all, thirteen tunnels have been driven, and during the past nine months, nearly two miles of underground workings have been run in addition to a lot of prospecting on the surface, with no evidences of a bottom to the ore. Enough has been done in three of these tunnels—the Ben Hur No. 1 and No. 2 and the Metropolitan—to justify the statement that in the immediate zone penetrated by these adits, over 30,000,000 tons of ore is available for extraction. It is the intention of the company to inaugurate mining by steam shovels during the early summer of 1906. Three shovels have been ordered for this work; one of them is to be delivered in February, when the stripping of the surface will commence, so that by the time the company's proposed 6,000-ton mill is in commission, the mine will be able to keep the plant supplied.

The company has just completed an experimental mill at Bingham, where it is proposed to try out several schemes of concentration; until the results are known, nothing will be done towards the awarding of contracts for the construction of the new mill, but the management anticipates that construction will not be delayed later than April 1, 1906. The plant is to be erected near the new smelting town of Garfield on the south shore of the Great Salt Lake and bonds for this purpose were voted last autumn.

The control of the Utah Copper Company's mine passed to the Guggenheim Exploration Company within the year after an exhaustive examination was made, and the proposed 6,000-ton mill will be put up in accordance with their recommendations. Ground was broken for the mill several months ago, practically all of the concrete foundations have been put in, and, late in the year, some contracts were let for the structural material and equipment. The management claims that in its Bingham mines there is now available more than 35,000,000 tons of

these porphyry ores and that the revelations have been so promising that it has been decided to stop further development and to devote all energy to the extraction of ore. The first 3,000-ton unit of the new mill be ready for operation in 1906; but it is hardly expected that the second one will until the following year.

The Starless group was purchased by E. A. Wall, former owner of the ground now operated by the Utah Copper Company and it will form the basis for another like enterprise, the group being located within the porphyry zone. The United States Mining Company has maintained about the usual output from its Bingham mines, but it drew heavier than ever before upon its Centennial Eureka mine in Tintic. This company, during the autumn, closed a deal for the purchase of the Richmond and Eureka mines at Eureka, Nevada, containing extensive bodies of silver-lead ore and has organized a subsidiary company, known as the Richmond-Eureka Mining Company. During the autumn, also, the smelter built at Kennett, California, for the treatment of the ores of the Mammoth mine was placed in commission, and during the year the United States Company purchased a controlling interest in the De Lamar refinery at Chrome, New Jersey. The Bingham Consolidated Company has taken from its Commercial mine in Bingham cañon from 250 to 350 tons per day, from the Dalton & Lark from 150 to 250 tons according to smelter requirements, and an average of 70 tons per day from the Eagle and Blue Bell mine of Tintic. The Yampa Smelting Company, allied to the Tintic Mining & Development Company, owner of the Yampa mine at Bingham, has added considerable equipment and has corrected many of the imperfections in its plant in lower Bingham. This company handles only the ore of the Yampa mine and, with the new equipment now being installed, will have facilities for the treatment of about 1,000 tons of ore per 24 hours. The New England Gold and Copper Company has conducted a successful development campaign; it has more than twice the ore reserves of a year ago and has kept the 50-ton mill in operation steadily.

The Bingham Central Mining Company has opened some good orebodies and ought to be ready to produce in 1906. The New Red Wing properties in the Markham Gulch division of Bingham were given over to new hands recently. A syndicate of New York, Boston and London capitalists secured control and organized to operate them a corporation known as the Utah Development Company; it has expended considerable money for equipment, which includes a large air compressor plant. A bonded indebtedness of \$50,000 has been paid off and the company is free from debt. New ground has been

added, which brings its total area up to over 125 acres. Four distinct orebodies have been opened and shipments of from 500 to 600 tons monthly have been maintained. The mine has developed some extensive tonnages of low-grade copper-silver-lead ore and will be ready for mill equipment in 1906.

At the big Utah Consolidated, ore reserves have been greatly increased, while at the same time the cost of production has been materially reduced. The mine has maintained a shipping record of 750 tons per day to its smelter near Murray, Utah, and has turned out approximately 18,000,000 lb. of copper in addition to the associated values in gold and silver. The Utah Consolidated ores are nearly self-fluxing, being composed of about 30% iron and equal percentages in sulphur and silica.

The Utah Apex Mining Company, whose properties are situated in Carr Fork cañon and adjoining the Yampa, Boston Consolidated and Utah Consolidated, has undertaken an extensive campaign of exploration and is running a deep tunnel to open orebodies from 1,000 to 1,500 ft. vertical depth. The adit has been run into the mountain for 700 ft. and will have to be run 800 ft. more to catch the first vein. The adit is to be connected with the upper workings and will become the main exit in the future for all ore. Some ore taken out in the course of development has been shipped right along during the year. The ore has netted about \$12 per ton, but some high-grade lots have run up to \$35. It is said of the Utah Apex that no other mine in Bingham has a more favorable contract with the smelters; the ore carries a heavy percentage of iron and the smelting companies pay for it just about enough to offset the working charges. Another property that has come to the front rapidly this year is the Phoenix, which has been supplied with a new air compressor and other modern equipment. Shipments have averaged about 40 tons per day for the past eight months. The old Shawmut property has been rejuvenated and the reorganized company is conducting a vigorous campaign of development and is putting the mill in shape again. The Bingham-New Haven property, located just above the Highland Boy mine of the Utah Consolidated, has added a 5,000-ft. tramway to its mine equipment. This connects the mine with a loading station on the Copper Belt Railroad. This mine is shipping from 75 to 100 tons per day.

The wonderful development in Bingham has brought about a big increase of population, and the Rio Grande Western is preparing to spend several million dollars in the construction of a new road and equipping it to handle the rapidly growing traffic in and out of that camp. A 17-mile spur, leaving the Bingham branch at a point five miles west of Bingham Junction and running northwesterly to the new

Garfield smelter, is almost completed and over this road the ore from the mines of Bingham will be transported to the reduction works. The present output of Bingham is about 3,600 tons per day, but this will be more than trebled in 1906.

The Garfield Smelting Company is building a copper plant near the old Garfield bathing resort on the south end of Great Salt Lake, which will ultimately treat 6,000 tons of ore per day. It is going up at a cost of at least \$2,500,000 and the first unit should go into commission within the next six months. The new Boston Consolidated and Utah Copper mills will be built at points respectively two and four miles from the smelter; and a new town, Garfield, will be built about midway between the smelter and the copper company's mill.

Park City suffered a serious setback last March when the great Ontario drain tunnel, built more than twenty years ago, caved in and remained closed until well into November. The output has averaged about 75,000 tons per month. The Silver King and the Daly West continued to be the principal producers and they paid to their shareholders \$1,300,000 and \$432,000, respectively. The cave-in interfered with the Daly West company's plan of campaign mapped out towards the close of last year to develop its orebodies at a depth of 2,100 ft. through an extension of the tunnel. The Ontario had just about completed the task of driving the adit to the Daly West side lines when the accident occurred. The contract with the Ontario company provided that from the boundary lines the Daly West was to take up the work at its own expense, and the Ontario, on the other hand, was to have been paid a rental of \$750 per month for the use of the tunnel. The Daly and the American Flag companies had planned to do some sinking to develop orebodies at depth, but the flood caused by the stoppage of the tunnel prevented.

In the Bonanza Flat section of Park City, however, development has been carried on vigorously and with the most gratifying results. It is a year ago that the West Quincy and Little Bell companies entered into an agreement whereby the former was permitted to develop its ground from the 600 level of the Little Bell mine by the running of a long cross-cut; this has proved one of the most important incidents of the year in Park City. For through it two more mines have been added. Effective development was done in the Thayne's cañon, but in a small way. The Wabash, in the northeastern part of the camp, has been spending an average of \$5,000 monthly in development, and its outlook for becoming a producer in the near future is bright. The New York Bonanza and the Naildriver, in the vicinity, have been actively developing and the former has done some shipping. The Silver King Consolidated is getting into in-

teresting ground and expects to break into an extension of one of the orebodies of the original Silver King. The Diamond-Nimrod and the Mount Masonic mines have kept up a steady campaign of development throughout the year.

During the year the Daly Judge company has carried forward an active campaign of development. The investigations have been confined principally to the 1,300-1,400- and 1,500-ft. levels. The response has been particularly gratifying on the first two levels named, and it is noted that as depth is attained, and as the levels are pushed westerly under the Bonanza Flat, better values are found, particularly in gold. Where zinc appeared in the ores of the old Anchor mine, it has given way to lead-silver-iron ore of a nature that will readily respond to concentration and make a much more desirable smelting product. The company has stored in the bins and on the dump near the mill about 18,000 tons of ore that is to undergo treatment.

There is a scheme on foot for the consolidation of the principal mines of the district. Among those mentioned as figuring in the deal are the Daly West, Daly Judge, Little Bell, Daly, Ontario, Naildriver and West Quincy.

The mines of the Tintic district have done well during 1905. Altogether there have been 35 shippers, including mining companies and leasers. The output of eleven months exceeded all of last year, and estimates place the production of the camp for the year at about 300,000 tons. As has been the case for several years the Centennial Eureka mine, owned and operated by the United States Mining Company, was not only the heaviest shipper of the Tintic district, but also has shipped a higher grade of ore than any of its neighbors, sending to the smelter during eleven months, 2,815 carloads. Other heavy shippers have been the Eagle and Blue Bell, Gemini, Mammoth, Bullion Beck, Uncle Sam Consolidated, Victoria, Yankee Consolidated, Grand Central, May Day, Swansea and South Swansea, the two last marketing some of its iron ore at a profit. The only mill operated in the district during the year was that of the Uncle Sam Consolidated. The May Day company, however, did some jigging. The Gemini company has a mill in the course of construction and it will be ready for business within the next three months. The leasing system has been adopted quite generally in some of the older producing mines of the camp and the plan has met with considerable satisfaction.

The opinion is growing that Alta, at the head of the Little Cottonwood cañon, is going to make another Park City. Developments in this once famous camp have been more important than at any other camp in the State, except Bingham. Some large and rich bodies have been developed in the Columbus Consolidated mine. A winze sunk from the Columbus tunnel

level revealed ore of high-grade shipping value. The extent of this body has not yet been determined; but in sinking the shaft to a point below the tunnel, ore to the value of \$150,000 has been shipped to the Salt Lake smelters. This winze is being continued and at the end of the year the ore in the bottom shows uniform values of from \$50 to \$60 per ton. Other important developments have been made in the Howland tunnel, where a great ledge of mill ore averaging 15 ft. in width has been opened. During the year fully 2,000 ft. were run and, altogether, there are from 10,000 to 12,000 ft. of workings in the Columbus mine. Its mill has been handling from 100 to 150 tons per day. The success of the Columbus has had a tendency to stimulate interest in the district, so much so that rail transportation for the camp is promised in 1906. The Continental Mines & Smelters corporation, operating the Continental Alta mine, has secured a lease on the right of way owned by the Rio Grande Western and will undertake the reconstruction of the road from Bingham Junction to Wasatch. Early in the year the Continental company completed the construction of the longest single wire-rope tramway in the country for operation between the mine and mill, five miles apart. The tram has one angle and it has been operated with complete success. Probably the most important deal affecting Alta during the year was the bonding of the old Flagstaff and Emma mines by a Salt Lake and Milwaukee syndicate, which has equipped these old-time producers for an active campaign. The Alta Consolidated Mining Company has been formed to operate the Flagstaff and it may take over the bond on the Emma, in which event the new corporation would secure a commanding position in the camp.

Mercur will show a heavier output of gold this year than it did last. The Consolidated Mercur mine has been worked more vigorously and ore reserves have been considerably increased. While the Sacramento has not done so well in gold, it has marketed more quicksilver. The Overland at Sunshine met with an accident last February; the old shaft caved in, and necessitated the building of a new one. This is now in progress.

At Stockton, in Tooele county, shipments have not been so heavy this year as last. This is due to the fact that the Honerine company cleaned up all the available ore in sight in the old dumps and closed the mill pending the completion of the drain tunnel. Other mine owners have held back for the same reason. However, active development has been carried on. The New Stockton Mining Company has opened up some extensive bodies of high-grade shipping and has blocked out a large tonnage of mill ore. The company is now installing a larger hoisting plant and is operating a 60-ton mill.

Several properties in the Big Cotton-

wood and in the American Fork district produced ore during the year. Next season will see these camps very active.

In the Gold Mountain district, progress has been steady. The Sevier Consolidated company, in addition to acquiring additional territory, has built a new 100-ton mill, power plant, a 7-mile transmission line and water system. At the Annie Laurie mine the management has been successful in increasing ore reserves. The mill has been enlarged and improved and has now capacity for the handling of 300 tons per day. Among other improvements was the installation of an auxiliary electric power plant. In other parts of the district and in the Maryvale section a lot of exploratory work has been done.

In Beaver county, progress has been made in development and production. The Cactus mine, operated by the Newhouse Mines & Smelters corporation, has been the center of interest in that section. The new mill went into commission in March, 1905, and since that time has handled 135,000 tons of ore from which was produced 311 cars of concentrate, all of which went to the plants of the American Smelting & Refining Company. Beginning with the new year the output of the mill will be increased to about 100 carloads per month. The management expects to commence mining with steam shovels about February. The square set and caving systems are already in vogue at the Cactus and the introduction of the steam shovel will give opportunity for some interesting comparisons.

The healthful condition of the market for zinc ore has enabled the Horn Silver to derive considerable revenue from that source. The Majestic Copper company's properties have been under development in a mild way, with energy centered mostly on the Harrington and Hickory and the Old Hickory mines. In the former some interesting bodies of lead ore were developed and some shipping done, while in the latter the outlook is not altogether discouraging for copper. The opening of an extension of the Horn Silver lode by the Frisco Contact company is looked upon as an important event. A serious faulting of the vein deceived the former engineers of the Horn Silver as to its location and it remained a mystery until those directing the affairs of the Contact company studied out the true conditions.

In Washington county, the Utah & Eastern Copper Company has spent the greater portion of the year in driving a deep tunnel to tap the orebodies lower down the mountain, and connections have only recently been made. The smelter, idle for a number of months, is in operation again. The Paymaster Copper Company has also operated a small smelter with some success. In the Park Valley district, the Century and Sunrise companies produced some gold bullion.

## Mining of Zinc, Lead, Iron, and Coal in Virginia.

BY THOMAS L. WATSON.\*

The varied mineral wealth of Virginia has long been known. The wide and varied range of this mineral industry is indicated by the fact that more than 24 different minerals are produced on a commercial basis. To this may be added a dozen or more known minerals which occur in the State but are not yet produced on a commercial basis. According to a special report of the Census Office on "Mines and Quarries" for 1902, "the total value of the products of the manufacturing industries based upon mining was \$27,272,601, or 20.6% of the total value of the product of all manufacturing industries in the State in 190." This variety makes the mineral industry an important factor in the commercial activity of the State. The present paper reviews briefly the principal producing areas of zinc, lead, iron and coal in the State, with special emphasis on the more important recent developments in these respective areas.

*Zinc and Lead.*—The workable deposits of lead and zinc ores in Virginia, as a rule, are intimately associated. Lead mining in the State dates back more than 150 years; but the production of zinc ores is much more recent, commencing with the opening of Bertha mines, in Wythe county, in 1879. Practically the entire production of the Virginia mines from the beginning in 1879 to the present time (Sept., 1905) consisted of the soft ores, carbonate and silicate, largely the latter, which assays about 40% metallic zinc. In 1893 the Bertha mine alone was producing 200 tons of soft ore per day. Since 1898, however, these mines have been worked for iron ore only, the zinc ore having been practically exhausted. The closing down of the Bertha mine as a producer of zinc ores has been followed by a decrease in production of zinc ores in Virginia. This condition has been productive, however, of a search more systematic than formerly for new deposits of zinc ores over the Virginia region; and, at present, much prospecting is in progress over parts of southwest Virginia.

Recent exploitation in this district has not been in vain; while development work has not been carried far in some places, it has in others, and it is believed that the future production will equal that of former years. The production in the future, however, will be of sulphide ores; and not, as in the past, of soft ores, silicate and carbonate. The outlook is especially encouraging at Austinville, where large well-defined ore-shoots of the sulphides are being developed. Prospecting is in progress in the southwest corner of Wythe county, at Cedar Springs; and at Rye Valley, Smith county, 10 miles west of Cedar Springs. Conditions are encouraging at both places, but particu-

\*Geologist in charge, Geological Survey of Virginia.

larly so at Cedar Springs, where a very pure massive blende has been opened, which should prove to be an easy milling proposition. The Cedar Springs Zinc Mining & Development Co. contemplates the erection of a commodious and modern concentrating mill at the mines at an early date, when systematic mining of the ores will begin.

Exclusive of the places mentioned above, there are many points in the Virginia district where prospecting is in progress, but the work has not reached the stage where a definite statement can be made. It is of interest to note, however, that prospecting is being so vigorously carried on in so many places.

Probably the most important advance made in the Virginia zinc industry during the year 1905 was a scheme for the utilization of low-grade zinc ore and washer tailing, which formerly were not considered workable. In accordance with this, a zinc-oxide plant, consisting of 12 furnaces, was recently built at the Austinville mines, in Wythe county. The grade of zinc ore, including tailing, used for making the oxide will average at Austinville from 15 to 20% metallic zinc. The plant has proved satisfactory. The oxide made at Austinville is shipped to the furnaces at Pulaski, where it is used for making spelter. As made at Austinville, the oxide contains about 4% metallic lead, and will average 70 to 75% metallic zinc. The successful operation of this plant at Austinville is of considerable importance, since it points out a method for utilizing low-grade zinc ores which elsewhere are not profitable.

Extensive improvements and developments were in progress during the past year at the Albemarle Zinc & Lead Co.'s mine in Albemarle county. A concentrating mill of 80-ton capacity per 24 hr. has just been completed, including eight sets of jigs, crushers, rolls and screens; also steam of sufficient power for operating the entire plant, with hoist, tram-cars and cable, for conveying the ore from the shaft to the mill. The dry process is employed here for separating the ore, which differs from the wet process only in the form of the jig used. The Crum jig is used at this plant, which substitutes air for water; the jigs can be set to 700 puffs of air per min. Compressed-air drills have recently been added to the underground mining outfit.

*Iron Ores.*—In value of production, iron ranks as the second mineral in the State, being exceeded only by that of coal. The total State production of iron ore per year is approximately 800,000 long tons, valued at the mines at about \$1,500,000. Three types of ores are produced, proportioned in output about as follows: brown hematite or limonitic ores, 765,000 long tons; red hematite, including red fossil ore, 32,000 long tons; and magnetite, 4,500 long tons. The production of brown iron ores of Virginia forms an important

percentage of the total output in these ores in the United States. Until recently Virginia held first rank among the brown ore-producing States, and at present it is exceeded in production only by Alabama.

Virginia is conveniently divided into four principal iron-producing areas as follows: (1) the Oriskany, which includes the counties of Alleghany, Botetourt and Craig; (2) the limestone area of southwest Virginia, which includes the counties of Pulaski, Wythe and Smyth (forming the New river-Cripple creek division) and Roanoke and Washington counties; (3) the Clinton, which includes Wise and Lee counties; and (4) the Piedmont or crystalline area, which includes Pittsylvania as the chief producing county.

*The Oriskany Area.*—The district derives its name from the geological horizon in which the ores are mined, the Oriskany sandstone. With the exception of one mine opened in the red fossil or Clinton ore, brown hematite comprises the only type of ore mined in this district. The principal mines in operation in the area during the year 1905, were: Oriskany, Ritch Patch, Longdale, Glen Wilton, Dolly Ann, Fenwick, Reid and Low Moor, operated by the following companies: Alleghany Ore & Iron Co.; the Chapman Iron, Coal & Coke Co.; the Longdale Iron Co.; the Low Moor Iron Co., and the Princess Iron Co.

A total of nine furnaces using Oriskany ores were in blast in 1905, distributed as follows: The Alleghany furnace at Iron Gate, the Buena Vista furnace, at Buena Vista, and the Gem furnace at Shenandoah. These three furnaces are owned and operated by the Alleghany Ore & Iron Co. The Longdale furnaces Nos. 1 and 2, operated alternately, are owned by the Longdale Iron Co. The Victoria furnace is owned by the Chapman Iron, Coal & Coke Co., and is located at Goshen. The Low Moor Iron Co.'s two furnaces, alternate stacks, are at Low Moor. The Princess furnace, at Glen Wilton, is owned by the Princess Iron Co. The Liberty furnace, at Liberty Furnace, Shenandoah county, owned by the Monarch Blast Furnace Co., is located north of the Oriskany area and runs on local ore. Of these furnaces the Buena Vista and Longdale Nos. 1 and 2 make basic iron; the remaining ones make foundry and forge iron.

The Oriskany is the largest mine in Virginia; it is producing at present at the rate of 100,000 tons of ore per year. It has large ore reserves, and the company is preparing to instal a new washer.

At Low Moor, operations have been shifted from the mining of brown ores of the Oriskany, to that of red fossil ore of the Clinton. This is the only known locality in Virginia where the Clinton red fossil ore is mined outside of the area of Lee and Wise counties. Clinton ore, however, has been mined in a number of

places in this vicinity in former times; it is believed that this marks the beginning of renewed activity in the mining of Clinton ore in this locality. This property was opened up during the past year and shipment of ore was begun. It is now producing at the rate of 50 tons of ore per day. The opening from which the ore is mined was made near the crest of an anticlinal fold, breached on one side and exposing the ore-bed, 760 ft. above the valley bottom. The ore is handled by a gravity system of cars, so that the loaded cars in descending to the tippel force the empty cars up the incline, 1,800 ft. long, to the mine openings. As yet the ore has been mined only along the crest of the anticline. Where mined, the ore-bed has a thickness of 28 in., the ore averages 47% metallic iron. It is underlaid by soft shale, a condition utilized for driving car-headings. At the Ritch Patch mine the ore is won at present by underground workings, chiefly from the head of tunnels driven into the orebodies; this is preparatory to the opening up of robbing-rooms, the usual method of winning the ore. At the surface workings of this mine considerable stripping is in progress, preparatory to the continuation of steam-shovel work.

In the Australia mine of the Longdale Iron Co., electric power has recently been installed for driving the ventilating fan. A compressed-air device has also recently been installed for handling the loaded cars at the shaft.

Near the Daggers Springs mine, in Botetourt county, recent prospecting has developed a promising body of Oriskany ore. Two openings are made from which ore is mined at present. As fast as mined the ore is stored on the grounds awaiting transportation facilities.

*The Limestone Area of Southwest Virginia.*—The limits of this area have been already given. Brown hematite comprises the only type of ore mined, confined almost entirely to the Shenandoah limestone of Cambro-Ordovician age; but the ore is associated in places with the underlying quartzite where the overlying limestone has been stripped by weathering.

The principal mines in operation in this area in 1905 were: The Faris, Rich Hill, Reed Island, Hurst, Patterson, Crawford, Tipton, Barron Springs, Red Hill, Sanders, Bertha, Foster Falls, Hematite, Little Wythe, Norma, Clayton, Locust Hill, and Taylor's Valley; these are operated by the Virginia Iron, Coal & Coke Co., and the Pulaski Iron Co. In addition to these, there are a few private operators in the district, but the region is practically controlled by the two companies named above.

The furnaces in blast in this area during 1905 were: The Pulaski furnace, at Pulaski, owned and operated by the Pulaski Iron Co.; the Bristol furnace, at Bristol; the Max Meadows furnace, at Max Mead-

ows; the Radford-Crane furnace, at Radford; the Reed Island cold-blast charcoal furnace, at Kayoula; the Dora furnace, at Pulaski; and the Crozier furnaces No. 1 and 2, at Roanoke; all of which are owned and operated by the Virginia Iron, Coal & Coke Co. The West End furnace, at Roanoke, is operated by the West End Furnace Company.

The Faris mine, recently opened up near Allisonia, Pulaski county, is reported to have produced 30,000 tons of ore in 1904. During 1905 a second steam-shovel was added to the mining outfit.

The Clayton mines, located on Draper mountain, near Pulaski, were opened up by the Pulaski Iron Co. during the year 1905. A narrow-gauge railway has been constructed to the mines by the company, and ore is being shipped. The same company has also recently opened up a valuable mine, called the Norma, near Cripple creek, in Wythe county. Brown lump ore is being shipped at present and a railway to the mines is under construction. A continuation of the Cripple Creek extension of the Norfolk & Western railway from Cripple creek to Speedwell has opened up another section of this famous valley.

The Ganaway, Andis and Speedwell banks, located near Speedwell and owned by the Virginia Iron, Coal & Co., will be producing at an early date. Some activity is being shown by this company in establishing new washers at old mines in several places over the Cripple creek region.

In Rye Valley, Smyth county, considerable recent prospecting was in progress in connection with the completion of the Marion & Rye Valley railroad to Sugar Grove. Mining on rather a small scale was in progress during 1905 on Slem's creek; the ore was hauled in wagons to, and shipped from, Sugar Grove.

Near Brown's Siding, on the Virginia-Carolina railway, in Washington county, a rather unique association of ore (including brown hematite, magnetic hematite, and ferruginous limestone) was partially developed during the past year. Some ferruginous limestone was shipped which averaged 30% metallic iron and was self-fluxing.

In Taylor's Valley, at the Virginia-Tennessee line on the Virginia-Carolina railway, a property of brown hematite ore which promises well is being developed. A railway has been built to the mines and the mine has begun producing. Across the line in Tennessee, near Laurel Bloomery, the Ward mine has been opened and a washer built. A narrow-gauge road has been completed between the mine and Damascus, connecting at the latter place with the Virginia-Carolina railway. This mine began producing September, 1905; the output is now said to be 2,000 tons of ore per month.

*Lee and Wise Counties.*—In this area the Clinton red fossil ore is being mined from

two beds, having a thickness of about 3 ft. each, and averaging 40% metallic iron. The Keystone Coal & Iron Co. is operating at Oreton, Wise county. Kelly & Irvine are operating at Big Stone Gap. The Boone Path Iron Co. is operating in Lee county. The Union Furnace at Big Stone Gap, Wise county, is owned and operated by the Union Iron & Steel Company.

*The Piedmont Area.*—The operations in this area are small and scattered. The principal producing county is Pittsylvania. The ores mined in the Piedmont area include red hematite and magnetite.

*Furnaces Recently Operated but Now out of Blast.*—These are: The Graham furnace, at Graham, operated by the Graham Iron Co., Lessee; the Ivanhoe furnace, at Ivanhoe, Wythe county, owned and operated by the New River Mineral Co.; the White Rock warm-blast charcoal furnace, near Rural Retreat, Smyth county, owned by the Lobdell Car-Wheel Co.; the Foster Falls warm-blast charcoal furnace, at Foster Falls, owned by the Virginia Iron, Coal & Coke Co.; and the Covington furnace, at Covington, owned by the Low Moor Iron Company.

The Foster Falls, Red Island, White Rock, and Liberty furnaces are the only charcoal furnaces in the State; all the others are modern coke furnaces.

The only furnaces making basic iron in Virginia are the Longdale and Buena Vista; the remaining ones make foundry, forge, and car-wheel iron. The reason for this is seemingly due to a difference in the composition of the ores in the two principal producing districts, namely, the Oriskany and the Limestone area of southwest Virginia, especially as regards the manganese content; the Oriskany ores, as a rule, contain higher manganese than the limestone ores.

*Preparation of the Ores.*—All the brown ores mined in the State are washed in order to remove the admixed clay. The ores are washed in log washers. In some instances, associated sand with the ores necessitates subsequent jigging. In the limestone ores of southwest Virginia, the ores are admixed principally with clay and have little associated sand; while in the Oriskany ores, there is relatively less clay and more sand. For this reason the Oriskany ores require jigging, whereas no jigging is usually required of the limestone ores in southwest Virginia.

*Coal.*—The annual production of coal in Virginia is about 3,500,000 short tons, valued at, approximately, \$3,500,000. The first production of bituminous coal in the United States was reported from the Richmond basin in Virginia early in the last century. The rank taken by Virginia as a coal-producing State, however, may be said to properly date from the opening up of the famous Pocahontas district in 1882.

The coal deposits of Virginia may be

grouped into three principal districts: (1) The Richmond Basin; (2) the area of Montgomery and Pulaski counties; and (3) the Southwest Area, which forms the southeastern part of the Kanawha basin.

*The Richmond Basin.*—The Richmond area lies within and near the eastern margin of the Piedmont plateau, on either side of the James river; it covers the counties of Henrico, Chesterfield and Goochland, and parts of Powhatan and Amelia. It comprises a total area of about 190 sq. mi. The strata consists of thick shale and sandstone, and scanty conglomerate, of Jura-Trias age.

This area is important, economically as well as scientifically; it contains the only free-burning coal located immediately adjacent to tidewater in the eastern portion of the United States. It is historically important, since it furnished the first production of bituminous coal mined in the United States. The production from the Richmond Basin increased from 54,000 tons in 1822 to more than 100,000 tons in 1828; during each of the years from 1822 to 1828, inclusive, the output from the district is reported to have exceeded that of Pennsylvania anthracite. The production from the Richmond Basin is reported to have increased continuously until 1832, when it began to decline; by 1850 it had almost ceased.

While the production from the area for many years has been small, it by no means follows that the coal has been exhausted; a detailed geologic study of the ores by Shaler and Woodworth indicates the presence of a quantity of coal sufficient to give the area much value. As proved by nearly a century of constant use, the quality of the coal is satisfactory for many purposes.

Additional importance attaches to the areas because of the occurrence of natural coke, which has long been in use; it stands high in the neighboring towns as a domestic fuel.

Operations in this area during 1905 were confined to Winterpock and Midlothian, in Chesterfield county, largely development preparatory to shipping. The Gaylor mines, north of the James river, in Henrico county, were closed down several years ago. Since closing down, the mines have changed hands, but as yet work has not been resumed. At Winterpock, a new incline was under way during the summer of 1905. At Midlothian, development work was in progress during 1905; the only mining of coal was limited to that for the company's use. The developments at Midlothian comprise a new incline, 1,020 ft. long by 16 ft. wide and 7 ft. high, on a 33° pitch. The year 1906 will be consumed in the completion of development work preparatory to shipping.

*Montgomery-Pulaski Area.*—This lies 30 to 50 miles west of the city of Roanoke. In the Montgomery county portion of the area, the mines are opened along the south slope of Brush mountain and on the

two slopes of a diminutive parallel ridge, locally known as Prince mountain, distant about 6 miles south from Brush mountain. In Pulaski county, developments have been on the slopes of Cloyd and Little Walker mountains, which are a southwest continuation of Brush mountain in Montgomery county. The coal area lies near the northern border of the two counties, and is crossed by New river, which is the dividing line between the counties.

The total estimated acreage of the Montgomery portion of the field is about 7,000 acres. The extent of the Pulaski part of the field is not certain, but it is probably nearly equal to the Montgomery field. It extends from New river to the town of Pulaski, which includes the developments so far made.

Coal was mined in this field prior to the Civil War, but not in an extensive way. It is reported that some of the coal used in the bunkers of the *Merrimac* (Virginia), in her fight with the *Monitor* in Hampton Roads, came from the Price mountain mines. For a period of 30 years after the Civil War the only mining carried on in this field was to supply a local market. For a number of years past large developments have been made, more extensive and systematic mining has been carried on in accordance with modern methods, and a steady increase in output over that of the local market has been indicated yearly.

The coal seams occur in strata of Mississippian or Lower Carboniferous age. On Price mountain, five coal seams are indicated, only one of which has yet proved to be workable. An average thickness of 4½ ft. of clean coal is mined from this seam. On Brush mountain, two seams yield workable coal, which average in thickness 3 and 4½ ft. of clean coal, respectively; they are named the "Little" and "Big" seam. Likewise two seams are worked in the Pulaski portion of the field. The coal is of excellent quality, of the semi-anthracite type. That of the Price mountain mines is harder, and consequently not so free-burning as the coal from Brush mountain.

In 1905 more than a half-dozen mines, operated by as many different companies and private parties, were in active operation on the north and south slopes of Price mountain. The product of these mines is in great demand as hard coal. The Virginia Anthracite Coal Co. has acquired most of the mineable coal property in Montgomery county. In the fall of 1904, a standard-gauge steam road was completed from the Norfolk & Western railway at Christiansburg to Blacksburg, via the Merrimac mines on Price mountain. The Virginia Anthracite Coal Co. has recently completed a breaker at the Merrimac mines, having a capacity of 500 tons per day with the present machinery; but by installing duplicate screens and

other machinery, this capacity can be more than doubled. The breaker has a storage capacity of 500 tons. The average run of the breaker at present is 100 cars of coal per month. The depth of working at these mines is 1,026 ft. on a dip of 22 degrees.

Underground work at the Merrimac mines is being pushed rapidly. As soon as sufficient ground is opened, additional machinery will be installed, and the breaker will be raised to its maximum capacity of 1,000 tons per day. Work is going forward on a large scale; agencies have been established in Chicago, Cincinnati, St. Louis, Roanoke and Richmond, where the Virginia product sells in competition with that from Pennsylvania.

During 1905, some half dozen operators were actively engaged in mining coal in the Brush mountain area; the principal ones being the Virginia Anthracite Coal Co., the Blacksburg Mining & Manufacturing Co., and a number of private individuals.

The principal mines working in the Pulaski field during 1905 were the Altoona, Belle Hampton, and the Kimball. The Kimball mines are located on New river, where it is crossed by the Norfolk & Western railway. This property has recently been acquired by the Pulaski Anthracite Coal Co., which is making extensive improvements, and which has a promising outlook. A breaker has recently been erected at these mines, and a small one is being built at the Belle Hampton mine by the Belle Hampton Coal Co. The Altoona mines, located 6 miles northwest of Pulaski, are owned and operated by the Bertha Mineral Co., at Pulaski. All the coal formerly used by the Bertha company at its zinc furnaces in Pulaski came from the Altoona mines, but only the "firing" coal or reducing material is obtained there at present.

*The Southwest Virginia Coal Area.*—This is much the largest, most productive and most important coal area in the State; it is probably the most valuable occurrence of bituminous coal found in the United States. In fact, it is due to this area that Virginia is entitled to rank among the coal-producing States. Of the total output in coal from the State last year, the southwest area produced more than 3,250,000 tons, valued at \$3,225,000.

This area is located in the extreme southwestern part of the State; it forms the southeastern portion of the Kanawha basin, and comprises the following counties: Tazewell, Russell, Scott, Buchanan, Wise and Lee. Of these, Wise and Tazewell counties are the important producers, with reported large reserves undergoing prospecting in places in the other counties. The relative importance in production of Wise and Tazewell counties is indicated in the following published returns from the two counties: Wise county produced in 1903, 2,563,285 short tons of coal, valued at \$2,322,855; Tazewell county for the

same year produced 840,195 short tons, valued at \$883,289.

The construction of the Norfolk & Western railway through southwest Virginia in 1882 opened up the famous Pocahontas coal district, which comprises Tazewell and Buchanan counties, in Virginia, and McDowell, Wyoming and Mercer counties, in West Virginia. The district includes about 450 sq. mi. of rough, mountainous land. The first mine is said to have been opened in 1882 at the village of Pocahontas, in Tazewell county, Virginia, from which the area derived its name. The principal vein worked in the district is the great Pocahontas vein No. 3, which is 11 ft. 3 in. thick. The method of mining employed is the "double-entry system," with rooms driven opposite each other and at right angles to the main entries. Ventilating fans of 300,000 to 500,000 cu. ft. of air per minute are used, and are driven either by steam or by electric motors. Tracks are laid in the rooms from the main entries, and the cars are hauled out by either electric or steam locomotives.

The Pocahontas coal has long been recognized as one of the best steam coals in the world. This is based on its low percentage of ash, volatile matter and sulphur and its high fixed carbon.

The Wise county area is usually referred to as the "Big Stone Gap coalfield"; it has an approximate area of 540 sq. mi. in Virginia and Kentucky.

Although the largest coal- and coke-producing county in the State, Wise was the last to be developed. Building of the Clinch Valley division of the Norfolk & Western railway in 1891 marked the beginning of the development of the Wise county coal district. Approximately 3,500 coke-ovens are operated in the district, which produce about 80% of the Virginia coke output.

The workable seams of coal range from 3½ to 12 ft. in thickness, of which there are eight, included within a vertical distance of about 1,200 ft. The four highest of these seams have their greatest development in the western part of the district. The Imboden, which varies considerably in thickness, is the most important seam in the area. The method of mining employed is the room-and-pillar system, with underground haulage by mules and electric locomotives. Ventilating furnaces are in use at many of the mines; exhaust fans are used as the mines become more extensively worked.

For heating platinum, spirit lamps are preferable to the use of ordinary gas. When gas is used, care should be taken to have the supply of air sufficient to insure complete combustion, since, with the flame containing free carbon, the platinum suffers deterioration by the formation of a carbide of platinum, which, oxidizing later, blisters the metal. For this reason, also, the inner cone or reducing flame should not be in contact with the metal.

### Nevada in 1905.

BY A. SELWYN-BROWN.

Practically, the whole of the State is mineral bearing; that is, the mineral districts are not confined to a limited portion of its area, but are generally distributed. In addition to this, Nevada possesses extensive artesian-water, capable of irrigating a large area of valuable agricultural land. The State contains many wide tracts of land which, under irrigation, could produce a variety of fruit.

The dark cloud which covered the State so long commenced to lift in 1901. The Tonopah mine was discovered in May 1900, and in 1901, became productive. The high returns obtained by the lessees (under the difficulties usually experienced in remote camps in desert regions), soon attracted attention. In the latter part of 1901 the rush to the district began. This led to the opening up of the whole of the southern portions of the State, as well as the southeastern

the surface by small gasoline hoists. For this reason, and also because the big smelting plants cannot treat a greater quantity of Tonopah ores, the output of the mine is small compared with what it can and will produce. In a short time the company will have replaced its gasoline hoists with powerful electric hoisting plants at the Mizpah, Silver Top, Red Plume and Desert Queen shafts, and power drills will be used throughout the mine. Early this year the new smelter at Garfield Beach, near Salt Lake, Utah, will be in the market for Tonopah ores, and the company's 100-stamp mill near Tonopah will also reduce about 450 tons a day. With these improved and cheaper facilities for operating the mine and marketing the ores, it is safe to predict that the company will easily maintain, if not increase, its 25c. quarterly dividend.

The Montana mine ranks after the Tonopah. It has been developed to a depth of about 800 ft., and has over 9,000 ft. of underground drifts and winzes. These workings have disclosed five distinct mineralized ledges. It is estimated

Kane investments. It has been developed by a main shaft (500 ft. in depth) and by numerous drifts. At the 200 ft. level one of the veins, starting away from the Tonopah mine, was encountered. It is 10 ft. wide and is said to average \$50 per ton. A crosscut from the 500-ft. level also cut a wide ledge, carrying shipping ore.

The West End mine is south of the Tonopah Extension. The mine is almost in the center of the town, and has an area of 20 acres. The shaft has reached a depth of 700 ft. At 390 ft. a well-defined quartz ledge of great width was cut. In the 415-ft. level, a large orebody averaging \$80 per ton was recently opened.

On Mount Oddie, a steep mountain peak, west of the Tonopah and Montana mines, are situated the Belmont, North Star and Mizpah Extension mines. The rich veins now being worked on the Montana and Tonopah mines have been found in the Mount Oddie mines; it is only a question of a little more development before they become regular shippers of high-grade ore.

During the past year Tonopah was fur-



TONOPAH, LOOKING EAST TO MT. ODDIE.

portion of California. Prospecting operations are still being pursued over a wide area and rich discoveries are frequent.

To-day there are a number of firmly established mining districts in Nye and Esmeralda counties.

**Tonopah.**—This is the best established and most promising camp in southern Nevada. The Tonopah, Montana, Midway, Extension, West End and other mines have larger reserves than are seen in any of the newer camps. Numerous other properties are being developed which will unquestionably pick up some of the known ore-bodies. It is a singular coincidence that the first developed mines at Tonopah are to-day the richest.

The Tonopah mine is now yielding a 25c. dividend quarterly; the company's net profit is \$3,000,000 per annum. There is enough ore developed to enable this profit to be maintained for several years. The present profits are being earned from an average shipment of only 850 tons a week, nearly all of which is mined by hand power from development work on and above the 600-ft. level, and raised to

that the ore opened up in the mine carries well over \$5,000,000. The area of the mine is about 160 acres. The company has recently placed a large contract for the installation of an electric hoist and air-compressor plant and contemplates the erection of a metallurgical plant.

The Midway adjoins both the Tonopah and Montana. It has been developed to a depth of 600 ft. There is a large quantity of high-grade ore blocked out between the 365-ft. and 600-ft. levels. Two rich veins have been developed, and several others which are opened in the Montana are expected to be found in the Midway ground when crosscutting is resumed. The Midway company declared a dividend of 5c. per share on Dec. 22 1905. This amount will be declared quarterly until arrangements can be made for the treatment of large quantities of ore; then monthly dividends will be declared.

The Tonopah Extension adjoins the Tonopah on the west. The company owns two patented claims and a fraction of another. This mine was one of the early and most successful of the Schwab-Mc-

nished with a good water supply and with electric lighting and power. Sanitary conditions have been improved, the health of miners is now more carefully watched than formerly. The monthly payroll in Tonopah amounts to \$250,000.

In the vicinity of Tonopah are situated the Manhattan, Liberty, Ray, Crow Springs, Lone Mountain, Gold Mountain and other mining centers where valuable mines are being actively developed.

**Bullfrog.**—The Bullfrog district is south of Goldfield, a little north of the Funeral Range, and extends practically to the California border line. It has come into prominence on account of the extent and richness of the gold mines on Montgomery mountain.

The Montgomery-Shoshone mine is the leading property on the field. The main shaft is 150 ft in depth, and is in sulphide ore. The development of the property has been continuous, and it is now stated that the ore opened up in the mine will amount to a large figure. The Shoshone vein has been opened on the southwest in the Polaris and Del Monte



claims, owned by the Montgomery-Polaris Company, the ore assaying as high as \$400 a ton. The vein appears to be running into the Bullfrog-Steinway property where the same character of talc ore has been struck on the 100-ft. level. Several other mines are developing ore-bodies of promise.

The Bullfrog district has been examined by competent engineers on behalf of Schwab & McKane, Oddie, and other Tonopah mining investors of prominence, with the result that large investments have been made by local capitalists. The Schwab-McKane group has acquired the Crystal and Rand mines, on the southern side of Montgomery mountain, and development operations will be commenced immediately. It is probable that, within six months at least, half-a-dozen mines will be shipping ore from Bullfrog.

**Goldfield.**—This town is situated about 25 miles directly south of Tonopah. It is a much younger mining center than Tonopah, but its name has become fam-

is erroneous. Goldfield now promises to become a solid, productive camp.

The Jumbo is one of the largest mines in the camp. The deepest shaft is a little over 450 ft. in depth. This mine has been involved in litigation for some time, but after this is properly settled, it is expected that the company will commence energetic development. There is little doubt about the good prospects of its ore-bodies: it will not take long to open the mine sufficiently to enable it to become a large and regular producer of high-grade ore. It will be, possibly, the premier mine of the camp.

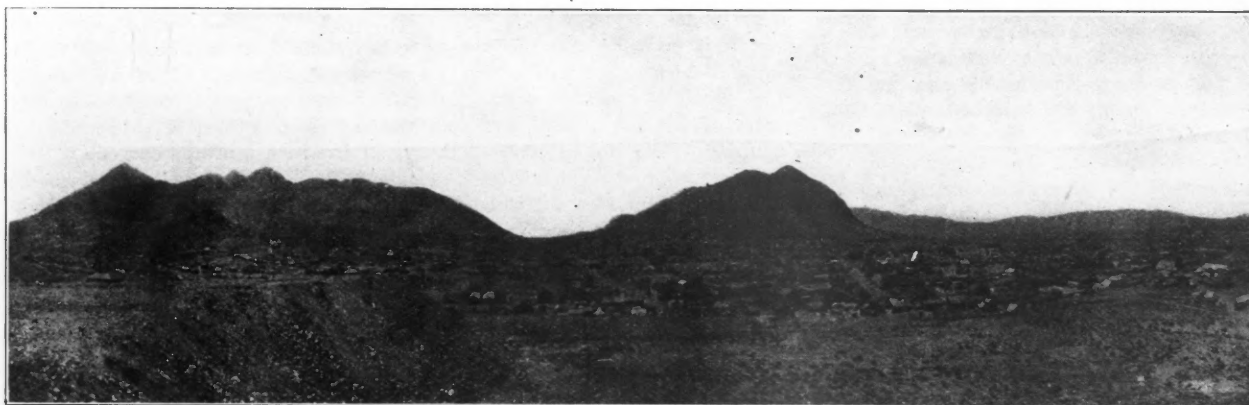
The Combination, lying a little to the southwest of the Jumbo, is next in importance. This property is being systematically developed, and is paying regular dividends of \$32,000 monthly. The Florence, which lies between the Jumbo and Combination, is a property of great promise; the main shaft is down about 360 ft. The Quartzite, Sandstorm, Kendall, Red Top, St. Ives, Diamondfield, Simmerone, Jumbo Extension, January, Velvet, Gold

Their annual output continues to be rather insignificant. These conditions will doubtless continue for a considerable time. The Comstock itself, however, is far from being worked out. The mines contain large bodies of low-grade ore; when present practices are revolutionized, and the field is operated on genuine commercial lines, it may again become an important gold and silver producer.

At Gold Hill, a couple of miles southwest of Virginia City, several gold mines are being successfully operated, in a small way, by working miners.

**Ely.**—This old camp in White Pine county is taking on a new lease of life. Several companies during the past year opened up the large copper-bearing porphyry and pegmatite dikes, and with promising results. The Nevada Consolidated Mining Company, owner of the Ruth mine, has developed its ore body to a depth of 600 ft. The quartz-porphry dike is over 400 ft. in width, and has an average value of 3% copper per ton.

A railroad 150 miles in length is being



TONOPAH, LOOKING SOUTHEAST TO MT. BUTLER.

iliar throughout the country on account of the many large fortunes some of the mines yielded during the past year to miners who worked several of the vein outcrops on lease. The following estimates of the ore taken by lessees from some of the more prominent mines are based on the shipment returns:

GOLDFIELD PRODUCTION.

<i>Jumbo:</i> Bowes-Kernick lease.....	\$ 500,000
Richard lease.....	75,000
Zinn lease.....	75,000
McDonald lease.....	100,000
Vermilyea and Bartlett lease.....	30,000
Curtis and Ridge lease....	125,000
<i>Goldfield Mining Co.:</i>	
January Jones lease.....	1,000,000
<i>Sandstorm:</i>	
Mayne, Davis and Loftus lease.	60,000
<i>Desert Rose:</i> Zeb Kendall lease...	10,000
<i>St. Ives:</i> Lewis and Lynch lease...	20,000
<i>Kendall:</i> Oddie and Gardner lease...	125,000
<i>Velvet:</i> Rleker and Rider lease....	30,000
<i>Florence:</i> B. J. Reilly lease.....	700,000
Durgan and Elkins lease....	400,000
<i>Diamondfield:</i> McKane lease.....	200,000

Total..... \$3,450,000

In the earlier days of this district it was thought that Goldfield ores were merely rich surface deposits; but recent developments have shown this impression

Bar, and Desert Rose are valuable properties, several of these having large reserves of high grade ore.

Goldfield possesses five stamp mills, and two samplers, the combined capacity being about 1,800 tons per week. It is proposed to increase this capacity shortly.

An important event of the year was the recent completion of the Tonopah broad gauge railway to Goldfield. It is probable that this line will be extended to Bullfrog early in the present year.

**Kawich.**—This is a promising district about 8 miles east of Goldfield. A large area of ground has been located on the Kawich range. The Gold Reed Company recently cut a wide body of high-grade ore in a tunnel 150 ft. below the outcrop of a vein which yielded high returns when first opened on the surface. Eearly this year a large force of men will be employed in the Kawich mines, and regular shipments will be made.

**The Comstock.**—Most of the celebrated mines on the Comstock are still working.

built from Toana to Ely, to carry mining traffic.

The Giroux Consolidated Company is building a large smelter at Ely; and the Nevada Consolidated Company will shortly have a 1,000-ton smelter in operation. White Pine county promises to become a large copper producer in the near future.

The progress of the "new" Nevada has been highly satisfactory from every point of view. Its industries are established on a firm basis; the gambling element has been well subdued. A large proportion of the mines in the Tonopah fields have been opened up by the profits actually obtained from ore taken out of the mines in the course of development. During the past five years, there has been a steady and substantial increase in gold and silver production and Nevada promises to take a prominent part in the production of these metals within a few years. When better railroad facilities are provided, this State will also assume a high position in copper production, and possibly in zinc.

### Metal Mining in Colorado During 1905.

BY GEORGE E. COLLINS.\*

The year 1905 contrasts favorably with its predecessors in having been practically free from the labor troubles, which in previous years did so much to hamper and discredit the mining industry. The only strikes which occurred were of brief duration, and of small significance. As a result of the eight-hour law passed by the State legislature, the millmen in Gilpin county struck for an eight-hour day, in the mistaken belief that the law applied to them. There was no union to deal with, and consequently little ill-feeling on either side; the matter was amicably adjusted by granting an eight-hour shift to all of the men who desired it, at a slightly increased wage rate per hour; to balance which a small advance was made in the milling charge. A strike on the Gold King mine, at Silverton, was of local importance only.

At present, the Silverton and Ouray districts are the only ones which can be said to be under the domination of the unions; it is only fair to the latter to state, that there are considerable elements in both local unions which favor moderation, and aim rather to promote the interests of the workers than to subserve the ambitions of the socialistic junta, which dominates the Western Federation of Miners.

The card system, now in use in several leading districts, has suffered a temporary check at Leadville, in consequence of an injunction issued by Judge Owers which, it is thought, will probably be dissolved on appeal to the Supreme Court. The general consensus of opinion among mining men who have studied its working is, that it is a fair and useful measure, which might be adopted with advantage by all the western mining districts, acting in cooperation. Its value is by no means confined to being a means of counteracting aggressive union methods. A more important advantage is that it tends to encourage competent and to eliminate worthless men; it is also the only practicable method of dealing with the great evil of ore-stealing; this is a serious factor at Cripple Creek, and in the San Juan, owing to the impossibility of securing convictions in the courts.

At the time of writing, no statistics of production are available; but the output of the State, as a whole, will undoubtedly show an advance over that of 1904. It is true that there were no sensationally new discoveries, but steady progress was made in nearly all the districts, owing largely to the improvement in labor conditions.

**Cripple Creek.**—The output was close to \$20,000,000; of this perhaps one-third was contributed by lessees, and the balance by men working on company account.

\*Mining engineer, Denver, Colo.

The Portland mine, of course, maintained its position of supremacy; followed by Stratton's Independence, the Golden Cycle, Findley, El Paso and Vindicator. Negotiations for the joint driving of a new drainage tunnel from Window Rock, at a level approximately 1,100 ft. below that of the El Paso tunnel, are under way; it is hoped that the work will be commenced early in this year.

Much interest has been aroused in the milling question, both in the direction of fine-crushing and raw-cyanidation of the lower-grade ores; and in roasting-cyanidation of the ordinary milling ores, in competition with the chlorination plants. The Dorcas cyanide mill has for several years past successfully justified its claim to existence; it is now reported that the Telluride mill will be remodeled and operated on ore from the Golden Cycle and associated properties. It is also announced that the Stratton's Independence Co. proposes to build a large mill for the treatment of its dumps by the Cassell method.

Opinions differ as to the tonnage of low-grade ores (\$5 to \$10), now available in the mines of the district; but, in any case, it is probable that the mining and milling of what have hitherto been regarded as unpayable ores, is destined to offset part of the diminution of output to be naturally looked for as some of the bonanza mines approach exhaustion.

**Leadville.**—The tonnage of shipments has increased during 1905, and will in all probability show a still larger increase during the present year. The principal shippers have been the Coronado, A. M. W. and A. Y. & M. groups, of the Western Mining Co.; the Moyer, Yak Tunnel, Ixex and Reindeer.

The first-named properties, worked under one management, are now producing from 15,000 to 18,000 tons monthly; of which 3,000 or 4,000 tons is zinc ore. The Yak Tunnel properties, recently equipped with an elaborate mill, and the Moyer, are also large zinc-ore shippers. The great orebodies in the Coronado are shipping nearly 250 tons daily; this tonnage will be doubled when connection is completed with the Penrose shaft. The Reindeer during the early part of the year produced a nearly equal quantity, but has now fallen off somewhat; the Ixex has maintained a large output, mainly mined by lessees.

The recent rise in silver will be of the greatest benefit to Leadville, where much of the ore is of so low a grade that an addition to the margin of 50c. to \$1 per ton means all the difference between loss and profit; mining costs there have unquestionably reached the lowest point (about \$1.40 per ton) ever attained in this State, under parallel conditions.

As a whole the Leadville district is now in excellent condition for extensive production; the ore now proved insures its prosperity for some years to come.

**The San Juan.**—The production of

*Ouray county* was largely maintained by a single mine, the Camp Bird; the annual report of this shows that its average monthly output is nearly \$200,000. The work of unwatering the old Red Mountain bonanza mines makes good progress; the Joker tunnel has already unwatered the upper workings of the Guston; great hopes are based on the revival of the area.

At *Telluride*, the principal mines, the Smuggler-Union, Liberty Bell and Tomboy, appear to be entering upon a period of prosperity. The first-named has been leased in large units, each of which forms virtually an extensive mine; both mills are running at full capacity. Recent developments in the Pennsylvania tunnel (Smuggler-Union), and Stilwell tunnel (Liberty Bell), at about the same horizon, justify the expectation that the principal mines in the district have a long life ahead of them. The production of the Liberty Bell has been curtailed by difficulties in connection with the re-constructed mill plant; this has been remodeled as a fine-sliming and filter-pressing plant. The Alta is being operated by a leasing company.

In the *Silverton* district, the Silver Lake, Gold King and Sunnyside continue the principal mines. New milling plants are being erected for the Neigold, Mogul, Gold Prince, and other properties. The year has been a prosperous one, although the bulk of the material treated has been of a very low grade. It is hoped that 1906 will prove the best year on record for San Juan county.

**Various Districts.**—In *Boulder county* mining is now more active than for many years past. The improvement is due partly to reasonable smelting rates; but partly also to realization of the fact that success is more likely to follow the adoption of standard methods, than of the theories of process mongers. Much interest is being evinced in the results of experiments in cyaniding telluride ore after roasting, which in many cases, as might have been expected, is entirely successful. Boulder county is never likely to rival the principal districts of the State, as the veins are comparatively narrow; on the other hand, one may safely predict a larger output in the future.

Conditions in *Gilpin county* have been somewhat depressed for two or three years, owing mainly to the exhaustion of local capital and the lack of outside assistance, which have curtailed development. Several properties have, however, made excellent records during the year, among which the Running Lode and Old Town should be mentioned. As usual, many parties of lessees have done well, especially in the East Notaway, Golden Wedge and Old Town. The depression is particularly noticeable in the Central and Nevada districts; at Russell Gulch the re-opening of the Pewabic, and the prosperity of the Old Town, secure employment for every available miner; great things are hoped from the unwatering of the Sara-

toga by a lateral from the Newhouse tunnel.

Of the *Clear Creek* district, much the same may be said; excepting that there is an ample supply of outside capital, thanks to a number of energetic promoters. Many of the mines, such as the Little Mattie, Gem and Lamartine, are employing many lessees, most of whom are doing well. At Idaho Springs, the community pins its faith to the deep-level tunnels, prominent among which are the Newhouse, Central and Lucania (projected to drain the Quartz Hill and Russell districts of Gilpin county, to secure the transportation of the ores produced therefrom), and the McClelland tunnel, which is planned to secure the same advantages for the Freeland district.

Above Georgetown, the Argentine district will be greatly benefited by the rise in silver, and by the improvement in the lead and zinc markets. The new owners of the Dives-Pelican and Terrible have erected mills for the treatment of the low-grade silver ores in the dumps and on the stulls of these famous old producers; preliminary runs give satisfactory results. Important underground discoveries are said to have been made in the Terrible; on the other hand, the production from lessees in the Silver Plume district has probably fallen off.

The silver-producing districts of Aspen and Creede have had a fairly prosperous year. At Aspen, the Smuggler was the largest shipper; the total shipments were larger, in quantity at all events, than for several years. The Rico-Aspen, at Rico, is being re-worked, mainly with a view to utilizing its zinc-ore reserves; a new mill for the separation of zinc from lead-iron concentrate has been erected on the old Union property at Breckinridge.

**The Zinc Industry.**—In the aggregate, the zinc resources of the State are considerable. Unfortunately, the zinc-blende is usually too closely associated with other sulphides to make a clean separation by wet concentration; a low-grade zinc product, while marketable under present conditions, nets the producer but a small proportion of its gross value. In some cases a fairly high-grade product may be made by magnetic or by static-electric methods; but too frequently gold or silver values are retained by the zinc product, and sacrificed. It can hardly be questioned that eventually some method, or combination of methods, will be devised for the treatment of these mixed sulphide ores, which will enable the producer to realize a larger share of the values contained; this problem is perhaps one of the most important now inviting the attention of western metallurgists. Whenever it is satisfactorily solved, the State will become a greater factor in the zinc market than it is today.

**Rarer Metals.**—The tungsten mining industry in Boulder county has already attained considerable proportions; the out-

put was between 700 and 800 tons of concentrate, worth locally nearly \$250,000. The ore (wolframite) occurs in greater or less quantity over a large area; but most of the deposits are small and bunched. Toward the end of the year, the value of tungsten concentrate fell off somewhat; but, even at present rates, a permanent and profitable industry may be established.

Regarding uranium, a carload shipment of pitchblende ore, said to have realized a high price, was made from the Kirk mine, on Quartz hill, in Gilpin county. Small lenses of the same valuable ore occur in the Wood, and in other neighboring veins.

A reduction plant is now being erected for the treatment of the vanadium-bearing sandstones of San Miguel county.

Considerable bodies of low-grade molybdenite ore occur in the central part of the State. The quantity of material available is large, but the best method of commercially handling it has not yet been determined.

**Independent Smelters.**—The Golden smelter, which was largely supplied from Clear Creek and Gilpin counties, closed down during the summer, and is hardly likely to reopen under present conditions. The "pyritic" smelters at Silverton and Ouray have not been operated; but a similar plant has been built at Grand Junction, and is said to be at work. The only independent smelting plant (aside from the Argo) in successful operation is that at Salida; this is mainly supplied from the New Monarch mine at Leadville, but it has also important contracts with mines in the Cœur d'Alene district.

**The Outlook for 1906.**—As a whole, the immediate outlook is satisfactory. Cripple Creek may be expected to maintain its present rate of production, while Leadville and the San Juan will probably show a considerable increase. The recent rise in silver, if maintained, will be of great advantage to most Colorado mining districts; for although it is not likely to lead to any considerable increase in production, it will add materially to the margin of profit. A revival of intelligent prospecting is urgently needed; in facilitating this the extension of the Moffatt railroad through Routt county proved of great benefit, not only to the northwestern part of Colorado, but also to the State at large.

The long, "stringy" nature of brass chips that are free from lead is noticeable. It is possible to invariably detect brass chips which are free from lead by this "stringy" appearance. The leaded brass chips are more convenient to handle than the "stringy" or unleaded variety, as the bulky nature of the unleaded chips renders melting a tedious and laborious operation. The leaded brass chips are easily packed and melted. The leaded brass chips are the ones which are found in the scrap-metal trade.

### Montana in 1905.

BY A. SELWYN-BROWN.

Last year witnessed greater activity in all branches of mining in Montana than any previous year. Throughout the year the principal mines and smelters were operated to their full capacity, excepting in a few instances where accidents interrupted operations for a few weeks. Among the most noteworthy mishaps were those at the Reins and Diamond mines.

Early in the year the 800-ft. level in the Reins mine was flooded. The water filled the openings and backed up the shaft to the 500-ft. level before additional pumps could be put in place to cope with it. In addition to the loss of time caused by this accident, a lot of trouble was experienced in dealing with a large cave-in at the 800-ft station.

The accident to the hoist in the Diamond mine (one of the Amalgamated properties) in September, reduced the output for several weeks. During the temporary absence of the engineer, the clutches slipped out of place, and the cages and cable fell down the shaft a depth of 2,200 ft. Fortunately nobody was injured.

The fire in the sulphide ore in the St. Lawrence mine (which has been smoldering for 12 years) is still burning; but is kept well under control by the Amalgamated Company's fire department.

In addition to the interruption of operation by accidents, some of the smaller properties were shut down for various periods to enable new machinery to be placed in position. Some delay was also caused in a few instances by re-organization.

**Copper.**—Montana, for several years, has produced more than 40% of the copper mined in the United States, but owing to the increased production of Arizona, this figure will be reduced. The leading producing mines are confined to a limited area (seven miles in length by six miles in width) at Butte. The total output of the Butte copper mines to date is valued at about \$660,000,000.

There are about 11,000 men employed in the Butte mines, and the pay-roll amounts to over \$1,200,000 per month. The copper output in 1905 amounted to about 340,000,000 lb. A local authority estimates the yield of the three large operators on the field in 1905 as follows:

	Cop'r. lb.	Ag. oz.	Au. oz.
Amalgamated .....	264,000,000	9,000,000	60,000
United .....	30,000,000	2,000,000	6,000
W. A. Clark .....	18,000,000	1,000,000	1,000
North Butte .....	20,000,000	1,125,000	1,800

The Amalgamated shipped about 7,000 tons of ore per day to the Washoe, at Anaconda, and 3,500 to the Great Falls smelter. The monthly output of the Washoe averaged about 15,000,000 lb., and that of the Great Falls about 7,000,000 lb. of copper per month.

One of the important developments of the year was the recent strike in the

Anaconda mine. It was made at a depth of 2,200 ft. The orebody is 50 ft. wide, and carries good values. It is proposed to sink to the 2,400 level before the new orebody is opened. The same orebody was later found in the Parrot, with 30 ft. of high-grade ore.

The United Copper Co. raised a little over 1,000 tons of ore daily throughout the year. The company's Belmont mine has a twin-compartment shaft down 900 ft. Considerable development work was done, and a satisfactory output is now being made. The mine employs 100 men. The Lexington is being developed on the 500-ft. level. The shaft below this level is full of water; but new pumps are being installed to enable the resumption of work on the bottom level. The ore is shipped to the Montana Zinc Company's plant. The electrical pumps in the Rarus having given satisfaction, the company decided to erect similar pumps on the Cora and Minnie Healey mines. In addition to operating the Rarus, Cora and Belmont to their full capacity, it purchased all the custom ore it could command.

The Clark mines were operated successfully throughout the year. In the Original mine the shaft has been sunk to over 2,000 ft. The vein on the 1,800-ft. level is 18 ft. wide and carries a better grade of ore than that in the upper levels. During the year extensive improvements were made in the Original plant. Chilean mills and Overstrom tables were added to the equipment. The blister copper-furnaces that were erected in 1902 were torn out, and a converting plant, 100 by 255 ft. equipped with two stands of 85 by 126-in. converters operated by electric power, were added to the plant. The three matte-furnaces were considerably enlarged.

At Clark's West Stewart mine the shaft was sunk to a depth of 2,000 ft. The vein in the lower workings is 30 ft. wide and carries an average of 10% copper ore. The output of the mine during the year was large.

The North Butte Co. confined its operations chiefly to the Jessie mine. The vein continued to hold its own in strength and quality. The output averaged between 700 and 800 tons of ore daily. Stock in this company was greatly boomed during the year. The rise of this company is one of the most important recent developments in the Butte district.

In the latter part of the year the East Butte Copper Co. increased its possessions, which now comprise nine fractional claims in the south-eastern part of Butte City. Some of the claims are yielding good ore. The Dutton mine is one of the most promising of this company's holdings.

The Boston & Montana Co. operated the Leonard, Pennsylvania, West Colusa, East Colusa, and Mountain View mines. The main shaft in the Leonard is 1,200 ft. deep. The ledge is of large dimensions. The West Colusa shaft is 1,600 ft. in depth,

and that in the Pennsylvania is down 1,800 ft. These two mines give employment to about 400 men.

The Boston & Montana smelter at Great Falls is still in operation with its electrolytic refinery. It has a capacity of 3,500 tons of ore per day and employs 1,500 men.

The Raven Co. struck a rich shoot of ore in the east 1,200-ft. level. In this property there is a large body of low-grade copper-silver ore east of the intersection of the Buffalo crosscut with the main vein.

The Pittsburg & Montana Co. has finally succeeded in putting its plant in working order. Its orebodies are developing well and the average value of the ore is higher than that obtained in the mines further west. At present the average value is about 4% copper and 10 oz. silver per ton. Early in November this company made its first shipment of copper bullion amounting to nearly 100 tons. It was smelted by the Baggaley process without the assistance of fuel other than the sulphur in the ore.

In the latter portion of the year, Joseph A. Coram, of Boston, acquired options on about 20 mining claims in Butte. Endeavors are being made to form a company with a large capitalization to develop the holdings.

*Silver.*—Although silver ores are found in many districts in Montana, yet silver production is mostly confined to the Butte mines. A comparatively small output of high-grade ore is annually obtained from claims in Jefferson county.

During the year the Granite-Bimetallic Company, which was a prominent silver-mining operator near Philipsburg, Granite county, pulled the pumps out of the mines and quit business. The cause of suspension was indebtedness due to attempts to recover fresh orebodies. The company operated its mines for more than 20 years; raised over \$30,000,000 of ore; and paid dividends amounting to about \$20,000,000.

*Gold.*—Fergus county has the chief gold producers in Montana. The output of the mines including gold, silver and lead, was valued at about \$1,200,000. The chief center of activity is Kendall, which is situated 18 miles north of Lewistown. The principal mines are operating on the North Moccasin mountain; they include the Kendell, Barnes-King, North Moccasin and the Bullard mines. The ore occurs in the form of a blanket vein. At the present time a large tract of new ground (known as the Fergus tract), which extends from the flat country up to the foot of the mountains, is being actively prospected by diamond drills.

A rich strike was made in the Sunrise group at Maiden.

In Lewis & Clark county, active development work is being done on the famous Whitlatch-Union mine. A rich strike is reported. Regular shipments are

being made, and there are indications of dividends.

The Jay Gould mine has been rejuvenated, and affords employment to 100 miners. The Howard mine is also on good ore. Shipments now being made to East Helena average \$30.

Beaverhead county, once noted for its gold production, produced very little last year. Bannack placers were almost deserted. The dredges on Grasshopper creek were idle. The chief producers in 1905 were the various placers on the Grasshopper and Rattlesnake creeks.

The Ajax mine, late in the fall, struck a large body of low-grade gold ore. This mine is in the mountains, northwest of Wisdom. It will be actively developed in the coming spring.

The property of the Hecla company, located 45 miles southwest of Butte, was sold in November. The Hecla company originally had a paid-up capital of \$40,000, and distributed \$2,250,000 in dividends without levying any assessments. Last year a debt of \$30,000 was incurred; the property was sold to satisfy a judgment.

The Southern Cross mine (in Deer Lodge county, 22 miles west of Anaconda) had a successful year. It shipped nearly \$1,000,000 worth of gold ore. The ore is an auriferous gossan and is used extensively at the Anaconda smelter in fluxing the Butte ores.

*Zinc.*—The Montana Zinc Co. made a small output of 45 to 52% zinc concentrate which was shipped to Iola, Kan. The lead product is sent to East Helena. Most of the company's ore is obtained from the Lexington mine. It is probable that the zinc output of Montana will increase in 1906.

The Electrolytic Zinc & Refining Co. made extensive improvements at the Helena & Livingston mill, near Corbin, Jefferson county, with the view of dealing with the zinc ore from the Comet mine.

*Coal.*—The chief coal producing districts are in Carbon county. The Red Lodge and Bear Creek fields embrace an area of about 20,000 acres. Collieries are operating at Bridger, Gebu, Elbow Creek and Joliet. The output in 1905 was about 1,000,000 tons. The Rocky Fork mines, at Red Lodge, owned by the Northern Pacific Railway Co., produces about 2,000 tons daily. Eight seams are being worked, the deepest being 2,500 ft. on the incline.

The Bear Creek mines are working three seams averaging about 7 ft. in thickness. The coal is of good quality. A new plant, capable of handling 2,000 tons daily, has been erected.

*Sapphires.*—These gems are mined by an English company at Yogo, Fergus county. Operations commenced about three years ago. The sapphires are found in the bed of the Judith river and in a regular vein formation from which they are mined much as diamonds are in South African mines.

### Eastern States of Australia.

BY F. S. MANCE.

A review of the mineral industry of the Eastern States of Australia during the year 1905 shows that the general results are most satisfactory. It is true that the gold yield falls short of that of the preceding years, but this is more than counterbalanced by the substantial increases in the production of other metals and minerals. In New South Wales and Queensland, the increase in the total output is particularly marked, and it is confidently expected that the final returns will show that the production for this year is the largest in the history of each of these States.

#### GOLD.

From the following statement it will be seen that the yield for 1905, and which, it may be explained, is based on the output for the first ten months of the year, is less by 83,291 oz. fine than the yield for 1904.

State.	1904. Oz. Fine.	1905. Oz. Fine.
Western Australia.....	1,983,231	1,954,150
Victoria .....	765,596	720,200
Queensland .....	639,151	598,700
New South Wales.....	269,817	280,250
Tasmania .....	65,821	70,500
South Australia.....	29,177	29,000
Commonwealth.....	3,752,893	3,652,800
New Zealand.....	467,898	484,700
Total for Australia.....	4,220,791	4,137,500

Among the Eastern States, Victoria still upholds its prestige as the chief producer of gold. The bulk of the yield has been contributed by the Bendigo field, and, although the output is less by some 35,000 oz. than that of the year 1904—which was the highest for the previous 30 years—still it is such as to furnish unmistakable evidence of the richness and permanence of the reefs. In the New Chum Railway, and the Victoria Quartz Mines, the existence of reefs carrying gold at the depths of 4,230 ft. and 4,090 ft., respectively, was demonstrated during the year, and this has still further strengthened the confidence of investors in this field. The aggregate returns from the Ballarat district vary little from those of the preceding year. The yields from the mines at Walhalla and Berringa show that the industry has made headway in these centres. From many of the mines working the deep leads at Rutherglen, Chiltern, Maryborough, and Creswick, good returns have been reported. The work of draining the deep and wet leads is being vigorously proceeded with, and substantial progress has been made, but the undertaking is not a light one, as instanced by the Loddon Valley mine, where 12,000,000 gal. of water have to be lifted daily. Increased yields are recorded as the result of the operations of the various dredges, but ordinary alluvial mining exhibits a decrease.

When compared with the encouraging return of the preceding years the decline in the gold yield of Queensland for the

year 1905 is very noticeable. The grade of ore raised from Charters Towers, the principal field, was much lower than in previous years, with the result that dividends fell off by fully 50%. This has naturally created a depression which has, to a greater or less extent, affected the gold mining industry throughout the State. Many of the mines on the Gympie field continue to give good returns, but, although a larger quantity of ore was dealt with, the total output failed to reach that of 1904. The record of the Mount Morgan company is very satisfactory, \$750,000 being paid as dividends during the year. It is expected that the smelting and bessemerizing works—which are being erected to treat the extensive bodies of sulphide ore will be put in operation early in 1906, and a substantial increase in the output from the mine may therefore be looked for.

In New South Wales the returns for the first ten months of the year showed well ahead of those for the same period in 1904, and this State appears in a better light than the neighboring States, although contributing a much smaller yield. The Mount Boppy mine on the Cobar field is this State's largest gold producer, and the character and magnitude of the deposit opened up point to this position being maintained for a lengthy term. The mines on the Wyalong and Hillgrove fields show improved results. The returns from the numerous gold dredges have formed an important addition to the gold yield, and so successful have operations proved as a whole that many additional plants are being installed.

Although the gold yield of Tasmania is small in comparison to that of the other States still it continues to show a steady advance. At the principal mines, the Tasmania and the New Golden Gate, additions have been made to the plants, and the mines have been placed in a position to augment their output. At the Tasmania mine, a pumping plant capable of lifting 8,000,000 gal. of water per day from a depth of 2,000 ft. has been installed. The gold refined by the Mount Lyell company from the blister copper also goes to swell the total yield of this State.

In South Australia the gold mining industry exhibits no expansion, and the only work of any extent done during the year was that by the Tarcoola Blocks company. The remoteness of the fields is the great drawback to their successful development.

#### SILVER.

The progress made by the silver-lead mines on the Broken Hill field during the year has been a matter of all-absorbing interest, and is perhaps best illustrated by the fact that shares which in 1904 had a market value of \$12,500,000 attained a value of \$26,250,000 towards the end of 1905. Full advantage has been taken of the sustained price of silver and lead, and the mines have largely increased their out-

put and made handsome profits. These mines have so far distributed \$62,500,000 in dividends and bonuses. It is, however, to the possibilities attending future operations in connection with the extraction of the zinc from the immense residue heaps that the most importance has to be attached. These residue heaps have accumulated during past years, until they total over 5,700,000 tons, the metal contents of which average approximately 6.3 oz. silver, 6.87% lead, and 18.48% zinc per ton. It has been amply proved that the several processes designed for the separation of the zinc are capable of profitably producing a marketable concentrate, and large quantities of this product have been exported during the past two years. The Broken Hill Proprietary Co. having decided to undertake the production of spelter, has the erection of a plant well under way, meanwhile, this company is exporting zinc concentrate to the extent of some 40,000 tons per annum. What was of more importance in this connection, however, was the entrance on the scene of operations of the Zinc Corporation, Limited. This company was floated during the latter months of the year, and has purchased some 1,500,000 tons of the zinc tailing, and secured an option over the output of several of the mines for some years ahead. The disposal of the tailing heaps has proved a source of wealth to the various mining companies, and has enabled the dividends to be substantially augmented. From the silver-lead mines in other centres in New South Wales encouraging reports have been received. At the Yerranderie field, work has been particularly active, and the mines have yielded well. At Howell, the exploratory work undertaken by an English company at the Conrad mines has proved satisfactory.

In the Cobar district a silver lead lode of exceptional promise has been opened up. At Coppabella a lode was located during the year which gave rise to speculation in stocks much in excess of its importance. In Tasmania the Zeehan and Dundas fields have contributed an increased output, and the lodes are being developed on a larger and more systematic scale. In Queensland good supplies of lead ore have been obtained from the Lady Jane and Girofla properties at Mungana (Chillagoe).

#### COPPER.

The copper mining industry is in a flourishing condition, and the outlook is most encouraging. The production by the Mount Lyell company, Tasmania, was much on the same scale as during 1904, and amounted to some 8,300 tons. The profits, however, show a decided increase, and amounted to \$1,520,000, a satisfactory result when it is considered that the ore yields under 2.25% copper, and, including gold and silver contents, is worth but \$10 a ton gross. A large output should be maintained for some years, as the bodies

of ore opened up at the 600- and 700-ft. levels have added greatly to the life of the mine. In South Australia, the mines on the Yorke peninsula have been in continuous operation, and the output may be set down, approximately, as 6,600 tons.

In New South Wales, the yield from the mines at Cobar, Nymagee, and Burraga is well in excess of that for 1904, and the general prospects are distinctly favorable to the output being still further augmented. In Queensland, the main supplies have, as usual, been drawn from the mines controlled by the Chillagoe company, but several mines of much promise, and notably the "O. K.," were opened up during the year. The treatment by the Mount Morgan company of the extensive bodies of gold-copper ore should result in a valuable addition to the copper production of Queensland during the year 1906.

**TIN.**

In this branch of the industry the improvement in the year's operation is very noticeable. In Queensland, the developments on the Walsh and Tinaroo field have been of a satisfactory character. The principal mine is the Vulcan at Irvinebank. At the 600-ft. level, the ore in one stope assayed 13% tin, and yielded over \$30,000 a fathom. The lode has been proved to a depth of 900 ft. At Stannary Hills, the mines have yielded well, and recent developments point to a substantial increase in the output during 1906. At Stanthorpe, on the border of New South Wales and Queensland, tin-ore in large quantity has been recovered by the dredges. The plants operating at Tingha (N. S. W.) have also secured large yields. The alluvial deposits in New South Wales continue to afford profitable employment for a large number of men, and good results are recorded. In the Mount Bischoff, Tasmania possesses the principal tin-mine in Australia, and to the end of 1905 this mine had distributed dividends to the value of over \$10,040,000. The company has taken advantage of the high price of tin to operate on the large bodies of low-grade material, which has an average value of about 1.25% tin. The cost of mining and treatment is covered by \$2.88 per ton, and, as shown by the results, this has left an excellent margin of profit. The Briseis and New Brothers Home mines have reaped the benefit of the extensive development work carried out in previous years. A well augmented output is consequently shown and the Briseis company has been enabled to liquidate its overdraft, which at the commencement of the year 1905 stood at \$200,000. As, in the other States, the dredging for tin in Tasmania has been attended with encouraging results.

**COAL.**

In New South Wales the coal trade gave evidence of much more vitality during the year. The export trade made a good recovery and amounted to some

3,500,000 tons for the year. Labor troubles have not been as pronounced as in previous years, and the opening up of extensive and easily worked seams in the Maitland district has enabled the mine owners to compete for, and regain, a fair proportion of the lost trade; the prices obtained have not, however, been nearly as high as in former years. The development of the deep coal seam beneath Sydney harbor is being energetically prosecuted. The main shaft is down 3,000 ft., and the air shaft has been sunk to 2,290 ft. The seam, where intersected, is 10 ft. thick, but only 3 ft. is clean coal fit for marketing. Borings indicate, however, that the seam will improve when opened out. In Queensland, the West Moreton coal field is the chief producing center, but owing to the number of mines which have been opened, the supply is in excess of the demand, and, as a consequence, the market has been glutted. In Victoria, the seams of brown coal have been worked on a larger scale, and the output has commanded a ready sale in the local market.

**OTHER MINERALS.**

The other branches of the mineral industry have in the aggregate contributed a large and valuable output. It is not expected that the value of the wolfram produced during 1904, and which totalled \$850,000, will have been exceeded, but the output should exhibit only a slight decrease, as work on most of the fields was fairly active. The mining for antimony received an impetus owing to the more favorable price obtainable. The output of precious opal from the White Cliffs opal field has been well up to that of the previous year, and it is valued at \$300,000. Arrangements have been completed for the manufacture of steel and iron in New South Wales, and work is to be started towards the end of the coming year.

**British Columbia.**

BY E. JACOBS.\*

The mineral production of British Columbia for the year 1905 shows a marked advance on that of 1904, the totals for the two years, respectively, being \$18,977,359 for 1904 and \$20,963,000 (estimated) for 1905. Should the revised figures confirm this estimate, which has been carefully made, the year just closed will have seen the largest production for any single year in the history of the province, both as regards tonnage of ores mined and total value of metals recovered. The increase in metalliferous minerals was nearly \$2,500,000, but a decrease in coal and coke of about \$600,000 reduced the net increase in total of all minerals to \$1,900,000, as shown in accompanying tables. While higher average prices for metals contributed appreciably to the gain made in total

\*Editor *British Columbia Mining Record*, Victoria, B. C.

value of production, the larger tonnage of ore mined and treated in two or three districts also substantially aided in making the year's production a record one for the province. East Kootenay and Boundary districts made notable advances in production, the former in lead-silver ore and the latter in copper-gold ore. Rossland mines in the aggregate about held their own, but the much smaller output of the Tyee mine, on Vancouver island, prevented the coast district from making anything like so good a showing as in 1904.

In calculating the values of the several minerals to obtain the totals shown in the following tables, placer gold has been taken at \$20 per oz., lode gold at \$20.67 per oz., silver at 60c. per oz. less 5%, copper at 15c. per lb., lead at 4.6c. per lb. less 10%; zinc ore averaged at \$24 per ton, coal at \$3 and coke at \$5 per long ton.

The following is an estimate of the value of the year's production, and shows as well the changes as compared with that of 1904:

	Amount.	Changes.
Gold, placer.....	\$1,110,000	D. \$ 5,300
Gold, lode.....	4,640,000	I. 50,392
<b>Total gold.....</b>	<b>\$5,750,000</b>	<b>I. \$45,092</b>
Silver.....	\$2,045,000	I. \$325,484
Copper.....	5,430,000	I. 851,063
Lead.....	2,368,000	I. 946,126
Zinc.....	320,000	I. 320,000
<b>Total metalliferous.....</b>	<b>\$15,913,000</b>	<b>I. \$2,487,765</b>
Coal.....	\$3,000,000	D. \$670,884
Coke.....	1,210,000	I. 17,860
Building materials, etc.....	750,000	I. 150,000
<b>Total non-metalliferous.....</b>	<b>\$5,050,000</b>	<b>D. 403,024</b>
<b>Total production.....</b>	<b>\$20,963,000</b>	<b>I. \$1,985,641</b>

**Production by districts was:**

	1904.	1905.	Changes.
Cariboo.....	\$474,600	\$460,000	D. \$14,600
Cassiar (Atlin, etc.)..	558,474	563,509	I. 5,026
East Kootenay.....	3,210,672	4,927,500	I. 1,716,828
West Kootenay.....	5,806,070	5,706,000	D. 100,070
Lillooet.....	34,583	30,000	D. 4,583
Yale (Boundary and Similkameen).....	4,190,281	5,651,500	I. 1,461,219
Coast (Mainland, Vancouver Island, etc.).....	4,102,679	2,874,500	D. I. 228,179
Miscellan'us (Building Materials, etc)	600,000	750,000	I. 150,000
	<b>\$18,977,359</b>	<b>\$20,963,000</b>	<b>I. \$1,985,641</b>

The following comparative table shows the quantities of minerals produced in 1904 and, approximately, those in 1905:

	1904.	1905.
Gold, placer.....Oz.	55,765	55,600
Gold, lode..... "	222,042	224,490
<b>Total gold..... "</b>	<b>277,807</b>	<b>279,990</b>
Silver.....Oz.	3,222,481	3,587,719
Copper.....Lb.	35,710,128	36,200,000
Lead..... "	36,646,244	57,200,000
Zinc Ore.....Tons	.....	13,330
Coal.....Long tons	1,253,628	1,080,000
Coke..... "	238,428	242,000

**Gold.**—The dry season was accountable for the decrease in placer gold. Various estimates published in provincial newspapers have credited Atlin with an increase of \$100,000 and upward, but these have not been confirmed from official sources, so have not been followed here. Cariboo output was smaller, owing to the unusually short run at the Consolidated Cariboo Hydraulic Company's big mine, at which the recovery, by reason of a shortage of water, was by far the smallest

in nine years. The increase in lode gold was contributed largely by the copper-gold mines of the Boundary district, and the Nickel Plate mine near Hedley, Similkameen. Against these increases Rossland is believed to have shown a small decrease, thereby lessening the net increase.

**Silver.**—The St. Eugene mine, at Moyie, East Kootenay, contributed the larger part of the increase in silver, and the Sullivan Group mines, near Marysville, East Kootenay added a share. Boundary also showed an increase, but the Lardeau, in West Kootenay, and the Coast districts produced less than in 1904.

**Copper.**—The shortening of shipments from the Tyee mine, Vancouver island, and from Texada Island mines, reduced the copper output of the Coast, the decrease being estimated at nearly \$165,000. Rossland probably made a small loss, but the Boundary added more than \$1,000,000 to its total for 1904, the largest part of this increase having come from the Granby Company's mines, at Phoenix, while the mines of the B. C. Copper Company and the Dominion Copper Company made up the remainder.

**Lead.**—Much the greater part of the lead produced came from the St. Eugene mine. Of the 28,600 tons of metallic lead produced, some 7,750 tons were from ore or concentrates exported to Europe, and the balance of about 20,850 tons was the output of British Columbian lead smelters. A fire at the St. Eugene stopped shipments from that mine for two months, otherwise the province's record year's production, viz., 31,679 tons in 1900, would most likely have been exceeded in 1905.

**Coal and Coke.**—Labor difficulties at the Western Fuel Company's collieries, Nanaimo, Vancouver island, caused a suspension of production during about seven months of 1905. The Wellington Colliery Company's mines, on the other hand, increased their total production by 27,000 tons. Revised figures may show the Crow's Nest Pass Coal Company's output of both coal and coke to have been larger than in 1904. On the Coast only about half the 1904 total of coke was made, while the Boundary coke from southwest Alberta to a considerable extent displaced that from the Crow's Nest Pass collieries in British Columbia.

**Improvements and Prospects.**—The employment of dredges and steam-shovels at Atlin in 1905 has induced companies to decide upon extended operations next year with similar machines. Additional capital has been secured for both drift and hydraulic mining in Cariboo district, the Cariboo Consolidated (deep drifting) at La Fontaine, and the Consolidated Cariboo (hydraulic) at Bullion, Quesnel Forks, having both thus provided for work on a larger scale. At the Ymir gold mine, Nelson district, an important discovery of pay ore has been made. In East Kootenay

extensive additional development and equipment at the St. Eugene and Sullivan mines, and the completion and operation of the Sullivan Group Company's lead smelter, are evidences of progress, while the Crow's Nest Pass Coal Company has provided for increased output by the construction and modern equipment of a 900-ft. steel trestle and tippie at its Coal Creek colliery. The Canadian Metal Company, of Nelson, has erected a zinc smelter at Frank, southwest Alberta, for the treatment of British Columbia zinc ores, and has acquired the Pilot Bay smelter and concentrator. A zinc separating plant has been installed at Kaslo by the Kootenay Ore Company, and the Monitor Company has put in a zinc concentrator at Roseberry, Slocan lake. A commission of experts is preparing a report on the zinc resources of the province. Additions and improvements to smelting plant have been made at the Hall Mining & Smelting Company's works at Nelson and the Canadian Smelting Works, Trail—at the latter for both copper and lead, while the electrolytic lead refinery at the same place has had its capacity increased to an output of 50 tons of pig lead per day. In the Boundary, the Granby Company has increased the treatment capacity of its smelting works at Grand Forks to 2,500 to 2,800 tons of ore per day, and has installed additional power plant at its mines; the Dominion Copper Company has blown in the two blast-furnaces at its smelter at Boundary Falls, and the British Columbia Copper Company has let contracts for three 500-ton blast-furnace blowers, electric machines, etc., to supplement its present 700-ton plant at Greenwood. The West Kootenay Power & Light Company is extending its operations to the Boundary, having two pole lines, each to be capable of delivering at Greenwood, 80 miles from the power station at Bonnington Falls, near Nelson, about 7,000 h. p., well on toward completion. The total capacity of the company's hydraulic development is to be increased to 32,000 h. p., for which increase additional water-wheels, generators, etc., are being installed. In the Similkameen, the Daly Reduction Company is preparing to add 60 stamps, to bring its mill up to 100 stamps.

On the Coast, at Howe sound, near Vancouver, the Britannia Copper Syndicate has completed, and is operating a crushing and concentrating plant, comprising crushers and rolls, Hancock jig, Chilean and Huntington mills, 70 vanners and concentrating tables, etc., and is extensively developing its Britannia mines. At Crofton, Vancouver island, the Britannia Smelting Company has acquired the smelter there, which has been idle for about two years, and is overhauling and adding to its copper smelting and bessemerizing plant, in preparation for continuously running these works. Railway construction that will benefit mining districts is in active progress in southeast Koo-

tenay, Boundary, Similkameen, and Nicola districts. Altogether the present condition of the mining and smelting industries is satisfactory and the outlook is promising for a considerable further increase in development and production in 1906.

## Mexico.

JAMES W. MALCOLMSON.\*

The extent of Mexico's mineral resources are but partially appreciated by those unfamiliar with that country, Long before railroads were built there, mining was important, but an enormous impetus has been given since the principal districts have been reached by railroads.

Today, Mexico's production of silver is above that of any other country, and until 1905 had been increasing steadily.

In copper production, Mexico is second only to the United States; and the production of gold is increasing so rapidly that in a short time Mexico may follow immediately after the three principal producers—Australia, Africa and the United States.

For the other metals, Mexico leads the world in the production of antimony, China being a close second; in the output of lead, Mexico takes fourth place, the United States, Spain and Germany being ahead.

Mexico has an area one-fifth that of the United States, with only one-twelfth of her railroad mileage, is sparsely populated, and with a large fraction of its population Indians; this will give some idea of the latent possibilities of the country.

The greatest advance during 1905 has probably been in the gradual and general replacement of antique methods of mining and ore treatment by modern machinery and modern processes. This is especially noticeable in the older districts, such as Pachuca and Guanajuato. These camps have produced no small fraction of the total silver supply of the world; they have been in operation continuously for centuries; they are taking on new life. In Pachuca the ancient patio process is retained, but the ore is concentrated over Wilfley and Johnson tables before amalgamation, and the horses have been replaced by plows operated by electric motors. In Guanajuato, after preliminary concentration, the cyanide process, in a modified form, has displaced the patio process entirely, on account of the higher gold values in the ores.

In both camps electric power is displacing the old methods of hoisting and pumping.

**Guanajuato.**—In this State the property of the Guanajuato Consolidated Mining & Milling Co. is now on an excellent footing. The mine is well equipped; large reserves of good ore have been discovered and opened up in virgin ground; the concentration and cyanide plants are giv-

\*Consulting mining engineer, El Paso, Texas.

ing good results, and the company looks with confidence to a satisfactory future.

In other properties in Guanajuato, mines are in process of development, mills are being erected, and in one or two instances, notably in the property of the Peregrina Mining & Milling Co., there is enough ore developed to assure a substantial profit on operations. This is largely owing to the gold which was not amenable to older processes. Several properties now being placed on the market, however, are not in this condition; before they can be put upon a profit-paying basis, new orebodies must be found, or the extensions of older deposits must be opened up.

*Pachuca, Hidalgo.*—The mines of Pachuca and Real del Monte, in the State of Hidalgo, which are largely owned and operated by local capitalists, have been extremely prosperous this year. The Real del Monte Co., controlling the Barron, Dificultad and Camelia mines, has practically reconstructed its mill at Loreto; the San Rafael and Santa Gertrudis companies have sunk their main shafts and opened up good ore on the deepest levels. Three-thousand h.p. is transmitted to this camp from Regla and from the overflow of the drainage of Mexico City, and thus much water is pumped from all the mines. The La Blanca mine has reduced its output, on account of difficulty in its main shaft; but exploration work has been satisfactory.

*El Oro, Mexico.*—The richest orebody in Mexico for several years has been opened up by the Esperanza Mining Co., operating in El Oro, in the State of Mexico. Late in 1904 a new vein was cut by diamond drilling, east of the older workings; by the latter part of 1904 monthly profits of \$350,000, United States, were earned. The value of the gold and silver mined was \$800,000, United States, monthly. During 1905 enough ore was discovered and opened up in the Esperanza mine to leave a total net profit of over \$10,000,000, United States currency.

Of the other companies operating in this district, the Dos Estrellas and the El Oro Mining & Railway Co. have maintained their production and increased their mill capacity during the year. The most promising unexplored area in this camp is that lying between the El Oro and Dos Estrellas mines; this is covered by the Somera and Victoria claims. Exploration in this ground has commenced on a large scale.

*Customs Smelting.*—On account of the unsatisfactory condition of Mexican lead-ore production, suitable for customs smelting, the increasing production of gold and silver ores, most of which is silicious, is seriously handicapped. It has become evident that the customs smelters using lead as a collector have not sufficient capacity to handle the output of gold and silver ore; and treatment rates on silicious ores have risen throughout the country. The result is that mines formerly operated

with profit have been compelled to shut down, and the silver output of Mexico is materially reduced. This condition has been made worse by the sudden increase of silicious ores mined and shipped to the smelters from El Oro during the year.

Copper as a collector is being more largely used in customs smelting than formerly, and it appears certain that the new plants now being started at Chihuahua, Velardena, Oaxaca, Angangueo and Terrazas will use copper to a larger extent than at the older customs smelters.

The Metallurgical Co., of Torreon, in Coahuila, has also decided to make an addition to its plant for the purpose of smelting silver and gold ores with copper.

*Greene Consolidated, Cananea, State of Sonora.*—The mines of the Greene Consolidated Copper Co. have increased their output, and are now mining over 3,000 tons of ore daily.

This company has perhaps accomplished much during the four years it has been operating. Over 33 miles of underground workings, shafts, winzes and levels have been driven, not including 8,000 ft. of diamond drilling. During the year (ending July 31, 1905), \$1,900,800 was paid in dividends, more than 64,000,000 lb. of copper being mined. The average extraction from the ore now handled is between 3.5 and 4% of copper. The production of the Cananea mines, since commencing operations in 1901, to July, 1905, has been 86,375 tons of copper, worth \$24,268,917.

*El Tigre, State of Sonora.*—In northern Sonora, the possession of the Tigre mine has been a source of much litigation between the former owners and the new purchasers. The facts in the case appear to be simple; and it is hoped that justice will be done to both parties and mining resumed on a large scale, as the property gives promise of becoming a great mine.

*Cerro Prieto, Sonora.*—At the Cerro Prieto property, of the Black Mountain Mining Co., in Sonora, a large deposit of gold ore has been opened; a plant is being erected at Magdalena, on the Sonora railroad. Water-tube boilers, steam turbines and electric generators will produce power at Magdalena which will be transmitted to the mines, 25 miles away, where the crushers, stamps, air-compressors and pumps will be operated at an estimated cost of \$100 United States, per h.p. year, coal costing at the boilers \$6.50, United States, per ton. One hundred stamps have been installed, and ore will be treated by amalgamation and cyanidation.

*Santa Eulalia, Chihuahua.*—The production of ores from Santa Eulalia has increased materially during 1905, the principal companies operating being the Potosi Mining Co., the Chihuahua Mining Co. and the Santa Eulalia Exploration Co. This district has now become the principal mining center of the State. More than 20,000 tons, of lead carbonate ores, carrying silver values, are being mined. The completion of the new smel-

ter of the American Smelting & Refining Co., at Chihuahua, 16 miles away, will enable lower-grade ores to be handled with profit. At present the camp is distant from the nearest smelters at El Paso and Torreon, 240 miles and 310 miles, respectively; this constitutes a serious drawback. The building of the Kansas City, Mexico & Orient railway, which is now in operation, 72 miles east and 185 miles west of Chihuahua, has made that point a natural smelting center and assures a prosperous future for the new plant.

*Batopilas, Chihuahua.*—The Batopilas Mining Co. uncovered a bonanza of native silver, which has been worked throughout the year. By the end of Oct., 2,000,000 oz. of silver had been mined; some magnificent specimens were secured. This mine is six days by horseback from the railroad, and has been developed with expense and difficulty. A tunnel 9,000 ft. long has been driven to open up the veins; the mills are operated by water power. The Batopilas silver mines have been worked since the 17th century, and made larger profits in 1905 than during any previous year.

*Zinc.*—In northern Mexico, several mines, which have heretofore been worked for lead, have now become producers of zinc carbonate ores. Three or four thousand tons of this ore is now being shipped monthly to the gas fields of Kansas, containing 35 to 45% zinc. Most of the ore is shipped from Monterey and from the Conchos river district, east of Chihuahua, which has just been reached by the Kansas City, Mexico & Orient railway.

*Monetary Reform.*—The adoption of the gold standard during 1905, has been of some benefit to the mining industry, principally in establishing a fixed value for imported supplies; the benefits arising from a stable currency will increase the volume of mining operations. The rise in the price of silver during the latter part of 1905 to a point where the actual and nominal values of the Mexican silver dollar were alike, probably helped materially in the transition from the silver to the gold basis.

*New Railroads.*—The extensions now in construction will help the development of the mining industry more than anything else. The Mexican Central railroad extension, from Guadalajara to Manzanillo on the Pacific coast, opens up a good mineral country. The extension of the Southern Pacific system, from Guaymas to Mazatlan, will also open up the rich State of Sinaloa, which has been previously almost entirely destitute of modern transportation facilities. The completion of two other roads—the Kansas City, Mexico & Orient from Chihuahua to the Pacific at Topolobampo; and the Cananea, Yaqui River & Pacific up the Yaqui river—will reach two of the richest mineral sections of the country.

In Chihuahua, the mining districts of



Urique, Barranca de Cobre, Batopilas. Lluvia de Oro, Guazapares and Palmarajo, will be reached by the Kansas City road; Sonora, a rich mineral country, which has been hampered by hostile Indians, will be at once pacified and opened for economical development.

The progress of mining in Mexico is largely measured by the progress of the railroads; the economical working of ore bodies containing large quantities of low-grade ore is almost impossible without transportation facilities. The story of mining in the Sierra Madre mountains of Mexico, where even today freight rates from the mines to the railroad range from \$30 to \$70, United States, per ton, reads like a romance; only mines with the highest grade of ore can be worked successfully.

The advance of mining is not marked by the discovery of bonanzas, as much as by the increasing tonnage of low-grade ores treated in great mills; such as those of El Oro, Pachuca, Guanajuato and Nacozari; or in the smelters of Cananea, Douglas, Mapimi, and Tezuitlan. In these plants, and even more in the great customs smelters of Monterey, San Luis Potosi, Aguascalientes, Torreon and El Paso, which depend entirely on railroad facilities, the most of the ore handled is low grade, the general average of the ore mined being less than \$15, United States, per ton.

### Chromite.

While there are many known deposits of chromite in California, which State supplies the entire output, the larger ones, such as those in Glenn, San Luis Obispo, Tehama and Alameda counties, have of late been inoperative. The reason for this is that the freight rates to eastern points, where the market is, are too high for the grade of ore usually mined, to be shipped. About 100 tons, worth \$14 to \$15 per ton, are being mined annually in Shasta county, which is practically all that is produced in the State, with the exception of a few occasional small lots from near Paskenta, Tehama county. An outside estimate for the output during 1905 would be 125 tons.

Before applying paint on concrete, the latter should be hard and thoroughly dry. The older the concrete the better the result. A good preparatory coating for oil paint is water-glass in three or four parts of water. It should be applied twice, and after washing the surface and permitting the same to dry it should be applied again. After drying, the paint can be safely used.

Carelessly made joints, either screwed or flanged, are not only productive of waste, deterioration, and loss in economy through leakage, but are often sources of positive danger as well.

### Mining in Ontario.

BY THOMAS W. GIBSON.\*

The stratified formations of Devonian age which underlie the southwestern peninsula of Ontario do not carry metallic minerals of economic value, but in the extensive tracts of Huronian rocks lying north, northeast and northwest of the Great Lakes there are undoubtedly, many metaliferous deposits of importance. The construction of railways into these new regions is having the effect of bringing these deposits to light, both by enabling the country to be more easily prospected, and also by actually disclosing the deposits themselves during the process of railway construction. For instance, the nickel mines of Sudbury were discovered while building the main line of the Canadian Pacific railway, now 20 years ago, although it was not until several years had elapsed that the real character of these ores was ascertained, the first working being for copper. Again, in the fall of 1903 the very interesting and complex ores of the Lake Timiskaming district, which carry free silver in great profusion as well as cobalt, nickel and arsenic, were found by workmen employed on the construction gangs of the Government railway.

The year 1905 has been marked by a very decided increase in the output of the mines of Ontario, and great activity in prospecting for minerals, particularly iron, copper, silver and cobalt. The nickel field of Northern Ontario has established its claim to being the most productive source of the world's supply of this metal, the only other serious competitor, New Caledonia, now being outstripped in quantity and value of yield. The Canadian Copper Co. and The Mond Nickel Co. are the producing concerns. The former continues to operate the great Creighton deposit, undoubtedly the richest nickel mine in the world, from which it raises about 800 tons of ore per day: From the No. 2 mine about 200 tons of ore daily are extracted. The ore is roasted to expel the sulphur, and afterwards smelted to a matte which is bessemerized, the product containing about 80% of nickel and copper contents. The company's new plant containing two smelters of 600 tons capacity each, is now working with much smoothness, and it is the intention to add a third smelter in the near future. At the High falls of the Spanish river a large water-power has been developed, and electric energy is about ready to be conveyed to Copper Cliff and Creighton for use in the mines and smelting plant.

At Victoria Mines, the Mond company has been actively engaged in mining and smelting during the entire year, the Victoria and North Star mines being the

source of the ore. This company also makes a bessemerized matte which it exports to Wales, where the refining of the nickel and copper is carried on by means of the Mond process. This is now in quite successful operation, and the works are being enlarged so as to keep pace with the output at the mines.

During the nine months ending September 30, 1905, about 7,200 tons of nickel, valued in the matte at \$2,530,000 was produced by these two companies. The largest previous output, which was in 1903, amounted to 6,998 tons for the 12 months. The total product for the year 1905 will be little short of 10,000 tons, which will constitute by far the largest yield so far. In addition to this, about 3,390 tons of copper was produced in Ontario during the nine months in question, mainly from these nickel-copper ores, but also in part from the cupriferous deposits of the north shore of Lake Huron. These deposits are likely to prove of considerable moment. Their great need is a local smelter which will afford a market for the ore, and thus obviate the necessity of incurring heavy freight charges to smelters in Michigan or New Jersey.

The unusual richness of the silver mines at Cobalt near Lake Temiskaming will be seen from the fact that for the nine months ending Sept. 30, 1,802 tons of ore were shipped, containing 2,400,000 oz. of silver, or an average of 1,332 oz. per ton. The gross returns were lessened by reason of a considerable quantity of argentiferous gravel being shipped from the debris of the veins, but some of the carloads of ore taken from the veins in place netted \$25,000 and \$30,000 and even up to \$60,000. Some 15 or 16 properties are now producing ore, nearly all of it very rich. The silver occurs mainly in a free state, but there is also considerable argente, and other compounds in smaller proportion. The veins are narrow, from 2 in. up to 18 in. in width. Masses of native silver up to 200 lb. weight have been extracted.

The cobalt and nickel arsenides accompanying the silver, while adding to its value, render the ore difficult of treatment, and for the moment constitute an obstacle in the way of developing the camp. The ore has so far been marketed in New York, but ore buyers there have become somewhat chary, and while willing to pay up to 95 per cent. of the values of silver, refuse to allow anything for the cobalt and nickel. This has led to a movement on the part of the mine owners to erect a reduction plant and refine the ores on the spot. In addition to the silver, the ore mined and shipped up to 30th September contained 118 tons of cobalt, 61 tons of nickel, and 425 tons of arsenic.

Practically the only producing iron mine in Ontario during the year has been the Helen property in Michipicoton, which during the first nine months yielded about

\*Superintendent of the Bureau of Mines, Toronto, Ont.

160,000 tons of ore, one or two other properties bringing up the total production during that time to 167,000 tons. The Helen ore is largely exported to the United States. Its owner, the Lake Superior Corporation, has two blast furnaces in operation at Sault Ste. Marie, but as the Helen ore is non-bessemer, and the pig product of the furnaces is used for the manufacture of steel rails, the Helen ore is practically all exchanged for bessemer ores from the Mesabi range.

Exploration work continued during the year on the Animikie range east of Port Arthur, where a large quantity of hematite has been located. Much of this is lean in quality, but there is a quantity of high-grade ore, and as impurities are low, it is altogether likely that mining will begin near Loon Lake at an early date. On the Atikokan range, where the ore is magnetic, operations are likely to begin soon for the purpose of supplying ore to the blast furnace now being put up at Port Arthur. The large magnetite bodies on the Moose Mountain or Hutton range are also likely to be the scene of mining ere long, as it is proposed to construct a line of railway from the Canadian Pacific railway to cross the northern nickel range, and also to afford an outlet for the Moose Mountain ores.

There are now five blast furnaces in operation in the Province, two at Sault Ste. Marie, just mentioned, and one each at Hamilton, Midland and Deseronto, the last named being a charcoal plant. The total output of pig iron for the first nine months was 187,797 tons valued at \$2,907,864. Two steel plants, one for making rails at Sault Ste. Marie, and the other for structural steel at Hamilton, turned out 101,176 tons of steel during this period.

The yield of gold in 1905 while somewhat greater than for 1904 was not large, this branch of the industry being as yet comparatively unimportant. The output up to Sept. 30 was 3,535 oz., the producing mines being the Shakespeare, St. Anthony, Sultana, Regina and Craig. In December some very rich ore was encountered in Laurentian mine in the Manitou District.

The yield of crude petroleum has, since June, 1904, been enjoying the stimulus of a Government bounty of 1½c. per gal. The total quantity produced in 1905 is likely to be larger than in 1904, partly by reason of the bounty, and partly because of new pools which are being brought in. The Petrolia and Oil Spring fields continue the main sources of production, but the Leamingtom area has undergone considerable extension northward, and is likely to yield a good deal of oil. Oil has also been struck on Manitoulin Island, where several wells have proven productive at a point about 25 ft. below the surface of the Trenton formation. About

500 bbl. have been produced of a good quality of crude.

The natural gas, salt and gypsum industries of older Ontario have been yielding at about their usual rate.

Mica, graphite and feldspar continue to be produced in considerable quantities in eastern Ontario.

A number of deposits of iron pyrites are being exploited, the ore raised from which is sent to the United States for the manufacture of sulphuric acid.

The auriferous mispickel ores of Hastings county are at present quiescent, but a deposit of similar character near Lake Temagami in Northern Ontario is being worked for gold and arsenic.

The corundum mines of Renfrew and Hastings counties continue to be operated, and the output of grain corundum for 1905 will probably be about the same as that for 1904.

### Rhodesia.

BY W. FISCHER WILKINSON.\*

The table given herewith shows the gold production for the year 1905 as compiled from the reports of the Rhodesian Chamber of Mines.

1905.	Tons Milled.	Oz.	Value, £.
Jan.....	78,159	32,531	115,263
Feb.....	71,467	30,131	108,413
March.....	82,988	34,927	127,346
April.....	82,021	33,404	120,137
May.....	81,189	31,634	114,269
June.....	90,391	35,660	127,812
July.....	96,925	35,095	126,441
Aug.....	93,804	36,066	130,755
Sept.....	91,556	36,183	130,386
Oct.....	.....	33,383	120,178
Nov.....	.....	32,861	118,299
Dec.....	.....	.....	.....

This indicates a gold production for the year of £1,500,000, or \$7,500,000.

The progressive totals to date are shown in the table herewith.

	Oz.
Output prior to 1st September, 1898.....	6,470
Output 1st September to 31st Dec., 1898.....	18,085
Output 1899.....	65,303
Output 1900.....	91,940
Output 1901.....	172,061
Output 1902.....	194,169
Output 1903.....	231,872
Output 1904.....	267,737
Output 1905 (estimated).....	1,047,640
.....	415,000
Total to December, 1905.....	1,462,640

The leading producers are the Ayrshire mine which has 60 stamps and has a monthly output of £12,000, and the Globe and Phoenix, with 40 stamps and a monthly yield of £16,000. In the Gwanda district, the West Nicholson, Geelong and Eagle Vulture mines have been amalgamated into one company called the East Gwanda Mines, Ltd. In September, this company had 100 stamps at work, yielding 3,425 oz. of a value of £11,322. Another mine on the eve of making returns is the Sabiwa mine in the Gwanda district, which has a 40-stamp mill and four 6-ft. Huntingdon mills.

The Killarney mine, with 20 stamps and

\*Consulting engineer, Consolidated Gold Fields of South Africa, Ltd., Johannesburg, S. A.

one tube-mill, makes from £5,000 to £6,000 a month. The Selukwe mine has a 40-stamp mill and makes about £8,000 a month. The Wanderer is a large low-grade mine, worked as a quarry, and milling ore of about 3½ dwt. grade with a dry-crushing plant equal to 100 stamps.

The ore is crushed to ¼-in. mesh, and is cyanided direct. The working expenses are about 8s. per ton milled. The Surprise mine with 20 stamps, and the Penhalonga mine with 45 stamps, each make monthly returns of from £5,000 to £6,000. A large number of mines are worked by tributaries, with small mills of from 2 to 10 stamps. During September there were 829 stamps at work, of which 595 were in mills of 20 stamps and upward, and 234 in mills of under 20 stamps.

A good deal of interest is being taken in copper mining, the principal occurrences being in the Victoria and Umbali districts in eastern Rhodesia, and in the country north of the Zambesi.

The coal production from January to September was 69,345 tons; during the same period 448 tons of lead were produced. The mineral production shows a promising expansion over previous years.

There are several new mines coming on, among which are the Giant, with 15 stamps and 2 tube-mills, in the Hartley district; and the Jumbo (with 45 stamps projected), in the Salisbury district.

Considerable interest was occasioned by the development on the so-called "banket" formation in the Lonagunda district, which lies 75 miles northwest of Salisbury. Except for the fact that the formation contains boulders and pebbles, it bears no resemblance to the Rand conglomerate beds; to call it "banket", which, in South Africa is a "name to conjure with," is misleading. The formation appears to be a schist made up of hornblende and chlorite, containing pebbles of granite, granophyre and quartz diorite. The width of the formation varies considerably; at one place, where it outcrops in a very distinct manner on the Hanyani river, the width is about 30 ft., with the granite country rock on both sides.

The formation has been traced in an east-and-west direction for 25 miles. With the exception of the work done at the Eldorado mine, little development work has been done to prove the value of the formation throughout this length. The property has been reported on by Mr. E. H. Garthwaite, consulting engineer to the British South Africa Company; his conclusions were that while the values obtained on the Eldorado (considering the amount of work done) were very satisfactory, unduly high values have been placed on this and other properties belonging to the company.

The first Portland cement made in the United States was produced by David O. Saylor, of Copley, Pa.

### Progress in Gold-Ore Treatment During 1905.

BY ALFRED JAMES\*.

The main features in gold-ore treatment during this year have still been finer crushing, and the treatment of slimed products. From Australia and Africa the tube-mill enthusiasm has spread to other continents, among the latest adherents being the Sao Bento in Brazil, as well as various concerns in the United States, Mexico and the Central American republics. The zeal, however, which led to the proposed use of these machines for crushing coarse particles is now being tempered by experience; and, as we prophesied in this JOURNAL a year since, it is now being seriously considered whether some form of pan or mill is not the more suitable machine for the breaking down of the coarser quartz particles. Denny, indeed, proposes to effect this preliminary work in a machine of the Chilean mill type and even to avoid the use of stamps entirely.

*Re-Grinding.*—To put it briefly, the tube-mill is now settling down into the position of a profit-increasing appliance; but at any moment the commencement of operations on the large scale in Johannesburg may render output increase once more the most prominent feature. At the moment we hear less of African tube-mill work, because local energies are concentrated on the putting into commission as rapidly as possible some 30 or 40 more of these machines of the largest size.

Of results achieved up to date, we have the Glen Deep figures that three mills per 100 stamps will effect a duplication of output (the original estimate of five mills was evidently a safe figure), and give an extra extraction of 1s. 6d. to 1s. 10d. per ton (see chairman's speech at the last annual meeting of the Rand Mines, Limited), with an estimated increase of output, without extra cost, of £231,176 per annum for the thirteen companies referred to.

In this connection it is interesting to know that one 5-ft. by 22-ft. tube-mill at the Glen Deep has actually proved itself capable of increasing the output of 20 stamps to 200 tons per day, using an 8-mesh screen in the battery, with a finished product from the tube-mills of under 2% retained on a 60-mesh screen. Further work showed that the same tube-mill dealt with the output of 40 stamps through a 10-mesh screen for a total output of 336 tons per day.

When using the 64-mesh screen, two-thirds of the total tonnage crushed was re-ground in the tube-mill; and three tons of material was passed or repassed through the mill for every one ton of output of finished pulp, or one ton intake of coarse sand.

The Robinson Deep enjoys the distinction of being the first mine at work on the Rand showing from practical working the amount of increased profit on output obtainable with more than one tube-mill at work. Last year, as stated in this JOURNAL, Mr. Caldecott anticipated an increased extraction of 5%, showing an increased clear profit of 1s. ½d. per ton. It appears from the speech of the chairman of the Consolidated Goldfields, that with two tube-mills only the output has been increased by 6½% and the monthly profit by over 19%, or over £5,000 a month, which is over 3s. per ton treated. From this it appears that Mr. Caldecott's estimate was entirely on the safe side.

This is a very fine showing, and if the other African mines can thus increase their profits by anything like £60,000 a year there must be a bright future in store for the industry. In this connection it appears that another of the Goldfields group, the Knights Deep, has increased its output by no less than 35%, using three tube-mills per 100 stamps, with a reduction in costs over milling the same quantity by stamps (using 50 extra stamps) of only 1s. 10d. a ton. Clearly the point to aim at is not merely the lessened cost of milling (arising from crushing by tube-mills plus stamps), but the increased extraction resulting from the finer comminution of the ore particles.

Leaving Africa for the moment and glancing elsewhere, it appears that the Waihi Co., in New Zealand, is able, with two tube-mills, to replace the 40-mesh screens on its 90-stamp mill by 20-mesh screens, with a resulting output increase of fully 30%. It is too soon, however, to gauge the full effect of this work on the future of this famous mine; until the most economic conditions of mesh and extraction are determined, the work done must be regarded as more or less experimental; but meanwhile the Waihi Co. has ordered more tube-mills.

At El Oro, in Mexico, an equally attractive result has been secured. The chairman refers to a better extraction of 13%, or an additional net profit of £65,000 per annum.

From Australia on the other hand, curiously enough, we have a controversy as to whether the pan is not a more efficient instrument than the tube-mill for sliming. The possibility of such a controversy was pointed out in this JOURNAL last year, and it is a most remarkable feature of Kalgurli work that their tube-mill practice (Hannan's Star excepted) appears to be decadent, rather than progressive. As a result of an idea, they cut down all their mills to 11 ft. or 13 ft., and it so happens that the only mill doing really good work (the mill that was most quoted in the discussion before the Institution of Mining and Metallurgy) is the old original Hannan's Star mill, with its big discharge and long cylinder. To show the fallacy of the recent Ivanhoe tests, it is only necessary

to compare the work there done with that elsewhere, and to remember that anyone, however incompetent, can make a mill run badly, but that such work is no criterion of the effective capacity of the apparatus. Apart, however, from the bad work of the Ivanhoe tube-mill, if they had only taken the normal costs of flints and liners instead of over double the amount, the figures given would have been as much in favor of tube-mills as they now appear the other way; it must be remembered that this normal cost, of 5d. a ton, is that shown by the Hannan's Star for crushing an incomparably harder grit. The Ivanhoe ore is a soft ore. In spite of this difference, however, the Hannan's Star mill (not a thousand yards away) is actually making a 25% better output per horse-power. Pans may or may not have a future in the economics of gold-ore treatment, especially on roasted ores; but such inefficient tests as those under notice tend to mislead rather than to inform. Apropos of these tests with pans, Nicholson deserves great credit for his excellent work.

*Amalgamation.*—One of the results of the impetus given to fine grinding is the discovery that much greater returns can be obtained on the plates from the slime product. The usual practice is to flow the pulp over ordinary silvered plates, and then, after re-grinding, over shaking plates. But, even without shaking plates, fine recoveries have been shown. Thus Holloway, in Korea, has increased his amalgamation extraction on an ore containing much pyrrhotite by no less than 50%. Denny shows that, while the plus 60-mesh product yields scarcely any result by amalgamation, the plus 100-mesh yields about 57% on the tables; the plus 150-mesh no less than 78.3%; and the plus 200-mesh an extraction of 83% on the plates only. Caldecott points out a similar experience; namely, that the bulk of the amalgamation extraction on the Robinson Deep is derived from the fine material; indeed, he calculates that both the Robinson Deep and Simmer & Jack recoveries on plates amount to almost exactly 90% of the gold content of the sand passing 90-mesh, assuming the gold on the coarser sand to be untouched.

*Filter-Pressing.*—Another result of the tube-mill boom is that filter-pressing is more in evidence than ever before. Denny has laid down two large installations of the latest type of Dehne press with hydraulic closing; he reports great success. Filter-presses in Africa have shown themselves capable of treating 2 dwt. slime at a profit, and of returning to the bank over 90% of the gold content; but the very success of the filter-press makes one all the more eager for a continuous or self-emptying press. Last year no less than five types of such presses were mentioned in this JOURNAL, but not one of them appears to have successfully survived the twelve months; even the Moore process

\*Mining and metallurgical engineer, London, England.

(of which one has heard so much) appears to be frequently handicapped by some mechanical defect of the plant; but now we have such names as Denny, of Johannesburg; Merrill, Homestake; Butters, Salvador, and Virginia City; Banks, Waihi; Hunt, Costa Rica; and Sulman & Ogle (London)—all bent on solving this proposition. It is to be hoped that some tangible successful improvement will result. The majority of these efforts are directed to an improvement of the Moore type of basket-frame press; in more than one case, experiment is directed to the hydraulic removing of the press cake from the cloth.

It should be noted here that the growing practice of filling presses by pumps has not infrequently been found to be attended with a lessened extraction, unless provision is made for the introduction of an air jet under pressure into the agitation vats. Probably the air introduced into the Montejus to keep the pulp in suspension was effective in aiding the solution of refractory gold particles; and this additional extraction was missed until an occasional current of air was similarly introduced into the agitators.

*Slimes Treatment.*—Other than by filter-pressing, this continues mainly on decantation lines. Denny appears to be able to erect at the Van Ryn a continuous-decanting plant at a much cheaper rate than the Williams type of plant. The latter is, of course, more complete, and should be capable of higher extraction; but Denny has brought up his returns to 70% by collecting his residues in a dam and returning the liquor collected there to the plant and the zinc boxes. Gluyas, at the Jubilee, has a continuous agitation by natural flow and settling process; but here, too, probably the difficulty is to get the residues sufficiently free from gold solution, or in other words to recover a large enough proportion of the gold after it is dissolved. Gilmore, at the Santa Francisca, is treating his slime by adding 9 lb. of quicklime to the ton of dry slime (containing 26% of alumina and resembling China clay); by this means he is able to leach a 4-ft. layer; whereas, without the quicklime, 1 ft. was almost impossible.

*West Australian Practice.*—This is being very ably expounded just now by Mr. Robert Allen (*The Monthly Journal of the West Australian Chamber of Mines*). But, generally, practice has now become so well settled that there is little to record, either in new methods or in lessened working expenses. Costs are now down to under 16s. a ton (2,000 lb.); for the Great Fingall (8s. per ton for treatment); 15s. for the Cosmopolitan (2,240 lb.) (5s. per ton for treatment); 18s. 5d. for the Ivanhoe and 20s. 4d. for the Lake View; which mark improvements over those given last year. Detailed costs at the Ivanhoe are as follows: Rock-breaking, 6d.; ore transport, 1d.; milling, 2s. per ton milled; fine-grinding sand, 10d. per ton

ground; cyaniding by percolation, 1s. 8d. per ton cyanided; cyaniding by agitation, 4s. 10d. per ton cyanided; filter-pressing, 1s. 3d. per ton filter-pressed. The Ivanhoe total treatment costs are 8s. 9d. per ton milled.

A curious feature of West Australian treatment is the addition of salt to the top of the vats containing concentrate. Mr. Allen states that an extraction of 97% is thus obtained for a consumption of cyanide of less than 2 lb. per ton. Without the salt, the extraction is from 80 to 90% for a cyanide consumption of 3½ lb. of cyanide per ton. It is assumed that Mr. Allen means ordinary chloride of sodium and not such a salt as a lead salt.

The percolation of sand does not appear to be meeting with much success; I am informed that even Mr. Moss has now discarded this part of his process, and is adopting complete sliming.

The Merton and Edwards furnaces still hold the field at Kalgurli. A local tip (which is responsible in no small degree for the high extraction obtained from the roasted product) is the addition of lead acetate (say, 2 lb. to each agitator charge of 60 tons); so that any soluble sulphide formed from an incompletely roasted product may be at once rendered innocuous.

At the South Kalgurli, this tip seems to have made all the difference between a 2½-dwt. residue and one carrying 20 grains only.

Undoubtedly the successful feature of the year at Kalgurli has been the good showing made by the South Kalgurli plant since it was taken in hand and equipped by Bewick, Moreing & Co. This plant is now treating 10¾-dwt. ore for an extraction of 95.6% at a treatment cost of 11s. 7d. per ton. Such a regularly obtained extraction is a record which it will be difficult to better. The process used is dry-crushing in ball mills; roasting in eight Merton furnaces; followed by nine mixing, amalgamating and grinding pans; then agitation and filter-pressing.

As evidencing how vigorously dry-crushing and roasting persists at Kalgurli, and even advances, it may be noted that all the recent plants have been dry-crushing and roasting; and that the firm which has been so prominently connected with the introduction of wet-crushing and bromo-cyanide, is not only responsible for the dry-crushing plant at the South Kalgurli, but is now also proposing to erect a similar installation at the Lancefield, which has already been equipped with a wet-crushing mill for the treatment of the surface ores.

Referring once more to the Ivanhoe tube-mill practice, one is tempted to ask: Why can an African tube-mill (taking a material at least as hard and much coarser) crush, to nearly as fine a mesh, four times as much sand per h.p. as the Ivanhoe does? Is it that the design and proportions of the Glen Deep mill are better? Is the Glen Deep mill better worked?

Or have silex linings anything to do with it?

*African Practice.*—This has already been partly discussed under the heading of re-grinding. Denny is now "total-sliming" all his material, and will probably have some interesting figures to furnish ere long. Already he is able to show 94% extraction, and filter-press residues of 0.16 dwt. only, as against sand residues of 0.7 dwt. He is circulating 0.025% solutions through his plant, and anticipates 98% extraction as soon as he gets the full benefit of his recently started tube-mill. By the way, there are now no less than 59 of these machines (at work, being erected, or on order) for the Witwatersrand alone.

Helman and Crosse have been experimenting with concentration by Wilfleys. But Caldecott has already shown that a large proportion of the gold occurs in the non-pyritic portion of the tailing and slime, and this must tell against any method of treatment based on concentration; or, in other words, it does not seem desirable to separate the sulphides from the sand in the spitz output, when both products (and not the former only) should be re-ground.

Stark has met with considerable success with his treatment of cyanide residues (described in this JOURNAL last year). Several mines propose to adopt this method. Mr. Stark is resigning from the management of the Crown Reef and applying himself to the exploitation of his process. The Blaisdell excavator was erected at the Robinson mine, and was run for a short time, but no figures of results have been furnished.

*Mexican Practice.*—Argall, Butters, Hunt, Gordon Wilson and Oxmann have shown that the era of "chloridizing roasting" is going out, and that fine-grinding has come to stay. Indeed, so great an impetus has the success of this sliming treatment given to Mexican ventures that a number of syndicates are now employed in acquiring old tailing heaps for re-treatment by modern methods. For the treatment of the slimed material, decantation is mostly employed, filter-pressing being held—with notable and successful exceptions—to be too expensive.

*Zinc-Box Work and Cleaning Up.*—One has heard but little this year of the Taverner lead-smelting method; but Miller, of Sao Bento (who has been using for some years a somewhat similar method devised by himself) gives an interesting account of his successful smelting in crucibles instead of in a reverberatory furnace.

Dr. Kirke Rose describes a simple and ingenious method of refining base bullion by the introduction of oxygen or air. The process needs no special tools, and is easily carried out with a minimum of loss, provided one keeps to the acid slag laid down by the author. Dr. Rose presented a most valuable paper on this subject (to the Institution of Mining and Metallurgy)

which should be perused by every cyanider the world over. Edmands describes his bullion refining (from 782.7 to 952.9 fine) by melting at a low temperature and adding 15% of sulphur. The fluid matte is poured off as soon as the gold has set, and contains 15% of the gold, and 73% of the silver. These values are recovered by fusing the matte with iron at a fairly high temperature.

Pawle, of Borneo, saves gold when cleaning up, by filling the last compartment of his box with coke. This last compartment is cleaned up (every three or six months) by merely rummaging the coke between the hands or revolving in a cylinder, the particles thus produced being smelted. He assays his solutions by throwing in a handful of zinc, and adding hydrochloric acid and lead acetate. The lead precipitate is rubbed into a pill in the palm of the hand and cupelled. When testing by Moir's method, he uses Lovibond's calorimeter.

There has been but little of interest in new processes. Professor Ramsay's report on the extraction of gold from seawater created some interest—another example of the formation of conclusions on insufficient premises.<sup>1</sup> The Elmores are understood to have another concentration process (copied from the floating off of the metallic particles by means of gas bubbles generated by an acid solution), and to seek to improve on the Broken Hill processes by a characteristically ingenious modification; the operation takes place in a vacuum, which thus increases the effect of the buoyant gas. One also hears of a process for treating auriferous antimonial ores, which is yielding 90% extraction to cyanidation after a suitable roast and wash.

The Dessau vertical gas-making retorts are operated on the unit system. Each furnace set or bench contains ten retorts 13 ft. in height, which are heated by a gas-producer placed centrally alongside of them. On either side of the producer are regenerators, and the temperature of the flame (made to travel backward and forward past the retorts by means of baffle-plates) is 1,400°. The gas-producer is of sufficient size to hold a charge of coke to last for 24 hours. Each retort takes a charge of from 1,100 to 1,210 lb. of coal, which, according to quality, may need from 8 to 10 hours to gasify. The volume of gas made by each retort in 24 hours is 14,125 cu. ft., or from 11,140 to 11,860 cu. ft. per ton of coal, according to quality. The illuminating power of the gas is much superior to that made from similar coal in the horizontal retorts, while the yield in coke is considerably greater and of better quality. It is stated that the tar made by the new process is more valuable than that formerly obtained when using horizontal retorts; the gas, moreover, has 50% less naphthalene than before.

<sup>1</sup>Don: *Transactions Am. Inst. Min. Eng.*, XXVII p. 615.

## Cement.

BY ROBERT W. LESLEY.\*

In reviewing the cement industry for the year 1905, the first fact that appeals to the mind is the enormous growth of the production of Portland cement in the United States. While the official figures of the Geological Survey for the production of Portland cement in 1905 are of course not yet made public, the production in 1904, which was not considered in any sense a specially good year for building, attained the enormous volume of 26,505,881 barrels, a gain of nearly 20% over the production for the year 1903. This percentage of increase was lower in 1904 than for several preceding years, yet the increase was no less than 4,462,908 barrels.

*Production.*—In considering the production for the year 1905, it is certainly safe to figure that the percentage of increase, in view of the enormous demand, will not be less than 20%, and that the production for the year will be somewhere between 31,000,000 and 32,000,000 barrels.

Another event recorded in 1905 is that, for the first time in the history of the American Portland cement industry, has the export of American Portland cement been greater than the imports of foreign Portland cement. The Government figures for the fiscal year ending June 30, 1905, show imports of 996,718 barrels, valued at \$1,276,597, as against exports of American Portland cement of 1,067,284 valued at \$1,484,795. This in itself is a remarkable tribute to the quality of the domestic product and to the enterprise of the American manufacturer.

In connection with the statistics of the industry, it may be noted that there has been of late years a falling off in the production of natural cement, the output of this material having in 1902 about struck its maximum figure—falling off about 1,000,000 barrels in 1903, and over 2,000,000 barrels in 1904. Thus, while the total output of hydraulic cement of all kinds in the United States increased only 1,776,117 barrels over 1903, the great gain was made in Portland cement, which, as above shown, increased over 4,000,000 barrels. This condition, in view of the low prices that prevailed in the early part of 1905, is likely to be witnessed again in the relative outputs of natural and Portland cements during 1905.

*Distribution of the Industry.*—For a number of years the Lehigh district—embracing the counties of Lehigh and Northampton, Pa., and Warren county, New Jersey—manufactured from 60 up to as high as 72% of the total amount of Portland cement produced. In 1900, the 15 works in that district manufactured 72.6% of the entire output. In 1904, the 18 works

\*Vice-President American Society for Testing Materials; Past President Association of American Portland Cement Manufacturers.

in this same district made about 54% of the country's production.

While a map of the United States in the early days of the cement industry would have shown very few Portland cement works outside of the States of Pennsylvania and New York, and a map of five years ago would show but little capacity outside of the above States, and Illinois and Michigan, yet a map of the producing territory in 1905 shows works in almost every State of the Union. This fact is rather singularly exemplified in the West, where rates are high, railroads but few, and the cost of cement at point of consumption involves a freight charge of sometimes three or four times the price of the cement itself at the mill.

California a few years ago was one of the great importing States. Vessels from Germany and England, bound for the Pacific coast for grain cargoes to Europe, usually carried Portland cement as ballast, or at extremely low rates of freight, and the western coast of the United States remained one of the largest markets for the European brands of cement. To-day California has three works and one of these is in process of enlargement so that it will become one of the great producers of the country and very likely will supply large quantities of cement to Mexico and Panama by reason of its easy access to the sea. With the development of mining and the installation of irrigation plants in Montana, Nevada, Wyoming, Utah and Colorado cement plants have been brought into existence in the latter two States, and in both cases developments are under way for largely increasing their capacity.

Another field originally exploited by the Iola Portland Cement Co., namely, the gas belt of Kansas, is to-day the center of an active cement industry, three works being already in existence and two more under construction, and with the cheap fuel and excellent limestone the farming section of the West, in North and South Dakota, Nebraska and Oklahoma, are being supplied with Portland cement which is rapidly supplanting the present high-priced lumber. The Dakotas find cement works at Yankton, S. D., while Missouri is the center of a large industry along the Missouri river at Hannibal and St. Louis. Of the older developments it is hardly necessary to speak, beyond stating that Michigan has grown into a large producer, while both Indiana and Illinois are to-day centers of rapidly developing Portland cement production.

The old Louisville district, which produced so many millions of barrels of natural cement, has at last come to realize that Portland cement is the product of the future, and under the auspices of those connected with the natural cement industry, a large works is now under construction in Kentucky, while at Kosmosdale nearby, another plant is in operation, controlled by Eastern capital. The Southern

States show some signs of development, works in Georgia, Alabama, Texas and Virginia being already in operation and other works, at the seaboard at Norfolk and at Nashville, Tenn., being projected.

*Materials.*—As the first successful manufacture of Portland cement in this country was confined for some time to the Lehigh district, it is but natural that raw materials of the character found there should have been sought by those engaged in the business in other parts of the country, and where soft limestones with soft shales or cement rocks have been found, excellent results have been achieved. The development of productive works in the marl and clay districts has not been so rapid, but the investigators in this field are discovering new processes and new methods for increasing kiln output with low fuel consumption.

*Machinery.*—In European works, and also in some of the western works in this country the use of longer kilns has been marked for many years, and the practice has been followed in other parts of this country, the tendency of leading manufacturers being to increase the length of the kiln with a slight increase in the diameter. The results, in a general way, may be said to produce an increased output per kiln, with a very slightly diminished coal consumption. In some of the new works, kilns running from 100 to 150 ft. long are installed. In crushing and grinding machinery, modern practice seems to tend to a more gradual reduction of the rock, as well as of the clinker, by means of intermediate rolls and crushers. Air separators are also coming in more generally. Many improvements in leading forms of grinding machinery are noted for the year, among them the new three-roll Griffin mill, the new form of the Kent mill and also the improved apparatus in tube-mills.

The year 1905 seems to have marked the final disappearance of the non-fire-proof mill, all modern construction of to-day being absolutely fire-proof, made either of steel or concrete. This applies not only to mill buildings, but to stock houses as well, so that from a very hazardous fire risk in the days of the old cement mills, the mill of 1905 has become practically a fire-proof building, on which little or no insurance need be carried.

*Growth of Standards.*—An interesting feature of the past year has been the final adoption and issue to the public of the new specification for Portland cement, formulated by the joint committee, of the American Society of Civil Engineers, the American Society for Testing Materials, the American Railway Engineering and Maintenance of Way Association, and the American Association of Portland Cement Manufacturers. This specification, which represents the work of the committee for several years, was finally established at the end of 1904, and so universal has been

the appreciation of the standards recommended that no less than 20,000 copies of the specification have been sent out to consumers, engineers and producers in all parts of the country. On the lines of the joint committee above mentioned is also the joint committee on concrete and reinforced concrete, which is charged with the preparation of standards in this new art. This committee is composed of representatives of the same societies, above named, who also had meetings with representatives of the National Board of Fire Underwriters; the National Fire Protection Association; the Concrete Block Machine Manufacturers' Association, and the National Association of Cement Users.

The work is no insignificant one and the Government laboratory at St. Louis, in charge of the United States Government advisory board, is co-operating in making the experiments required. The work is likely to take several years, but its results will be most important, not only to the producers of cement, but to the great body of engineers, contractors and consumers who are engaged in the art of concrete and reinforced concrete.

Other associations on similar lines formed during the year are, the Association of Cement Users, which held its first meeting in Indianapolis last year, where 600 users of cement in its various forms were present, and the Northwestern Cement Products Association, which also held a meeting early in the year, and was largely attended by those interested in cement in the Northwest. These bodies are all in close touch with the Association of American Portland Cement Manufacturers, whose scientific papers, produced during the past year, have been read and quoted largely all over this country and in Europe.

*The Market.*—The features of the market during 1905 were the extremely low prices prevalent during the early months. The early advent of winter in 1904, with the snow storms of November and December, had a tendency to close outdoor building construction very abruptly, leaving considerable stocks of cement on hand at the end of the year, so that manufacturers found themselves hampered with large volumes of cement with the winter months, continuous snow storms and a cessation of building operations confronting them. In view of the limited storage in the cement districts of the United States, the effect of this accumulation of material was to break prices and to cause some of the producers to market their material at almost any figure. A disease of this kind is contagious, and it has been repeatedly demonstrated that a floating surplus of a few hundred thousand barrels of cement in the spring will govern the market for the entire year. This certainly was almost the case for 1905, as the early spring contracts governing the bulk of the business for the year were made at a time

when conditions were most inauspicious; when the demand for cement was practically nothing, and when stocks were accumulating at the mills owing to the unprecedented adverse weather conditions. In April, building operations were resumed on a large scale all over the country, though, owing to the closing of many contracts at low prices, the cement manufacturers reaped but little benefit from this increased demand. This continued to be the case until June, when prices stiffened in many parts of the country, although in July there was again a falling off, which lasted for a short time, but in September consumption overtook production. In the latter months of the year the enormous demand, coupled with a car shortage all over the country, produced in some sections what was almost a cement famine.

The first effects of this cement famine, so to speak, were felt on the Pacific coast, where the local newspapers were filled with articles describing work held up because of the impossibility of securing cement, and where the arrival of cars of cement from interior districts, or vessels with cement from abroad, were almost occasions for rejoicing. This condition of affairs spread from the West to the East, so that the shortage which began in California was again repeated in Utah and Colorado, which in turn were forced to buy large quantities of cement from works east of them in Missouri and Kansas.

The advance in the price of lumber, owing to the denudation of the forests, had—together with the great growth of wealth in the West—produced an enormous demand for Portland cement for purposes of construction hitherto unthought of. As a natural consequence, the Western works were soon taxed to their utmost capacity and every mill was behind with its orders.

Eastern mills, which, during the early season, had been largely limited to the Eastern market owing to the cost of freight from the Lehigh region to the Western States, soon found a demand from all parts of the country for their product, and they, too, were promptly overloaded with orders. This condition prevailed all over the country during October and November and marks the close of the present year, which terminated with the lowest stock on hand at any similar period. It is to be regretted that an industry so important as that of Portland cement should, by reason of the bad weather in the early part of its business year, have suffered such large losses as it has during 1905, caused by the extremely low prices made on account of the temporary necessities of the mills. Portland cement is as important in construction as lumber, steel and brick, is a staple commodity and has a steady and increasing demand. Manufacturers are now providing sufficient capital and sufficient storage

capacity to take care of their outputs during the winter months, so that in dull seasons they may be able to hold their cement without sacrificing prices, not only on current sales, but on the enormous future requirements of the contractor for his work during the year.

**Fluorspar.**

BY F. JULIUS FOHS.\*

The presence of fluorspar in the United States was reported as early as 1817, but it was not until 1870 that any shipments were made. Shipments were made that year from the Royal mines in western Kentucky. Southern Illinois mines followed suit two years later, and since 1880, production from them has been continuous. The annual output up to 1898, had not exceeded 10,000 tons. Western Kentucky mines have exceeded in shipments those of any other American district, since 1901, and also those of any foreign country save Germany. The Castle Dome district of Arizona and the central Tennessee district have been shipping since 1902. Their sales have thus far been small, but central Tennessee reports an increase for 1905. A small amount has been produced in the last two years in central Kentucky, but as yet no shipments are reported. Fluorspar is secured as a by-product of lead and zinc in Albemarle county, Virginia<sup>1</sup>; at the Cripple Creek mines with gold tellurides; and at a number of other points to a less extent, none of which is being used at present.

**Production in 1905.**—Arizona, Illinois, Kentucky and Tennessee continued as the fluorspar producing States. The production for the year was not far short of 50,000 short tons. Of this western Kentucky may be credited with 30,000, southern Illinois 19,000, central Tennessee 600, and Arizona 400 or more tons. This production is practically twice that of 1904. Of the 1905 production about 12,000 tons were ground No. 1 fluorspar, being more than double the amount ground in 1904. Shipments of ground fluorspar from Kentucky alone exceeded 5,000 tons, while the total of all kinds from Kentucky may be estimated at 26,500 tons, compared with 12,910<sup>2</sup> tons for 1904. Tennessee shipped 520 tons in 1905, compared with a total shipment of 600 tons for all previous years. It will thus be seen that shipments kept step with increased production.

The following table shows the number of companies that produced and prepared

fluorspar for the market and the number of companies shipping to consumers in 1905. One of the shipping companies was not itself a producer.

	Companies Producing.	Companies Shipping.
Castle Dome district, Ariz...	1	1
Southern Illinois district....	4	5
Western Kentucky district....	12	4
Central Tennessee district....	1	1
	18	11
Less companies shipping from two States.....		2
Totals.....	18	9

Besides these producing companies, there were numerous others, developing properties and some of them producing fluorspar, which, however, did not ship or sell fluorspar during the year, whose production is not included in the above estimates.

**Fluorspar Mining.**—Practically all the mines at work in 1904 were operating in 1905, with a number of new ones. A number of new orebodies were encountered in the exploitation of old mines, and in this respect the year showed a marked advance.

**Central Kentucky District.**—The Monitor (formerly Chinn) Mineral Co. continues development work in Mercer county, at the Twin Chimney mine, some work also being done at the Fantail mine. At the former, the shaft is being deepened; at the latter, a crosscut is being driven, the vein consisting principally of fluorite. At the Twin Chimney, the vein averages about 4 ft. It is banded, for the most part symmetrically, fluorite, barite and calcite occurring in separate bands, varying from an inch to a foot in width. While barite forms only a very small part of the vein at this mine, there are other veins in the district that consist largely of barite, some of which will be operated the coming year. The shaft at the Twin Chimney has been sunk to 225 ft. (80 ft. below the adit), and the vein in the bottom is 5 ft. wide, largely fluorite with but little barite, with walls of Camp Nelson (Chazy) limestone. The veins of this section have been briefly noted in a recent report.<sup>3</sup>

**Central Tennessee District.**<sup>4</sup>—Two properties were operated in the latter part of the year. The Foley mine is situated about eight miles west of Carthage in Smith county. Here, near the surface, massive crystalline fluorspar occurs in boulders weighing from 10 to 1,500 lb. in a limey clay. In sinking the shaft, 25 ft. of limestone was encountered, immediately below which is an 8-ft. vein of fluorspar dipping 10° to 20° west and striking northwest. Crystallized calcite, very similar in appearance to the fluorspar, lines the foot-wall, which consists of a gray lime-sand or clay resulting from the disintegration of the limestone. The fluorspar is said to average 98% calcium fluor-

ide. This may be a blanket vein originally replacing limestone, similar to those in the Western Kentucky and Southern Illinois districts, occurring in close proximity to a vertical vein.

The Alcorn property, about 89 miles east of Nashville on the Tennessee Central, was also being developed. Here yellow crystallized fluorspar occurs covering the ground within a foot or two of the surface. Some 30 tons have been mined from surface picking. Sinking has failed to locate the veins, though fluorspar is found to fill limestone crevices 8 to 10 ft. Similar fluorite is reported from the vicinity of Nashville.

**Southern Illinois District.**—The Fairview mine was sufficiently developed by the early part of 1905, to make it capable of turning out 50 tons daily, from its 211- and 270-ft. levels, giving it the record for daily production. This mine is capable of producing large amounts of fluorspar, since it has maintained a width of 6 to 30 ft. for over 500 ft. without showing any evidence of decrease. The product shows no change in the lower level. A sufficient amount of galena is secured with the fluorspar to pay more than the running expenses of the mine and mill.

The Rosiclare output was about 25 tons daily while running, secured from the 300-ft. level, where the vein shows no change in character beyond the usual pinches and swells.

At the Black mine near Bay City, where a number of small veins had been previously opened, a 12-ft. vein carrying fluorspar and galena was encountered, placing it on the list of producers for 1905. Some shipments were made from the Lee mine. Here there is an exceptionally wide vein of gravel fluorspar.

**Western Kentucky District.**—The widest vein operated in this district during 1905 was 36 ft. of gravel fluorspar, at the 145-ft. level of the Pogue mine. The widest lump vein was 16 ft. at the John mine. At the Mary Belle mine, two new veins were encountered and one of the shafts showed 15 ft. of fluorspar with galena associated, while another shaft at the same mine showed nearly 3 ft. of solid galena. At the John mine a 12-ft. vein of fluorspar was secured at a fault on the 247-ft. level, while within 50 ft. an 8-ft. sheeted zone running well in lead and zinc sulphides was secured. Among the new producers was the Kentucky mine, which has a 12- to 20-ft. vein of gravel fluorspar in the upper levels and 10 ft. of lump in the lower one; this mine together with the Matthews, with which it is connected, produced a good tonnage during the year. The new Memphis slope gave up to 12 ft. of No. 1 lump at a depth of 75 ft. The Keystone mine with a good vein carrying some galena, the Wheatcroft and a new shaft on the Tabb land, may be mentioned among the others as having large veins producing

\*Assistant geologist, Kentucky Geological Survey; published with permission of the Director.

<sup>1</sup>"Lead and Zinc Deposits of Virginia." Thomas L. Watson, Virginia Geological Survey, 1905, p. 42.

<sup>2</sup>"Production of Lead, Zinc and Fluorspar in Western Kentucky." F. Julius Fohs, Chap. V, Kentucky State Mine Inspector's Report, 1903-4.

<sup>3</sup>"The Lead- and Zinc-Bearing Rocks of Central Kentucky." Arthur M. Miller, Bulletin 2, Kentucky Geological Survey, 1905.

<sup>4</sup>The data relative to the Foley mine and Alcorn property were furnished by D. C. Roberts, of the operating company.

in 1905, while veins of 6 ft or less were numerous. Among new deposits may be mentioned those opened on the Ben Belt, Brown, Cox, Senator and Parish properties. The last named is a large flat deposit replacing limestone near a fault.

The shafts for the most part continue shallow, the majority of deposits being worked within 100 ft. of the surface. But a few shafts exceed 200 ft. and only the John mine has reached 250 ft.

Detail surveys were made by the Kentucky Geological Survey during the year, which the writer had in charge, and a deal of new and valuable data relative to the deposits and industry have been brought to light and will be published at an early date by the Survey. Two preliminary railroad surveys were executed with a view of putting a belt road into the mining field.

*Castle Dome District.*—This district, while on the list of producers, has not made any shipments for the last two years. It is reported<sup>5</sup> that there are thousands of tons of crude fluorspar on the dumps. It is secured here as a by-product from silver-lead mines. Only such fluorspar is removed from the mine as is necessary to facilitate the mining. That previously shipped from this district, it appears, was largely used in the manufacture of portland cement by California plants. Its use for this purpose has been discontinued; the lack of demand for the Arizona product may thus be accounted for, there being at present no other industries in the immediate section for which it may be used.

*Fluorspar Milling.*—No fluorspar milling is being done, except in the western Kentucky and Illinois districts. Some lump was shipped in previous years to be ground elsewhere, but now the ground product is largely shipped direct to the consumer. The year has seen the largest tonnage of ground fluorspar produced and shipped, ever known. That shipped from one mill in western Kentucky exceeded the total output of the State for the previous year.

In southern Illinois, the Fairview mill was remodeled in the early part of the year, and the capacity increased. Cooley jigs and a Wilfley table were installed to replace jigs of the Hartz pattern. The lead concentrate of the plant is considerably cleaner than that made previously, but the fluorspar product is not improved, a No. 2 product being turned out crushed in two sizes. At the time of the writer's visit, the daily capacity of the mill for concentration of fluorspar and galena was about 40 tons, while the grinding division handled about 100 bbl per day. The capacity, however, is being increased.

No changes are to be noted for the Kentucky or the Rosiclare mill. The Nancy Hanks mill erected by the Albany

<sup>5</sup> Private communication of Robert D. Luce, Supt., Castle Dome Mining & Milling Co.

Mining and Investment Company has just been completed. It is at their Nancy Hanks mine near Salem, Ky. This mill, like most of the others of the district, follows somewhat the Joplin pattern, but differs in the installation of a rather complete sizing system using a new type of shaker screen and a separate four-cell jig for each size. The problem is to concentrate the fluorspar and galena. A new grinding mill is being erected by the Keystone Lead and Zinc Company at their John mine about eight miles from Salem, Ky.

The new Eagle mill near Salem was practically completed this year and the building for the Sanders mill is about ready for the installation of machinery. The aim of these mills is the separation of the sphalerite (blende) from the fluorite so as to produce a commercial zinc ore, and at the same time save the associated galena. The former is a dry concentration plant using Hooper pneumatic tables and a very complete sizing system. The character of the Sanders plant has not been learned.

The Central Kentucky district is to have a new mill,<sup>6</sup> to be used for the separation and grinding of fluorspar, barite and calcite. The Monitor Mineral Co. has let a contract for the mill, the work to begin on it in February. Its equipment is to consist of a picking table, two crushers of the Blake type, three sets of Cornish rolls, two four-cell differential jigs, sizing screens, accessory elevators and conveyors, a Ford concentrating table, one rotary dryer, one Griffin mill (with provision for two) to grind the fluorspar, and eight buhr mills of Virginia buhrstone for grinding the calcite and barite. An additional section of the plant is to be constructed to manufacture barium salts. Later, the calcite in part is to be utilized in the manufacture of hydrated lime and sand-lime brick at the mine.

*Uses.*—Among the more recent applications of fluorspar to new uses may be mentioned: (a) In the reduction of aluminum from bauxite, a purpose for which the demand is likely to increase, at the same time causing a decrease in the importation of cryolite. (b) As a flux for gold ores, assisting in decreasing gold losses as in the Cripple Creek district. (c) As a bonding for constituents of emery wheels. (d) For carbon electrodes, increasing their lighting efficiency and at the same time decreasing amount of required current.

The various uses of fluorspar may be summed up as dependent on its chemical composition, fluxing properties, phosphorescence upon heating, optical and pseudogem properties. During 1905, between 150 and 200 companies in America used fluorspar. The increased consumption of the mineral has been noteworthy.

<sup>6</sup> These data were given by Prof. C. J. Norwood, Director, Kentucky Geological Survey.

## California Quicksilver.

BY CHARLES G. YALE.

Affairs in connection with the quicksilver-mining industry in California are in rather a bad way—worse, in fact, than they ever have been. Prices are low; there has been an over-production and a decided decrease in consumption. There was a marked decrease in production in 1905, due in a large part to the lack of demand at profitable rates. The smaller mines can not sustain themselves at present prices of the metal, and even the larger ones are making only small profits. Where the mines are fully developed and equipped, where fuel is cheap, and where the ore bodies are within easy access to reduction works, they can continue to work; but otherwise some of them will have to be closed down.

In 1904, the State produced 28,876 flasks of quicksilver, 75 lb. each, valued in total at \$1,086,323. The figures for 1905 have not yet been compiled, the output has been between 4000 and 5000 flasks less than in the previous year.

The consumption of quicksilver in the mining districts of the United States has fallen off materially in late years, notwithstanding the expansion of the mining industry and the rapid increase in the number of properties being worked. The conditions of ore treatment have greatly altered; much more ore is now smelted than was formerly the case. Very few silver mines are now being worked where the pan-amalgamation process is in use. In the bonanza days of the Comstock (when the famously rich ores of the Consolidated Virginia & California were being worked by pan-amalgamation) the loss of mercury per ton of ore was about 7 lb. Naturally, immense quantities of quicksilver were used. In working gold ores, by the ordinary milling process of the present, the loss of mercury is small; it is used, retorted, condensed, and used over again; so that even large mills require only a few extra flasks each year. In some mines, where they crush, roast, and lixiviate the ore, of course they use no mercury at all. Many other mines ship their ores, carrying gold and other metals, direct to the smelters, having no reduction works of their own.

Colorado, now the largest gold- and silver-producing State of the Union, does not take as much quicksilver as the west coast of Mexico requires from California. This is due to the many smelters which handle the ores; it indicates, to some extent, why quicksilver is in less demand than formerly in active mining centers.

Of late, China, and particularly Japan, have been the largest consumers of quicksilver, drawing supplies from the California mines. The Japanese, who have been using an explosive (the composition of which is kept secret), have been giving



unusually heavy orders for mercury from California; probably fulminate of mercury has entered to some considerable extent into the manufacture of the explosive. The mercury which goes to China is made into vermilion. This oriental demand has been a good thing for the California quicksilver miners who otherwise would have had even less chance to sell their product. At the same time quicksilver sold in the Orient has to compete with that derived from Spain, Austria and Italy; it must therefore be sold at a lower price than in the United States where the metal is protected by a duty of 7c. per lb. In fact, this duty has been the salvation of the quicksilver miners of this country. But when we sell to China and Japan, we have to dispose of the product at from \$5.25 to \$7 per flask less than we obtain for it in this country.

It is for this reason that the quicksilver mine owners, instead of selling their product independently, dispose of it through selling agencies. The quicksilver is stored in San Francisco; all that can be sold, is sold in the United States, at the best prices possible. When stocks become large and must be sold, certain portions are sent to foreign countries, such as Japan and China, at lower prices. By having all the supply of quicksilver "pooled," each mine in proportion to its output, gets its proportion of both home and foreign sales, according to price.

If this system were not pursued, some mines would get all the advantage of the high prices of home sales; and others would have the disadvantage of foreign sales at low prices. Competition in this respect would break the already bad market, and would reduce the present prices.

Of course the miners would not export at all if there were a good market and demand in this country. Therefore the export prices depend, to some extent, on the surplus production in this country. As already stated, there is a difference of from \$5.25 to \$7 per flask between the price obtained here and that obtained in Japan.

The average price obtained for California quicksilver in New York during 1905 has been about \$38.50 per flask of 75 lb.; it has been about 50c. per flask lower in this State. This figure does not consider the export prices, which, as stated have been lower. Therefore, with the large quantity exported, the quicksilver miners of the State have not really received for their product the average value quoted.

The grade of cinnabar ore now being worked in California is much lower than formerly; seemingly, the high grade ore deposits have been exhausted, except where small bunches are occasionally found. Many mines are now working on ore carrying one-half of 1% metal; only those worked on a large scale and with

full equipment can maintain themselves or make a profit under present conditions. The quicksilver mines in Texas have a higher grade of ore, some of them handling 2½% ore; they are doing well. But ore of 1% is now considered high-grade in California.

As an indication of the decadence of quicksilver mining in this State, the once famous New Almaden mine of Santa Clara county (owned by The Quicksilver Mining Company of New York), is about to close down. This mine alone has produced far more quicksilver than all other mines of the United States put together; it was worked before gold mining commenced in California and has been in operation ever since. For the past few years, it has been working over old dumps, and such ore as it was able to get in the mine; but it is understood that there has been no profit. During one year of the life of this mine, for 12 consecutive months, the average output of all the ore was 36% quicksilver, even then the furnaces were badly constructed and leaky so that there must have been considerable loss in reduction. In its prime, this famous mine produced much more quicksilver in one month, than it has done in a year of late.

The outlook for quicksilver mining in California is discouraging; no one is able to predict confidently any material change for the better within the immediate future. No prospective increase in demand is apparent. Possibly, the successful developments in the mines of Tonopah, Goldfields, Bullfrog and other new districts of Nevada (provided large mills are erected), may make some difference in demand locally; but, even in that direction, the uncertain increase in consumption will not be very marked.

The present conditions threaten the closing down of a number of smaller mines in this State; it is improbable that many new ones will be opened and developed, unless the ore should happen to be of unusually high-grade.

Incidentally, Germany of late has been importing very unusual quantities of quicksilver, obtaining it from Spain, Italy and Austria. In 1904, Germany imported 647 tons; for the first nine months of 1905, the importations were 536 tons, or 15,758 flasks. The same rate continuing would make the importation over 20,000 flasks for the year, which is little less than the amount produced by the mines of California.

Quite a number of quicksilver properties in California have been under development in the past few years. The following list comprises those which have been producing more or less during 1904 and 1905: Colusa county, the Manzanita Lake county, the Abbott, Chicago, Great Western, Helen, Mirabel, and Boston (or Redington). Napa county, the Corona (or Vallejo), Etna, Johnson, Manhattan,

Napa Consolidated, Twin Peaks, and Wall Street. San Benito county, the New Idria (largest producer in the State) and Ramirez. San Luis Obispo county, the Alice and Modoc (or Little Bonanza Co.), Oceanic, Polar Star, Clark, Karl and Riconada. Santa Clara county, the Century (or Guadalupe), and New Almaden (Quicksilver Mining Company). Solano county, the St. John. Sonoma county, the Cloverdale, Culver-Baer, Great Eastern, Mount Jackson, Socrates, and Sonoma. Trinity county, the Altoona.

### Magnesite.

There was no increase during 1905 in the production of this substance in California, the only State that produces it, the demand, in fact, having slightly fallen off. Most of the supply continues to come from the mines near Porterville, Tulare county, though Fresno and Napa counties make a small yield each year. The only movement of note in this industry was the first shipment, in December, from the mines of the American Magnesite Co., on the borders of Alameda, Stanislaus and Santa Clara counties, and the opening of the new factories of this company on the shore of San Francisco bay, at Oakland. The works have been under construction during the year, and are only now completed. They will manufacture various products, including brick, from the magnesite yielded by their own mines. Only a few carloads have thus far been shipped from mine to factory, and this will be marketed as manufactured products shortly. It is expected that the mines will make a large output in 1906. The crude ore is worth about \$3 to \$3.50 per ton; and after being calcined by the carbonic and gas manufacturers, and the gas removed, the calcined material is sold to paper factories at from \$10 to \$14 per ton. Not more than 3,000 tons crude were mined in the State in 1905, worth about \$3.50 per ton in San Francisco.

If any preparation is used for the purpose of making a tight joint in piping, it should be put on the thread of the pipe and not on the valve thread, for the reason that in the latter way, as the pipe is screwed into the valve, the substance is pushed in, and is in danger of getting on the valve seats or discs, which is liable to cause trouble.

In connecting valves to pipe, they should be tightly closed, thereby making them as rigid as possible and less liable to strain, besides serving to keep from the working parts substances likely to injure them. When the connections are all made, the valves should be opened, and before being again closed, they should be thoroughly blown out to remove foreign substances liable to stick to and injure the discs and seats.

### The Tin Market for 1905.

The statistical position of tin, which during last year was supposed to be a strong one in regard to supply and demand, has proven to be so to a very marked extent. The production, both in the Straits and in the Dutch colonies, has fallen off somewhat, while the consumption of tin throughout the world has increased to a considerable extent. How far this is true of the United States is best illustrated by the fact that although the imports during this year were more than 4,000 tons larger than during 1904, the quantities of tin held in stock are smaller at the end of this year than they were at the beginning of the same. In consequence of this fact it is not to be wondered at that values appreciated the way they have, and that prices have now reached the highest level for a generation.

At the beginning of the year under review, Straits tin was selling at about 29½c. per lb., which price remained stationary for futures until the middle of March, while spot tin fluctuated continually in sympathy with the stocks that were available. It commanded as high as 30c. during the period above mentioned. Toward the end of March London quotations advanced considerably, and although buyers here were at first reluctant to follow the advance in price abroad, they were at last compelled to do so, with the result that about the middle of April quotations were put up to 31c. for spot, and 30c. for future tin. During the latter part of April London prices declined, and New York quotations followed suit; 29¾@30c. per lb. for spot metal was the price then established, and it remained at about this level until the middle of June.

From this period on the market advanced gradually in sympathy with London, where speculation reigned supreme. Bull operators were assisted in July by the announcement that Banka sales would be further reduced, and a price of 33c. per lb. established. Profit taking, which continued during August and September, weakened the market temporarily and by the middle of October prices here had receded to 32c. per lb. Fresh inquiry developed at these lower prices, and the demand became extraordinary. Quotations jumped by leaps and bounds, and reached 35c. by the beginning of December.

The consumption continued at an extraordinary rate during the month of December, and as shipments from abroad had decreased considerably, owing to the fact that there was no spot tin available in London, and stocks could only be replenished by shipments via London, which were made from the Straits, the spot market in particular became extremely firm,

and a premium was readily paid for metal on the spot. The market at the end of this year is quoted at 36@36¼c., depending upon deliveries.

### Antimony.

The principal source of antimony in the United States is the hard lead obtained by the desilverizing companies. Since its principal utility lies in its combination with lead in bearing and type-metals, the antimony itself is rarely separated from antimonial lead, but the compound product is used directly. Whereas hard lead was formerly discounted, as being suitable only for the roughest purposes, it now commands a premium.

The output of hard, or antimonial lead in the United States during 1905 was 11,037 short tons, of which total about 3,000 tons must be assigned to foreign sources. Estimating the average contents at 23%, the total output contained 2,538 short tons of antimony.

Mathison & Co., of England, controls the production of metallic antimony in this country, having a plant at Chelsea, N. Y. This company recovered a certain amount of antimony during 1905 from domestic sources.

Deposits of ore in which antimony constitutes the chief value are not rare in the United States, but, as a rule, they are too remote from transportation and have never been profitable. A recent mining enterprise is that of the Central Nevada Mining Company, which is developing an antimony mine in the Toyabe district, 45 miles north of Tonopah. The owners and operators are Japanese.

#### ANTIMONY MARKET FOR 1905.

The shortage of antimony occasioned by the shutting off of the supplies from Japan made itself severely felt during the past year. This condition was aggravated by the increased consumption, partly for war purposes but largely for the industries, so that by the end of June prices which, at the beginning of the year had been 8½c. per lb. for Cookson's, 8¼c. per lb. for Hallett's, and 8c. per lb. for other brands, had advanced 3c. per lb.

During July European producers again raised their prices, which, at the end of August stood at from 14 to 15½c. per lb. Subsequently prices declined, as it was expected, that, the war being over, Japan would again enter the market with its production. On this downward movement the lowest prices were reached about the middle of November, when quotations were 12c. per lb. for Cookson's and 10½c. per lb. for other brands. As exports from Japan, however, failed to materialize, prices again advanced rapidly, and stood at the beginning of December at 13½c. per lb. for Cookson's and 12½c. per lb. for other brands.

The pronounced shortage of stocks made itself felt during December, and as prices were advanced by Cookson's from time to time, the market here was quoted very much higher: 15½c. was asked for Cookson's antimony, while other brands could be procured at values ranging between 13½c. and 14½c. per pound.

### Iron and Steel.

BY FREDERICK HOBART.

A year ago, in reviewing the iron and steel industries in 1904, it was said: "If a curve should be drawn, representing the course of the iron and steel industry in the United States for a number of years, it would strongly resemble the wave line as traced by a hydrographer, the crest of each wave representing a period of prosperity, followed by one of depression, as the wave loses its force and recedes. In the case of the iron diagram, however, it would be found that each wave of prosperity rises to a higher point than its predecessor. This is to be expected, not only on account of the national growth in population and substantial wealth, but also because of developments in metallurgy, improving the quality and reducing the costs, and of the rapid progress made in the substitution of metal for lumber and other materials in construction. . . . Even the receding wave never reaches as low a point as its predecessor."

The rising wave which was apparent in the latter part of 1904, continued to rise during the whole of the year just closed. There was, it is true, a slight hesitation toward the close of the first quarter of the year, but it was only temporary. As soon as it began to be apparent that the year's crops would be abundant, all hesitation disappeared. From that time on the demand for pig iron and for finished material of all kinds increased with a rush; and the year closes with furnaces and mills overwhelmed with orders and obliged to use every effort to keep up with contract deliveries. Construction of all kinds has been active beyond all precedent; money for investment has been abundant, and the consumption of iron and steel has been the largest ever known. The increase in furnaces, in furnace and mill capacity made in the years 1901-1903, which some conservative observers feared was excessive, has proved hardly sufficient.

*Iron Ore.*—The production of iron ore in 1905 was, naturally, the greatest on record. The production and shipment of ores from the Lake Superior region, which furnishes the raw material for between 75 and 80% of the pig iron made in this country, is closely reported; and in the Southern district, the second great ore-producing region, it is possible to make a close approximation. Outside of these districts the production of iron increased considerably. The demand led to the extension of mining everywhere and to the reopening of old mines. Thus the Chateaugay and other mines in the Northern Adirondacks; the Port Henry mines in the Champlain region of New York; the old mines of New Jersey and of the Lehigh Valley in Pennsylvania, were all active. In the Hudson district

several old mines have been reopened and promise a fair output during the coming year.

The production of iron ore in 1905, estimating as closely as possible, is given in the following table:

	1904	1905
Lake Superior shipments ..	21,822,839	33,829,197
Southern mines .....	5,450,000	7,175,000
Other States .....	2,190,000	3,050,000
<b>Total production</b> .....	<b>29,462,839</b>	<b>44,054,197</b>
Imports .....	487,613	851,720
<b>Total supply</b> .....	<b>29,950,452</b>	<b>44,905,917</b>
Exports .....	213,865	215,900
App. consumption.....	29,736,587	44,690,017

The imports and exports for December are estimated. In this table no account is made of increase or decrease in stocks. The known stocks, chiefly those on Lake docks, were not unusually large at the beginning of the year, and those on hand at the close of navigation season did not show any great change from the first of the year. It is probable that the stocks in furnace yards today are larger than they were a year ago, but it is impossible to ascertain the exact figures. Making allowance for this, the actual consumption of iron ore in 1905 was close to 43,000,000 tons, an average of 1.87 tons of ore used per ton of pig iron made.

**Limestone**—The consumption of limestone and dolomite, for flux in making iron, is estimated at 11,435,900 tons. The average consumption of flux is about 1,115 lb. per ton of iron made. Dolomite is used only in the Southern furnaces.

**Pig Iron**—The American Iron and Steel Association has furnished the complete figures for the first half of the year. For the second half the production is estimated on the basis of the number of furnaces in blast each month. The division of iron into various grades for the second half is made on the same ratio as that ascertained for the first half. On this basis we estimate the production of pig iron in 1905 as follows, in long tons:

	First half	Second half	Year
Foundry and forge.....	2,888,604	3,080,100	5,968,704
Bessemer .....	6,008,427	6,373,500	12,381,927
Basic .....	1,966,592	2,085,050	4,051,642
Charcoal .....	170,512	178,500	349,012
Spiegel and ferro...	129,040	130,300	259,340
<b>Total</b> .....	<b>11,163,175</b>	<b>11,847,450</b>	<b>23,010,625</b>

This production compares with that of the year 1904 as in detail as follows:

	1904	1905	Changes
Foundry and forge.....	4,358,295	5,968,704	I. 1,610,409
Bessemer .....	9,098,659	12,381,927	I. 3,283,268
Basic .....	2,483,104	4,051,642	I. 1,568,538
Charcoal .....	337,529	349,012	I. 11,483
Spiegel and ferro...	219,446	259,340	I. 39,894
<b>Total</b> .....	<b>16,497,033</b>	<b>23,010,625</b>	<b>I. 6,513,592</b>

The total increase in 1905, as compared with 1904 was 6,513,592 tons, or 39.5%; as compared with 1903, heretofore the year of maximum production, the increase was 5,001,373 tons, or 27.8%. The larger proportionate increases were in basic and bessemer pig, though foundry iron also made an important gain.

Counting the ore, fuel and flux con-

sumed, the production of pig iron in 1905 required the handling of between 75,000,000 and 80,000,000 tons of material. Some of it required transportation over long distances; thus nearly all the Lake Superior ore was used in furnaces a thousand miles distant from the mines.

The proportion of furnaces active was very high, especially in the last half of the year. The prices and demand for iron made profitable the operation of many of the older furnaces on the list. On Dec. 1 there were over 80% of the available furnaces in blast, and of those idle, nearly all were necessarily so, undergoing repairs after long campaigns. A recent statement prepared by the American Iron & Steel Association gives the changes in blast-furnace capacity from June 1, 1904, to Nov. 1, 1905, as follows:

	Capacity.
Completed furnaces, June 1, 1904.....	28,114,000
New Furnaces completed.....	1,982,000
Increased capacity of furnaces re-built.....	500,000
<b>Total</b> .....	<b>30,596,000</b>
Furnaces abandoned .....	461,000
Furnaces idle since June 1, 1904....	1,500,000
<b>Total deductions</b> .....	<b>1,961,000</b>
<b>Furnaces standing Nov. 1, 1905</b> ....	<b>28,635,000</b>

In addition to this, 16 furnaces which were in course of erection on Nov. 1, 1905, will have a total annual capacity of 1,830,000 tons. Of these furnaces 3 stacks, with an annual capacity of 315,000 tons, will probably be ready for blast in January, 1906; 2 stacks, with an annual capacity of 240,000 tons, will be ready in February; 2 stacks, with an annual capacity of 215,000 tons, will be ready in March; 1 stack, with an annual capacity of 145,000 tons, will be ready in April; 3 stacks, with an annual capacity of 450,000 tons, will be ready in June; and 5 stacks, with an annual capacity of 465,000 tons, will be ready in the summer or fall of 1906.

This shows that by the middle of 1906 the total yearly productive capacity of the furnaces standing in the United States will be 30,465,000 tons of pig iron. Making liberal allowance for the number necessarily under repair, or idle for unavoidable reasons, we will be able to turn out at least 27,500,000 tons of pig iron a year; a quantity which will be, from all present indications, ample to cover all the demand which is likely to arise. It may be added that at the close of 1905, the production is at the rate of a little over 25,000,000 tons a year. The important question for the new year is not blast-furnace capacity, but the keeping up of the supplies of ore and coke.

**Steel**—There are no data obtainable for the exact production of steel, since reports are only published yearly. Assuming, however, the same ratio of steel to pig iron as in 1904, the output of steel in 1905 was approximately 19,328,000 tons; and this is a conservative estimate. The approximate division of this output would be into 10,950,000 tons bessemer, 8,250,000 tons open-hearth, and 128,000 tons crucible and special steels. The open-hearth

process, especially in basic steel, continues to grow in importance. The success of the Ensley plant in Alabama, making basic open-hearth steel from pig-iron furnished by local furnaces, has resulted in the construction of new steel plants, and the projecting of others; so that 1906 will probably see a considerable increase in the output of basic open-hearth steel.

**Finished Iron and Steel**—Statistics are not yet available for the production of the different varieties of finished iron and steel. It may be said, however, that there was a great increase in the output of all kinds of material, which was most marked in structural material and plates; while bars and merchant steel were not far behind. The rail business of the year was large, probably the biggest on record.

**Changes and Consolidations**—The practical completion of the Lackawanna steel plant at Buffalo constitutes the most important addition to producing works during 1905. Many improvements and enlargements of works are projected, and work on some has been begun; but generally these changes will not be effective until late in 1906.

The negotiations for a Southern consolidation, to which reference was made a year ago, made little progress until late in the year. In December it was announced that the syndicate headed by John W. Gates had acquired a controlling interest in the Tennessee Coal, Iron & Railroad Company. The consolidation of this company with the Southern interests of the Republic Iron & Steel Company will follow, though the manner and details of the combination have not been arranged.

The important works of La Belle Iron Company at Wheeling, W. Va., have been the subject of negotiation, and it is understood that the control has been placed in the hands of a syndicate, with a view to the ultimate disposition of the property to the best interests of the stockholders—that is, to the highest bidder. The result is, as yet, uncertain.

**Metallurgical Practice**—The use of dry-air blast has continued to be the subject of experiment under the direction of James Gayley. Only partial reports of the results have been made; a recent statement comprising the operation of two furnaces of similar size and construction, shows an important saving of coke in the stock using dry-air blast. Further details will be made public at a later date.

The Canadian government has continued its experiments in the electric smelting of iron and steel. An appropriation was made for the construction and operation of furnaces at the Sault Ste. Marie. The work is in progress under the direction of Dr. Eugene Haanel, Dominion superintendent of mines, and Dr. Héroult, the French expert. Substantial results will probably be obtained during the new year.

Other improvements have been largely, as in 1904, in the direction of increasing

capacity, handling material with more economy of time and cost, and generally in labor-saving appliances. In these directions advances have been made, but no improvement of special importance is recorded.

The year was comparatively free from labor disturbances. Full occupation and the maintenance of a generally high scale of wages have prevented discontent. Late in the year advances were made voluntarily in the Carnegie steel works.

A shortage in the supply of manganese ore in the later months of the year caused embarrassment to the steel companies. This was chiefly due to the internal disturbances in Russia, which stopped mining in the Caucasus, and prevented the exports of manganese ore, of which America had been a large buyer. This interfered with the production of ferromanganese, which has been in very short supply. The sources of manganese in this country are limited. At present the chief home supply comes from the Leadville district in Colorado, and an active season has begun there for the mines furnishing these ores.

*United States Steel Corporation*—As was to be expected, the business of the Steel Corporation showed a substantial gain in 1905. The reports for three quarters of the year, covering the nine months ending Sept. 30, give the following results, the net surplus being the amount remaining after paying all charges, renewal and improvement funds, and dividends on the preferred stock:

Net earnings	1904.	1905.	Changes.
First Quarter..	\$13,445,232	\$23,025,896 I.	\$ 9,580,664
Second Quarter	19,490,726	30,305,116 I.	10,814,390
Third Quarter	18,773,933	31,240,582 I.	12,466,649
Three Quarters	\$51,709,891	\$84,571,594 I.	\$32,861,703

Net Surplus.. \$2,233,521 \$9,816,701 I. \$7,583,180

A conservative estimate of the net earnings for the fourth quarter of 1905 is \$35,500,000; which would give for the full year net earnings of \$120,071,594, against \$73,176,523 in 1904; \$109,171,152 in 1903, and \$133,308,763 in 1902. The business on hand at the close of the year was unprecedented in quantity, an official estimate giving the unfilled orders on Dec. 31 as 7,300,000 tons, which is over a million tons in excess of the highest previous record.

The Corporation continues its hold up on the iron ore output; in 1905 its shipments from the Lake Superior region were 55.2% of the total mined. The blast furnace capacity owned, however, is still insufficient, and heavy purchases of pig iron were necessary. These were made chiefly from furnaces in the Mahoning and Shenango Valleys.

*Foreign Countries*—The iron and steel industries in Europe were generally prosperous through the year. In Great Britain for the first half of the year, the production of pig iron was 4,621,600 tons, and of steel 2,999,982 tons; the gains being 572,635 and 464,170 tons—12.4 % and 18.3%—respectively. The trade was gen-

erally active, and the total pig iron production for the year was probably at least 9,300,000 tons. The export trade was large, its total value, including machinery, showing an increase over 1904, in the 11 months ending Nov. 30 of £6,785,561, or 13.9%. This gain was well distributed over almost all lines. Prices were generally well maintained, and the state of trade at one period was the occasion for a strong bull speculation in pig iron warrants.

In Germany the pig iron output for the 10 months ending with October was 8,970,539 tons, an increase of 571,047 tons, or 6.8% over 1904. It is safe to say that the total production of pig iron in 1905 was close to 11,000,000 tons.

In Belgium pig iron production for eight months showed a gain of 3%. In France also there was a moderate advance during the year.

In short, the demand for iron and steel was good in almost all parts of the world throughout 1905, and the year made an excellent record.

#### THE IRON AND STEEL MARKETS.

The record for the markets for iron and steel in 1905 is well given in the letters which follow. These cover the chief primary and secondary distributing centers of the country. Naturally, under the prevailing conditions, the course of prices has been upward, especially during the later months of the year. During the last quarter, in fact, the chief producing interest has been, apparently, anxious to keep prices down. The various pools in which it predominates have refused to advance prices at times when they were really expected, and were apparently warranted by conditions. There were various reasons, financial and political, for this course; but its effect has been in some respects rather deceptive. A large proportion of the business during the fourth quarter of the year was done at premiums, or advances over pool quotations. Billets, for instance, on actual transactions, have not been within sight of pool prices; the same can be said of structural steel, plates and bars. The only branches of the trade where these premiums have not been paid are rails, sheets and tin plates.

The railroads were an important factor, placing large orders, not only for rails, but also for bridges, cars—especially steel cars—and locomotives. The new railroads built amounted to about 4,500 miles, but a much greater quantity of material was needed for new sidings, additional tracks, and similar improvements. The construction of electric railroads was also active, and called for a large quantity of material.

#### ALABAMA IRON MARKET.

BY L. W. FRIEDMAN.

While the definite figures as to the year's production at the blast iron furnaces, steel plants, rolling mills, cast-iron pipe works and other kindred industries in Alabama have not been given out as yet, enough is known to show that there has been an increased output all along the line. The average quotation for the year has been high and a summary of conditions in Alabama shows that the manufacturers in these respective lines have prospered, despite obstacles which beset them in the first part of the year. A strike among the union coal miners, which began in July, 1904, of course, had its influence when the year opened up, but with all that the iron prices were quite high, as compared to what they were a few years back, and the market was considered firm. For three months at the beginning of the year there was a fairly good demand, the prices ranging between \$11 and \$12.50. The spring came on and there was a changed feeling. The demand was not as brisk as it might have been, and while furnace companies were in a position to hold their product for better prices, there was no telling how long such a condition would prevail. Four months went by and there was an accumulation of iron in more than one furnace yard. But the lane was not long and the turning point came on with a rush. The buying was in large lots and before the end of the summer it was officially announced that every ton of the year's make was sold, inquiries on hand indicating the need of great quantities of iron. The fall started in with a rush for iron and prices advancing; the year closes with every ton of accumulated iron sold and being delivered as fast as railroads can handle it and the daily make, much increased, used steadily to assist in filling the orders. Quotations have advanced to a basis of \$14.50 per ton for No. 2 foundry iron, and almost every company in this State has booked orders which will practically cover the probable make for the first quarter of the coming year and with some shipments will continue through the first half and even longer into 1906.

The year witnessed the completion of the No. 6 furnace at Ensley (Tennessee Coal, Iron & Railroad Company), the first furnace which was able to produce over 400 tons of iron a day in this section. It saw the start on the erection of a new furnace at Gadsden (Alabama Consolidated Coal & Iron Company); saw the new furnace of the Woodward Iron Company with a daily capacity of 300 tons and more started up; the re-building of a furnace at Ensley and the repairing of several other furnaces, one in particular, Alice furnace in Birmingham, property of the Tennessee Company, which was thought to be dead some time ago. The strike of the union miners caused a short-

age in coal and coke, the latter commodity in particular, but the furnace companies sought their needs in other districts and kept up the iron production here. As a result, those who figure on production believe that there will be an increase of at least 10% in the total output for the year. In 1904, Alabama produced 1,453,513 tons of pig iron. The production for 1905 should be near 1,600,000 tons. The home consumption of iron, that is that used in Birmingham, the Birmingham district and in the State, will probably go to 25 or 30% of the entire production. There has been steady operation at all the iron-using industries in this State, the cast-iron pipe makers, the foundries and machine shops, the car-wheel makers, the rolling mills, and other concerns having many orders to fill and their daily needs being enormous. The district reports the greatest production of cast-iron pipe on record.

The steel industry has succeeded during the year just coming to a close, the highest production ever attained at the Ensley plant (Tennessee Company) in one day—1,100 tons—being noted just a few weeks since. The month's production went above 23,000 tons. Improvements were made at this plant and more work is still under way. The formation of the Southern Steel Company, capital stock, \$16,000,000, was announced in December; it is a merger of the Alabama Steel & Wire Company and the Underwood Coal Company. The plants of the concerns consolidated have all been in steady operation right along, the output at the steel rod, wire and nail mills at Ensley being greater than ever before. It is announced that improvements will be made and the capacities increased all around. Good prices obtained for the various finished steel products in this district and there was a strong demand for everything in this line. Steel wire, nails and staples went to Mexico, Cuba and other foreign countries during the year, while the South and Southwest have been using the Alabama product extensively.

The Republic Iron & Steel Company kept its Gate City rolling mills in steady operation through almost the entire year. The big Birmingham mills resumed two months since. The Tennessee Coal, Iron & Railroad Company, declining to recognize the Amalgamated Association of Iron & Steel Workers, secured other help and for the most of the year kept the Bessemer rolling mills in steady operation, working on steel. The rolling mills at Sheffield, Anniston and elsewhere in this State have done well.

Foundries and machine shops were busy. Much sugar machinery was manufactured in this district. The blow given by the announcement that the Williamson Iron Company would cease business Jan. 1, 1906, having sold its property in sufficient quantity to redeem all bonds and pay off all stock, is overcome by the announce-

ment that Payne & Joubert, of New Orleans, will erect in the early part of the coming year a large foundry and machine shop in the Birmingham district; the Birmingham Steel & Iron Company will erect a large steel foundry; while the Hardie-Tynes and the Birmingham Machine & Foundry companies are contemplating extensive improvements.

Among the industries established in this district during the past twelve months might be stated the Birmingham Drop Forge Works, the Kilby Locomotive & Switch Works, the Frog & Switch plant, the Cannon Pump Works, all at North Birmingham. Work will start soon on the new cast-iron pipe works of the American Cast Iron Pipe Company at North Birmingham, and on large cast iron pipe works at Ensley by the Tennessee Company.

THE CHICAGO IRON MARKET.

BY E. MORRISON.

In comparison with the previous year, 1905 was profitable and satisfactory. The first half of the year was dull and disappointing, after the revival of the iron business generally in the last quarter of 1904. But in the latter part of July came the turn of the tide, with a sharp revival of prices and heavy sales that continued well toward the end of the year. December has shown the usual quiet that signifies nothing of weakness in any branch of the iron and steel trades. For the new year the prospect is fair at least.

In January pig iron sold at \$17@17.50 for Northern No. 2, and \$13.50@14 for Southern No. 2, Birmingham, or \$17.15@17.65 Chicago. Little iron was sold in the first month of the year, both melters and furnacemen being reluctant to enter into the usual contracts for deliveries six to eight months from the date of the order. The period of small but general sales continued to May, when the market became very weak for pig iron, with no marked strength in any branch of the iron industry.

From May to July the market declined steadily for pig iron. The January prices continued fairly maintained up to May, but between this date and the middle of July Northern No. 2 went down to \$15.50, its minimum for the year, and Southern sank to \$11 Birmingham, or \$14.65 Chicago. In June there was hardly any buying. Consumers were buying from hand to mouth and it became apparent that the needs of the market were not being supplied—that the needs of the users of iron must lead to a revival that would be marked by a boom period. For there was no check to the great consumption of iron and no clouds appeared in the business sky. The experience of the last half of the year showed that the optimism of the sellers of iron during the period of stagnation was based on correct analysis of the situation.

When the revival came, in the latter part of July, it caused active buying throughout August, usually one of the dullest months of the year. Southern advanced quickly \$1 and \$1.25 and Northern followed a week or two later with similar advances. There was active buying by the malleable works to cover their wants for the last half of the year; the grey iron foundries were not so quick to contract for their iron, but as soon as it became apparent that the tendency of the market was upward for an indefinite time, all classes of melters poured in their orders.

The maximum business of the year came in September and October, but prices continued to rise until December, when they stood \$19.25@19.75 for Northern No. 2 and \$18.15@18.65 for Southern No. 2. By December 15 most requirements for the first six months of 1906 were probably met, and foundrymen began to be reluctant about further contracts, in the belief that there would be a repetition of the usual January quiet and that prices would not immediately be advanced.

Highest and lowest prices for the year, with corresponding figures for 1904, are shown in the following table:

	1904		1905	
	Highest.	Lowest.	Highest.	Lowest.
Lake Superior charcoal.....	\$18.00	\$14.50	\$20.40	\$16.50
Northern foundry, No. 2.....	17.00	13.00	19.75	15.50
Southern foundry, No. 2.....	17.45	12.65	18.65	14.65
Bar iron.....	1.65c.	1.25c.	1.90c.	1.60c.
Tank plates.....	1.875c.	1.565c.	1.665c.	1.765c.

Remarkably heavy buying of rails and railroad supplies characterized the market from September to the close of the year. This business in December became comparatively quiet, but still heavy, orders being apparently limited only by the capacity of the mills. Western railroads have been the heavy buyers. The price of rails, standard sections, has been \$28 throughout the year.

Building materials have been in very good demand for the last half of the year. Beams and channels (3-in. to 15-in.), and angles (3-in. to 6-in.), advanced from 1.665c. in January, to 1.765c. in March, which latter price lasted until September, when an advance was made to 1.865c., the standard quotation for the rest of the year. The greatest business in structural material was done in September.

Iron and steel bars have been strong since September. Early in the year iron bars sold for 1.65@1.70c.; by the middle of June the price had dropped to 1.50@1.55c., but from Aug. 1 there was a series of advances that brought the price for the end of the year up to 1.85@1.90c. Soft steel bars brought 1.565c. in February, but advanced in March to 1.665c., which quotation prevailed for the remainder of the year.

Coke has been affected by both the variation in the iron market and trans-

portation conditions that made it scarce in the closing months of the year. In January and February it sold for \$5.40@ \$5.65 (\$2.75@\$3 at ovens) for 72-hour Connellsville. The minimum price became \$5.15 in July and August, and the car shortage raised quotations sharply in October, when Connellsville brought \$6.15@\$6.30 (\$3.50@\$3.65 at ovens). In December coke sold at \$5.90@\$6.40, with prices and supplies varying with the weather.

#### THE CLEVELAND IRON MARKET.

BY GEORGE H. CUSHING.

From the standpoint of activity in pig iron the past year has been unusual. Few years in the recent past will show such a steady demand throughout the twelve months. Few years have shown prices to be so steady. There were fluctuations to be sure, but closing prices are only \$1.50 to \$2 higher than the opening. Since so much of the year's business was done during the first few months and since the higher prices paid during the past few months have been on small lots and for future delivery, it is safe to say that the opening prices were close to the average price for the year. This is a most unusual exhibition. At the beginning of the year in this territory No. 2 foundry iron was selling around \$16.50 in the Valleys. The indications at the close of the year had been for a good business and the opening market verified the indications. Furnacemen, confident of the future, were buying ore to meet their prospective needs through the year. Before the end of the first quarter foundrymen were purchasing iron for second-half delivery. All appearances were for a year of uninterrupted industry. Toward the middle of the year the basic and bessemer markets had a certain influence on the entire situation. Foundry products were strong and the demand was unabated. But the Steel Corporation in May had an option upon some outside iron. This was not exercised, the information being vouchsafed that the Corporation did not intend to buy. Many of the foundry interests, failing to see in this move anything but a skeptical forecast of conditions, began to hedge. There was, during June and July, a hesitating tendency in the general market which was not encouraging. Under the pressure prices eased off, inasmuch as furnaces of all sorts were in need of business to keep them running. About that time the foundry interests in this territory combined to buy their iron at the lowest prices under a pooling arrangement. The market was in a condition where a big block of business would have coaxed out lower prices. But about that time the furnaces were out of their low priced ores and the cost of labor had been increased. The situation was such as to suggest that a sharp decline in prices was not to be considered. All interests,

therefore, combined to hold up the price of the iron and by this means the dull period of midsummer was tided over. The hesitancy on the part of the Steel Corporation was the usual uncertainty as to crops. Toward the middle of August it began to appear that bumper crops might reasonably be expected in all cereals. This immediately suggested a strong demand for steel and buying in pig iron was consequently resumed. Two or three big orders for steel-making irons opened the flood gates and all sorts of orders and inquiries began to pour in. From the low price of \$14 for No. 2 in the Valleys the quotation mounted steadily but gradually through the remainder of the year and closed at \$18 in the Valleys for No. 2, or \$1.50 a ton above the opening. Since most of the business done during the fall was on an average of about \$16, the statement is borne out that the average price for the year was close to that of the opening.

Toward the end of the year there was a burst of buying enthusiasm which suggested that period of 1902, when everything was booming. The difference was that it was on a larger and more liberal scale. In the past year and a half about 30 new furnaces have gone into blast in this territory. While the ore movement was exceptionally heavy, exceeding the receipts for any year in history, the figures show that consumption was closely abreast with the receipts. The year ended, therefore, with many of the consumers unable to supply their needs for pig iron from local furnaces and forced to rely upon outside sources for such material as they needed. There was such a striking demand for all grades of iron that producers are now of the opinion that the danger point as to prices is being reached and that the market is rushing, in its over-anxiety toward a setback.

*Finished Material*—The market for finished material opened strong in January and closed buoyant in December. Between times there was such active buying that the record made in 1902 was equalled and excelled. The most conspicuous feature in this market was structural steel. At the beginning there was a rush of buying by the larger interests. Some of the consumers thought this was but temporary and held off their orders until the spring was well advanced, hoping to get better prices. Toward the opening of the building season it was discovered that many of the Cleveland contractors were without their supply of material and that it could not be easily obtained. The buyers had to peddle their orders among several of the larger and smaller mills. It was then hoped that the easier times which usually come in July would enable the Cleveland contractors to supply their needs. Before that time arrived, however, other buyers had been in the market, especially the shipbuilding interests and the supply of steel was exceedingly short. This reached the extreme stage in Sep-

tember. To complicate the situation after that date there was an unequalled number of orders for new ships on the lakes. Before the end of the year this reached such proportions that the largest company on the lakes was unable to offer deliveries on ships before the following September, when the steel companies were buying the boats and offering to make any sort of delivery on steel the shipyards wanted. Under such stress as this there was a period for three months when the supply of steel to the smaller consumers and those who had not covered, came almost entirely from the jobbers. A few of the eastern mills, under belief that the market was going to be exceedingly strong, had conserved their supply for the open market and obtained premiums. The price advanced twice during the year. At the opening it went from 1.50c Pittsburg to 1.60c Pittsburg and in August there was another advance to 1.70c Pittsburg. Toward the end of the year there were sales as high as 3c at the mill for the smaller sizes, while 2.40c was common. The middle part of 1904 had seen a fight in the billet pool over a conversion contract which broke the prices. The opening of 1905 found the market strong and the material in good demand. The middle of the year brought a decline, when the material, for a time, was a drug on the market. Toward September, after the crops had been assured, there was another period of short supply and active bidding. Some of the biggest mills, which usually have their own supply, were in the market for as much as 50,000 tons. A little later on it was found that there was very little if any wrought steel to be had. Then some brokers who had bought on speculation, began to unload their holdings and obtained fancy prices. All through the year an effort was made to keep the association price at \$21.50 a ton Pittsburg. At the opening, as high as \$25 was paid and at the close of the year buyers were bidding \$30 to \$32 for bessemer billets, without getting any large quantity. The weak spots in the market were sheets and pipe. There was no time when either of them approached the state of buoyancy shown by the other lines. It was plain that even for the heavy consumption all through the territory in general lines, the mills were showing over-production. It was simply a case of the productive capacity running ahead of the need of the territories. In this respect a strong contrast is found with the structural business. In that trade the demand has been steadily on the increase while the productive capacity has not been appreciably increased. It has been a matter of open comment that sheet production is far ahead of the possible needs, while there is ample room for new structural steel capacity, if the demand is to continue at anything like the present pace.

In rail sales this territory has not been conspicuous. The big railroads operating

here, buy either through the New York, Pittsburg or Chicago markets. This leaves the Cleveland markets dependent upon traction developments, to a large extent, for rail tonnage. The unusual expansion in that sort of transportation companies, has brought about a steady demand for tonnage. The activity in the opening of new coal mines, has increased the demand for light rails. This demand carried that material to a premium almost constantly through the year.

Bars, both iron and steel, proved the most unsteady commodities in the market, fluctuating wildly both in price and in demand. In both lines the same demonstration was made as in some of the other grades, with the exception that the fluctuations were wider. The demand was strong at the opening of the year, grew very weak toward the middle and closed excessively strong. In bar steel the uncertainty during the latter part of May, June and July grew out of the conflicting reports as to the state of the crops. When this passed, buying of bars by the agricultural implement works immediately began. This was soon supplemented by the buying of the car-builders. At the close of the year bar steel was in such demand that the mills were compelled to stop taking orders and buyers had to peddle their wants. In bar iron the opening was strong. Toward the middle of the year the demand fell off, scrap dropped violently and it seemed there was an over-production. A few of the mills closed, being the exception to the general rule. But almost before the doors were closed and the repairs started, a new buying movement began, under the influence of lower prices. Mills cut short the time usually allotted to idleness and resumed operations in a week or ten days with repairs only partly completed. Inside three months from that date the supply for the remainder of that year had been sold up and by the opening of December a majority of the mills were making the announcement that they were sold up for the first half of 1906. The situation was altogether unprecedented, the mills shifting from weakness to strength overnight and then getting back in the dumps again, only to rally with the same surprising speed. All through the last half of the year mills were so besieged by buyers that salesmen were not wanted and forces were reduced. Toward the close the violent straining of the smaller mills against the bounds which held them to conservative prices, threatened to break the pools which, however, continued to hold, the conservative forces governing the market almost completely.

Although platinum is not oxidized in the air at any temperature, nor attacked by any single acid, yet there are many substances that attack and combine with it at comparatively low temperatures.

PITTSBURGH IRON AND STEEL MARKETS.  
BY S. F. LUTY.

The volume of business in the iron and steel industry in 1905 exceeded all former years. When official reports are compiled of production for the 12 months ending Dec. 31, they undoubtedly will show that records have been broken in most lines.

One of the features of the year was the success of the leading interests maintaining a steady market. Prices of the principal products varied but little and advances were not ordered at times when conditions seemed to warrant an increase. It was apparent that the associations or pools that meet to discuss trade affairs were determined to prevent a runaway market. Occasional readjustments were made and at no time during the year were pool prices known to have been shaded. Instead premiums were paid in a number of lines that were in great demand.

The steel mills were busy from the opening to the closing of the year and there was not a dull period except in a few lines in the summer months. Production of all finished steel products was

prices of bessemer iron fell below \$15 at furnace. During the year the Steel Corporation bought in these districts from 350,000 to 400,000 tons. Its first purchase was 25,000 tons in January at \$16.35, Pittsburg, which was 50c. less than the market, and the last for delivery in 1905 was 45,000 tons in October at \$17.35, Pittsburg. No purchases were made in the summer months and prices declined. The prices of pig iron at the opening and closing of the year show an advance of \$1.50 in bessemer, \$2 in foundry No. 2, and less than \$1 in gray forge. Bessemer iron sold in January at \$16.85 and 50c. less was the rate for the next three months, when there was a decline until the low point was reached in July, when sales were made at \$14.85. The January price of \$16.85 was established in October, and less than \$18 could not be done in the last two months of the year. The report of the Bessemer Pig Iron Association in January showed that 86% of the furnaces using Lake Superior ore were in operation and 96% were operating in December.

Average prices at Pittsburg, 1905.	Pig Iron.			Ferro-Manganese.	Steel.				Nails		
	Bessemer.	No. 2 Foundry.	Gray Forge.		Bessemer Billets.	Rails.	Sheets No. 28.	Tank Plate.	Steel Bars.	Wire per Keg.	Cut per Keg.
January.....	\$16.85	\$17.35	\$16.35	\$45.00	23.00	28.00	2.30	1.50	1.40	\$1.75	\$1.75
February.....	16.35	17.10	16.10	46.00	24.00	28.00	2.30	1.60	1.50	1.80	1.80
March.....	16.35	17.00	16.00	47.00	24.00	28.00	2.40	1.60	1.50	1.80	1.80
April.....	16.35	16.85	15.95	51.00	24.00	28.00	2.40	1.60	1.50	1.80	1.80
May.....	16.10	16.60	15.60	50.00	23.00	28.00	2.30	1.60	1.50	1.80	1.80
June.....	15.60	15.60	14.85	50.00	22.00	28.00	2.30	1.60	1.50	1.80	1.80
July.....	14.85	15.35	14.50	50.00	23.00	28.00	2.30	1.60	1.50	1.75	1.80
August.....	15.35	15.10	14.35	50.00	24.00	28.00	2.30	1.60	1.50	1.70	1.60
September..	16.10	15.60	14.75	54.00	25.00	28.00	2.30	1.60	1.50	1.75	1.60
October.....	16.85	16.85	15.85	62.00	26.00	28.00	2.25	1.60	1.50	1.80	1.65
November..	18.10	17.85	16.85	100.00	26.00	28.00	2.30	1.60	1.50	1.80	1.65
December..	18.35	18.35	17.10	125.00	26.00	28.00	2.30	1.60	1.50	1.80	1.70

greater than at any time in the history of the industry. Although the mills were operated to capacity, it was impossible to meet requirements in the last half and some of the sheet and tin-plate mills of the leading producer were forced to remain idle, owing to inability to get raw material. The greatest demand was for plates, bars and structural material, and the mills have orders booked that will keep them in steady operation for seven or eight months of 1906. One interest has orders yet to be filled calling for fully 500,000 tons of structural steel. The plate mills are crowded with business, owing to the heavy orders for cars placed by the railroads and big contracts from ship-building interests. Contracts were placed by agricultural implement makers early in August for over 500,000 tons of steel bars, for delivery through the season which extends to June.

The pig iron market was particularly interesting. Production in the Pittsburg and Valley districts was greater than ever before and profitable prices were maintained throughout the year. This was due partly to purchases of outside iron by the United States Steel Corporation at good prices, which resulted in stimulating the market. There was a weakness in July and August, when

One of the strange features of the bessemer pig iron market was that the tonnage sold was less in the months than prices were at the lowest point than at any other period of the year. A record of the large sales of the year was kept, but does not include the many sales of lots of 1,000 tons or less. It shows the following tonnages: January, 111,200; February, 112,900; March, 152,400; April, 49,000; May, 36,150; June, 34,100; July, 31,100; August, 29,400; September, 153,200; October, 120,100; November, 68,150. The estimated sales for December, and from 300,000 to 500,000 tons in small lots, bring the total sales recorded here up to over 1,500,000 tons. This does not represent the production in the Pittsburg and Valley districts, as it does not include the pig iron that went directly into steel making.

There was no shading of prices in any of the finished steel products, except possibly sheets and tin-plate, and this was due to the fact that the capacity of the mills of the country is greatly in excess of the demand. The pool price of steel billets remained at \$21 throughout the year but no sales were made at less than \$23 except in June, when only \$1 premium was asked. During the last quarter billets were quoted nominally at \$26. Sheet and

tin-plate bars commanded a rate of from \$1 to \$2 above billets. In February plates, bars and structural material were advanced \$2 a ton and wire and merchant pipe prices were increased \$1 a ton. The leading interest advanced sheets \$2 a ton in March, but the new rates were not generally maintained. Meetings of the plate, billet and beam pools were held in July and prices were re-affirmed. Some members wanted to order an advance but it was thought best to keep the old prices and quote premiums. Late in August structural material was advanced \$2 a ton, making the prices higher than at any time since 1899 and the first quarter of 1900. Beams were advanced to 1.70c. The price of beams at the opening of the year was 1.50c. and the price was advanced to 1.60c. on February 16. Narrow plates were advanced \$2 a ton in September by discontinuing the differential of \$2 on plates 14-in. and under, and making 1.60c. the uniform price for ¼-in. and heavier, 6¼-in. to 100-in. wide inclusive. On Oct. 1 the American Sheet & Tin Plate Company readjusted prices of tin plate. A rate of \$3.55 a box was announced on Dec. 22, 1904 but it was not maintained, sales being made as low as \$3.25 a box. The price was fixed at \$3.30@3.35 a box for 100-lb. coke plates. Prices of ferro-manganese were more active than any other commodity. The troubles in Russia caused a famine in manganese ore, and prices began to go up. Until the last quarter the average price was around \$50 a ton for 80% ferro. In October sales were made at \$62 and in November \$100 a ton was paid. Some sales were made at \$125 a ton in December. The Republic Iron and Steel Company in November announced 2c. as the price for iron bars, the highest rate quoted for many years, and \$10 a ton above the pool price for steel bars.

One of the large deals of the year was the contract made in March by the Pittsburgh Steel Company for 192,000 tons of steel billets. It called for deliveries to begin on July 1 and to continue for one year, the Republic Iron & Steel Company to furnish 6,000 tons monthly and the Carnegie Steel Company 10,000 tons monthly. The price was not made public, but it was said to be \$23, guaranteed against a decline. The contract made by the Pittsburgh Steel Company in 1904 called for 10,000 tons monthly from the Republic and 3,000 from the La Belle Iron Works. It ran for one year and expired on June 30. The additional 3,000 tons provided for in the new contract goes to the Seamless Tube Company, an allied interest of the Pittsburgh Steel Company, which completed a large tube plant in June. Late in June the steel market was considerably strengthened by another deal of the Pittsburgh Steel Company with the Carnegie Steel Company. It contracted to take its entire require-

ments of bessemer and open-hearth billets from the Carnegie interest for a period of years, exclusive of the contract now in force, and which will expire on July 1. The company consumes 200,000 tons of billets annually and the new contract calls for 1,000,000 tons.

The railroads were heavy buyers of equipment. The Pennsylvania placed orders for 37,321 steel cars and the Baltimore & Ohio for 10,000 cars. The steel plate mills and the car concerns in the Pittsburgh district will be greatly benefited by these contracts. Deliveries extend through 1906. The plate mills and car works have enough business to keep them in full operation through the new year.

The year was remarkable for the absence of labor troubles in the iron and steel plants. Wage scales were adjusted satisfactorily and in some instances on a higher basis than the previous year. The sheet and tin-plate workers, owing to the conditions in those lines, made some concessions. Early in January the Pittsburgh Erectors' Association made a settlement with the International Association of Bridge & Structural Iron Workers and also with the unions of other crafts employed, as all its members had important contracts and were kept busy through the year. The strike against the American Bridge Company, declared by the structural iron workers, interfered with the completion of some contracts in this district but the strikers did not suffer as they were at once employed by independent concerns that had urgent contracts. The rate for puddling at the opening of the year was \$4.90 a ton and in the last half it was \$5.50 a ton with a corresponding increase for the finishers. The puddling rate was raised to \$5.12½ on March 1 and owing to an advance in the price of bar iron on which wages are based the rate was increased to \$5.37½ a ton on May 1. The scale expired on June 30 and the Republic Iron & Steel Company entered into a new agreement with the Amalgamated Association of Iron, Steel & Tin Workers which provided for a base of \$5 a ton. All the independent interests accepted the new scale and under it a rate of \$5.50 a ton for puddling went into effect on July 1.

Steel rail orders did not come in as satisfactorily as in former years, not more than 750,000 tons having been placed up to Feb. 1. The outlook was not favorable, but later orders began to come in, and the tonnage was greater than the previous year. The price of steel rails for 1906 was fixed at \$28 a ton early in September and orders were placed rapidly by the railroads. Before the end of the year over 2,000,000 tons had been contracted for. The \$28 rate has been in force since April, 1901.

## The Lake Ore Trade.

BY GEORGE H. CUSHING.

It is now definitely ascertained that the lake and rail shipments from the head of the lakes amount to over 34,000,000 gross tons of ore. This compares with 22,500,000 tons during the season of 1904 and with 27,500,000 tons during the season of 1903. Going back over the figures for the past ten years we find that in 1895 the total movement was only a little over 10,400,000 tons. The shipments therefore in ten years have increased about three and one-half times.

The year closes with an extraordinary demonstration. Plans are being made for the shipment of even greater quantity of ore during the coming year 1906, the statements of conservative ore producers being that the shipments will add 1,000,000 tons at least to the output of 1905.

The movement of this immense amount of ore has not been without its interesting incidents. For one thing the production of this past year has fully demonstrated that the production of the upper lake territory has been verging close upon the capacity of the present mining machinery. The statement is made by conservative producers that, even taking into account the improvements in methods to be made during the winter, it will not be possible for the upper lake mines to produce more than 1,000,000 tons in 1906 in excess of what they produced in 1905. This is entirely aside from the question of what might be done with a larger bulk in case it should be produced. The question of lake tonnage has been, while not serious, at least interesting during the past year. Estimates have been made of the possible carrying capacity of lake fleets during the past five years which have had to be revised during the year 1905. As far back as 1900 and 1901 it was estimated that the lake fleet was 10% in carrying capacity in excess of any possible need for that year. That was when ore, coal and grain shipments showed their usual proportion to each other. Subsequently vast increases both in the size, number and speed of proportion of ships caused the statement to be made that existing lake tonnage was anywhere from 20% to 30% in excess of any possible demand. Under the circumstances it was a gloomy outlook for the lake vessel interests. The past year has brought a revision of this estimate.

The movement of coal was far less than was anticipated. Until late in the fall, the movement of grain was by no means a factor in the lake transportation methods. Lumber never interferes with the movement of the other coarse commodities, while package freight requires a class of boats constructed for that particular purpose and no other. It was an un-



expected and unusual feature, therefore, to find this excess supply of tonnage engaged at a rapid pace in the movement of iron ore. In fact had the other trades interfered to their usual extent with the movement of ore, the year's figures would have been radically different. As it was all boats were employed throughout the season at good rates and with the minimum amount of delays. This is illustrated by the statement that some of the vessel concerns will be able to pay a dividend of 20% during the winter, while others will not fall below a dividend of 10%, even though the boats belonging to those fleets be small and antiquated.

As a contributory cause to this rapid increased speed at the ore docks is not to be left out of consideration. At the beginning of the wave of prosperity which swept over the country in and after 1897 all the docks on the lakes were equipped with the now old-style traveling cranes and buckets operated by man and shovel power. At the present time this equipment is the exception rather than the rule, docks being supplied with automatic unloaders. In one instance only it is possible to unload one of the new 10,000-ton boats in less than five hours. But even the slowest of the automatic devices can unload that amount of ore in 15 hours. This time was formerly allotted to the hoisting of 3,500 to 4,000 tons of ore.

Another addition to the docking facilities on the lower lakes has been the expenditure of large sums by the railroads to readjust the yard facilities adjacent to the ore docks. In crowded districts, such as those at Cleveland and Ashtabula, it has been found necessary to reserve the space in the immediate vicinity of the docks for yard room, while the storage piles have been established at a considerable distance away, being served by engines and cars engaged exclusively in that business. The improvement in these facilities has enhanced the value of the docks as far as fast movement of materials is concerned. It has made possible the heavy movement down the lakes, by keeping boats in port, not to exceed an average of two days at a time. Another contributory cause is of course the increased equipment of the railroads.

At the beginning of the year there were no expectations of any such enormous shipment. The preceding year had been one of dullness in the lake trade. Toward the end of 1904 some improvement in conditions was shown, but this improvement was not of such a nature as to give rise to any extraordinary hopes. This was shown by the fact that ore prices had been reduced in order to coax buyers back into the market. The Ore Association had just been revived and its ability to govern the market was still open to question. Besides finished material market was not at that time firmly enough established on a solid footing to make

occasion for any sanguine prophecies as to the future of the trade. There was some uncertainty also in the standing of the furnaces themselves. Many furnaces had been idle for a good part of the time during 1904 and their number had been increased. Buying, consequently, was scattered through the year, some of the heaviest sales being made late in the season.

The developments proved that all furnaces might be kept actively employed throughout the year, a thing which is almost unprecedented in iron history, in view of their large number and the volume of their output. Not only that, but the amount of iron produced by each was rapidly taken up by the mill interests, with the result that the end of the year found an actual shortage instead of an excess of ore supply. It is apparent there is more ore on lake Erie docks than ever before. The total number of furnaces having increased, it is also evident there is more ore on the furnace stock-piles, in the aggregate than ever before. But the average amount on the stock-yard of each furnace has not been increased, but, on the contrary, appears to have been lessened.

The increased amount of ore having been shipped down the lake it is of course expected that the direct movement should have increased, since lake docks are not capable of having stored the difference between the former and the 1905 movements. But that the percentage of ore received and shipped direct has actually increased seems to be incredible. Yet such is the showing of the figures made by the railroad operating officials.

Another item which contributed to the heavy movement of ore is the absence of any labor difficulty. The year 1904 had been interrupted by the strike of the lake masters and pilots, delaying the opening of the season until June. At first there was a fear that this old fight would be resumed, but the peace arrangement made before navigation opened proved satisfactory through the year. The early opening of the season of navigation, the complete freedom from storms until after the principal volume of business had been moved, relieved the lake boats from any annoyance by delays and assisted materially in the heavy movements shown. It was apparent from the speed attained at the outset that the year was to be one of unusual shipment, which was borne out to the end of the season, even the stormy months of October, November and the first part of December, not being able to check the flow of the ore down the lakes.

At the close of the year an indication of the future was clearly given in the statement made by the head of the Ore Association that 96% of the ore to be shipped during the year 1905 had been sold before the close of the first week

in December. Buyers paid readily an increase of 50c. a ton for their ores, while some of the high-grade—and now scarce—ores brought as high as a 60c. increase.

That the vessel interests did not fully appreciate the importance of the past season is shown by the eagerness with which they accepted the same rates, as paid during 1905, for the transportation of this ore for 1906. These rates are 75c. from the head of the lakes to Lake Erie ports, 70c. from Marquette and 60c. from Escanaba. The peculiar ownership and control of lake fleets, however, at the present time, deprives the market of some of its former advantages. One of the evils of the lake ship trade is the prevalence of managers who have little or no interest in the fleets themselves, contrasting strangely with the old system of the owners managing their own boats. The alliance between these managers and the big steel and shipbuilding interests tends to establish lake rates on a stable basis.

### Lake Superior Iron Mines.

BY DWIGHT E. WOODBRIDGE.

In the course of a review of the Lake Superior iron ore trade of 1904, written a year ago, the present writer stated that, "it is necessary for Lake Superior miners to produce the coming season at a rate much above that of 1902, when 27,500,000 tons were forwarded. And mines are preparing to do this. On every range they are extending operations, and new properties are being opened, especially on the Mesabi, where not far from ten shippers will be in the field in 1905." The year then has now closed and the truth of this prophecy is demonstrated, even more decisively than was expected, and the shipments of the year, compared to those of 1905, or even of the banner year, 1902, look tremendous.

A year ago the various railways engaged in hauling ore to Lake Superior were arranging to spend about \$3,000,000 in additional facilities for hauling and loading ore. Two-thirds of this was by the roads running to the Mesabi range, and owned by the United States Steel Corporation. At present the various roads running to the Lake are arranging to spend about three times that sum, the total of their expectations at this time running up to \$8,750,000. Of all this vast sum the Duluth, Mesabi and Northern, whose operations are entirely confined to the Mesabi range, is spending \$4,500,000, and the two remaining roads that serve Minnesota mines, about \$1,500,000 more. Every shipping port on the upper lake and almost every railway company handling ore in quantity, has a share in this enormous expenditure, whose size is somewhat indicative of the expected increase in ore movement. Naturally the Mesabi range, whose proportion of the total

shipments is steadily increasing, is leader in betterments; and it is with reason, too, that the United States Steel Corporation, whose business is 56% of the whole, should be compelled to send more than all others combined.

The year 1905 has been one to test the facilities of every branch of the industry; mines on all ranges; railroads to Lake Superior ports; shipping on the lakes, receiving docks at lower lake ports and railways from Erie to interior furnaces. The enormous shipment of 33,500,000 tons, so far beyond anything that had been done in past years, and so much ahead of expectations, gave a severe proof of the ability of every link in the chain. The test was exceedingly satisfactory. But all facilities are to be materially extended during the present winter. In no preceding season have there been under construction so many ore pockets at upper lake ports as are contemplated now; never but once have the roads added so heavily to car and motive power equipment; in no previous year have there been such contracts for new ore ships; while the betterments at lower lake ports in the way of new unloading machines, both electric and steam, more stockpile room, added car equipment facilities to move ore from docks to furnaces, are on an important scale.

There has been talk of greatly increased ore shipments for 1906. Some estimates have gone even to 40,000,000 tons out of Lake Superior region. It is hard to see how such an increase can be made, or where the ore is to come from. It is undoubtedly true that the old ranges have practically reached their maximum; the additions of the immediate future must be from Mesabi. After such a magnificent jump as this range has made this year, 7,171,000 tons, is it capable of another of five or six million tons in a single season? It does not appear so. Neither railroads nor mines are now in position to stand such a strain, nor are the contemplated betterments of the winter calculated for such a tonnage, extensive and elaborate as they are.

For many decades the decennial increase of the Lake Superior region has been at the rate of about 300%. There have been seasons when this rate was not maintained, others when it was slightly exceeded. Without exception the lean years have been followed by extraordinary shipments, when the rate was fully up to or actually above this remarkable standard. For instance, the year 1904 fell far beneath the average ratio of growth. But 1905 has more than made up the difference and brought the comparative figures about as they have been for the past five decades. It is nothing less than wonderful that such a proportion should steadily be kept up, notwithstanding the enormous figures now attained each year. But the averages are as fol-

lows; and they show this vast increase per ten-year period to have been slightly exceeded for some decades:

Year.	Shipments for the Year.
1855 .....	3,000
1865 .....	194,000
1875 .....	881,000
1885 .....	2,467,000
1895 .....	10,430,000
1905 .....	33,500,000

For the decennial periods ending with each of these years the totals have been as follows, in round numbers:

Period Ending.	Shipments for Period.
1855 .....	78,083
1865 .....	864,186
1875 .....	6,822,806
1885 .....	17,433,226
1895 .....	70,063,845
1905 .....	201,513,647

The tendency of the past few years toward concentration of iron ore properties in the hands of large consuming interests, has been carried forward and emphasized by the events of the year. Several of the more important independent mining interests, which at the beginning of the year had mines producing standard bessemer ores in quantity and covering a wide variety of physical and chemical characteristics, have cleaned up their entire holdings, which have passed into the hands of various furnace concerns. These mines, which were among the most prominent sellers of ore on the public market, are now off the list altogether, their owners intending to conserve these excellent ores for their own benefit. The price of explored but undeveloped properties on the Mesabi range and elsewhere has also risen in a marked degree, and ore in the ground now approximates 7 and 8c. a ton above royalty rates. These prices are not for the desirable high grade ores of the old or even of the Mesabi ranges, but are for ores that a few years ago would not have been considered as good for much else than road material, averaging no better than 56 or 57% and heavily charged with moisture.

In this connection comes to mind the fact that the iron content of ores shipped from Lake Superior has declined materially during the past few years, and is still dropping. It is a corollary to the ownership of mines by the steel-making companies, which are not liable to make so great objection to lean ores if from their own mines as they would if the same grades came from properties of others. The extended use of these lean ores will tend to prolong the life of many a property on the various Lake ranges far beyond the limits that has been set, for there is an enormous tonnage of such ores that had never been figured as available, and would not be to-day if the mines were selling on the open market. To-day there is far more mixing of ores at the mines to get a grade that will pass, than in the old days, when the furnaceman bought grades and made his own metallurgical mixture.

All these things have tended to increase royalty rates, and while many

leases are still made at the old figures of from 20 to 30c a ton, there is a stiffening of other conditions. Ores of high grade and easily mined now bring practically their own price, in the ground. The average mining man has not, in the past, discriminated sufficiently between a low royalty and a high cost of mining on the one hand, and a higher royalty and a mining cost that is at least sufficiently low to make up for the difference in royalty rate, on the other. The higher royalty has usually been asked, too, for an ore worth far more in the open market than that for which the ordinary rate was asked, so that the man paying a high royalty almost invariably got, not alone a better ore and salable for a higher price, but one that could be mined from 10 to 25c a ton less than others. A few well located and easily mined properties, containing small tonnages of high grade standard bessemer ores, have recently been leased at prices from two to three times the average rate, but they are exceptional and cannot be considered either as fixing a rate or as establishing a precedent. Fee owners generally are looking for higher figures, or some other inducements in their leases, and demand the best lessees; some large tracts of land are taken off the market altogether for the time being. Still, on the other hand, there are large tracts still to be had at old figures, tracts that in some cases show ore and give every indication of carrying great quantities of fairly desirable iron.

The activity of various mining and steel-making interests in securing located ore deposits has had its natural effect in the renewed search for mines. There has been this year an awakening of widespread importance in the exploration of ore-bearing lands in the Lake Superior region. This has been not alone on the favorite Mesabi range, but in other districts that had been passed by and neglected for years in favor of the Mesabi. Even the Vermilion range, whose exploration record has shown a series of dismal and costly failures ever since the finds at Ely, in the mid-80's is attracting much attention. Many drills are now working there, and several shafts are going down through hard jasper and iron formation rocks. The indications are what they have always been on that range, but no man can say what may be the result. It is probably true that millions of dollars have been expended in drill and other work on the Vermilion, with no return, and in spite of the extended search, for many years, the original Soudan location and the Ely basin so far remain the sole source of ores in the district. Explorations are in general progress on the Menominee range, where the formation is so broad and strong as to allure many of the best men in the business. Finds have been comparative-

ly few, but more than in any other range aside from the Mesabi and the opportunities there are generally conceded to be the best in the Lake region to-day. Outlying portions of the Marquette district are also under exploration, and with some measure of success. The deep development of Gogebic mines, mentioned a year ago, is still in progress and is just now especially notable on the western end of the district, where important developments may be reported soon. Deep work in the Newport and other mines of the central portion of the range has shown its ores to be persistent with depth, and to make under what were supposed to be base dikes as well as beneath minor dikes at higher altitudes. A little exploration has been carried on lately in the Michipicoten region, but nothing is known as to its results. On the western Mesabi range, where the larger companies were working a year ago, they have maintained steady and elaborate operations. The Oliver Iron Mining Company, especially, has become deeply interested in that part of the range, and has been continually picking up lands and developed properties. It has now under construction a railway to the center of this new district, which has been expected to be in readiness for ore traffic during the early part of 1906, and from which it has hoped to ship more than 1,000,000 tons the coming season. Unexpected and unavoidable delays, however, have conspired to check construction, and it may be late in the year before mining can commence on a scale of much importance. The company has an enormous tonnage in sight in this part of the range, mostly of ore that must be milled to extract its excess of free sand, but that, once washed, will be of good physical and chemical character and excellent in the furnace. The district is one in which large capital is required for preliminary operations, as well as for the actual mining of its ores. Its deposits are very wet, so deep that no surface mining is probable, and of such a character that sales to independent consumers, appear improbable. In addition to the Oliver Company the Great Northern road has heavy investments in the district, and between these two practically all the region is parcelled out.

In new districts about Lake Superior exploration has progressed with considerable activity. The most interesting of these is what is called the Deerwood region, about 100 miles west of Duluth, close to the main line of the Northern Pacific road, in a region that presents almost no surface indications. This was carefully studied by Mr. Cuyler Adams with the aid of the dip needle. He, and others who have followed his lead, have found lines of magnetic attraction with a strike generally northeast by east and southwest by west, usually practically parallel, and at some points of their work quite numerous. Drilling has been car-

ried along above and near these lines and a very large tonnage of low grade ores has been shown up. From 20 to 30 drills have been employed in this work all the year, and it was supposed a year ago that by the close of 1905 it would be possible to determine quite accurately the probabilities of the district. But it is difficult to determine much with vertical holes in a vertical formation, such as this appears to be, and very little more is known to-day than was apparent a year ago. A few drill holes show a non-bessemer ore suitable for foundry use in quantity sufficient to mine. A few have shown seams of merchantable ore, but these do not seem to be economically valuable, at least not now. Scores of holes have been sunk through ore running from 20 to 45% iron, high in phosphorus, high in manganese, and the tonnage of this rock exposed is probably very great. Some of the ore is very high in manganese, but the combined analysis is, in most cases, so low as to make it of little worth. A great many million tons have been shown in the district up to date, but the bulk of it is mere rock. With so much of this lean ore it will be surprising if somewhere, in addition to the comparatively light tonnages of good material that have so far been shown, other finds are not made. Scattered along the district are from 30 to 40 drills, all hard at work. One shaft has been sunk and a crosscut has been driven through the ore, but with no very satisfactory result. Several consuming interests identified with the Republic Iron & Steel are to try it soon.

An interest in the newly discovered Moose Mountain range, lying north of Georgian Bay, in Canada, has passed into the hands of prominent railway men of that country. A railway is to be extended to the district, ore docks will be constructed on Georgian Bay, and the shipment of ore to American furnaces will begin in a small way the coming season. The control of these deposits, which are much greater than is generally appreciated, rests with Americans who are identified with the Republic Iron and Steel Company.

Developments have been carried on a part of the year in the Atikokan region of western Ontario, with the intention of utilizing its high grade magnetites in furnaces to be erected on Lake Superior and for shipment to other points in Canada. Developments in other parts of western Ontario have ceased, for the time being, at least, and the general opinion seems to be that little of value has been found, despite many remarkable statements that have been made.

Work has continued on the Baraboo range during the year, and there has been slow but steady mining from its single mine. Developments in the district have not been as satisfactory as was hoped, and there is little prospect that much more

will be done in a mining way for some time.

Ten years ago the largest iron ore cargo on the Great Lakes was about 4,000 gross tons. Four years ago it had increased to 7,400 tons, this time on one of the barges of the then new Pittsburg Steamship Company. In 1903 the biggest load of ore was 7,800 tons, on the steamer *Edenborn*. The following year the *A. B. Wolvin* broke all records with 10,250 tons and this year the new *E. H. Gary* of the Steel Corporation, carried out of Lake Superior 12,328 tons. The record is still rising and the largest cargoes of 1906 are likely to be above 13,000 gross tons. Eight ships are now under construction for steel making companies, each of which is to be 600 ft. long, or 32 ft. longer than anything now afloat. The lake shipbuilding companies have more than 30 iron ore vessels under construction, the average cargo capacity of which will be better than 9,000 gross tons. These ships will have an aggregate season capacity for 5,750,000 tons of ore, and will give ample facilities for any probable addition to the ore shipments of the year. The annual increase in cargo capacity of lake shipping is a notable one, and this year has been as marked as ever. At the docks of the Duluth, Missabe & Northern road the records of the past few years show that the annual increase in average load taken from the docks has been as follows, in gross tons:

The shipments of iron ore from the Lake region during the season of navigation, by ports, are given below; the shipments from the Michipicoten range in Canada being appended:

Port	1904.	1905.	Changes.
Escanaba.....	3,644,267	5,307,938	I. 1,663,671
Gladstone.....	480	.....	D. 480
Marquette.....	1,907,301	2,977,828	I. 1,070,527
Ashland.....	2,288,400	3,485,344	I. 1,196,944
Superior.....	4,169,990	5,118,385	I. 948,395
Duluth.....	4,649,611	8,807,559	I. 4,157,948
Two Harbors.....	4,566,542	7,779,850	I. 3,213,308
Total.....	21,226,591	33,476,904	I. 12,250,313
Michipicoten.....	117,153	169,527	I. 52,374
Totals.....	21,343,744	33,646,431	I. 12,302,687

The all-rail tonnage is not yet completely made up; so far as ascertained it was 456,000 tons. Adding to this an estimate for December rail business, the following statement will show the total carried by the various railroads serving the mines, during 1905:

	Tons.	
Duluth, Missabe & Northern.....	8,804,443	25.9
Duluth & Iron Range.....	7,778,768	22.9
Great Northern.....	5,118,385	15.1
Chicago & Northwestern.....	6,729,975	19.8
Lake Superior & Ishpeming.....	1,844,823	5.4
Duluth, South Shore & Atlantic.....	1,243,388	3.6
Chicago, Milwaukee & St. Paul.....	1,310,021	3.9
Wisconsin Central.....	799,394	2.3
Wisconsin & Michigan.....	100,000	0.3
All rail not included above.....	98,000	0.3
Total U. S. lines.....	33,827,197	99.5
Algoma Central & Hudson Bay.....	169,527	0.5
Total.....	33,996,724	100.0

The estimate for December rail tonnage is a conservative one, so that it is possible that the corrected figure may be a little over 34,000,000 tons.

The tonnage by ranges for three years

was as follows, in long tons:

	1903.	1904.	1905.
Marquette.....	3,040,245	2,843,703	3,941,701
Menominee.....	3,749,567	3,074,848	4,700,556
Gogebic.....	2,912,912	2,398,287	3,483,344
Vermilion.....	1,676,699	1,284,513	1,676,714
Mesabi.....	12,892,542	12,156,008	20,024,882
Total U. S.....	31,271,965	21,755,359	33,827,197
Michipicoten.....	201,387	117,153	169,527
Total.....	31,473,352	21,872,512	33,996,724

The increase in 1905 over 1904 was 12,124,212 tons, or 55.4%; over 1903 it was 9,523,372 tons, or 38.9%. This year's figures again show the growing importance of the Mesabi, which supplied 58.9% of the total ore, comparing with 13.8% for the Menominee, 11.6% for the Marquette, 10.3% for the Gogebic, 4.9% for the Vermilion, and 0.5% for the Michipicoten range.

**Arsenic.**

The output of white arsenic in the United States in 1905 was 875 short tons, valued at \$52,481, as compared with 498 tons, worth \$29,504 in the preceding year. The Everett plant, of the American Smelting & Refining Co., treating the arsenical pyrite of the Monte Cristo mines, increased its output somewhat. The Washoe smelter at Anaconda, Mont., belonging to the Amalgamated Copper Co., began to ship refined white arsenic in 1905. This is recovered in dust chambers in the main flue from the Brunton roasters, and is re-sublimed and crystallized in a specially constructed refinery, built during 1904. The white arsenious oxide, averaging 99.8% pure, is shipped in carload lots. One new arsenic furnace has been ordered and the capacity of this department will be enlarged.

The realgar deposits on Mineral creek, Lewis county, Washington, are still under development, most of the year having been occupied in enlarging and altering the plant, which is expected to be in full operation in 1906. A considerable amount of white arsenic was recovered during experiments, none of which was marketed. Production at the arsenic mines at Brinton, Va., was suspended during the year, while the mine underwent development.

Arsenic is in steady demand by the tanning industry, and the manufacturers of paris green. It is used to some extent in the preparation of aniline colors, where it is valuable for its oxidizing property.

Palladium is occasionally used for scales on scientific instruments when a white metal is desired which will not tarnish nor corrode. The consumption of palladium is very small. The only other commercial use is in the automatic gas igniters which depend upon the property palladium has of bringing about the combustion of illuminating gas. Finely divided palladium is mixed with platinum black (finely divided platinum) and a pellet of asbestos is coated with this mixture. As soon as the gas strikes the pellet, combustion follows.

**Coal.**

BY FREDERICK HOBART.

The coal production of the United States, which reached a total of 350,740,062 short tons in 1904, was still larger in 1905, the total being 373,207,956 short tons, a gain of 6.3%. The production given in the accompanying table is necessarily estimated for the closing months of the year, but it is believed that it will not differ materially from the complete figures to be collected later. The year 1905 was generally a prosperous one for coal miners. Demand for coal was large, and the talk of over-production which was heard so much in 1904 and in the earlier part of the year just closed, has gradually died out. The increased production was generally absorbed by a consumption which was without parallel in previous years. In the last quarter of the year mining was interfered with to a considerable extent by difficulties in railroad transportation. There was not equipment enough to move the coal offered, and this difficulty was sufficient to restrict mining in many places. This was the greatest trouble of the year.

PRODUCTION OF COAL IN THE UNITED STATES.

States.	1904. Short Tons.	1905. Short Tons.
<b>Bituminous:</b>		
Alabama.....	11,273,151	12,000,000
Arkansas.....	2,009,451	2,100,000
California.....	79,062	48,558
Colorado.....	6,721,147	8,844,711
Georgia and N. Carolina.....	400,191	385,600
Illinois.....	37,077,897	37,183,874
Indiana.....	9,872,404	9,772,000
Indian Territory.....	3,011,972	3,000,000
Iowa.....	6,542,005	6,510,000
Kansas.....	6,323,875	6,600,000
Kentucky.....	7,167,324	7,325,000
Maryland.....	4,277,196	4,200,000
Michigan.....	1,414,834	700,000
Missouri.....	4,115,695	4,733,164
Montana.....	1,359,409	982,000
New Mexico.....	(f) 1,613,334	1,576,000
North Dakota.....	269,297	290,000
Ohio.....	24,583,815	25,665,800
Oregon.....	111,540	112,500
Pennsylvania.....	99,660,167	110,625,000
Tennessee.....	4,782,302	5,200,000
Texas.....	1,195,944	1,200,000
Utah.....	1,563,274	1,594,943
Virginia.....	3,576,092	4,023,103
Washington.....	2,905,689	2,850,000
West Virginia.....	30,222,881	35,000,000
Wyoming.....	4,996,828	5,100,000
Alaska and Nevada.....	78,868	85,000
<b>Total.....</b>	<b>277,065,582</b>	<b>297,706,453</b>
<b>Anthracite:</b>		
Colorado.....	55,404	60,503
New Mexico.....	24,707	24,000
Pennsylvania.....	73,594,369	75,417,000
<b>Total.....</b>	<b>73,674,480</b>	<b>75,501,503</b>
<b>Grand Total.....</b>	<b>350,740,062</b>	<b>373,207,956</b>

PRODUCTION OF COKE IN THE UNITED STATES.

States.	1904. Short Tons.	1905. Short Tons.
Alabama.....	2,340,219	2,600,000
Colorado and Utah.....	789,060	1,381,449
Georgia and N. Carolina.....	75,812	69,500
Indian Territory.....	44,808	51,530
Kentucky.....	64,112	67,320
Montana.....	41,497	35,272
New Mexico.....	10,150	85,000
Ohio.....	109,284	126,000
Pennsylvania.....	13,281,475	16,250,000
Tennessee.....	379,240	380,000
Virginia.....	1,101,716	1,267,000
Washington.....	45,432	45,000
West Virginia.....	2,276,451	2,467,000
Other States.....	1,476,036	1,500,000
<b>Total.....</b>	<b>22,035,292</b>	<b>26,219,071</b>

Pennsylvania continues to lead the coal mining industry of the country. Produc-

ing practically all the anthracite and 30% of the bituminous, its mines furnished about 49% of the total coal output. Following it, but at a long interval, the important coal producers in order were Illinois, West Virginia and Ohio, mining respectively 9.8, 8.4 and 6.7% of the total. West Virginia is growing faster than any other State, and the probabilities are that, in two or three years at most it will pass Illinois and take second place in the list.

The year has been marked by the opening of new mines in different fields, but to a greater extent by the introduction of improvements at many mines; largely in the way of the introduction of mechanical haulage, the use of electricity for transmitting power, the installation of washing plants and generally in the application of labor-saving appliances and the improvement of the marketed product. The use of coal-cutting machines made less progress in 1905 than in some previous years.

The production of anthracite in Pennsylvania, as given in the table, has been ascertained as below; the shipments of anthracite being always reported in long tons:

Shipments from mines, 11 mos.....	76,015,088
Shipments in December, estimated.....	5,200,000
<b>Total shipped to market.....</b>	<b>81,215,088</b>
Used in operating mines, etc.....	6,121,509
<b>Total mined, long tons.....</b>	<b>87,336,597</b>
<b>Total mined short tons.....</b>	<b>75,416,989</b>

The proportion allowed for use at mines and breakers, and by employees, is the average for a series of years, as shown by the Pennsylvania reports. Of the coal shipped to market about 62% is of the larger sizes, known as prepared sizes, which are used for household purposes and are sold at full prices. The remaining 38% is of the small or steam sizes, which come, to a considerable extent, in combination with bituminous coal and are sold at lower prices than the prepared sizes. The coal used at collieries is almost entirely of the small sizes. Included in the shipment is a certain quantity of what is called washery coal; that is, small coal obtained by washing the old culm banks which abound in the anthracite region. For several years this has been from 3 to 4% of the total, but it has a tendency to decrease as the old banks, which accumulated when the saving of coal was not so close as it is now, are gradually exhausted.

The shipments of bituminous coal to the seaboard for consumption were, probably, the largest on record, and the demand for coal throughout the eastern territory was very large. Conditions in the central West also favored a large output.

The shipment of coal up the Lakes, which supplies a large and growing section of the Northwest, increased in a much smaller proportion than had been expected, notwithstanding the advantages of a long season of navigation. The total shipments reported from Lake Erie ports

for the season of 1905 were 10,574,198 tons; as the total for 1904 was 9,297,480 tons, the increase shown was only 1,276,718 tons, or 13.7%; a considerable gain but still a disappointment to shippers. In part this is accounted for by an increased tonnage of all-rail coal—largely from Illinois—which is placed at the receiving ports on Lake Michigan. The coal tonnages reported as passing through the Sault St. Marie canals—that is the portion of the tonnage which goes to ports on Lake Superior—was as follows:

	1904.	1905.	Changes.
Anthracite.....	991,228	984,701	D. 6,527
Bituminous.....	5,463,641	5,524,355	I. 60,714
Total.....	6,454,869	5,509,056	I. 54,187

The total increase was only 0.8%, though the use of coal for mines, railroads and other purposes in the Lake Superior district must have showed a much larger gain. In part the small gain was due to the difficulty in securing cargoes promptly toward the end of the season.

The accident record of the year has not been a good one, and a number of explosions and other disastrous calamities have been recorded. It looks very much as if attention had been so much concentrated in increasing production, that precautions for safety had been measurably neglected.

**Coke.**—The great activity of the iron trade through a large part of the year caused a strong demand for coke, and the increased production over the previous year is estimated by good authorities at 20 to 25 %. The Connellsville region in Pennsylvania furnished a part of this increase, and there was also a large advance in the coke output of West Virginia.

**Connellsville Coke.**—The production of coke for the year is estimated in round numbers at 16,000,000 tons. Of this tonnage the production of strictly Connellsville coke was almost 13,000,000 tons and in the Masontown and other fields the output was a trifle over 3,000,000 tons. Prices of standard Connellsville coke at the opening of the year were practically the same as at the close, but there was a big drop in the middle of the year. In January furnace coke sold at \$2.75 and \$3, but contracts for the first quarter were made at the rate of \$2.50. Foundry coke was quoted at \$3 and \$3.25. In May prices declined to \$1.90 for furnace and \$2.70 for foundry. In June there was a further decline and the low point of the year was reached with furnace coke at \$1.80 and foundry at \$2.70. In October prices were firm at \$3 for furnace and \$3.50 for foundry. These prices prevailed until December, when there was slight weakening for prompt shipment.

**Changes and Consolidations.**—Changes in anthracite coal ownership have not been important, and are referred to in the article on the anthracite coal trade, which follows.

In the western bituminous field there were many changes, all in the direction of combination and consolidation. In the Pittsburg district the changes are noted elsewhere. In Indiana several combinations have been found which include a number of smaller companies, the most important being the Vandalia Coal Company. The same condition exists in Southern Illinois, where a number of small companies have been brought into three large concerns. In both Indiana and Illinois the new combinations are either directly under railroad control, or have intimate relations with the railroads, the evident object being to put the contract of the business as much in the hands of the railroads as possible.

In the central and northern field of Illinois there were many changes of ownership, here also the tendency being to consolidation. The railroad control, however, is not manifest in those fields, most of the changes having been for partly business reasons.

In Ohio there were not many changes. In West Virginia there was a good deal of buying of undeveloped coal lands. Some of these were bought for immediate opening, but a large proportion will be held in reserve, at least for a time. An important area of coal territory in West Virginia will be opened by the construction of the Deepwater-Tidewater railroad, the western end of which is now well advanced toward completion, and will furnish an outlet for many new mines. The eastern end of this new road will nearly parallel the Norfolk & Western for many miles, and the road will have its tidewater terminus on Hampton Roads.

West of the Mississippi few changes are to be reported. In the coalfield of the Indian Territory there has been some consolidation the new developments are promised for the coming year.

**Labor Conditions.**—The coal fields have been measurably free from strikes and labor troubles. Some disputes have arisen in Kentucky and Tennessee and in the central district of Pennsylvania, but these have been generally settled by agreement. Some trouble threatened from the passage of the Illinois law requiring the employment of shot-firers. A question arose over the payment of these men, but it was finally settled by arbitration.

Since the great strike of 1902, the anthracite mines have been operated under the compromise award made by the Anthracite Strike Commission. The bituminous coalfields of Pennsylvania and the mines of Ohio, Indiana and Illinois have been under what is generally known as the Inter-State agreement of 1904. Both agreements will expire on April 1, 1906. Then have been all sorts of rumors of a general strike to come on that date, most of them having very little foundation thus far. The United Mine Workers

in the anthracite region have already held a convention which has placed negotiations with the operators in the hands of President Mitchell and The Executive Committee. The anthracite trade is so closely controlled, that the whole business is in the hands of a few men, and the present probabilities seem to be that the agreement may be renewed, with a continuation of the Conciliation Board to settle minor disputes.

In the West a convention is to be held in Indianapolis in January to form a new agreement if possible. There also the present indications are in favor of a peaceable settlement, though there is still some uncertainty felt. An attempt was made to force the operators into an association which would meet the miners as a unit; but it failed practically, because the Pennsylvania and Ohio operators refused to join in the movement. Should trouble arise in the West, there will be, as there was two and seven years ago, an important disturbing element found in the position of West Virginia, where the miners have never been affiliated with the general organization.

The strike of the United Mine Workers in Alabama, which began in 1904, still nominally continues. The large furnace companies, however, seem to have been successful in establishing the "open shop," and the production of the State shows a fair increase.

**Foreign Coal Trade.**—The exports of fuel from the United States for the 11 months ending November 30, are reported by the Bureau of Statistics of the Department of Commerce and Labor as follows:

	1904.	1905.	Changes.
Anthracite.....	2,110,544	2,082,483	D. 28,061
Bituminous.....	5,861,227	6,478,739	I. 617,512
Total coal.....	7,971,771	8,561,222	I. 589,451
Coke.....	478,033	552,938	I. 74,905
Totals.....	8,449,804	9,114,160	I. 664,356

With the exception of some which is taken by Canadian blast furnaces, the coke goes chiefly to Mexico. The distribution of the coal exports was as follows:

	1904.	1905.	Changes.
Canada.....	6,135,685	6,529,926	I. 394,241
Mexico.....	823,621	827,970	I. 4,341
Cuba.....	457,026	519,072	I. 62,046
Other W. Indies...	219,561	277,020	I. 57,459
France.....	10,694	4,504	D. 6,190
Italy.....	69,116	67,428	D. 1,688
Other Europe.....	60,462	29,000	D. 31,462
Other countries..	196,606	308,302	I. 111,696
Total.....	7,971,771	8,561,222	I. 589,451

Naturally our large exports are to adjoining countries, such as Canada, Mexico and the West Indies. It may be added that most of the coal exported to other countries goes to South America. The exports to Canada in detail were:

	1904.	1905.	Changes.
Anthracite.....	2,081,200	2,046,173	D. 35,027
Bituminous.....	4,054,425	4,483,763	I. 429,338
Total.....	6,135,625	6,529,926	394,301

Canada thus took 98.3% of the anthracite exports and 69.2% of the bituminous

ous or 76.3% of the total coal exported in 1905.

Imports of coal and coke into the United States for the 11 months ending Nov. 30 were as follows:

	1904.	1905.	Changes.
Canada.....	1,106,361	1,184,583	I. 78,222
Mexico.....	221	38	D. 183
Great Britain.....	116,799	58,013	D. 58,786
Other Europe.....	60	359	I. 309
Australia.....	213,419	165,282	D. 48,137
Japan.....	44,829	41,956	D. 2,873
Other Countries.....	759		D. 759
<b>Total.....</b>	<b>1,482,438</b>	<b>1,450,231</b>	<b>D. 32,207</b>
Coke.....		64,988	I. 64,988
<b>Total.....</b>	<b>1,482,438</b>	<b>1,515,219</b>	<b>I. 32,781</b>

With the exception of some Nova Scotia coal received at Boston, the greater portion of the imports is on the Pacific Coast. A little of the coke comes from Germany, but most of it from British Columbia. Of the imports in 1905, there were 26,072 tons classed as anthracite, the rest being bituminous coal.

*Foreign Countries*—The production in Great Britain showed no material change, and the increase was only moderate, as it has been for several years past. It is safe to estimate the total at about 240,000,000 long tons, or 268,800,00 short tons. Great Britain is the chief coal exporter of the world, between 35 and 40% of the coal mined being used beyond the limits of the country, either as exports, or by steamships engaged in foreign trade.

The coal production of Germany for the 10 months ending Oct. 31 was 142,389,667 metric tons, of which 99,151,160 tons were coal and 42,438,507 tons brown coal, or lignite. The total increase was 2.5%. Imports and exports nearly balanced each other. The figures indicate a total for the year of about 171,000,000 tons.

Austria-Hungary, France and Belgium, the other large European producers, show little change from year to year. Austria-Hungary exports some coal, but France consumes more than she produces.

In the year 1905 the world probably mined and consumed at least 900,000,000 metric tons of coal. Of this great quantity the United States contributed, in round figures, 350,000,000 tons; Great Britain 240,000,000 and Germany 171,000,000 tons. The three countries named furnished 85% of the world's coal supply.

In the Durham collieries, England, the pillar and stall system of mining is carried out to great perfection. The proportion of coal taken out in the first working depends upon the depth, because the greater the depth, the larger the pillars. It was at first almost universal to take out in the first instance about 33%, leaving about 66%. In the present practice, not more than 20% is taken out in the very deep pits in the first instance, leaving very large pillars, which it has been found can be subsequently worked out with practically no loss at all.

#### THE ANTHRACITE COAL TRADE.

The past year's conduct of the hard-coal market bears striking tribute to the benefits of centralized control. Not only was the largest annual output of anthracite ever produced in this country marketed without the slightest fluctuation from established prices, but its monthly quotas were forthcoming with the regularity of any well-established manufacturing enterprise. The realization of this latter condition in the trade, advantageous alike to miner, transporter, and consumer, has resulted from the four years' operation of the retrograding summer discount scheme, through which, by common consent of the operators, a reduction of 50c. per ton on prepared sizes takes effect on April 1, to be restored by monthly increments of 10c. until it disappears in September. For two years now, as a result of this plan, April, May and June have seen the heaviest shipments of the year; a complete inversion of the course of shipments in earlier years, and accomplished in spite of the preponderating importance of domestic anthracite for winter fuel.

Returns of December shipments are not yet available, but estimating them at below the average of the previous 11 months, on account of the interruptions of the holiday season, the total marketed output of the Pennsylvania anthracite fields in 1905, which went to its destination by railroad, was something over 61,000,000 long tons, as compared with 57,492,522 tons in 1904 and 59,362,930 tons in 1903, which year, coming after the disastrous strike of 1902, had established a phenomenal record.

Yet this tremendous output was attained without special effort. During August, many mines were shut for days at a time; shipments suffered from exceptionally bad weather early in the year, and from insufficient car supplies during its closing months, and at no time were the selling agencies besieged with buyers. When figures representing the total output of the mines can be ascertained, the increase of 1905 over all previous years will be still more accentuated, since the continuous effort recently has been to lay up and keep intact, great stocks of coal against a possible shortage in the summer of 1906.

Shipments over the anthracite-handling railroads, during the first 11 months of 1905 compare with the same period of 1904 as follows, the figures being in long tons:

	—1904.—		—1905.—	
	Tons.	Per Ct.	Tons.	Per Ct.
Reading.....	10,343,278	19.8	11,527,650	20.6
Lehigh Valley.....	8,717,519	16.6	9,183,971	16.4
N. J. Central.....	6,576,157	12.6	7,294,948	13.0
Lackawanna.....	8,546,309	16.3	8,606,889	15.4
Del. & Hudson.....	4,837,197	9.2	5,188,872	9.2
Pennsylvania.....	4,363,603	8.3	4,449,749	7.9
Erie.....	5,221,145	9.9	5,687,993	10.2
N. Y., Ont. & W.....	2,410,739	4.6	2,611,323	4.7
Del., Sus. & Schuyl.....	1,413,431	2.7	1,463,693	2.6
<b>Total.....</b>	<b>52,429,378</b>	<b>100.0</b>	<b>56,015,988</b>	<b>100.0</b>

It must be remembered that these tonnages do not include coal used at the mines nor that sold locally, these two points of consumption averaging respectively 9.5%

and 2% of the total output; neither do they include fuel supplies to the shipping railroads' locomotives.

Changes in tonnage, and in proportion of shipments, were:

	Tons.	Per Ct.
Reading.....	1,184,372	1. 0.8
Lehigh Valley.....	466,452	D. 0.2
N. J. Central.....	718,791	1. 0.4
Lackawanna.....	60,580	D. 0.9
Del. & Hudson.....	351,675	0
Pennsylvania.....	86,146	D. 0.4
Erie.....	466,848	I. 0.3
N. Y., Ont. & W.....	200,584	1. 0.1
Del., Sus. & Schuyl.....	50,262	D. 0.1

Every road showed an increased tonnage, though all did not partake equally of the total increase. None of the changes is striking; it was known that the Reading had been accelerating its coal production, and that the Lackawanna has had to curtail the output of several of its largest collieries pending the installation of improved mine plants and breakers.

New York harbor trade in the domestic sizes recorded no noteworthy events, its ups and downs having been synchronous with the fluctuation of the thermometer. The 50c. discount on April 1, even though magnified by the local dealers to a concession of 65c. per ton on domestic sizes, created no enthusiasm, although dealers had no difficulty in disposing of their consignments promptly upon arrival. Ominous reports of growing dissatisfaction with their terms of employment, among the anthracite miners, and the suspicion that the prevailing wages agreement would not be replaced at its termination, April 1, 1906, without some friction, led prudent householders to stock their bins early, and this demand, coupled with a simultaneous car shortage, protracted the spring activity well into summer. During the warm months, domestic trade was exceedingly dull, and not even the approach of winter prices afforded any stimulus. It was not until the last of October that demand improved and a month later before it became urgent, when a car shortage assisted in creating a condition of some stress.

The market for steam sizes, pea, buck-wheat, rice and barley, is influenced by two circumstances, unknown to the domestic sizes: A large part of the small coal is recovered at the breakers in the preparation of the larger domestic sizes, so that its output varies directly with that of the prepared sizes and cannot be controlled separately. Additional sources are found in the old culm piles now treated by washeries; then, in the market, the fine sizes come into direct competition with bituminous coal for use in steam plants and for this reason are unable to establish prices on the basis of their own supply and demand. Neither are they subject to the summer discount plan adopted for the domestic sizes. Ordinances for the prevention of smoke in New York and other cities give anthracite steam sizes a slight advantage. During 1905, the small sizes maintained their selling price fairly constant; a slight flurry occurred in March,

but it was quickly subdued. All through the summer they came forward in abundance, but only in June did any dealers find it expedient to shade prices. Late in September an active demand arose for pea coal; many large steam plants filled their storage room and arranged for additional space. This soon developed into an urgent inquiry for all the fine coals, even washery coal moving off quickly; prices, however, did not respond.

Transportation was excellent throughout the year except for a few days late in January, when a blizzard tied up the coal industry at both ends and along the line. The railroads, however, were the first to recover, and during the rest of the winter it was the unloading of frozen coal, the ferrying from New Jersey terminal points to New York, and the towing of barges by the outside route to Boston that made trouble. Shortage of cars was a fertile source of complaint throughout the year. In view, however, of the enormous tonnage moved last year, it might be suspected that some of the complaint came from force of habit rather than from real hardships. The anthracite trade twice a year suffers a periodical shortage of cars—in the spring when the opening of Lake shipping causes a demand for cars to the Lake ports, and in the autumn, when the grain harvests of the West call for all available cars. Then, too, the shipping of anthracite to New England by all-rail routes, a recent innovation, has grown marvelously, and already, the main-line roads are considering means to suppress the exodus of their cars to this territory.

New England had an acute recollection of its distress during the winter of 1902, and with the first note of discord in the anthracite field, started in to lay up supplies. In its haste to amass hard coal, it nearly neglected to provide for its bituminous supply. Indeed, along the Sound, it was not until August, when anthracite had nearly resumed its normal winter price, that bituminous coal was able to attract any attention, and to depose hard coal from its monopoly of the market.

The western anthracite markets have never fully recovered from the blow received during the strike of 1902. In the large cities, where the chief market for this coal is found, the use of bituminous coal received a great impetus in that year. The higher-grade coals of West Virginia and the Hocking Valley found a place which they have largely retained in domestic use. They have replaced a certain part of the anthracite formerly used, and in so far, limited its consumption. Making this allowance, the western trade was generally steady and even, very much as the eastern market was. The Lake trade, owing to the longer season of navigation, was better distributed, and there was not the rush and confusion which marked the opening and close of the season of 1904. Prices were generally main-

tained, as in the East, and the trade showed no special incidents.

Among the number of sales of independent operators to the big corporations, the one involving the largest consideration was the sale of Coxe Brothers & Company's entire property and assets to the Lehigh Valley Railroad Company, for \$18,400,000. Among the properties was the Delaware, Susquehanna & Schuylkill Railroad, 76.5 miles long, over which Coxe Brothers had been shipping their output, more than 2,000,000 tons annually, in their own trains to Penn Haven Junction, and thence, over the Lehigh Valley's tracks to Perth Amboy. The Erie Railroad Company bought the John Jermyn estate's mines, near Scranton, for about \$2,000,000. These were the last remaining independent producers of consequence in the Lackawanna valley. The Schuylkill Coal & Iron Company bought 357 acres of coal land in Branch township, formerly known as the Tyson & Kendrick tract, from which no coal has been mined for several years. The Scranton Coal Company, subsidiary to the Ontario & Western railroad, bought the Black Diamond mine at Simpson, a heavy independent producer. These absorptions have left S. B. Markle & Co. as the only outstanding important producer. An accompanying feature of this campaign has been an increased number of small companies recently organized to operate outlying and intermittent areas of coal land.

The condition of the mine workmen during the year has been good. Local disturbances have occurred, but have usually subsided promptly under the influence of the Conciliation Board. This organization has grown into high favor with both operators and employees, and with its three years' experience has become a valuable feature. Wages continued to be adjusted on the sliding scale, under the supervision of Commissioner Neil. They remained unchanged during the early months, but in the latter half, rose as much as 6% in some months. The approach of the termination of the present agreement, which expires April 1, 1906, has caused a certain amount of uneasiness. In preparation for it a convention was called at Shamokin, on Dec. 14, and it was strongly urged upon the local unions to exercise caution in the selection of their delegates. As a result, the convention was marked by conservatism, and the policy to be adopted in future arrangements with the operators was left to the discretion of the Mine Workers' president and executive board.

At the mines, some difficulty arose at the prospect of enforcing a new State statute covering the employment of child labor in anthracite mines. The miners' union had been instrumental in obtaining this legislation, which prohibited the employment of boys under 14 years old in breakers, and under 16 years in mines. This provision was generally complied with, although it raised the minimum

age by two years in each case. Another provision required a testimonial as to a certain amount of elementary school education from all employed under 21 years of age. This clause led to a certain amount of hardship and was declared unconstitutional by the county court.

Another decision, by the Pennsylvania Superior Court, declared unconstitutional that part of the miner's certificate law demanding two years' experience in a Pennsylvania mine as a requisite to the holding of a certificate, without which no miner was permitted to work underground. This decision removed one of the weapons which the union miners had relied on in case of a contest with their employers, since no restriction now prohibits the giving of the necessary certificate to a qualified miner from another State.

#### SEABOARD BITUMINOUS MARKET.

The soft-coal market in the eastern part of the United States presents a number of points of contrast to that of anthracite. In the first place, the productive area is much more widely extended, western Pennsylvania, West Virginia, Maryland and Virginia, all contributing to the Atlantic seaboard soft-coal market. This fact, together with the greater number of railroads, conveying the product to tidewater, prevents any such centralization of interest as is found in the hard-coal industry. In neither trade is any official centralization recognized, but in the hard-coal market a certain kind of understanding has existed for a number of years. The soft-coal industry is only just beginning to realize its community of interest, and for the past two years has attempted, in an unassuming way, to arrive at a more satisfactory basis of action, for the common welfare. In the matter of disposing of the product, a very large proportion of the soft coal marketed is sold on yearly contracts, April 1 being the accepted beginning of the year. At this date, a consumer and a producer will agree upon a certain tonnage to be delivered at regular intervals during the year, at a stated price per ton; either at the mines or at the tidewater shipping point. This practice removes a large amount of coal from the influence of temporary ups and downs, and the remainder is, therefore, less liable to violent fluctuation. No such discount as is in vogue among the hard-coal producers has ever come into effect in the soft-coal trade.

With the opening of the year, demand for soft coal was active, and trade was largely tainted with speculation, owing to the severe weather which tied up the railroads and made deliveries of the product at several points exceedingly difficult. Active demand continued well into the summer, when a condition of exceptional quiet began to prevail. Toward the last of September a rush to make up for deficiencies of the warm months began, and

for a time it looked as though there would not be coal enough to go round; only the knowledge that a large amount of this tonnage was going into stock piles for the winter prevented a general feeling of uneasiness at the prospect. A contributing cause to the dullness of the bituminous market during the summer, was an exceptional amount of interest shown this year in anthracite at its bottom prices. As soon as the anthracite discount had again recovered, bituminous came to the fore.

At the approach of April, the beginning of the contract year, it became an object of concern to learn what action the main-line railroads would take in arranging their through rates for the season, and to learn what would be the consensus of opinion among the miners. Hesitation was removed by the announcement of the railroads that last year's rates would continue for another year, the Norfolk & Western and the Chesapeake & Ohio made a rate of \$1.35 to Norfolk and Newport News; the Pennsylvania, with a haul of 100 miles shorter distance, made the rate \$1.50 to New York city. The mine-workers of central Pennsylvania, at their convention in Altoona, showed a conciliatory spirit, but their desire for position at the opening of the following year prevented them from noting the fact that their high wages constituted an insurmountable handicap in competing with the chief production of the non-union territory. They demanded and obtained a continuation of the 62c. rate for pick mining. The first contract for the new year was greeted with relief, when it was noted the previous year's price was maintained. Subsequent contracts not only confirmed this continuation, but, if anything, showed a tendency toward higher prices, particularly on the better grades. The average basis for most of the year's contracts was \$2.70 f. o. b. New York harbor shipping points, or \$1.15@ \$1.20 at the mines. For the ordinary grades of coal, a slightly lower price was accepted in the hope of creating a more stable basis; on the poorer grades, 5 or 10c. was sometimes conceded in order to get a contract, particularly in new territory. These concessions had the effect of delaying the placing of some contracts, a tendency which the insistence on high prices for the better grades only tended to confirm.

Trade in New York harbor on the whole was active throughout the year. In the spring, when arrivals were irregular, a certain amount of speculative business crept in. The railroads lent a hand in correcting this by keeping a strict oversight on the unloading of coal from their cars at terminal points. Whenever any shipper allowed a number of loaded cars to accumulate, his requisition for empties at the other end of the line was discounted; one or two applications of this remedy was sufficient to instill upon the mind of the shipper the necessity for unloading his

coal promptly. This feature, while it prevented speculation, at the same time had a depressing influence upon market prices. During the summer, trade was rather quiet, although no stagnation was apparent at any time. With the approach of cold weather the market resumed activity in an aggravated form.

A notable feature of the market during the year was the remarkable persistency with which New England, particularly the far eastern and shoal-water ports, laid in supplies of coal. Demand from this territory was unusually active throughout the year. Contracts, too, began to play an important part in the far eastern trade, greatly surpassing in amount the purchases of coal in the open markets. So keen were the New England manufacturers to lay by supplies of coal that, at times, the unloading facilities of the receiving ports were taxed to the utmost, and demurrage charges on vessels kept waiting were not uncommon. By the end of the year, contracts had been disproportionately fulfilled, leading to the belief that before the end of the contract season other supplies would have to be sought.

Trade along the north shore of Long Island Sound presented a spectacle never before seen. In the early spring, as soon as the ice-bound harbors were open, a rush of coal set in which swamped the unloading facilities of the ports; the New York, New Haven & Hartford railroad was especially unable to cope with the demands upon its facilities. By April this rush had subsided and then the district set itself diligently to work to lay in supplies of anthracite at the prevailing low prices of that month. They gave their entire attention to this kind of coal, and bituminous trade suffered accordingly. This was all the more to be regretted by the fact that freight rates to this territory by water were never so low, and the procrastination in laying in supplies of soft coal was dearly paid for later on when boat rates advanced 25c. per ton. When in August, the demand for hard coal had been nearly satisfied, bituminous coal was sought with an urgency out of all proportion to the possibility of supplying it. From that time until the end of the year the supply of soft coal could not begin to keep up with the demand, while advancing the freight rates and the impossibility of getting supplies by rail made it a costly experience.

All-rail trade throughout the year was as active as the producers would permit it to become. By the middle of September, the delay attending the return of cars from New England roads led the Baltimore & Ohio, and the Reading railroads to embargo shipments in their cars to the New York, New Haven & Hartford. Demands for all-rail shipment continuing, the producers were led to adopt the expedient of adding to the price of such coal, and a basis of \$1.50 was adopted for

the purpose of checking all-rail shipments.

Producers complained almost continuously throughout the year of insufficient car supplies, the shortage at some times being almost acute. On the whole, however, those producers who showed reasonable speed in unloading their cargoes at terminal points were fairly well supplied with cars. Ordinary shortage was not so objectionable as the irregularities that marked the supply in certain districts; this condition made it impossible for shippers to depend upon a smooth running of their mines. Railroad transportation during the year was unusually good; at certain seasons of the year better than schedule time was maintained for long periods.

For carrying coal along the Atlantic seaboard, vessels were in good supply throughout the year. With the opening of the Delaware river and Chesapeake bay, in the middle of March, the large number of the boats waiting for cargoes had a depressing influence on freight rates, and many of them were driven to accept lumber or anthracite coal, which paid better rates. As soon as any congestion was noticeable at harbor points the boat owners were not slow to take advantage of it by demanding the loading and discharging clause, by the provision of which they were able to get their cargoes promptly, regardless of the trouble and expense to which they may have put the shippers in providing the cargo at the dock. During the summer, freight rates to New England fell to an abnormally low figure. With the departure of many small boats to other lines of trade, a shortage set in and when demands for them arose in the early fall, rates quickly recovered to a high figure. Large boats were in abundant supply throughout the year; only the small ones were sometimes hard to get.

The year was free from labor disturbances of any importance. Operators in union districts, however, are beginning to feel the burden under which they are laboring, as compared with their competitors in non-union fields.

There is a difference in opinion as to the effect of increased depth of working of coal mines upon spontaneous combustion in the latter. Some engineers consider that owing to the greater pressure and increase of temperature, there is more liability to spontaneous combustion. Other engineers hold that the effect of pressure would be rather in the direction of avoiding spontaneous combustion. It has been pointed out that in certain collieries, where gob fires occur, these never take place in the long-wall works, where there are no faults, but always at some place, where, owing to faults, the roof does not settle as tightly as usual.



## CHICAGO COAL TRADE.

BY E. MORRISON.

With the steady growth of population and manufacturing industries, the coal trade of Chicago for 1905 has been satisfactory to everybody connected with it, as regards volume of business. More coal undoubtedly has been sold and used than in any previous year. Prices, however, have been for the greater part of the year so low as to make profits small both to the miner of the coal and to the dealer.

This condition is a result of the great anthracite strike of 1902-3, when the need of fuel to take the place of anthracite and the high prices of anthracite caused hundreds if not thousands of new mines in the Middle West to be opened. Once opened the mines were considered of value for working purposes, regardless of the condition of the market. With coal under almost every farm in Illinois, combination of the bituminous field owners has been impossible. Hence there has been over-production and little profit for anybody in the business.

In the last quarter of 1905, however, the situation has been somewhat better for the dealer on account of the car shortage, which has restricted shipments to the local market. But if this has aided the dealer and the individual operator, it has been at the expense of the producers of Western coal generally. The mines of Indiana and Illinois have not been operated for more than one-third to one-half time, because of the lack of cars. The end of the year sees the trade to all appearances somewhat improved; there are no such accumulations of coal on track as have caused demoralization of the market and profitless sales in the past; but on the other hand, these conditions are recognized as being only temporary, and the plain fact remains that more coal is being produced in the Western fields than can be disposed of at a reasonable profit.

Fewer contracts were made this year for supplies of coal than last year, the tendency of users of coal being to hold off from contracts in view of the open market's being so favorable to them. In general, there has been more buying for immediate delivery, outside of contracts. These conditions have made the market fluctuating to a greater degree than last year. In the absence of labor strikes of magnitude or other disturbing elements, prices have been fairly steady, though the last quarter of the year has seen advances of prices that offer profit to the dealer and the operator.

At the end of the year, Western bituminous averaged \$2.25@\$2.75 for lump and egg; \$2@\$2.30 for run-of-mine and \$1.50@\$1.60 for screenings. These prices were in general advances over the first of the year, for in January lump and egg brought only \$1.80@\$2; run-of-mine, \$1.50@\$1.70 and screenings, \$1@\$1.40.

Eastern coals have had a somewhat

parallel course to Western, in demand and transportation conditions. During the first half of the year the market was depressed for these coals; in the last quarter they commanded premiums over previous prices and were hard to get. Hocking at the end of the year brought \$3@\$3.75; in January it was quoted at \$2.75@\$3, against circular prices of \$3.20 at the beginning and \$3.40 at the end of the year. Smokeless coals gained in popular favor, unquestionably, through the anti-smoke crusade and the growth of appreciation of high-grade fuels, and advanced in price through the car shortage. Youghiogheny was sold mostly on contracts, but advanced on free sales 30@40c. during the year.

The anthracite market suffered from the general prosperity of the country. There was a reluctance of consumers to lay in their winter stocks, in the spring and summer, through a feeling that the 10c. a month discounts did not amount to much, and the popular belief that there would be plenty of coal for everybody when it should be needed. Retailers expressed these opinions to wholesalers, and generally delayed laying in coal that the consumer would not buy immediately. With a mild winter this general condition will not cut much figure in the trade; with severe and prolonged cold weather, it will cause great congestion of business early in the coming year.

Receipts of coal by lake at Chicago and Waukegan were approximately 926,000 tons anthracite and 108,000 tons bituminous, making a total of 1,034,000 tons, against 1,024,853 tons last year. There was no division of receipts in 1904 as to anthracite and bituminous by the custom-house officers, who say, however, that bituminous in 1904 was about 10% of the total, and was chiefly Hocking coal.

The coal business will be greatly benefited if the tunnels under the Chicago river, which now make the limit of draft for vessels entering the North Branch and South Branch 17 ft., are removed by April 15 next, as is required by the order of the Secretary of War. There is 22 ft. of water throughout the main river and the South Branch, except at the tunnels. It is possible, however, that the city's street railway policy will delay this improvement, which has been sought by the marine interests for years and is urgently needed.

## CLEVELAND COAL MARKET.

BY GEORGE H. CUSHING.

Were it only a matter of recording the bare details of the movement of coal on the lakes during the season of 1905, the situation would be comparatively simple. But during the past two years the coal business has grown complex, due in the main to the unprecedented increase in the productive capacity.

At the outset it is to be said that while the lake season of navigation in 1905 was fully two and a half months longer than

during the preceding year, the movement by lake does not show the gain which might have been expected. The statement of one of the railroad general superintendents is representative. He says that during the season of 1905 the lake-dock facilities have been engaged only to 30% of their normal capacity. This is the more striking when it is said that coal-dock facilities on the South Shore of Lake Erie did not undergo the same process of reconstruction and improvement as did the ore docks. In fact, the railroads showed a very slight inclination to increase their coal-handling facilities.

The causes leading up to this situation are numerous. It was apparent that at the opening of the season of navigation the docks in the upper lake region had more than their usual supply of coal on hand. At the same time there was a revulsion of feeling in the Northwest against the high prices which had been paid for the Pennsylvania and Ohio coal, which seemed entirely out of keeping with the prices in the home market, the cost of transportation and the reasonable profits to the middlemen for the handling of this fuel. This feeling was not appeased by a quarrel which arose between two of the principal shippers. The firm of M. A. Hanna & Company, which had sold its mines to the Pittsburg Coal Company, had a five-year contract for the handling of the output of those mines. This expired with the beginning of last April and was not renewed. An open rupture was declared, each threatening to cut into the territory of the other.

This feud appeared at the time when northwestern consumers were about to come into the market for the purchase of their season's supply of coal. A price war broke out on fuel coal to lake steamers only, but the hope was aroused in the Northwest that sooner or later prices of coal generally would be reduced by the competition. Having a large supply of coal on hand, the consumers and dealers of the Northwest could easily afford to await a better time for buying their supply, which they did.

About that time reports began to appear all through this territory that the western mines were beginning to sell to the trade in the Northwest, taking away from Ohio and Pennsylvania their best customers. This dates back to the time of the anthracite coal strike, when the bituminous deposits of the East found a ready market near at home, and when the supply was diverted from the upper lakes to meet the demands of the East. Seizing the opportunity, the Illinois mines began to find an opening for themselves in the Northwest, which they have not since been willing to yield. When the dispute between the two big shippers in question arose, producing hesitancy in the minds of the northwestern buyers, the western mines were quick to take advantage of the situation.

It is perhaps nothing more than a coincidence that at the same time the western railroads began to break away from established channels of commerce and to seek an outlet other than the Atlantic seaboard for some of their products, ending in the open espousal of the Gulf as a point of export. This resulted in a prolonged rate disturbance affecting the lines running to the Gulf and those running to the Atlantic seaboard. The avowed purpose was to ship goods through the Gulf at a lower rate than that paid on the movement through the Atlantic seaboard. This naturally raised the question of the loading of equipment in both directions. Through rates were materially lessened, with an effect upon the local tariffs and the entire western rate fabric was materially disturbed.

One of the immediate effects of this disturbance was a rate arrangement to the advantage of the western coal shippers. It was found possible not only to ship coal from the Illinois field all rail to the Northwest and by lake and rail to the same destination, but it even reached the point of attracting the coal producers from further south into the northwestern field. This brought about a development where the central Northwest was being fed also by the deposits from Arkansas and even from Oklahoma. The result of this dual competition was to materially lessen the demand for the Ohio and Pennsylvania coal in the Northwest, and the reduction in the amount of coal shipped was a natural consequence. This competition in the future promises to be one of the serious questions in the entire coal business. At the same time the situation is somewhat complicated by the entrance of a new field into the same competition. A group of aggressive railroad financiers have obtained possession of a coal-carrying railroad, stretching diagonally across Ohio and connecting the Great Lakes with the Ohio and Kentucky coalfields. Their avowed purpose is to increase the movement of the coal from the fields tapped, into the Northwest, thereby further curtailing the market for the Ohio and Pennsylvania producers.

Under these varying influences the prices of coal have been anything but strong. At the beginning of the year and in the middle of winter prices were down to rock bottom. The best grades of run-of-mine steam coal were selling at 90@95c. at the mines both in the Ohio and the Pennsylvania districts. These are considered mid-summer prices, and during a dull season at that. It was a question of peddling coal, to get it taken even at these figures, and a break was only prevented by the knowledge of the coal operators that they could not produce for much less.

But apart from the outside competition for the Ohio and the Pennsylvania producers, conditions at home had an important bearing also on prices. Coal con-

sumption in the United States has been increasing at an astonishing rate during the past few years. The increase in the number and activity of industrial plants, and all which that entails, had aroused large hopes on the part of the coal producers. The market was exceedingly alluring. Besides the deposits were numerous, and capital for the development of properties has seldom seemed more easy than at the present time. The number of mines producing coal has been greatly increased under the circumstances. The natural result was a demand for railroad equipment at various points all out of keeping with the increase in the supply. Making a proportionate distribution among the patrons of the railroads, of necessity brought about a lessening of the supply to each one. This in turn curtailed the production of the various mines, although not of necessity lessening the output in the aggregate.

The relation between the supply of railroad cars and the condition of the crops is very close. An abundant crop of farm products almost invariably means a shortage of equipment, provided the supply of rolling stock before was not out of proportion to the demand of the trade—a condition which has never existed. Toward the end of the year the abundance of the crop having been established, this shortage of cars was evident in an exaggerated form, and produced an immediate effect upon the condition of the coal trade in this territory. The demand for cars was so urgent that the railroads were forced to divert equipment from the lake trade six weeks before the close of the season of navigation. This put an end virtually to lake shipments, long before the shippers were ready. At the same time railroad operations were so heavy that they were using coal in excess of their contract requirements. This caused them to confiscate coal consigned to others.

At the same time it had the effect of shortening the supply at the commercial centers and caused competitive bidding for the amount of coal actually being shipped. As a result, prices ran up violently at the close of the year. The last three months found the price increased from 95c. to \$1 at the mines to \$1.40 to \$1.50 at the mines, with possibilities of still higher prices. Consumers were actively bidding one against the other at the close of the season and the result was striking.

#### PITTSBURG DISTRICT COAL.

BY S. F. LUTY.

The production of coal in the Pittsburgh district in 1905 was greater than the previous year, and almost equal to the record of 1903. In the absence of official reports the production for December is estimated and the actual tonnage will likely exceed the estimates of leading operators who were unusually conservative in giving out the figures. While the tonnage was heavy and business

good, the profits were not satisfactory or as large as 1904.

Prices throughout the year were unusually low. At the opening, quotations were based on run-of-mine coal at \$1.05 a ton at the mine, but this rate was invariably shaded when a good contract was offered. In July as low as 95c. a ton was quoted, but some sales were reported to have been made at 80c. a ton. There was no improvement in prices until October when rates were fixed as follows: Run-of-mine, \$1.20 a ton; ¾-in., \$1.30; 1¼-in., \$1.40; slack, 90c. A shortage of railroad cars and an increased demand made it possible to obtain these prices and in November an advance of 10c. a ton was announced by some of the principal interests. The year closed with the market in fairly good condition and a favorable outlook for the new year.

Some important deals were made by the Pittsburg Coal Company, the leading producer. The first was in April, when it entered into a contract with the United States Steel Corporation to furnish coal to its plants in the Pittsburg district for a period of 25 years. It is estimated that fully 3,000,000 tons will be required annually. The National Mining Company, a subsidiary interest of the Steel Corporation, was more active in 1905, and its production amounted to about 800,000 tons. This may be increased to 1,000,000 tons in 1906. In November the Pittsburg Coal Company closed a contract with the Republic Iron & Steel Company for its coal requirements for a period of five years. The tonnage will run from 500,000 to 750,000 tons annually. At the same time the company renewed its contracts for furnishing coal to the St. Louis and Cincinnati gas works.

The Jones & Laughlin Steel Company has become the largest independent coal producing concern in the district and is probably the largest in the country, its production for the year amounting to fully 2,500,000 tons. This company, however, is not a competitor in the market, as it consumes its entire product. Last June it bought 9,600 acres of valuable coal land, increasing its holdings to 15,000 acres.

Several independent coal companies added to their holdings and increased their capacity, notably the United Coal Company, its production in 1905 being almost double that of the previous year. In February it bought two large mines from the Hazel Kirk Coal Company. The production of the Pittsburg-Buffalo Company, J. W. Ellsworth & Company, and the Washington Coal & Coke Company also was greatly increased. In July the Carnegie Coal Company absorbed the Chartiers Coal & Coke Company, which added to its strength.

As the mining rate had been fixed for a period of two years in 1904, there was no uncertainty and contracts were made

early. Competition for trade was very keen and some contracts were made at very low prices. One of the remarkable features of the year was the absence of labor troubles. While a few local strikes occurred, none amounted to anything. Some foreigners attempted to cause a suspension at the mines of the Ellsworth Company for a trifling dispute over the discharge of one of the employees, but the leaders of the United Mine Workers' prevented it and insisted upon the strict observance of the contract. Another feature of the year was the successful shipments of coal by river to the lower markets, there being comparatively few accidents. The rivers were navigable for several days every month in the year, and the shipments exceeded those of 1904. Owing to the large stocks constantly on hand at all lower ports, prices were not satisfactory to the shippers. Fully 16,000,000 bushels went out in January and about 13,000,000 bushels in March. The next largest shipments were made in June and October, 12,000,000 bushels being shipped in each of these months.

The production in the Pittsburg district for the year, with December estimated, and including 8,000,000 tons produced in the Westmoreland field, amounts to 43,750,000 tons. The output of the principal companies is given as follows: Pittsburg Coal Company, 15,000,000 tons; Monongahela River Consolidated Coal & Coke Company, 6,000,000 tons; Jones & Laughlin Steel Company, 2,500,000 tons; United Coal Company, 2,000,000 tons; Pittsburg-Buffalo Company, 1,750,000 tons; J. W. Ellsworth & Company, 1,750,000 tons; Washington Coal & Coke Company, 1,500,000 tons; National Mining Company, 800,000 tons; People's Coal Company, 800,000 tons; Patterson & Robbins, 500,000 tons; Hazel Kirk Coal Company, 400,000 tons; Carnegie Coal Company, 350,000 tons; Meadowlands Coal Company, 350,000 tons; M. A. Hanna & Co., 300,000 tons; M. H. Taylor interests, 250,000 tons; other independent interests, 1,500,000 tons.

John H. Jones, president of the Pittsburg-Buffalo Company, who is regarded as one of the leading authorities in the country on the coal trade, declares that the official reports for 1905 will show the largest production of coal both in this country and foreign countries ever known. He estimates the production of anthracite and bituminous coal in the United States for the year at 390,000,000, possibly 400,000,000 tons, an increase of more than 40,000,000 tons over the production of the previous year which was 351,196,953 tons. From present indications this year's record will be broken in 1906. Mr. Jones says that in his judgment 1906 will be the greatest industrial year the world has ever known and production of anthracite and bituminous coal will exceed 500,000,000 tons.

### Alabama Coal.

BY L. W. FRIEDMAN.

With a strike among several thousand union coal miners on at some of the larger collieries in the State, the production of coal in Alabama for the year 1905 will show an increase of several thousand tons as compared to the output of 1904. There has been steady operation throughout the year at the commercial coal mines, where union labor is employed, at the convict mines and at the non-union mines, while at the mines where new labor has been employed in the place of the strikers, the production has been increasing right along until to-day it is fast approaching the normal conditions. The production of coal in Alabama in 1904 showed a decrease as compared to the previous year, the strike of the union miners beginning in July, 1904, having considerable effect. The output for this year will show not only an increase in a comparison with that of 1904, but also with the previous year. Last year the production was 11,163,194 tons, and the year previous, 11,700,753. While the final figure is unknown, the State mine inspector and his assistants, who have been over the coal-bearing fields often through the year, opine that the production for 1905 is close to over 12,000,000 tons. There are some who believe that the figures will aggregate over 12,000,000 tons, but this optimistic feeling is not indulged in by the inspectors nor those who have been giving the matter close study.

Some important moves have been made in the coalfields of Alabama during the past year. In addition to the starting of developments in the upper Cahaba coalfields, in the northeastern part of Jefferson county, and in St. Clair county, two large mines being in operation already, a large number of coal companies have been organized and work begun on new mines in different portions of Jefferson county, in Walker, Shelby, St. Clair and other counties. The Pratt Consolidated Coal Company, now with a daily output of 8,000 tons of coal, purchased this year many thousand acres of coal lands in Jefferson and Walker counties and mines are being opened thereon. Just as soon as railroad extensions can be constructed to the new mines the coal production will commence and will be pushed until this company is getting out 20,000 tons of coal a day. The Tennessee Coal, Iron & Railroad Company a few months since began work on a shaft near the Pratt mines and it is proposed to use this shaft outlet for the coal from three of the present mines in addition to working the coal that is struck in its development. A complete electric haulage system is being placed and the shaft promises to be one of the best ever sunk in Alabama. The Alabama Consolidated Coal & Iron Company also

began sounding for coal under a seam of coal now being worked at their Lewisburg mines, in Jefferson county. If this plan should be successful, there is a belief that other companies will make a similar test, the geologists and other experts all expressing the belief that in Alabama there are two seams, one over the other. These are but a few of the important events which have taken place in the coal industry in Alabama during the past year. The purchase of coal property on all sides has been almost continuous.

There has been a steady demand for all the coal that has been mined. With but a few weeks' exception there has been no railroad car shortage in this State. The railroads in this district give the coal industry much attention, and without exception every railway line ordered new coal cars during the past twelve months, which began arriving just as the coal demand picked up and there was urgent desire to move the product promptly.

The coke industry has suffered in Alabama during the past twelve months, though it is believed there will be a little increase shown in the year's output as compared to what it was in 1904. The production this year may run to 2,500,000 tons, as compared to 2,340,219 tons last year and 2,653,185 tons in 1903. The furnace companies in this district had very little trouble in purchasing coke in West Virginia and other districts, though the price was high. Work was started during the year on no less than 300 new coke ovens and half of these have been placed in operation. The year 1906 will see a still further improvement in this direction.

### Coal in California.

As is well known, the California coals are lignites of rather inferior quality. Since the enormous increase of output of fuel oil in the State, and its almost universal use for steam purposes, the California coal miners have been hard put to it to sell their product at any advantage. The few large mines have been compelled to put up briquetting plants in order to find a market for the coal, in the form of briquettes, using heavy oil or refined asphalt as a binder. The extensive briquetting plant of the Tesla mines in Alameda county was burned in 1905, and will be re-built at Oakland, on the San Francisco bay shore. The Pittsburg Coal Mining Company, of Contra Costa county, has completed its own briquetting plant, and is now marketing its product. Two smaller briquetting plants have been lately built in Oakland and San Francisco. In 1904 the output of coal in California was 79,000 tons, valued at \$376,000, a very large proportion of which was from Alameda county, though some few thousand tons were from Contra Costa county,

and still less from Monterey and Orange countries. The mines all produced 1905, but on a smaller scale for the reasons given.

### Illinois Coal.

Mr. David Ross, Secretary of the Bureau of Labor, has supplied us with statistics of the coal mining industry in Illinois during the fiscal year ending June 30, 1905, in advance of the publication of this report. Coal mined during that period amounted to 37,183,374 short tons, valued at \$38,689,858, an increase of 105,477 tons in quantity, but a decrease of \$2,084,365 in value, as compared with the preceding fiscal year. Distinguishing between those commercial, or shipping mines, and those that are worked intermittently to supply a local demand only, the State's output was contributed thus:

	No.	Tons mined.	Average.
Commercial mine.....	397	35,956,643	90,571
Small mines.....	593	1,226,831	2,069
Total.....	990	37,183,374	92,640

The large mines are thus seen to have supplied 96.7% of the whole output, or 0.2% more than their share in the previous year. Commercial mines increased in number by 17, and small ones by 41 over the previous year; both classes showed diminished average outputs. The disposition of the product was this:

	Tons.	Per ct
Sold and shipped from mines.....	31,667,073	85.2
Supplied to locomotives.....	1,178,237	3.2
Sold to local trade.....	2,600,808	7.0
Used, or wasted, at mines.....	1,737,256	4.6

The amounts and the average value per ton of the grades, into which the output was sized, were:

	Tons.	Per Ct.	Value.
Run of mine.....	9,248,558	24.9	\$1.062
Lump.....	16,819,321	45.2	1.291
Egg.....	1,716,219	4.6	1.237
Nut.....	2,036,152	5.5	0.865
Pea.....	6,247,511	16.9	0.480
Slack.....	1,115,613	2.9	0.301
Total.....	37,183,374	100.0	\$1.041

The use of mining machines is growing. The tonnage of coal undercut by machinery was 8,202,066, or 22% of the whole, as against 20% cut in this way during the preceding year. The average price per long ton paid for pick mining was 57.82c. and for machine mining, 44.32c. The total number of miners employed was 41,202, assisted by 12,234 men and boys underground, and 5,794 on the surface.

Fatalities numbered 199, a rate of 3.4 deaths per 1,000 men employed, as compared with a rate of 2.87 during the previous year. Accidents involving the loss of a month or more of time, happened to 535 men, or to 9 out of every 1,000 employees.

When heated to redness, palladium tarnishes with the formation of a blue film, but does not melt. At ordinary temperatures it remains untarnished like pure gold or platinum.

### Indiana Coal.

SPECIAL CORRESPONDENCE.

A review of the general business in the coal-mining districts of Indiana for 1905 shows a decided decline as compared with 1904 and 1903. The selling price of coal has been higher, but during the summer months the mines were operated perhaps less than an average of three days per week. During the fall and winter months the market has been keen, but the car shortage has been provoking. The large grain crop of the middle West, together with increased output of manufacturers, making an increased demand for cars and engines, is largely responsible for the depressed condition of coal mining in Indiana.

A significant feature of the business in Indiana during the year was the merging of 35 mining companies into eight district merger companies with large capital and announcements of stupendous development mapped out for the Indiana coalfields. There were 137 coal-mining companies operating in Indiana in 1904. The merger companies absorbed 35 of these, which, with the new companies organized, leaves 212 companies operating, an increase of two over the number reporting last year. There have been 25 new mines opened and 8 mines abandoned, making a net gain of 17 new operating shafts.

The total number of mine employees, of which all were miners except 1,777 outside men, during the year 1904, was 17,838. This year State Mine Inspector James Epperson estimates an increase in the number of miners at 1,000 and a decrease in the outside men of at least 400. The latter is due to the organization and concentration of the merger companies. The total number of days the Indiana mines were operated in 1904 was 29,641, an average of 165 days; in 1905 there was a perceptible decrease, notwithstanding the increase in the number of the miners.

The total number of tons of coal produced for market in 1905 is estimated at 9,772,404, as against 9,872,404 for 1904, a decrease of a 100,000 tons or more. The causes assigned for this decrease are heavy spring floods, lack of summer market, and car shortage during the last quarter.

The amount of money spent in improvements will be about the same as for 1904, when it was \$74,231. The amount of money expended in the purchase of mines and coal land by the merger and other companies will run up into at least two figures in the million-dollar column.

Very little coke is produced in Indiana, although extensive preparation is said to have been made for coke-ovens in the southern Indiana field. There were fewer fatalities and a smaller number of serious and minor accidents to employees and to mining property in 1905 than in 1904.

The Southern Indiana railroad, built

and operated by John R. Walsh, who recently failed, has proved a great developer of the coal business. It provides an outlet for the coalfields of Green and Sullivan counties, and has been a large factor in increasing the output of the district and in building up mining towns and cities all along the line of his road. None of the big trunk lines which now handle Indiana coal have facilities enough. It will cause no surprise if there should be a lively warfare between these railroads and the Walsh roads.

### Coal in New Mexico.

BY J. E. SHERIDAN.

The production of coal in New Mexico in 1905, estimating the December output, reached a total of 1,600,000 short tons, this being the net quantity shipped from mines. The coke reported for the year was 85,000 short tons, shipped from ovens. The average value of the coal at mines was \$1.50, and of coke \$3 per short ton.

The number employed in mining, taking the average for the year, was 1,720 men and 60 boys underground; 460 men and 48 boys on the surface; a total of 2,288 persons. This gives an average of 699 tons of coal mined per employee. The number of persons killed by accident during the year was 5, an average of 2.185 per 1,000 employed.

In addition to the foregoing persons engaged in the actual mining of coal, an average of 300 men have been employed in construction work.

During the year important changes have taken place in the ownership of some of the larger properties, which will doubtless result in a great increase of production in 1906, and still greater increase in years immediately following. The Dawson mines and Dawson Railroad were purchased by a company supposed to represent the great Phelps-Dodge copper mining and manufacturing interests. While the name of the Dawson Fuel Company has not been changed, yet the management of its affairs is under immediate control of Prof. James A. Douglas, president of the Copper Queen Consolidated Company, while the Dawson Railway and the El Paso & Northwestern Railroad have now become a part of the El Paso & Southwestern system owned by the Phelps-Dodge Company. Since the change of ownership 336 new coke-ovens have been put under construction at Dawson, and will be completed within the next 90 days. It is reliably stated that the company contemplates increasing this number to 800 in the immediate future. The new ovens are being built with a view to utilizing the surplus heat, which was formerly wasted, for the operation of an extensive power plant, and also to recover the by-products, as is done at some coke-ovens in Europe. To supply the 800 ovens and maintain the production of coal

for market will necessitate an increase of 200% in the production of these mines, or more than 1,000,000 tons per annum.

The coal areas of the Maxwell Land Grant, formerly operated by the Raton Coal & Coke Company, have been taken over by the St. Louis, Rocky Mountain & Pacific Company. The new operators are building 168 miles of railroad from Elizabethtown, N. M., to Des Moines, a station on the Colorado & Southern Railroad, with short spurs connecting the mines at Van Houten, and Blossburg, N. M., with the main line.

There is a strong demand for the coal from this field in the markets of Kansas and Oklahoma, and the production has been largely restricted, and is today very much restricted, by lack of transportation facilities. The Santa Fé, Raton & Eastern Railway has completed a short line to connect the mines of Johnson and Baramesas with the Santa Fé system at Raton, thus giving transportation facilities to the mines mentioned. It is highly probable that the production of coal in New Mexico will be increased 100%, and the production of coke fully 200% during the ensuing year.

### West Virginia Coal.

BY WILLIAM NELSON PAGE.\*

In Professor William B. Rogers' first reports on Virginia, about 1836, he attached little importance to the coals in his "No. XII, or the Pottsville Conglomerates," referring to them as "barren measures." He was inclined to place this series in the Sub-Carboniferous, along with the underlying Mauch Chunk, or Umbral shales; and, even when the Chesapeake & Ohio railway was first connected from tide-water to the Ohio river in 1873, no value was attached to these coals; they were not then considered as a future asset in its transportation; the 60 miles through this formation, from Hinton to Kanawha Falls, being regarded as absolutely barren territory.

In the latter part of 1873, John Nuttall and Joseph L. Beury, two pioneers with large coal experience, first began to prospect along the New River cañon, where the one hit upon the Sewell or Nuttall seam, at Nuttallburg, while the other opened the Fire Creek seam at Quinnimont. For many years thereafter little importance was attached to these finds, as the seams were thought to be too thin for economical mining, and the coal too soft for the fire-boxes and boilers then in vogue, the rapid combustion in which required lump; in consequence of this there was little or no demand for slack, or fine coal, which was charged with stopping the flues, and wastage through the stack.

At the time, only two mines in the Kanawha District, Cannelton and Coalburg,

\*President and manager, Loup Creek Colliery Co., Nelson, West Va.

were prepared to ship by rail; these had been running boats in high water, down the Kanawha to the Ohio for a number of years. About 1874, however, several new mines were started in this district, as the coal was lumpy and easily marketed, but for years the slack was wasted. No attempt had been made to correlate the different seams, and little was known of the coals, farther than the fact that they were of different varieties, the Coalburg being a block, or splint; the Cannelton, an excellent cannel; while the Nuttallburg and Quinnimont coals were recognized as an unusually pure, high-carbon, low-volatile, caking variety, though difficult to market. When Professor David Thomas Ansted stated (about this time) that these were to be the standard steam coals of the future, there were few converts to his theory, which has since been so well verified in their adoption as a standard fuel by the U. S. Navy, and the principal maritime powers of the world.

Since the improvements in boilers, by the enlargement of heating surfaces and slower combustion, it has been found that the fine coal is less objectionable than the lump from other high-volatile coals, as the smoke bears a direct relation to the hydrocarbons; as a rule, the higher these are in the bituminous varieties, the harder and lumpier is the coal; and, under modern practice, the high-carbon coals, though fine, give the best results in steam, with less smoke.

The total production of West Virginia in 1873 has been estimated at 1,000,000 net tons; the output did not reach 2,000,000 tons until 1882. Within these nine years the market was restricted to the fuel requirements of the Baltimore & Ohio, of the Chesapeake & Ohio railways, and of local blast-furnace consumption in Virginia; there were also limited, but growing river consignments to Cincinnati. Within the next ten years the annual increase was nearly 1,000,000 tons, the output for 1894 being 11,627,575 tons. The greater part of this remarkable increase was due to developments in the Pottsville coals by the extension of the Norfolk & Western Railway into the Pocahontas field, and to great activity along the Chesapeake & Ohio in both the New River and Kanawha districts. Thus the value of these smokeless steam coals began to be appreciated as the markets extended over a wider field, covering the Atlantic seaboard as far north as Portland.

In 1904 the production was 32,602,819 tons, a gain of nearly 21,000,000 tons in 10 years, or more than 2,000,000 tons annually; the output for 1905 will approximate 35,000,000 tons, making West Virginia very nearly even with Illinois, and second only to Pennsylvania. The average annual bituminous increase of the United States for the last 10 years has been a little in excess of 16,000,000 tons,

or nearly half the production of any single State with the exception of Pennsylvania. The northern part of the State, covering the Potomac and Monongahela mining districts, has not been idle; the former producing nearly 2,000,000 tons in 1904, and the latter ranking third; the Kanawha-New River district being first, with the Norfolk & Western district as second, the State is divided into five districts, known in ordering as the Potomac, Monongahela, Wheeling, Kanawha-New River, and the Norfolk & Western.

Up to the present the Geological Survey has correlated at least 18 separate workable measures, varying in thickness from 3 ft. to 14 ft., with an aggregate thickness exceeding 70 ft. Five of these are in the Pottsville series, from which about one-half the output of the State is now being drawn. Beginning from the bottom, the seams have been classified as follows: Pocahontas No. 3, Pocahontas No. 4, Fire Creek, Beckley and Sewell, of the Pottsville. Continuing upward through the Kanawha, Allegheny, Conemaugh, Monongahela, and Dunkard series, and using Pennsylvania nomenclature, the seams have been identified as the Clarion, the Lower-, Middle- and Upper-Kittanning, Lower- and Upper-Freeport, Mahoning, Pittsburg, Red Stone, Sewickley, Waynesburg, Washington and Dunkard. While the area of the Pottsville measures above water level is less than one-fourth the total coal area of the State, yet numerous borings, in the counties of Fayette, Raleigh, Wyoming, and McDowell, have recently demonstrated the fact that at least two of these seams maintain their economical thickness for several hundred feet below water level; it is safe to assume that three thousand square miles of this series may in time be made productive. From the recently increased demand for these smokeless coals, and from unprecedented investments now in progress, a few years will certainly witness a tonnage from that field larger than the present production of the State—conditioned upon transportation only.

West Virginia has been dependent upon three trunk lines for transportation, namely, the Baltimore & Ohio, the Chesapeake & Ohio, and the Norfolk & Western; for the last 10 years all these have been taxed to their utmost capacity, so that the increased production during this period is not to be measured by the mining capacity, but by the additional facilities afforded by these roads. As far back as 1890, they could not haul 50 per cent. of the mine capacity as then developed; and to-day, after the expenditure of millions in double tracking and betterments, they are not prepared to handle even 25 per cent. of the tonnage that could be offered from mines now in operation, without any additional opening. Large expenditures are still being made by all three

of these roads, and their capacity will undoubtedly be increased from year to year, but the increased capacity of the mines will more than balance the additional facilities they can provide. The enormous increase of consumption in our own country, with prospects of a foreign trade, together with the concentration of the great manufactories under management of comparatively a few far-seeing men, have brought about the most active investments in coal lands ever witnessed in any country, or any time. Practically all of the coal-carrying roads, and many of the large consumers, are now purchasing coal lands, not only for immediate use, but also to be held in reserve for the future; wisely foreseeing the enormously increased demands that must soon be made upon the supply.

To meet these enlarged conditions, the Deepwater and Tidewater railways are now under construction, from No. 2 Pool on the Kanawha River to Sewell's Point on Hampton Roads; it is confidently hoped that the through line can be put in operation within two years from this date. The Deepwater road will run 85 miles along the line of demarkation between the Pottsville smokeless coals above water level on the east, and the Kanawha measures above water level on the west, with the Pottsville seams just below. It will develop a new coal territory—in the same coals—as large as those of the Chesapeake & Ohio and the Norfolk & Western combined. This road, when completed from Hampton Roads to the Lakes, at the lowest grade line crossing the Appalachians, together with the enlarged facilities contemplated by the existing lines, should very nearly double the present production of West Virginia, though even in that event the shipping facilities may still remain inadequate.

The Coal & Coke railway, up the Elk River from Charleston, is being rapidly pushed to a connection with the Wabash system near Elkins, and will furnish an additional outlet to the northward; but this road nowhere touches the Pottsville, or smokeless coals, and its coal traffic will be confined to the Kanawha, and upper measures. The same is true with the Kanawha & Michigan, now operating along the north side of the Kanawha River from Gauley Bridge to Point Pleasant, where it crosses the Ohio, and which, in connection with the Toledo & Ohio Central system, is a competitor of the Pittsburg & Hocking Valley districts, in the lake trade. The principal seams worked along this line are: The Pittsburg, below Charlestown; the No. 5, or Mahoning; the Coalburg, or Lower Freeport; the Cedar Grove, or Middle Kittanning; the No. 2 Gas, or Lower Kittanning; and the Eagle or Clarion. From the Middle Kittanning upward, the coals are non-coking, with a few local exceptions;

but from that horizon downward they are all good coking coals.

For the fiscal year ending June 30, 1904, the tonnage of coal and coke, handled by the railroads from the State was as follows:

	Coal, Tons.	Coke, Tons.
Baltimore & Ohio.....	7,988,955	425,439
West Virginia Central & Pittsburg.....	1,809,833	277,583
Kanawha & Michigan..	1,508,861	85,360
Norfolk & Western....	6,749,131	1,353,533
Chesapeake & Ohio....	5,976,644	325,453
Total.....	24,033,424	2,467,368

To this must be added transportation by water, and fuel consumed by the railways, mines, etc.

Recently there has been such a marked increase in the demand for all fuels, as to overtax the capacity of every coal-carrying road in the country; and, if the annual increase continues, additional transportation must be provided without delay. But, unfortunately for West Virginia, the construction of trunk lines through her mountains and cañons, is a costly undertaking. On the other hand, the cheap mining-costs, and high-grade coals, will undoubtedly assure all the market that her transportation facilities can supply in the future. Under these conditions, there should be no jealousy nor rivalry between the roads of the State, since not one road has been able to handle its traffic properly in the past, nor is it probable that any one road can do so in the future.

The Mine Inspector reports on more than 600 mines in active operation at present, within the State; and these, at an average of less than 300 tons daily, would produce 60,000,000 tons annually; or nearly double the present output. I venture to assert that the average capacity of these 600 mines could, within one year, be increased to 500 tons daily, or 100,000,000 tons—and without additional capital.

#### Sault Ste. Marie Canals.

The traffic through the canals at the Sault Ste. Marie in 1905 was the largest ever reported. The total freight carried through was 44,270,680 net tons; an increase of 12,724,524 tons, or 40.3% over 1904; and of 8,309,534 tons, or 23.1%, over 1902, hitherto the year of greatest traffic. The United States canal was open in 1905 for 246 days, April 14 to Dec. 16; the Canadian canal 255 days, April 10 to Dec. 20. The total number of vessels passed through the locks was 21,679. This gives averages of 87 vessels and 177,083 tons of freight per day. The average cargo carried was 2,042 tons.

The decrease in copper was due chiefly to increased shipments by rail last winter.

Silicon-copper seems to possess a definite elastic limit. It is this property which produces a good spring metal and spring steel, which is the ideal spring metal, has an elastic limit very nearly approaching the ultimate strength.

#### Mining Stocks.

Speculation in 1905 was strong, especially in the shares of copper mining companies. Industrial shares also were strong, especially in the latter part of the year. The greatest market for mining stocks in this country at present is found in Boston, where coppers are a specialty, though other stocks also find favor. The course of that market is well sketched in our special correspondent's letter, which follows.

The Colorado and Utah stock markets have been only moderately active through the year though conditions have been favored generally advancing prices. In San Francisco the dealings in Comstock shares, which for years have gone on in a small way, were overshadowed by an active and rather interesting market for the new Tonopah, Goldfield and Bullfrog stocks. The speculation in oil stocks, however, has almost completely subsided into what seems to be permanent dulness.

In New York, in spite of high rates for money and some other drawbacks, business has been active. For most of the year the public has not been strongly in evidence and the dealings have been largely among pools and speculators who are well known. It has been, to a very large extent, a professional market. General business has been so active; time and money so fully occupied by trade, that the stock exchanges have been neglected by outsiders.

Such as the market was, it established some new high records. To take some prominent stocks, Amalgamated Copper shows lowest and highest quotations of \$70 and \$111¾ against \$43½ and \$82¾ in 1904; American Smelting and Refining common, \$79¾ and \$170 against \$46 and \$82½; Tennessee Coal, Iron & Railroad, \$68 and \$148, against \$31½ and \$77½; United States Steel common, \$24¾ and \$43¾, against \$8¾ and \$33½. United Copper, Tennessee Copper, Granby Consolidated of Canada, and Greene Consolidated, of Mexico, also made high records. In all cases the highest points were reached in December. Some new stocks, Federal Mining and Smelting and American Smelters Securities, found much favor. Anaconda Copper had an extraordinary advance, also in December.

Dividend payments were generally good throughout the year. Metal mining companies were favored by high prices and were enabled to increase their payments, while a number of new companies entered the list. This was the case with several copper companies, while Tonopah discoveries have brought out three large dividend payers to which others may be added later. About the only important lapse was the passing of its preferred dividends by the Pittsburg Coal

Company for the last half of the year; but this seems to be due to temporary causes and an early resumption may be expected. The large anthracite companies generally increased their dividends.

#### THE BOSTON MINING STOCK MARKET.

BY E. A. WILKINS.

The year 1905 will pass into the annals of history as one of the greatest ever known for copper-mining companies. Although the full benefit has not been reflected in all of the shares of the same, no doubt this may come about in the early part of 1906. The early part of the year was not unlike that of 1904. The price of the metal was strong and stable, while the share market was quiet and discouraging to the holders of stocks. The remarkable improvement in the statistical position of the copper metal caused the price to advance to a higher level than since 1899, when the Amalgamated Company tried to maintain a high price, but failed in its effort. Probably the average price received during the year was from 15½ to 15¾c. per pound, which left an ample margin of profit to the companies. This is shown, not only in market appreciation of the shares, but also in the dividends paid. Sixteen companies have distributed over \$10,000,000 more to stockholders than they did in 1904. The total amount paid was over \$24,000,000. Of the sixteen companies four did not pay anything in 1904, but contributed \$2,260,000 in 1905. The increase of the remaining 12 companies was over \$8,000,000, or about 60%. The Amalgamated Company more than doubled its payment, with likelihood that it will do better next year. The Osceola doubled its payments, and the Calumet & Hecla paid \$1,000,000 more than in 1904. Copper Range Consolidated started payments during the year, and distributed \$1,535,940, while North Butte came in with \$500,000, and Old Dominion with \$175,000. The Atlantic resumed dividends, paying \$50,000. In fact all of the 16 companies increased their dividend payments. From the year's profits the Mohawk will pay \$2 per share, or \$200,000, in January, and the Granby has also entered the dividend list. The above calculation does not include separately the sub-companies like Anaconda, Boston & Montana, and Parrot, of the Amalgamated, nor Baltic, Trimountain and Champion, of the Copper Range, or the Montana Ore Purchasing Company, of the United Copper Company.

The rise in some stocks has been phenomenal during the year. North Butte has been the most conspicuous. From a curb price of \$15 early in the summer, the stock rose to \$93. The market, however, was made largely by a Western element which has entered the copper share arena. United Copper, which did not get above \$6 in 1904, rose to \$68.75. Stocks of the Bingham camp have been the most

sought for, and from this camp have been developed a number of promising properties. Boston Consolidated was taken in hand in the fall and rose to \$27 per share. Its best price in 1904 was \$7.87½. Utah Consolidated did well, rising over \$16 in the year, to \$58.87½ per share. Copper Range did not quite equal its 1904 price record of \$74.50, owing to the fact that there was more or less pressure to keep it down. Allouez had a good rise to \$49 per share, or almost a \$30 advance.

The developments of this mine were phenomenal and set all the mines in Michigan to seeking for the Kearsarge lode, with a greater or less degree of success. Their success or non-success was reflected in the share market. Arcadian, on prospects of locating the lode, rose to \$7; Franklin to above \$20; Isle Royale to \$28.75; Rhode Island to \$8.87½; Tecumseh to \$16.25; Adventure to \$10.25; Centennial to \$34.12½; Mohawk to \$65, and Osceola to \$115. Most of the stocks had extreme rises of from 50 to 100%, and a few even more. Tecumseh, for instance, had an extreme range of from \$2 to \$16.25, or 700%. These prices were made in the fall, and since that time Michigan mining shares have been neglected. Other new price records were Wolverine at \$134.50 and United States at \$44.25. Old Dominion at \$36, and Michigan at \$18.50. Calumet & Hecla touched \$710, against \$642 at the close of 1904.

#### London Mining Market in 1905.

BY EDWARD WALKER.

There have been no booms of any sort during the past year, but plenty of money has been invested in legitimate mining propositions. Those who have the good standing of the mining industry at heart are not sorry at this absence of senseless stock-exchange gambles.

From a financial, as well as a metallurgical point of view, perhaps the most important event of the year has been the development of processes and the provision of capital for the exploitation of the vast heaps of zinc tailings at Broken Hill. The scarcity of zinc and its high price, together with the invention of the necessary processes, have caused these hitherto useless heaps to suddenly become an important factor in the metallurgical world.

The market for shares in South African mines has been practically non-existent during the year. The importation of Chinese labor has been an undoubted success, as far as increase in mining activity on the Rand is concerned. Efforts to create a boom over the auriferous conglomerates in Rhodesia and over the discovery of tin deposits in the Transvaal were to a certain extent successful in South Africa, but the temptation to plunge did not spread to London. The prospecting enterprise in Madagascar, which was a sort of offshot of South African development work, ended ingloriously, but the speculation

was of no interest to Englishmen. The introduction of tube mills for finer grinding before cyaniding has been an interesting development in South African practice during the year.

Early in the year the West Australian market was upset by the Great Boulder Perseverance fiasco, where it was found that the reserves had been greatly overestimated. Otherwise this section of the mining market has been steady and the leading producers, such as Oroya-Brownhill, Great Boulder Proprietary, Golden Horseshoe, Ivanhoe, and Sons of Gwalia are all maintaining their output and are economically administered.

The American mines owned in London have been prominent all the year. Stratton's Independence continues to produce a profit. Camp Bird is a regular dividend payer. El Oro, after having spent large sums of money on new plant out of profits, is beginning to show distributable profits again. Oroville Dredging, Ltd., has been successfully floated, to acquire various active enterprises in California. Esperanza, in Mexico, has struck a bonanza which should bring large profits to English shareholders. The Mexican Mines of El Oro has been formed to take over properties from El Oro Company. The Tomboy Company pays dividends earned by the Argentine claim. The San Francisco del Oro, in Mexico, has raised £150,000 new capital to erect concentrators and other plant and to provide funds for further development. The Le Roi Company has been occupied chiefly in directors' quarrels as to amalgamation with other interests in British Columbia. The Tye Copper Company, on Vancouver Island, has had to suspend dividends, owing to the exhaustion of the ore reserves. The Boston Consolidated, of Utah, has raised £250,000 new capital for the purpose of erecting a plant to concentrate and treat their great masses of low-grade ore. The Arizona Copper Company is also spending money on new concentrators and smelters.

Copper companies, such as the Rio Tinto and Cape Copper, have done well during the year, owing to the high price of the metal. The former has redeemed the whole of its debenture debt of three million pounds by the issue of new ordinary shares at a high premium. The Caucasus Copper Company, on which so much money has been spent, is still in a difficulty with regard to effective concentration, but at the present moment the intention is to persevere with magnetic separators. The Spassky copper mine, in Siberia, has developed wonderfully and promises to be a producer of unusually rich ore; in fact, the Spassky and the Esperanza mentioned above are what may be called the scoops of the year. The Etruscan Copper Estates have given up trying to pretend to be a big mine and have adopted Mr. Alexander Hill's advice to abandon smelting and go in for prospecting. The Capillitas Company

and the Famatina Company, both in Argentina, have raised new capital for further plant and developments, as also have the Cerro Muriano Mines in Spain. The Central Chile Copper Company has become a regular producer and now ships its matte to New York. A scheme is under consideration for raising new capital in order to erect further metallurgical plant.

Little is heard of West Africans. The Ashanti Goldfields Corporation is the most active in this section. Gold-mining interests in New Zealand are confined practically to the Waihi company, which continues to be a large producer. Egyptian mining progresses slowly, and actual mining is being done by three companies. The Indian mines have continued to be regular producers, without any specially noteworthy feature during the year.

Of miscellaneous enterprises, it may be recorded that the Dunderland Iron Ore Company, in Norway, has erected all its plant and should be turning out briquettes before long. The Mond Nickel Company, after many years of hard work, is now established as a successful enterprise. The tin mines in Cornwall continue to make ends meet, but yield little profit. The English Crown Spelter Company has had to abandon the zinc mine in Wales, on which much money was spent, on account of difficulties in concentration. A large tract of coal land in South Wales has been acquired by German interests, though the company formed, called the Whitworth Collieries, Ltd., is nominally in English management.

### Zinc Oxide

Zinc Oxide was produced in 1905 by the New Jersey Zinc Co. and its subsidiary company, the Mineral Point Zinc Co.; also by the Ozark Zinc Oxide Co. of Joplin, Mo., and Coffeyville, Kan. The New Jersey Zinc Co. supplies the Eastern market with the oxide made at its works at Palmerton, Penn.; the Mineral Point Zinc Co. supplies the market in the central and western states from its works at Mineral Point, Wisconsin. The Ozark Zinc Oxide Co. supplies a portion of the market in Kansas City and the Southwest.

The Palmerton works employ the franklinite ore from Mine Hill, N. J. The Mineral Point Zinc Co. uses partly ore from Wisconsin, and partly ore from Colorado and other districts west of the Rocky Mountains. The Ozark Zinc Oxide Co. obtains its ore supply from Kelly, N. M., where it owns the Graphic mine. This company has recently completed a new plant at Coffeyville, in the Kansas natural gas field.

The total production of zinc oxide in the United States in 1905 was 65,403 short tons, valued at \$80 per ton f. o. b. works, against 57,613 short tons, valued at \$78.50 per ton in 1904. The large annual increase in the production of this sub-

stance is chiefly indicative of the growing demand for it as a pigment, although a considerable part of it is consumed in the rubber trade, which is also increasing rapidly.

### Lead Pigments.

The production of lead pigments continues to expand, every variety of product in 1905 showing an increase over the previous year. The total output of white lead was 130,192 short tons, of which 27,500 tons was marketed dry and the remainder in oil; the combined output in 1904 was 126,336 tons. In 1905, the production of red lead was 14,635 short tons as compared with 13,938 tons in 1904; of litharge, 13,111 tons as against 12,487 tons; and of average mineral (a finer grade of red lead), 1,181 tons as against 1,125 tons in 1904. In addition to these carbonate and oxide products, there was an output of 7,200 tons of "zinc-lead", a pigment obtained by the smelting of Colorado ores, and 6,977 tons of "sublimed white lead", a mixture of lead oxide and sulphate obtained by the volatilization of galena ore.

### Garnet in New York in 1905.

BY D. H. NEWLAND.\*

The production of garnet for abrasive purposes is a small industry that has its basis in a limited and somewhat special demand of the domestic market. Outside of the United States, the industry seems to be undeveloped, though this can hardly be due to lack of deposits, for garnet is a common rock constituent. In hardness, garnet is inferior to corundum and carborundum. Its relative cheapness and adaptability to special uses, however, have furnished a field for its employment in which it has now become too firmly established to be displaced without a material change in trade conditions.

The output of garnet in New York State during 1905 amounted approximately to 2,700 short tons, or 300 tons less than in the previous year. The chief producers, as heretofore, were the North River Garnet Co., and H. H. Barton & Sons. The former company has opened a new deposit on Thirteenth Lake, Warren county, five miles southwest of North River, where it has erected a large mill for crushing and concentrating the rock. The old workings in the town of Minerva, Essex county, have been abandoned. The deposit is of different type from the one formerly operated, the garnet being found in a hornblende-feldspar rock that probably belongs to the anorthosite series. The rock at the Minerva mine, as well as

in the neighboring deposits of Gore Mountain, which are operated by H. H. Barton & Sons, is a dark, hornblende schist or amphibolite and has the appearance of an altered sediment. The North River Garnet Co. is the only producer that separates the garnet mechanically, the others sorting it by hand.

Some experimental work was done by G. W. Smith, of Keeseville, during the year on a deposit situated in northern Essex county. The garnet is massive and occurs in irregular bodies in anorthosite. Except for admixture with small crystals of pyroxene, the deposits are quite pure so that there would be little waste in working. A face of almost solid garnet 30 to 40 ft. high is exposed in one place. This garnet has a loose granular texture, readily breaking up under slight pressure into small grains.

Many other deposits in the eastern Adirondacks have been reported.

Garnet is used mostly in the form of paper by the leather and wood-working industries. It is said to have a life several times longer than sandpaper. Its advantages over quartz are due not alone to greater hardness, but to the cleavage-like parting, which ensures a sharp cutting edge as well as a smooth surface for attachment to the paper. This parting is a prominent feature of Adirondack garnet.

### Mining in Korea.

An American engineer, who has been some months in Korea, writes: It is difficult to give an opinion on the future of Korean mining, as very little prospecting has been done. The mineral output is mostly gold from alluvial diggings, and some copper. Economical conditions are good for cheap mining, and the climate is excellent. The country is in a transition stage, and it is difficult to prophesy with regard to its future, as the Japanese have not yet defined or indicated their policy. The Government intends to issue mining regulations soon. The foreign engineers are trying to have these rules framed to suit modern conditions, but with what success I cannot tell as yet. It is possible that some good mines may be discovered in this peninsula, but general geological conditions seem to deprecate any idea that it will ever prove the Eldorado that some irresponsible people are stating it to be. Nothing will be obtained here without considerable work and capital.

With the exception of the Oriental Consolidated Mining Co., an American concern, there are no mines here successfully worked, at least by foreigners. The British mines are only paying expenses, and are very nearly worked out, while the Germans have long ago given up their concessions, and nothing has been done in the matter of other foreign concessions beyond securing good titles.

\*Assistant State Geologist, Albany, N. Y.



Metal and Mining Companies—U. S.

Table with columns: Name of Company and Location, Authorized Capital, Shares (Issued, Par Val.), Dividends (Total to Date, Latest Date, Amt.). Lists various metal and mining companies such as Alaska Mexican, Amalgamated, and others.

Coal, Iron and Other Industrials—United States.

Table with columns: Name of Company and Location, Authorized Capital, Shares (Issued, Par Val.), Dividends (Total to Date, Latest Date, Amt.). Lists various industrial companies such as Ala. Con., C. & I., pf., Allis-Chalmers, and others.

Canada, Mexico, Central and South America.

Table with columns: Name of Company and Location, Authorized Capital, Shares (Issued, Par Val.), Dividends (Total to Date, Latest Date, Amt.). Lists various international companies such as Amistad y Conc'dia, Butters' Salvador, and others.

**Metal Market.**

New York, Jan. 3.

**Gold and Silver Exports and Imports.**  
At all United States Ports in Nov. and Year.

Metal.	Exports.	Imports.	Excess.
<b>Gold:</b>			
Nov. 1905 ..	\$1,137,318	\$5,171,141	Imp. \$4,033,823
" 1904 ..	20,813,443	4,777,105	Exp. 16,036,338
Year 1905 ..	44,126,935	48,614,475	Imp. 2,388,540
" 1904 ..	107,709,000	81,467,050	Exp. 26,241,950
<b>Silver:</b>			
Nov. 1905 ..	5,631,819	4,272,581	Exp. 1,089,238
" 1904 ..	3,405,366	2,439,742	" 965,624
Year 1905 ..	49,316,953	30,930,532	" 18,386,421
" 1904 ..	46,020,584	23,884,087	" 22,136,497

These statements cover the total movement of gold and silver to and from the United States. The figures are furnished by the Bureau of Statistics of the Department of Commerce and Labor.

**Other Metals.**

**Daily Prices of Metals in New York.**

Dec.—Jan.	Copper.			Tin.	Lead.	Spelter.	
	Lake, Cts. per lb.	Electrolytic, Cts. per lb.	London, £ per ton.			New York, Cts. per lb.	St. Louis, Cts. per lb.
28	18½ @ 18½	18½ @ 18½	79½	36	5.60	6.50 @ 6.60	6.40 @ 6.42½
29	18½ @ 18½	18½ @ 18½	79½	36	5.60	6.50 @ 6.60	6.40 @ 6.42½
30	18½ @ 18½	18½ @ 18½	.....	36	5.60	6.50 @ 6.60	6.40 @ 6.42½
31	.....	.....	.....	.....	.....	.....	.....
2	18½ @ 19	18½ @ 18½	.....	35½	5.60	6.50 @ 6.55	6.37½ @ 6.42½
3	18½ @ 19	18½ @ 18½	80½	36	5.60	6.50 @ 6.55	6.37½ @ 6.42½

London quotations are per long ton (2,240 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. The price of cathodes is usually 0.125c. below that of electrolytic. The lead prices are those quoted by the American Smelting & Refining Co. for near-by shipments of desilverized lead in 50-ton lots, or larger orders. The quotations in spelter are for ordinary western brands; special brands command a premium.

**SILVER AND STERLING EXCHANGE.**

Dec.	Sterling Exchange.	Silver.			Jan.	Sterling Exchange.	Silver.		
		New York, Cents.	London, Pence.	Pence.			New York, Cents.	London, Pence.	Pence.
28	4.85	64½	30	1	.....	.....	.....	.....	
29	4.85	64½	29	2	4.85½	64½	30½	.....	
30	4.85	64½	30	3	4.85½	64½	30	.....	

New York quotations are for fine silver per ounce Troy London prices are for sterling silver. .925

**Copper.**—The feature of the market just prior to the close of the year was the resale to Europe of considerable quantities of copper on the part of the Chinese, for prompt shipment from Shanghai, at prices considerably below current market quotations. The market here was somewhat dull, in view of the holiday season, but this week there has been a rather good inquiry, particularly from Europe, for early delivery, which has given a better tone to the market.

The close is steady at 18½ @ 19c. for Lake copper; 18½ @ 18½ for electrolytic in ingots, cakes and wirebars; 18½ @ 18½ for casting copper; the range being chiefly according to the delivery.

The standard market in London has been very firm throughout the week, but quotations are still rather low as compared with refined sorts. The close is higher and firm at £80 2s. 6d. for spot, £79 15s. for three months.

Statistics for the second half of December show a decrease in the visible supplies of 500 tons.

Refined and manufactured sorts we quote; English tough, £86 @ £86; best selected, £86 @ £87; strong sheets, £95.

**Tin**—The market in London reacted further, touching at one time £160 10s. for spot, £160 2s. 6d. for three months. At the lower quotations a very heavy inquiry made its appearance, and prices both here and in London reacted sharply. The close there is firm at £163. for spot, £163. 7s. 6d. for three months, and here at 36c.

Statistics for the month of December show a decrease in the visible supplies of 200 tons.

Imports of tin into the United States for the 11 months ending Nov. 30 are reported as below, in long tons:

	1904.	1905.	Changes.
Straits.....	15,081	17,635	I. 2,554
Australia.....	287	539	I. 252
Great Britain.....	18,019	18,016	D. 3
Holland.....	618	411	D. 207
Other Europe.....	356	762	I. 406
Other countries.....	26	42	I. 16
Total.....	34,387	37,405	I. 3,018

The imports from Great Britain are chiefly Straits tin. The principal increase in 1905 was in direct import from the Straits.

**Lead**—The market has been rather quiet and quotations unchanged. Small lots of spot lead still command a premium, being quoted around 6c.

The London lead market is steady and closes unchanged at £17 10s. for Union. Spanish lead, £17 11s. 3d. for English lead.

Spanish lead, £17 11s. 3d. for English lead.

Imports of lead into the United States, with re-exports of imported metal, for the 11 months ending Nov. 30 are reported as follows, in short tons:

	1904.	1905.	Changes.
Lead, metallic.....	8,553	4,012	D. 4,541
Lead in ores and base bullion.....	94,825	85,913	D. 8,912
Total imports....	103,378	89,925	D. 13,453
Re-exports.....	79,563	66,022	D. 23,541
Net imports....	23,815	33,903	I. 10,088

Of the imports in 1905, Mexico furnished 78,928 tons and Canada 9,801 tons. The imports from Mexico decreased 15,263 tons, as compared with 1904, while those from Canada increased 1,518 tons. Exports of domestic lead were 237 tons in 1904, and 271 tons in 1905.

**Spelter.**—There is little more pressure to sell, and as consumers are rather well supplied for a few weeks ahead and not ready to make additional commitments, the market has developed a somewhat easier tendency. Quotations at the close are 6.50 @ 6.55 New York, 6.37½ @ 6.42½ St. Louis.

The London market has been very firm and active, advancing at the close to £29 7s. 6d. for good ordinaries, £29, 12s. 6d. for specials.

Exports of spelter from the United States for the 11 months ending Nov. 30 were 8,863 short tons in 1904, and 3,688 tons in 1905; a decrease of 5,175 tons. Exports of zinc ore were 28,755 tons in 1904, and 22,747 tons in 1905; a decrease of 6,008 tons. Exports of zinc dross—not reported separately in 1904—were 3,953 short tons in 1905.

**Antimony**, is very firm, quotations being unchanged.

Imports of antimony into the United States for the 11 months ending Nov. 30 were as follows in pounds:

	1904.	1905.	Changes.
Metal and Regulus.....	3,418,850	4,989,940	I. 1,541,090
Antimony ore.....	2,031,042	1,660,003	D. 371,039

There was an increase of 45.1% in metal and regulus imported; but a decrease of 18.3% in ore.

**Nickel.**—Quotations for large lots, New York, or other parallel delivery, are 40@ 47c. per lb., according to size and condition of order. For small quantities, prices range from 48 up to 60c, also according to size for order and deliveries.

Exports of nickel, nickel oxide and nickel matte from the United States for the 11 months ending Nov. 30, were 7,061,405 lb. in 1904, and 8,890,187 in 1905; an increase of 1,828,782 lb. Imports of nickel ore and matte were 7,441 tons in 1904, and 12,341 tons in 1905; an increase of 4,900 tons.

**Platinum.**—Quotations are firm at \$20.50 per oz. Gas-engine sparking points vary from 87c. for "A," to \$1.80 for "B."

Imports of platinum into the United States for the 11 months ending Nov. 30, were 6,596 lb. in 1904, and 6,586 lb. in 1905; showing a decrease of 10 lb. only.

**Quicksilver.**—Prices in New York continue steady at \$40 per flask for large orders—over 100 flasks—and \$40.50 for jobbers' lots, down to 10 flasks. For retail quantities, under 10 flasks, pound prices are charged, which work out to \$41.75@42.25 per flask. San Francisco prices are steady at \$39 for domestic orders, and \$37.50 for export. The London price is £7 5s., but second hands ask only £7 2s. 6d. per flask.

Exports of quicksilver from all United States ports for the 11 months ending Nov. 30 were 1,479,298 lb. in 1904, and 908,558 lb. in 1905; a decrease of 570,740 lb. or 7,610 flasks.