

# THE ENGINEERING AND MINING JOURNAL

MINING AND METALLURGY ESTABLISHED 1866

VOL. LXXIX.

NEW YORK, THURSDAY, JANUARY 5, 1905.

No. 1.

## THE ENGINEERING AND MINING JOURNAL

ESTABLISHED 1866

PUBLISHED EVERY THURSDAY  
261 BROADWAY, NEW YORK.

T. A. RICKARD.....EDITOR  
FREDERICK HOBART } .....ASSOCIATE EDITORS  
CHARLES S. PALMER }

### SPECIAL CONTRIBUTORS.

R. W. RAYMOND.

PHILIP ARGALL	W. R. INGALLS
R. GILMAN BROWN	D. H. NEWLAND
T. IANE CARTER	ROBERT V. NORRIS
J. PARKE CHANNING	EDWARD W. PARKER
A. G. CHARLTON	R. A. F. PENROSE, JR.
JOHN A. CHURCH	EDWARD D. PETERS
DONALD CLARK	F. DANVERS POWER
HENRY F. COLLINS	C. W. PURINGTON
J. H. CURL	T. KIRKE ROSE
G. A. DENNY	J. E. SPURR
S. F. EMMONS	JOSEPH STRUTHERS
F. LYNWOOD GARRISON	W. H. WEED
ROBERT T. HILL	CHARLES G. YALE

JOHN A. HILL.....PRESIDENT  
J. T. MORRIS.....MANAGER AND TREASURER

TELEPHONE 6865 CORTLANDT. P. O. BOX 1833.  
CABLE ADDRESS "ENGINJOUR" NEW YORK.

### BRANCH OFFICES.

CHICAGO.....520 Monadnock Block  
PITTSBURG.....701 Keystone Building  
DENVER.....206 Boston Building  
SALT LAKE CITY.....662 Main Street  
BUTTE, MONTANA.....19 & 20 Owsley Block  
SAN FRANCISCO.....168 Crocker Building  
LONDON, ENGLAND.....20 Bucklersbury. E. C.

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 Monday morning of issue week; changes of copy by the preceding Thursday.

Copyright, 1905, by

THE ENGINEERING AND MINING JOURNAL.

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

## CONTENTS.

The Pioneers.....T. A. Rickard	1
United States Mineral and Metal Production in 1903 and 1904.....	2
The Production of Gold and Silver in U. S., T. A. Rickard	3
The World's Gold Production..T. A. Rickard	4
The Commercial Movement of Gold and Silver	5
Copper.....Frederick Hobart	6
The New York Copper Market.....	8
Platinum.....	8
Lake Superior Copper.....C. E. L. Thomas	9
*Arizona Copper Mines.....James Douglas	10
Lead.....W. R. Ingalls	11
The Coeur D'Alene.....Stanly A. Easton	13
Southeast Missouri.....H. A. Wheeler	13
Antimony.....	14
Zinc.....W. R. Ingalls	14
The New York Zinc Market.....	15
The Missouri Ore Market.....Jesse A. Zook	15
*Alaska.....Alfred H. Brooks	16
Colorado.....	19
*California.....Charles G. Yale	20
Bismuth.....	21
Nevada.....C. C. Burger	22
Quicksilver.....	22
South Dakota.....Jesse Simmons	23
Spodumene.....	23
*Montana.....B. E. St. Charles	23
*Utah.....L. H. Beason	25
Idaho.....	26
The Klondike.....J. P. Hutchins	27
Cyanidation in the United States, Charles H. Fulton	28
Metallurgical Progress in Africa and Australia, Alfred James	31
*Mexico.....James W. Malcolmso	33
Rhodesia.....	36
The Transvaal.....W. Fischer Wilkinson	36
New Zealand.....E. W. Bonwick	38
*Eastern States of Australia.....F. S. Mance	39
*Western Australia.....H. C. Hoover	41
Oil and Gas in Kansas and Indian Territory, Erasmus Haworth	42
Arsenic.....	43
Ontario Mines.....Thomas W. Gibson	44
*British Columbia.....E. Jacobs	46
Coal.....	47
The Anthracite Coal Trade.....	48
The Seaboard Bituminous Coal Trade.....	49
Alabama Coal.....L. W. Friedman	51
Chicago Coal Market.....E. Morrison	51
Pittsburg District Coal.....S. F. Luty	51
The Lake Coal Trade.....George H. Cushing	52
Iowa Coal.....	53
Ohio Coal.....	53
West Virginia Coal.....James W. Paul	54
Illinois Coal.....	55
Iron and Steel.....Frederick Hobart	55
The Alabama Iron Market.....L. W. Friedman	58
Chicago Iron Market.....E. Morrison	58
Pittsburg Iron and Steel Market.....S. F. Luty	59
The Lake Ore Trade.....George H. Cushing	61
The Lake Superior Iron Ranges, Dwight E. Woodbridge	61
Cement.....	63
The Chemical and Mineral Trades, Charles C. Schnatterbeck	63
Nitrate of Soda.....	64
Bromine.....	64
Fluorspar.....	64
Sulphur and Pyrite.....Charles C. Schnatterbeck	65
The Phosphate Industry.....	65
The New York Stock Market, Charles C. Schnatterbeck	66
The Boston Mining Stock Market.....E. Wilkins	67
London Mining Market.....E. Walker	68
Dividends and Assessments.....	69
Weekly Metal Market.....	72
Personals.....	72

\*Illustrated.

## EDITORIAL.

To

The Memory of  
the Pioneers of  
American Mining.

I have a toast; lift high the glass  
To those old heroes who  
First crossed the plains and found the pass,  
To make a way for you.

To those who traced the river gold  
The Spaniard sought in vain;  
The first to see the range unfold  
Beyond the sagebrush plain.

Those Argonauts of yesterday,  
Whose Colchis dream came true;  
Those voyageurs who cleared the way  
More wisely than they knew.

The track they broke for other men  
Is crossed by rail and plow;  
And where they built their campfires then,  
The cities bivouac now.

Their footsteps linked the sounding shore  
From Sandy Hook to Golden Gate;  
Their deeds breathe youth for evermore,  
A bugle call to challenge fate.

The great cathedral guards their sleep,  
The unfettered sky is over them,  
The proud Sierras vigil keep,  
And wind and wave their requiem.

A toast to the adventurous!  
Explorers, miners, engineers!  
Who blazed the trail ahead for us,  
The pioneers! the pioneers!

T. A. RICKARD.

January 1, 1905.

## United States Mineral and Metal Production—1903 and 1904.

	Customary Measure	1903.			1904.			Changes.
		Quantity.	Value.		Quantity.	Value.		
			Total.	Per Unit.		Total.	Per Unit.	
<b>Non-metallic:</b>								
Arsenic, white.	Sh. T.	611	\$35,028	\$57.33	498	\$29,504	\$59.25	D. 113
Barytes.	Sh. T.	50,397	152,150	3.02	22,502	74,736	3.32	D. 27,895
Bauxite.	L. T.	48,087	171,306	3.56	48,966	189,325	3.87	I. 879
Bromine.	Lb.	597,000	170,140	.29	897,100	213,985	.35	I. 300,100
Carborundum.	Lb.	4,760,000	476,000	.10	7,000,000	700,000	.10	I. 2,240,000
Cement, natural hydraulic.	Bbl. (a)	7,030,271	3,675,520	.52	5,000,000	2,500,000	.50	D. 2,039,271
Cement, portland.	Bbl. (b)	22,342,973	27,713,319	1.24	22,000,000	20,900,000	.95	D. 342,973
Coal, anthracite.	Sh. T.	75,288,206	158,100,232	2.10	69,749,962	149,990,870	2.15	D. 5,538,244
Coal, bituminous (c).	Sh. T.	277,076,986	327,075,530	1.18	273,774,922	316,768,701	1.16	D. 3,302,064
Coke.	Sh. T.	25,262,360	66,459,623	2.63	23,500,000	56,400,000	2.40	D. 1,762,360
Cobalt oxide.	Lb.	120,000	228,000	1.90	100,000	215,000	2.15	D. 20,000
Copper sulphate (d).	Lb.	43,124,454	1,811,227	.04	63,309,394	2,849,484	.05	I. 20,184,940
Copperas (f).	Sh. T.	20,240	121,440	6.00	12,404	868,315	70.00	D. 7,836
Crushed steel.	Sh. T.	378	52,850	139.82	395	55,300	140.00	I. 17
Fluorspar.	Sh. T.	42,523	213,617	5.05	26,180	153,081	5.85	D. 16,343
Garnet.	Sh. T.	4,413	146,955	33.30	3,363	99,463	29.58	D. 1,050
Graphite, artificial.	Lb.	2,620,000	178,370	.07	3,195,251	221,686	.07	I. 575,251
Graphite, crystalline.	Lb.	4,525,700	164,247	.04	4,594,282	173,120	.04	I. 68,582
Iron ore.	L. T.	32,471,550	55,201,635	1.70	29,366,654	36,708,318	1.25	D. 3,104,866
Lead, white.	Sh. T.	112,700	12,228,024	108.50	118,079	11,807,900	100.00	I. 5,379
Lead, red.	Sh. T.	12,300	1,385,900	112.68	13,800	1,759,500	127.50	I. 1,500
Lead, orange mineral.	Sh. T.	1,009	168,000	168.00	800	124,000	155.00	D. 200
Limestone and dolomite flux.	L. T.	12,029,719	5,423,732	.45	8,788,000	3,515,200	.40	D. 3,241,719
Litharge.	Sh. T.	12,400	1,326,800	107.00	14,200	1,597,500	112.50	I. 1,800
Phosphate rock.	L. T.	1,570,228	4,993,912	3.18	1,782,503	5,703,582	3.20	I. 212,275
Pyrite.	L. T.	199,387	787,759	3.95	181,763	647,276	3.56	D. 17,624
Sulphur.	L. T.	39,310	789,738	20.09	191,250	8,139,500	42.56	I. 151,940
Zinc-lead.	Sh. T.	4,500	253,125	56.25	6,781	398,384	58.75	I. 2,281
Zinc oxide.	Sh. T.	54,034	5,005,394	92.63	58,808	5,513,838	93.76	I. 4,774
Zinc ore, exported.	Sh. T.	39,418	957,000	25.04	31,392	882,516	28.11	D. 8,026
<b>Total non-metallic.</b>			<b>\$675,496,873</b>			<b>\$629,295,184</b>		
<b>Metallic:</b>								
Aluminum.	Lb.	7,500,000	\$2,325,700	\$0.31				
Antimony (e).	Lb.	6,174,000	389,579	.06	4,633,036	\$301,147	\$0.07	D. 1,540,964
Bismuth.	Lb.	Nil.			(f) 10,891	22,871	2.10	I. 10,891
Copper.	Lb.	689,045,796	(c) 90,726,660	.13	748,540,800	(h) 95,588,660	.13	I. 59,495,004
Gold.	Troy ounce.	3,560,000	73,511,700	20.67	4,080,532	84,551,300	20.67	I. 530,532
Iron, pig.	L. T.	18,009,252	288,125,032	16.00	16,563,938	219,474,679	13.25	D. 1,445,314
Lead.	Sh. T.	276,694	23,447,050	84.74	313,553	27,021,997	86.18	I. 36,859
Nickel.	Lb.	114,200	45,900	.40	100,000	47,000	.47	D. 14,200
Platinum.	Troy ounce.	110	2,080	18.91	120	2,340	19.50	I. 10
Quicksilver.	Flask (g)	37,866	1,564,734	41.32	43,499	1,783,459	41.00	I. 5,633
Silver.	Troy ounce.	54,300,000	29,322,000	.54	53,603,000	30,672,173	.57	D. 697,000
Zinc.	Sh. T.	158,562	17,118,216	108.00	176,849	18,038,598	102.00	I. 18,347
<b>Total metallic.</b>			<b>\$526,681,651</b>			<b>\$477,504,224</b>		

(a) Barrel of 300 lb. (b) Barrel of 380 lb. (c) Includes cannell. (d) Includes a small amount made from metallic copper. (e) Existing only as a constituent (20%) of hard lead. (f) Bismuth contents of ore mined, but not smelted, in the United States. (g) Average value of Lake copper at New York, less 0.25 c. per pound. (h) Average price at New York of Lake and electrolytic copper. (i) Flask of 75 lb. (j) Includes only that marketed as copperas.

The preliminary estimates of mineral production in the United States indicate a condition of healthy prosperity, despite an actual diminution in the total value of products. Two basic industries suffered by reason of lower prices; there is a decrease of 1,500,000 tons in the pig iron made during 1904, and there is a falling off, amounting to 2 per cent, in the coal output. In the production of gold, the great tonic to vigorous business the world over, there is a notable increase, the total being the highest on record. While ten or eleven million dollars is a small sum as compared to the grand total of mineral wealth produced in these United States, it indicates a continued expansion of a pioneer industry, the development of which leads to multitudinous activities. The output of silver is quiescent and largely incidental to the mining of other metals, but the better price, from 57 cents per ounce, in January, to 61 cents, in December, and the greater stability of the market for that metal, will stimulate production and aid the search for new

treasuries of ore. Other metal industries, notably the mining of copper, lead and zinc, profited from better prices. There is a growth of 9 per cent in the amount of copper produced and a higher total valuation; the output of lead increased by 30,000 tons, and that of spelter by 18,000 tons. Tin mining remains an infant industry, only a few tons having been produced, in South Carolina, in South Dakota and in Alaska.

The statistics for the year do not reflect the improvement in the condition of the mineral industry, because the greater activity of the last six months is largely obscured by the unfavorable state of affairs which characterized the earlier portion of the year. 1905 starts under auspices more radiant than the record of last year's production would indicate, every important mineral commodity being quoted higher. In iron, the great industrial barometer, the improvement is striking, for while No. 2 foundry, Birmingham, sold at furnace for \$8.75 to \$9 per ton at the beginning of the past year, it rose to

between \$13.75 and \$14 at the end; speaking generally, iron prices are 40 to 50 per cent better all round. In coal, though the increase of price is not marked, there is a betterment; the effects of over-production, due to the stimulus consequent upon the anthracite strike of two years ago, are wearing off, and a more stable market is anticipated. Copper, the use of which, like that of iron, reflects the advancement of modern civilization, closed the year at 15 cents at New York for the electrolytic brand, as compared to 12½ cents per pound in the previous January. Lead was quoted at \$4.60 per hundred pounds at the end of the year, as against \$4.35 twelve months earlier, and spelter closed at 6 cents per pound, which was 26 per cent better than in January last.

Untoward financial conditions, the sequel to a debauch of speculation, exercised a depressing influence upon mining early in 1904, but the recovery has been unmistakable. The industry advances irresistibly because it is based upon the exploitation of a continental area.

## The Production of Gold and Silver in the United States.

By T. A. RICKARD.

Through the courtesy of the Director of the Mint we are enabled to give authoritative statistics for the production of gold and silver in the United States; they appear in the accompanying column. It is apparent that the past year has seen a general increase in the profitable activity of the gold mining districts. The total is about \$11,000,000 ahead of 1903, and is the highest on record.

Colorado has made up most of the diminution chronicled a year ago, the output being \$3,500,000 more than in 1903, and only \$2,000,000 less than the maximum attained in 1900, when the yield was \$28,829,400. In this State, Cripple Creek continues to make the preponderating contribution, the output being estimated at \$16,000,000, as compared to \$13,000,000 the year previous. These figures indicate forcibly that the labor troubles, which gave this district so much unfortunate notoriety, did not hinder mining operations as much as was feared. The tonnage produced was greater than in 1903, and the dividends were larger. Several surface discoveries of a promising character have supplemented the opening up of new orebodies in the older mines, and greater activity in exploitation has followed the lowering of treatment charges. This stimulus, due to more favorable rates, together with higher prices for the lead and copper occurring in ores that are smelted, has undoubtedly encouraged mining all over the State. Outside of Cripple Creek, the other districts exhibit no marked difference, save in San Miguel and Ouray counties, where, despite the yield from several big mines, there has been a falling off, due in part to the continued strife between mine-owners and mine-workers; but this is now practically at an end, so that in 1905 the Camp Bird, Tomboy, Smuggler-Union and Liberty Bell are sure to increase their aggregate output.

California is worthy of her traditions, the production exhibiting a steady increase during recent years. During 1904 there was plenty of water for the stamp-mills, so that the re-opening of old mines on the Mother Lode, due to better economic conditions, has been facilitated. The most interesting feature is the growth of the dredging industry, which is now responsible for as large an output as the hydraulic and drift mines combined. From Oroville the application of dredges is being extended to other more mountainous districts, with a success which has proved stimulating to the investment of capital.

In Alaska, important discoveries were made on the Tanana river, where three thousand men have been at work during the season. The Fairbanks district generally has witnessed a period of increased activity. Capital is being invested in several comprehensive ditch systems, the

completion of which will permit of large hydraulic operations. At Nome, also, long ditches are being built. The beach deposits at Nome are becoming depleted; but, despite this fact, the inland placers are contributing sufficient gold to keep the output at nearly \$5,000,000, the estimate being \$4,878,500 for 1904, as against \$4,437,400 in 1903. Of the total gold output of Alaska, estimated at \$9,000,000, about one-third comes from the Treadwell group of lode mines on Douglas island, where a depth of 1,000 ft. has now been attained. There is more intelligent exploration on foot in Alaska to-day than in any other mining region on this conti-

Further discoveries is afforded by the results of prospecting in the adjoining region, and also in Lincoln county, where Searchlight and other camps are springing up, by reason of the construction of the new railroad between Salt Lake and Los Angeles.

Montana also exhibits a healthy increase. Fergus county is the chief gold district; a group of progressive mines, exploiting lodes some of which are in limestone, maintains a steadily increasing output, which undergoes treatment by cyanide. At Helena, the old Whitlach-Union mine has been resuscitated, and in the country tributary to Helena there are other productive mines of some promise. Dredging in Alder gulch continues. Beside the extraction of gold by direct meth-

Production of Gold and Silver in the United States.

States and Territories.	Gold.		Silver.	
	1903.	1904.	1903.	1904.
Alabama	\$4,400	\$29,000	Fine ounces.	Fine ounces.
Alaska	8,614,700	9,000,000	143,600	184,200
Arizona	4,357,600	4,250,000	3,387,100	3,400,000
California	16,104,500	19,000,000	931,500	1,380,000
Colorado	22,540,100	26,000,000	12,990,200	12,500,000
Georgia	62,000	99,000	400	1,200
Idaho	1,570,400	1,960,000	6,507,400	7,000,000
Kansas	9,700	9,700	97,400	97,400
Maryland	500	2,800		
Michigan			50,000	50,000
Montana	4,411,900	4,960,000	12,642,300	12,750,000
Nevada	3,388,000	5,140,000	5,050,000	4,500,000
New Mexico	244,600	248,000	180,700	180,000
North Carolina	70,500	115,600	11,000	13,000
Oregon	1,290,200	1,300,000	118,000	132,000
South Carolina	100,700	113,200	300	600
South Dakota	6,826,700	7,270,000	221,200	185,900
Tennessee	800	200	13,000	59,100
Texas			454,400	454,400
Utah	3,697,400	4,700,000	11,196,800	10,500,000
Virginia	13,500	3,300	9,500	1,200
Washington	279,900	310,000	294,500	200,000
Wyoming	3,600	40,500	200	13,800
Total	\$73,591,700	\$84,551,300	54,300,000	53,603,000

As estimated by the Director of the Mint.

ment, and the scope of it is being immensely increased by greater accessibility and facility of transport, due to the building of railways and wagon roads from the coast to the interior. Progress is slow but substantial.

South Dakota is feeling the benefit of advanced methods of cyanidation, and shows a general progress, in which the famous Homestake is taking the lead. Of the total output of \$7,270,000, nearly \$5,000,000 is contributed by the Homestake company, whose equipment has been increased by 100 stamps, together with additions to its cyanide plants.

In Nevada, the completion of the railroad to Tonopah has not only helped that district, but it has stimulated operations at an adjoining camp named Goldfields, the rapid growth of which constitutes the most interesting episode of the year. Situated in an almost waterless desert, Goldfields has shown, as was the case at Tonopah, that rich gold ore can give profits sufficient to overcome natural obstacles, however great. The production of this new district is dependent entirely upon narrow seams of phenomenally rich ore, the persistence of which will be tested during the ensuing year. Expectation of

ods, a large part of Montana's output is incidental to the refining of the immense quantity of copper produced by the mines at Butte. Fully \$1,350,000 is derived from this source.

This applies also to Utah, where the recent expansion of copper mining in the Bingham district has helped gold production, through separation of the precious metals occurring in copper sulphides. This is a specially important feature of the low-grade copper deposits of the 'porphyry belt.' The complex ores produced in the Centennial-Eureka, and in other mines of the Tintic district, yield gold in association with silver. This is true also of the big mines at Park City. On the other hand, the essentially gold mining districts, such as Mercur, have not done particularly well. In the Gold Mountain district, the Annie Laurie and Siever mines have enlarged their cyanide mills. General progress undoubtedly has been stimulated by the growth of the smelting industry in the Salt Lake valley, the reduction of the big output of copper sulphide ore affording a good market for silicious material containing the precious metals.

Arizona is apparently without change.

The principal activity is in the San Francisco district, where the Goldroads mine is the chief producer. Among the older mines, the Congress has found good ore at 1,500 ft., and is increasing its equipment. Around Prescott, especially in the Bradshaw mountains, a large number of small mines are contributing, their success being aided by a local market for their ores at the Val Verde smelter. In the desert country bordering the Colorado river there is a revival of activity.

In Idaho, Oregon and Washington, gold mining holds its own, without noteworthy incident. The southern States all show a healthy increase, save Virginia; but their aggregate production is small when compared to the efforts made to awaken in-

important direct producers of silver, and the old Alice mine, at Butte, has been in operation, but these once famous properties are responsible for only a fraction of the output, the bulk of which is accountable to the copper industry of Butte. The proportion of silver separated in the refining of this copper is decreasing as the mines become deeper, so that the production of silver does not increase as the copper industry grows.

In Utah, nearly two-thirds of the silver is obtained from the lead ores of Park City, together with Eureka, Mammoth and other mining centers in the Tintic district. One-third of the silver is derived from the refining of copper smelted from sulphide ores, mined chiefly

### The World's Gold Production.

By T. A. RICKARD.

The gold output of the world has increased during 1904 to \$351,000,000, as compared to \$326,500,000 in 1903. This increase is due, for the most part, to better conditions in the Transvaal, and to the continued successful mineral development of the United States. In Australasia new sources of production have failed to balance the exhaustion which is as adjacent districts, gives promise of a development of Alaska, the overshadowing event in the record of gold mining during the past year has been the introduction of Chinese labor into South Africa and the consequent immediate stimulation of mining on the Rand.

The notable features of the American gold mining industry are considered separately on another page.

Australasia exhibits a slight decrease, accountable almost entirely to Western Australia. Nevertheless the Federation, together with New Zealand, is again the largest gold producing region in the world, a distinction which it will hold for the last time for many years, if progress in the Transvaal fulfils present expectations. Gold mining in Australia during 1904 was characterized by absence of important events. The decrease in Western Australia is not important because it is distributed over a large number of districts. The bulk of the output continues to come from sixteen large mines, most of them situated at Kalgoorlie. Despite several scandals due to mixing gambling with business, there has been a gradual approach to cleaner methods, and this has been accompanied by the application of unusual technical skill. Results from diamond-drilling on the 1,900-ft. level of the Great Boulder mine afford strong encouragement for deeper exploitation, and strengthen confidence in the life of the group of big mines to which the State owes its eminence as a gold region. In Victoria the greater depth attained at Bendigo is more interesting than important, the deepest workings in that old district having proved disappointing. The Victoria quartz mine has explored at 4,024 ft. without result. But the shallower mines have done well, so that the output is the best for thirty years. The elaborate operations, now fully started, on the 'deep leads' in the Ballarat and adjacent districts, give promise of a development in Victorian gold mining which will contribute notably to an increase of production. If the water can be handled at a reasonable expense, the exploration of these ancient alluvial channels will be highly stimulated during 1905. English capital is heavily invested and the outcome is being watched with keen interest. In Queensland the most notable event is the proof at Mt. Morgan of an enormous body of gold ore, containing copper; this parallels the discovery at Leadville, in Colorado, where copper in marketable

Output of the Leading Gold Producing Countries of the World.

Country.	1903.	1904.	Changes.
United States.....	\$73,591,700	\$84,551,300	I. \$10,959,600
Canada.....	18,834,490	17,410,000	D. 1,424,490
Mexico (a).....	10,182,459	10,690,782	I. 508,323
Russia.....	24,980,320	22,500,000	D. 2,480,320
Transvaal.....	61,259,281	77,913,663	I. 16,654,382
Rhodesia.....	4,065,436	4,640,415	I. 574,979
British India.....	11,140,069	11,445,874	I. 305,805
Australasia.....	89,207,421	86,763,731	D. 2,443,690
All others.....	33,305,750	(b) 35,000,000	I. 1,694,250
Total.....	\$326,566,926	\$350,915,765	I. \$24,348,839

(a) Based upon exports and coinage during fiscal year ending June 30. (b) Estimated.

terest in a region which first produced gold in the United States. The gold reported from Kansas is from the refining of pig lead, and that credited to Tennessee is from copper.

The silver output of the United States is practically unchanged. An increasing proportion of it is incidental to the mining of other metals. Colorado appears to have lost the lead, although her production is very close to that of Montana; in any event, the dominating position of Colorado as a silver producer is a thing of the past, for not only does Montana rank equal, but Utah is pressing close. These three States are responsible for 35,750,000 ounces out of the total of 53,603,000. In Colorado, Leadville still contributes one-half the total; that district enabled Colorado to win the supremacy from Nevada, as soon as the Comstock declined, in 1880; and to the exhaustion of the big silver-lead ore deposits of Leadville is due the gradual decrease of silver production in Colorado from its maximum, 26,350,000 ounces, in 1892. Aspen is practically exhausted, and Creede furnishes a dwindling output, so that a large proportion of the silver is accessory to the extraction of gold and lead in Clear Creek, San Juan, San Miguel, Ouray and other countries. Leadville has prospered during 1904, not so much in output of silver, which decreased, but in the proved extension of known ore channels, the full benefit of which will become apparent during the present year.

In Montana, the Granite Mountain and Bimetallic mines continue to be the most

at Bingham. This indirect source is growing faster than the mining of silver-lead ores, and promises to assume a preponderating importance within a few years.

The mines of the Cœur d'Alene account for fully \$6,000,000 out of the \$7,000,000 credited to Idaho; this district is in a flourishing condition, recent activity having been stimulated by the deeper development of large orebodies in the Bunker Hill & Sullivan mine, at a time when that property was supposed to be on the verge of exhaustion. A new mine, the Snowstorm, has come to the front, and, on the whole, the outlook in the Cœur d'Alene is excellent. On the Comstock, in Nevada, there has been some mining activity, but this has been subordinate to the share market. Tonopah is responsible for the bulk of the output, which ought to be well maintained, with the aid of Goldfields. In Arizona, the reopening of the Tombstone mines is proceeding satisfactorily; but the Commonwealth mine, at Pearce, is nearly exhausted. Nearly a half of the silver production comes from copper ores obtained chiefly in the Bisbee district and in the Bradshaw mountains. The silver of California and the other States not mentioned in this review is incidental to gold mining, except that of the Presidio district, in Texas.

The lightest known solid is solidified hydrogen, a white ice or snow-like substance of sp. g. 0.07. Lithium comes next with a relative sp. g. of 0.59; it floats on petroleum.

quantity has been encountered in ore regarded as distinctively argentiferous. In New South Wales the exploitation of copper deposits is yielding an increasing amount of gold, as is the case, for instance, in Utah. Dredging of river bottoms is a factor in the gold production of Victoria and New South Wales, but operations are on a small scale. In northern Tasmania the unwatering of the Tasmania mine will affect the output favorably. The new districts in the desert country of South Australia are only of local importance, although there remains a large area of unexplored country which may prove productive when the transcontinental railroad is completed. In New Zealand, dredging of the southern rivers has expanded, until now more than a hundred machines are in operation, the total yield from this source being valued at over \$2,000,000 per annum. This industry is maintained by local enterprise and appears to have reached its maximum importance. In the north island, the Hauraki peninsula is still feeling the collapse of the boom of 1895 and 1896, when a large number of mines were placed on the London market, with unfortunate results. The Waihi continues to be one of the great mines of the world, having produced \$2,900,165 in the year ending last June. Other mines in the Ohinemuri district are undergoing development, but, on the whole, a decreasing production is likely.

The Transvaal ends the year in good spirits; the introduction of Chinese coolies under indenture has proved an economic success, and it appears likely now that there will be a sufficiency of labor, not only to supply existing mines, but also to permit of starting many new enterprises held in abeyance since the war. Production is nearly on a level with the maximum attained in 1899, the yield for December amounting to \$725,000 as compared to \$796,382 in August, 1899, just before hostilities began. This rate is certain to increase steadily, as the influx of Chinese allows more stamps to be started. Better success in recruiting for Kaffirs also encourages the hope that the supply of natives will be augmented, as has been the case of late. On a plentiful labor supply the vast investment of capital depends for regular returns, and this appears assured. Metallurgical progress has been a feature of 1904, and successful prospecting with drills on the eastern Rand has extended the known productive area. Apart from these definite improvements, there has been the steady decrease of costs due to greater efficiency in organization and to competition among skilled men eager to produce the best results. While the lessening of expense must have a limit, that limit has not been reached as yet, so that it will continue to be an encouraging factor until such time as the economic minimum is attained. The average yield decreases as expenses are lessened; they are now

about \$9.25 per ton, and are likely to go down to \$7.50. It is believed that, despite disappointments to be encountered in mining below 4,000 ft. of vertical depth, the output will go on increasing until the Transvaal contributes annually \$150,000,000 or even \$200,000,000 to the world's gold supply.

Rhodesia has grown in importance. Apart from a record yield of 224,500 oz. fine gold, valued at \$4,640,415, there have been several discoveries of moment. These include the 'banket' found in the Lomagunda district and gold-bearing gravel in the Victoria district. The value of these occurrences has yet to be determined, but there is reason to believe that they will prove the basis for a notable increase of activity in the territory of the British South African Company. This company has modified the mining ordinance in such a way as to encourage prospecting. There is a vast area in this part of Africa which is steadily being explored and it is likely that, with the enlarged operations of existing mines, Rhodesia will be contributing gold at the rate of 500,000 oz. per annum within a few years. Despite its deadly climate and the failure of many unwarranted undertakings, West Africa continues to maintain a steady output and is likely to do better as the few large enterprises come to fruition. West African mines are yielding at the rate of 72,000 ounces per annum; this output includes two dredging companies.

Russian gold comes almost entirely from the Siberian mines, the placers of the Ural having dwindled to unimportance. Of the total output only about 10 per cent comes from quartz mines, the remainder being extracted from gravel deposits distributed over an enormous range of territory, but chiefly in the Nerchinsk district of the Trans-Baikal and on the Amour. Dredges are being introduced and several are at work in the South Yenesei region, the Altai and the Ural. While the production of gold has not been materially increased by the application of dredging, the fact is important as indicative of a more progressive spirit among operators in an important mining region.

In Canada the output comes mainly from the placers in the far north; these maintain a steady production, the exhaustion of bonanza ground being partially compensated by the systematic exploitation of the larger and poorer gravels. The whole of the Canadian Yukon is credited with \$10,300,000, the decrease of \$1,000,000 being due to the lessened output from the Klondike. The season was unusually favorable, the rainfall was copious and the snow melted slowly. The construction of several reservoirs and ditches will aid production during the coming season. In the south, British Columbia, with an output of \$6,264,000, exhibits a slight increase, due chiefly to the Similkameen district. In

western Ontario there is a scattering of gold mines, but their total output continues to be small. The same is true of the old mining districts of Nova Scotia.

In Mexico, progress in gold mining forms part of a general activity which is lifting the Republic to a splendid position. The chief gold district is El Oro, 90 miles from Mexico City, where there is a group of remarkable mines, now in excellent condition, and likely to continue productive for several years. In northern Mexico there have been important discoveries at Lluvio de Oro, Minaca and Santa Barbara. Mexico is likely to increase its gold output steadily.

In Egypt there has been a revival of activity in the Sudan, the Um Rus mine giving encouraging results. The participation of John Taylor & Sons and of Mr. George B. Robinson in Egyptian mining has stimulated interest. No great increase of production is recorded as yet, most of the operations being of an exploratory nature. Indian gold mining centers in the Kolar goldfield, where a group of seven companies maintains a large output; it is not likely that this will undergo further expansion, as several of the mines have now passed their period of maximum productiveness. During 1904 the production was 3,073,241 oz. fine, an increase of 100,000 oz. In Korea, the Oriental Consolidated mines, in the Wunsan district, produced \$850,000; but the war interfered with smaller operations, so that the output of the country is estimated at \$1,000,000. Much of the gold appearing in Korean exports is of Chinese origin. Japanese gold mining, hitherto negligible, has become prominent by reason of important discoveries made in the Iwate district. In Sumatra, the Redyang Lebong, Lebong Soelit and neighboring mines are in the ascendant, but the goldfields of the Celebes, Borneo and New Guiana have not fulfilled expectations.

#### THE COMMERCIAL MOVEMENT OF GOLD AND SILVER.

In the United States gold shipments in 1904 were the largest in years. This is partly explained by the Cuban loan made to aid the new government in developing its various industries; and also to the export of \$18,000,000 on account of the Panama canal purchase from the French company. Gold imports have been nearly doubled as a result of the \$40,000,000 received from Japan for trans-shipment to Europe. The large foreign demand for gold was helped by the low rates of interest here and the higher rates in the European markets. The demand for gold there was largely on account of war loans.

For the eleven months ending November 30 the movement of gold in the United States was as follows:

	1903.	1904.
Exports . . . . .	\$42,882,178	\$107,709,000
Imports . . . . .	48,037,398	81,414,345
Excess . . . . . Imp.	\$5,155,220	Exp. \$26,294.6

Silver exports show an appreciable increase, due to the greater demand from the East. Imports were mostly from Central and South America and Mexico, to be refined here for export to London. The movement of silver in the United States for the eleven months ending November 30 was as follows:

	1903.	1904.
Exports .....	\$34,094,689	\$46,020,584
Imports .....	21,895,853	23,692,105
Excess of imports. . .	\$12,198,836	\$22,328,479

A noteworthy feature of the movement of gold in Great Britain in 1904 is the small excess of imports over exports, which has no comparison in recent years. This was largely due to the repayment of Continental loans, some of them made during the Boer war.

In silver, the encouraging development has been the heavy purchases by India as a result of that country's prosperity. From January 1 to December 15, inclusive, the silver shipments to the East from London, as reported by Messrs. Pixley & Abell's circular were:

	1903.	1904.
India .....	£6,906,830	£9,273,218
China .....	310,060	455,857
Straits .....	796,879	79,286
Total .....	£8,013,769	£9,808,361

The increase in the shipments this year amounts to £1,794,574, and was principally supplied by silver received from the United States.

MONTHLY AVERAGE PRICES OF SILVER.

Month.	New York.		London.	
	1903.	1904.	1903.	1904.
January .....	47.57	57.055	21.98	26.423
February .....	47.89	57.592	22.11	26.665
March .....	48.72	56.741	22.49	26.164
April .....	50.56	54.202	23.38	24.974
May .....	54.11	55.430	24.89	25.578
June .....	52.86	55.673	24.29	25.644
July .....	53.92	58.095	24.86	26.760
August .....	55.36	57.806	25.63	26.591
September .....	58.00	57.120	26.75	26.349
October .....	60.36	57.923	27.89	26.760
November .....	58.11	58.453	27.01	26.952
December .....	55.375	60.563	25.73	27.930
Year .....	53.57	57.221	24.75	26.483

Civilization, said Liebig, may be measured by the soap used in the respective countries of the globe. Others would adduce, as the ethnic meter, the use of law, the use of gold, silver, and checks in exchange, the use of glass or paper. Still others might suggest the use of steel, of copper, of cement, of sulphuric acid and soda, or even of electricity.

On the Klondike the men who work on a royalty are called 'laymen,' the ground under lease being the 'lay.' These terms correspond to 'tributers' and tribute 'pitch,' as used in lode mining.

**NITROGEN.**—Liebig showed that nitrogen is essential for life. All food must contain it: hence, a man may starve on oil or potatoes. The nitrogen in man is in the reduced form of ammonia derivatives; plants, however, can eat nitrogen, both reduced as ammonia, and oxidized as nitric acid, but these must be neutralized as harmless salts.

## Copper.

By FREDERICK HOBART.

While the copper industry in the United States has made substantial progress, the collection of statistics has been a matter of difficulty, as in the two or three preceding years, owing to the mistaken policy of secrecy adopted by some of the leading producers. This has made it impossible to secure exact data from several of the more important districts, and has made it necessary to estimate their output on the basis of such information as is obtainable. This condition will doubtless give occasion for wild speculations as to the output, but these will not be received with serious attention. They are of no benefit to producers or to the trade.

In preparing the figures given it has been necessary to take into careful consideration the local conditions in the various districts and to take all statements at their probable value. In the important Lake Superior region, in California, in Arizona and Utah a very close approximation is fortunately possible, only the December output being estimated.

With this preface, the production of copper for the year 1904 is estimated as follows, comparisons being made with the statement given in 'The Mineral Industry,' Volume XII; the figures are in long tons:

	1904.	Changes.
Montana .....	110,500	I. 1,125
Michigan .....	92,322	I. 6,474
Arizona .....	81,750	I. 13,182
Utah .....	18,625	I. 1,750
California .....	8,482	D. 51
Other States .....	15,820	I. 212
Copper in sulphate .....	6,671	I. 3,867
Total .....	334,170	I. 26,559

The total increase was 8.6 per cent; this is a much higher proportion of gain than for several years past. The United States continues far in advance of all other producers, furnishing from 55 to 60 per cent of the entire copper supply of the world.

In addition to the ores mined in this country, smelters and refiners have handled a large quantity of foreign material. We have the official returns for eleven months of the year, showing the actual movement of this foreign copper, and the figures follow.

Imports of copper and copper material, with re-exports of foreign metal, for the eleven months ending November 30, are reported by the Bureau of Statistics of the Department of Commerce and Labor as below, in long tons:

	1903.	1904.	Changes.
Fine copper:			
Imports .....	56,525	57,782	I. 1,257
Re-exports .....	934	486	D. 448
Net imports .....	55,591	57,296	I. 1,705
Ores and matte:			
Imports .....	252,063	246,131	D. 5,932
Re-exports .....	5,150	.....	D. 5,150
Net imports .....	246,913	246,131	D. 782

For the year 1904 the Bureau has reported the copper contents of ore and matte. Taking these, we find that the total quantity of copper imported for the eleven months last year was as follows, with the sources from which it came:

	Fine copper.	Copper in ores.	Total.
Mexico .....	39,951	8,194	48,145
Canada .....	7,012	6,187	13,199
Great Britain .....	7,548	.....	7,548
Other countries .....	3,271	1,167	4,438
Total imports .....	57,782	15,548	73,330
Re-exports .....	486	.....	486
Net imports .....	57,296	15,548	72,844

The ores and matte from Mexico were 61,702 tons, with a copper content of 8,194 tons, or an average of 13.3 per cent. The Canadian imports were 171,950 tons, with a copper content of 6,187 tons, or an average of only 3.3 per cent. That is, a considerable part of the Mexican imports consisted of matte, while the imports from Canada were chiefly ore. The imports from Great Britain were largely of copper sent here to be refined. Mexico furnished 65.7 per cent of the imports, and Canada 18.0 per cent.

Exports were very large, showing an increase of 86 per cent over the preceding year. European countries, especially Germany, were large and steady takers of metal. The indications were that their buying was almost entirely for consumption, as quick deliveries were constantly requested, and little or no speculative buying could be detected. Demand for electric enterprises and for the manufacture of war material was very large. There is reason to believe also that many consumers abroad began the year with light stocks, and they were therefore obliged to buy constantly to meet their current needs. Most of the copper thus supplied to Europe has undoubtedly gone into finished forms, and consumers' stocks at the close of the year are again moderate.

A new demand, so far as our trade is concerned, made its appearance in the form of orders from China, which were received in the latter part of the year. That country has generally been supplied from Japan, but its imports were cut off by a reduction in the output of the Japanese mines and an increase in the consumption there, for the manufacture of cartridges and the like—both due to the war with Russia. At first it was said that copper was required for coinage, as China had entered upon the work of readjusting the minor monetary circulation. It soon became apparent, however, that the demand was greater than could be possibly accounted for on the coinage theory, and various explanations have been suggested. The most probable, perhaps, is that of a large manufacture of war material. The currents of Chinese internal trade are so obscure, however, that it is necessary to accept simply the fact that China is buying our copper, leaving the reader to make such explanations as he pleases.

Exports of copper and copper material from the United States for the eleven months are reported as follows, in long tons:

	1903.	1904.	Changes.
Fine copper .....	121,697	226,508	I. 104,811
Ores and matte .....	10,538	16,324	I. 5,786

Copper contents of ore and matte are

not reported. Estimating them, chiefly on the basis of value, we find that the total exports in 1904 were, approximately, 231,354 long tons of fine copper. This quantity exceeds the net imports by 158,510 tons. Of the exports this year, 45,554 tons went to Great Britain; 221,175 tons to other European countries, and 1,430 tons to China. The shipments made to China up to the end of November represent only a small part of the purchases made here for that country, as deliveries will extend over several months to come. It is difficult to give the shipments to Germany separately, as the customs returns credit exports to the port of destination only. Thus no less than 61,716 tons are reported as going to Holland, but very little of this was retained in that country, by far the greater part being shipped to Rotterdam in transit for points in Germany and elsewhere.

Imports and exports of copper in Germany for the nine months ending September 30 were as follows, in metric tons:

	1903.	1904.	Changes.
Imports .....	59,561	79,304	I. 19,743
Exports .....	3,596	3,130	D. 466
Net imports .....	55 965	76,174	I. 20,209

The increase in total imports was 33.2 per cent; in the net imports, which represent the approximate consumption of foreign copper, it was 36.1 per cent.

Imports and exports of copper in Great Britain for the 11 months ending November 30 were as follows, in long tons; the totals giving the approximate quantity of fine copper contained in all material:

	1904.	Changes.
Copper ore .....	71,674	D. 5,206
Matte and precipitate .....	59,366	D. 7,684
Fine copper .....	82,502	I. 24,949
Total imports, fine copper .....	110,363	I. 20,586
Exports .....	45,876	D. 3,701
Balance, imports .....	73,487	I. 24,287

Of the imports, 188 tons of ore, 4,294 tons of matte and 44,736 tons of fine copper were from the United States. The increase in imports, taking the total of fine copper, as compared with 1903, was 20.8 per cent; in the net imports, 49.4 per cent.

Returning to this country, and adding to the figures given above, the estimated imports and exports for the month of December, the course of copper for 1904 may be given as follows, again in long tons:

United States production .....	334,170
Net imports for the year .....	79,400
Stocks, January 1, 1904 .....	64,690
Total available supply .....	478,260
Exports of domestic copper .....	249,854
Approximate consumption .....	178,570
Total deductions .....	428,424
Stocks, January 1, 1905 .....	49,836

The stocks at the close of the year were distinctly below the normal point. This is in this country equal usually to about two months' production; that time being required on an average to transport metal from the mines or smelters, refine it and make it ready for market, in the case of electrolytic copper. The Lake product can be delivered more quickly, but even then

some time is required for transportation. The doubtful point in the statement given above is, of course, the consumption; but our estimate is based upon the opinions of observers who have had long experience in the trade. During the first half of the year the actual consumption was comparatively light, probably not more than two-thirds of the quantity required in the first half of 1903. From July on, there was a gradual, but marked improvement, and by the end of the year the requirements of manufacturers had again reached large proportions.

The fact which upset the calculations of many of the would-be prophets was the large and continuous foreign demand, which absorbed all of our surplus, and more. The present outlook is for continued large consumption in the United States, which may necessitate a restriction of exports. This will be a result of the great expansion in the use of electric power on railroads, and of the greater tendency toward the utilization of water-power and its transmission to points where it is needed. It will be a few years only before we begin to realize the waste now going on at coke-ovens and other plants, and begin to utilize the gases now lost in generating power for transmission. The conversion of coal into electricity at the mines on a great scale is also possibly not very far in the future. All this will make a continuous and increasing demand for copper, which is a necessity in electric work, and cannot be replaced, unless the production of aluminum should be developed on a scale which, at present, seems hardly possible.

The production of copper in the four leading districts—Montana, the Lake Superior country, Arizona and Utah—is treated in the special articles given elsewhere. It is only necessary to say here that Arizona and Utah show striking gains, while the Lake district is still far from showing the decadence which some people have been pleased to predict for years past. In California there was a slight decrease, chiefly owing to smaller returns from the Mountain Copper. Montana shows only a small gain, owing to causes so often discussed as to need little attention here. In Colorado, where most of the copper is a by-product of the smelters from ore valued chiefly for its precious metals, there has been little change. The Seven Devils district in Idaho seems to be at last in a fair way to show its real value. In other districts no important changes are to be noted. The Tennessee Copper Company, in the old Ducktown district, continues a steady producer. The old Elizabeth mine, in Vermont, which has been idle for two years, is to be re-opened, and an interesting application of magnetic separation will be tried on its ore.

While no new discoveries of importance have been noticed, some new producers will take their places in the list in 1905.

The more important of these are in the Warren district in Arizona, where the Calumet & Arizona mine has come forward so prominently as a producer.

In other countries the greatest advance has been made in Mexico, where the Greene Consolidated, the Nacozari and other mines in the same region have become important producers. The Boleo has continued its steady output. In fact, copper seems to be the growing feature in Mexican mining, and there is no doubt that the country will be an important factor in the world's copper supply of the future. The greater part of the Mexican copper finds its way to market through the refineries of the United States.

In Canada the large low-grade mines of the Boundary district in British Columbia are producing successfully, and are being developed on a large scale. The Tye, on Vancouver Island, has become a steady producer. In the eastern part of the Dominion, the old Eustis mine continues to be worked. Little has been heard of the discoveries in Nova Scotia which were reported two or three years ago.

In Newfoundland the Tilt Cove deposits have furnished their usual quantity of ore.

In South America there is little new to report. Some development is going on in Peru. It is understood that work is in progress at the Cerro de Pasco, now owned by Americans, but no definite reports are made. In Chile there has been little change in production, or in working.

No changes of importance have been noticed in the European mines. The Rio Tinto, in Spain, shows little change in production. The same can be said of the Mansfeld, in Germany. The Etruscan Copper Estates, in Italy, for which much was promised a year or two ago, seem to have proved a failure.

In the Australian States, Mt. Lyell continues the chief producer. The Cobar district has not done well, and the South Australian mines have reported only the usual output.

The discoveries reported in Rhodesia still wait proof of their real value. The mines of the Cape Copper Company, in Namaqualand, have recovered from the damage done them during the Boer war.

There are reports of copper deposits in the Philippines, which have been supported by actual work in a few places. Much is still to be done, however, before any definite opinion can be formed of their extent and possible importance.

Upon the whole, it may be said that the consumption of copper made more advance than its production did, in 1904.

**ZINC SMELTING.**—In most smelting the refuse part of the ore is thrown off as a fusible slag and the valuable portion is gathered as a fusible metal or matte; but in smelting zinc, the formation of a slag is avoided, the zinc being reduced 'dry,' and then distilled.

## THE NEW YORK COPPER MARKET.

The course of the market during 1904 was rather monotonous until the late fall, when a sharp advance set in. It was again followed with marked attention, not only by those directly and indirectly connected with the industry, but also by the general public, owing to the latter's ever-increasing interest in copper shares.

Production for the year 1904 will probably show an increase of about 8 per cent over last year, mostly as the result of a larger output in Arizona and the Lakes, while in Montana the litigation between the Amalgamated Copper Company and the United Copper Company continues to act as a check to a rational development of the industry in that State.

While consumption in the United States during the first six months showed a falling off of about 30 per cent, Europe had quite a revival of business, especially as far as the electrical industry is concerned, and large quantities were also required for war purposes. A new feature has been a heavy demand from the Far East. Copper mining in Japan no doubt suffered considerably owing to the war, and production in that country was practically at a standstill of late. While the orders placed by that country were rather limited, the quantities bought for China assumed very large proportions, and contributed in great measure to the rise in values at the end of the year. Exports for the year reached the high figure of about 240,000 tons.

When, at last, consumption over here improved, it had the natural result; that is, a steady advance in price. At the present time the brass- as well as the sheet-mills are very busy indeed. Railroads and shipbuilders also are taking their usual quota. The most extensive demand for copper in the future, however, will be in the use of this metal for traction purposes, several of the most prominent railroads having decided to substitute electrical power for steam, not only for local, but also for long-distance traffic.

The production of sulphate of copper again absorbed fair quantities of raw material.

The year opened with Lake copper quoted at 12¼, electrolytic at 12½, and casting copper at 11¾. Consumers both here and abroad, finding these values attractive, bought freely for early as well as future delivery, and prices advanced steadily to 12¾ for Lake, 12½ for electrolytic and 12¼ for casting. Toward the end of January, manufacturers over here became very apathetic, and during February dullness reigned supreme, values receding again to the opening quotations of the year, there being some pressure to sell on the part of leading producers.

The disturbed condition of the financial markets, caused by the outbreak of hostilities between Russia and Japan, also exercised a depressing influence. A strike

broke out at the mines of the Baltic, Champion and Trimountain companies at the Lakes, which lasted for some time.

It was not until the second half of March that the aspect of the market changed. It became evident that while the European manufacturers had bought freely at the low prices ruling, home consumers had allowed their stocks to become depleted. At the end of the month Lake had advanced to 13c., electrolytic to 12¾, and casting to 12½. During April, May, June and July the market ruled steady within narrow limits, heavy purchases for foreign account and consequent large exports remaining the chief feature.

In August values might have improved if it had not been for one of the prominent Lake companies, which pressed its product for sale and disposed of very large quantities, especially abroad, at low figures.

In September a better tendency was noticeable, and during the last three months of the year there was a steady advance, which finally carried prices to 15c. The causes for this are various. In the first place, there was an enormous demand from Europe, which at first was looked upon with suspicion, but which later on was found to be legitimate. Secondly, even before the election, business in the United States showed a decided improvement, and consumers who previously could not be induced to lay in a supply of copper at 12c., bought freely at the higher prices. Thirdly, there was the unexpected demand from the Far East, which assumed very large proportions, and which came at a time when the metal was badly needed at home.

## MONTHLY AVERAGE PRICES OF COPPER IN NEW YORK.

	— Electrolytic. —		— Lake. —	
	1903.	1904.	1903.	1904.
January. . . . .	12.159	12.410	12.361	12.553
February. . . . .	12.778	12.063	12.901	12.245
March. . . . .	14.416	12.299	14.572	12.551
April. . . . .	14.454	12.923	14.642	13.120
May. . . . .	14.435	12.758	14.618	13.000
June. . . . .	13.942	12.269	14.212	12.399
July. . . . .	13.094	12.380	13.341	12.505
August. . . . .	12.962	12.343	13.159	12.468
September. . . . .	13.205	12.495	13.345	12.620
October. . . . .	12.801	12.993	12.954	13.118
November. . . . .	12.617	14.284	12.813	14.456
December. . . . .	11.952	14.661	12.084	14.849
Year. . . . .	13.243	12.823	13.417	12.990

## MONTHLY AVERAGE PRICES OF STANDARD COPPER IN LONDON.

Month.	1903.	1904.	Month.	1903.	1904.
Jan. . . . .	53.52	57.500	July. . . . .	56.64	57.256
Feb. . . . .	57.34	56.500	August. . . . .	58.44	56.952
March. . . . .	63.85	57.321	Sept. . . . .	56.82	57.645
April. . . . .	61.72	58.247	Oct. . . . .	55.60	60.012
May. . . . .	61.73	57.321	Nov. . . . .	56.30	65.085
June. . . . .	57.30	56.398	Dec. . . . .	56.36	66.375
			Av. year	57.97	58.884

Thus a price level has been reached which is a great boon to the producer, without at the same time being a hardship to the manufacturer, always provided that present values can be maintained. This ought not to be difficult if the interests of the trade are not subordinated to the exigencies of the stock market, as has been the case so often in the past. The in-

trinsic position of the market makes the outlook certainly very promising.

The closing quotations for the year are 14¾@15c. for Lake copper; 14¾@14¾ for electrolytic; 14½@14½ for casting copper.

## Platinum.

The production of platinum did not show an increase, although the demand for it continues very strong. As in previous years, fully nine-tenths of the production of this valuable metal were supplied by Russia, chiefly from placer workings in the Ural region. In 1903 the reported output in Russia was 204,892 troy oz. Some increase was made in that year, chiefly due to the introduction of dredges in the valley of the river Iss, where the most productive placers are found. In 1904 the production was curtailed, on account of the war with Japan and the drafting of many of the Ural workers into the army, reducing the available force. A short time ago it was reported that an American firm had taken an option on the output of the Taghisk placers, in the Urals, for a term of 10 years, at an average price of 10,000 rubles per pod, which is equivalent to \$9.78 per oz. for the crude metal. Outside of Russia, the principal part of the supply comes from placer workings in Colombia, in South America. A small quantity is obtained in British Columbia, and other small amounts in Wyoming, Oregon and California. The California metal is obtained at the San Francisco Mint, in parting and refining gold which comes from certain localities in Trinity, Shasta and Plumas counties, in that State. Some platinum and palladium is also recovered at the Orford Copper Company's works, at Constable Hook, N. J., in refining nickel matte from the Sudbury district in Ontario. The quantity of the domestic supply, however, is not sufficient to affect the market seriously, and the principal part of the metal used in this country is imported from Russia. Most of it comes here in crude form, and is refined at the works in Newark, N. J., and in New York. For the 11 months ending November 30, these imports are reported at 6,596 lb., which compares with 7,607 lb. in 1903, and 6,467 lb. in 1902.

Prices of platinum in the United States were very strong throughout the year, as supplies were not abundant, and the consumption in the electrical and chemical industries is generally increasing. The quotation for ingot metal in New York advanced from \$18.50 per oz. to \$19.50 at the close of the year. The metal is, therefore, very nearly as valuable as pure gold.

A 5 per cent solution of nitric acid in alcohol makes a good etching and coloring agent for steel; the effect can be well observed in seven to ten minutes.



**Lake Superior Copper.**

By C. E. L. THOMAS.

Surveyed from almost any material standpoint, the year 1904 has been a highly successful one for the Lake Superior copper mining industry. Dividends have shown an increase of more than a half a million. The price of the metal has responded to the enormous consumptive demand both at home and abroad, and during the last few months it has been strong and higher. Mining companies have been benefited by the advance in the copper market, and net earnings will reveal great improvement when the actual results of the past year are published in the annual reports to the stockholders. The list of dividend-paying mines is now the largest since 1901, and the prospects are auspicious for the addition of at least two more in 1905. Several of the newer mines are demonstrating their capacity, by making more copper and larger profits; the outlook for the younger enterprises is good, while the old mines are developing new ground, improving their plants and devising new methods of winning the metal at a minimum cost. The prosperity of the past year has not been confined to the owners; it has been shared by the laboring men. Wages have remained good, and, while some discontent was manifested at certain properties early in the year, resulting in the curtailment of output and earnings, labor, as a whole has been satisfied, as well it had a right to be. Everything considered, the outlook for 1905 is excellent. The towns and cities, collectively, have shown no diminution in population, and more men are employed than ever before in the history of the district.

It was just 62 years ago that the first copper mine was opened in the Lake Superior district, yet this continues to be one of the largest and most profitable copper-producing regions in the world; it enjoys the unique distinction of having yielded dividends continuously for 56 years, the first one having been paid in 1849, two years after the opening of the Cliff, the first successful mine. The production is given in the adjoining table. The figures for 1903 are exact, those for 1904 are necessarily approximate; they are in pounds. The estimates may be relied upon, however, as coming close to future official reports:

Mine.	1903.	1904.
Calumet & Hecla . . . . .	76,490,869	79,000,000
Osceola . . . . .	16,059,636	20,500,000
Quincy . . . . .	18,498,288	18,225,000
Tamarack . . . . .	15,286,093	14,000,000
Champion . . . . .	10,564,147	12,250,000
Baltic . . . . .	10,580,997	11,900,000
Trimountain . . . . .	9,237,051	11,500,000
Wolverine . . . . .	9,024,034	9,850,000
Mohawk . . . . .	6,284,327	8,100,000
Atlantic . . . . .	5,505,598	5,100,000
Franklin . . . . .	5,309,030	5,050,000
Isle Royale . . . . .	3,034,601	2,500,000
Mass. . . . .	2,576,447	2,450,000
Michigan . . . . .	275,708	2,400,000
Phoenix . . . . .	202,823	1,250,000
Centennial . . . . .		1,100,000
Adventure . . . . .	2,182,608	725,000
Winona . . . . .	1,036,944	550,000
Ahmeek . . . . .		300,000
Miscellaneous . . . . .	50,000	50,000
<b>Total . . . . .</b>	<b>192,199,201</b>	<b>206,800,000</b>

The output shows eight per cent more refined copper in 1904 than during the preceding year. With the exception of two or three million pounds, the entire gain was made by the mines opened on the Baltic lode, and the Kearsarge amygdaloid. Had it not been for the labor strikes which caused loss of time at the Quincy, Atlantic, Baltic, Trimountain and Champion mines, the district would have shown a greater increase in output. It will be noted that the mines opened on the Baltic lode, which owe their inception to the high price of the metal five years ago, made approximately 35,650,000 lb. fine copper. These three properties, the Baltic, Trimountain and Champion, are destined to make great progress in the next few years, and eventually will rank close to the Calumet & Hecla in point of production. The Baltic and Trimountain are owned outright by the Copper Range Consolidated Company, which also owns a half-interest in the Champion. Crediting it with the output of the first two properties and one-half the latter's, its production last year was 29,525,000 lb., which makes it second only to the Calumet & Hecla Company. The most notable gain has been made by the Osceola, which increased its production about 25 per cent.

As the product of the mines is disposed of through various channels, it is extremely hard to arrive at the valuation of the output. Valued at the average selling price of the metal, the Lake mines have received nearly \$28,000,000 for their product this year. Dividend disbursements amounted to nearly 20 per cent of the gross yield. Lake Superior mines have produced approximately 3,388,600,000 lb. fine copper up to the end of 1904, and realized from the sale of same, about \$514,200,000. Upwards of 25 per cent of the latter amount has been returned to shareholders in dividends.

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

	Lb. Copper.		Lb. Copper.
1895 . . . . .	129,330,749	1900 . . . . .	142,151,571
1896 . . . . .	142,057,500	1901 . . . . .	155,716,848
1897 . . . . .	142,702,586	1902 . . . . .	170,325,598
1898 . . . . .	147,965,738	1903 . . . . .	192,299,191
1899 . . . . .	146,950,338	1904 . . . . .	206,800,000

Production depends so much on factors of an uncertain nature that it is difficult to forecast the output in 1905. It is safe to say that the advance made this year will not only be held, but there will be further growth. Among the older mines the Osceola and Quincy should both do better. The three South Range properties and the Mohawk should make good gains, while the Tamarack will likely recover some of its lost ground. Franklin is ripe for an increase and the Mass should make more copper as a result of its enlarged working force. Adventure, too, will show a better yield. Centennial and Ahmeek, two new producers on the Kearsarge lode, should take rank among the moderate-sized shippers.

The dividends are as follows:

Mine.	1903.	1904.
Calumet & Hecla . . . . .	\$3,500,000	\$4,000,000
Champion . . . . .	300,000	300,000
Osceola . . . . .		192,300
Quincy . . . . .	550,000	500,000
Tamarack . . . . .		90,000
Trimountain . . . . .	300,000	
Wolverine . . . . .	330,000	450,000
<b>Total . . . . .</b>	<b>\$4,980,000</b>	<b>\$5,532,300</b>

The force of men employed in the mines, mills and smelters of the district numbers 16,000; it has never been so large.

The present status of the active mines, beginning at the extreme northeast, is briefly stated herewith:

At the Phoenix, work on the West vein has been abandoned, to be concentrated on the St. Clair vein, which makes a favorable showing. The latter cannot keep the mill supplied, however, and the Ashbed may be opened in order to make up the deficiency. The Mohawk, which suffered from the burning of a rock-house, is in excellent condition now. The work of furnishing its four producing shafts with modern equipment is well along. About the middle of the year work on a new shaft, No. 5, was started and down to the present depth—60 ft.—the showing is excellent; sinking has been suspended pending the completion of a shaft-house. The average depth of this mine is 900 ft., the deepest level being at 1,100 ft. South of the Mohawk, the Ahmeek is proving a valuable mine and promises to surpass the record of the other mines on the same—Kearsarge—lode. It has two shafts, one down 400 ft. and the other 600 ft. Shipments average 160 tons daily from the extension of drift stopes. This mine has been a producer for the last six months and the mill runs give good promise for its future.

A second shaft is being started by the Allouez to tap the Kearsarge lode. The first will cut the bed in February, at a depth of 1,500 ft., the present depth being 1,300 ft. This mine should be producing about the middle of 1905.

The Osceola is coming into its own and now ranks second among individual producers. Its North and South Kearsarge mines are proving highly profitable, while the old Osceola branch is making a fair showing at present copper prices. Great improvements have been made at the stamp-mills, and an additional expenditure of \$75,000 will be made at the plant in 1905, for the conversion of more of the stamps to the steeple-compound type, which has proved so successful.

Wolverine shows little change. It is making the cheapest copper on Lake Superior, pays good dividends and maintains its production. Construction work has ceased for the present so that production is uninterrupted; an uneventful history is the best for a mine of this high type.

Centennial has practically cleaned up its stockpile and should be in a position

to know the average yield. Production began a few months ago, but has been small owing to the treatment of the surface accumulation. The work of getting the second shaft in shape for production will be completed next summer. The Arcadian mill, of three stamps, was purchased last January.

North of the Mohawk, the Miskwabik and Bohemian Range companies are exploring. The former is prospecting a formation believed to be the Kearsarge lode. The Mayflower and Old Colony companies are employing small forces and are still engaged in a search for paying lodes, east of the Kearsarge. Nothing of value has been found by either.

At the Calumet & Hecla a large amount of new work is being done. At No. 13 shaft stoping on the Osceola amygdaloid has been resumed, and a regular production is being maintained. The work of remodeling the stamp-mills is going forward steadily and the plant will be brought up to date in every department. Two shafts have been sunk on the Kearsarge lode, and a third is located on the southeastern corner of the property for exploration purposes. No. 19, the northernmost opening, is shipping rock regularly and No. 20 will begin in a short time. The general outlook at this bonanza mine is bright indeed. A large electric power-plant is being built at Lake Linden to furnish operative power for the mines, mills, etc., and a great saving should result. Some exploratory work has been done a couple of miles west of the mine on lands it owns in that section, but nothing authentic is known regarding the results.

Tamarack has recovered from the effects of the shutdown at No. 2 shaft, which has been repaired, and is now making copper on a good scale. Openings in the ground adjacent to No. 5 shaft are better and the outlook is much improved, as compared to a year ago.

Diamond drilling on the Laurium is understood to be fraught with considerable importance, and more vigorous steps may be taken to prove the property next summer. Two borings have been completed and a third is now in progress. Tecumseh shows no signs of becoming active, many reports to the contrary notwithstanding. The Rhode Island is still exploring, with indifferent results. Franklin is in excellent shape. Its new shaft at the Junior mine (on the Allouez conglomerate) is penetrating good ground and furnishes an increasing output. The old mine has not done so well as formerly and its days are numbered. Developments at the Junior, however, make it reasonably certain that the company will do better this year.

Nearly everything of value has been disposed of by the Arcadian and it will be a long time before it again receives attention, if ever. Quincy has made many improvements in its equipment, at mine, mills

and smelter, and should decrease its copper cost henceforth. No. 8 shaft, on the Mesnard property, will be in a position to furnish a good product towards the close of 1905, and No. 4 shaft is greatly improved.

Isle Royale's prospects have been greatly improved by the openings on Section 11, where a new shaft has been opened to a depth of 130 ft. Production at that point begins shortly, but will not be large for a year or more.

Atlantic has confined its work to the more profitable stretches of ground and is not making so much copper as a consequence, though the yield per ton treated has improved. The prospects are that the Atlantic has a good mine in Section 16, which should receive attention next summer. Development work on all sides of this property is encouraging.

The Superior Copper Company, a new concern, is down about 90 ft. It is the purpose of the management to cross-cut the formation in both directions to ascertain whether the shaft is on the east or west vein of the Baltic lode.

Baltic is now operating normally and is making its copper as cheap as the majority of the mines in the district. Trimountain is improving perceptibly and its outlook is very encouraging; work has been retarded by the change in mining methods. Champion has ample drill capacity now and is pushing the development of its ground. It is enlarging its mill and the addition should be completed next summer.

Work on the Globe, owned by John Stanton, may be resumed next spring, though there is nothing definite on which to base such a statement. The location is excellent and local people are confident that it will make a paying mine.

The St. Mary's Mineral Land Company has become active in exploration work and is sinking a drop shaft on the Challenge property, south of the Globe. After a good depth is reached, cross-cuts will be extended to cut the lodes which were located with the diamond drill, one of which is thought to be the Baltic.

The Elm River is still exploring, work being confined to No. 1 shaft. There have been efforts made to float the Kaukauna, adjoining, but no active work has resulted as yet. Wyandot is investigating a new bed uncovered in the Misery river; a shaft is being opened on this formation with good promise.

Winona discontinued production a couple of months ago and is confined to development work. The management has conducted a careful mill-test and is satisfied that the property has promises of making a valuable mine.

Adventure has emerged from the slough of despond and is making a better showing. Its output has been increased gradually during the past six months and it is now making a profit. Attention is being given

to the Evergreen lode, which heretofore has not been opened much, though it is prolific in mass copper and good stamp rock at the Mass.

New life seems to have been given the Mass, which is prosecuting a vigorous campaign of development in the two older shafts, and at the third shaft, where work was resumed recently. Openings in the third shaft are particularly inviting and promise well.

The Michigan is utilizing one head at the Mass mill and developing its ground in good shape. The Branch vein and Calico lode are doing nicely and the property is making a good profit. The Victoria is confined to surface work, the development of the mine having reached a point which will enable rock shipments for five years without another foot of exploration. A stamp-mill is being constructed out of the salvage of the old Belt mill, which was purchased last summer. The Copper Crown Mining Company, of St. Louis, Mo., has a number of men at work on the Hamilton, where the prospect is said to be hopeful.

### Arizona Copper Mines.

By JAMES DOUGLAS.

The activity in the southeastern section of Arizona, which was a conspicuous feature of the copper trade of 1903, has been fully maintained in 1904. A new producer has entered the field in the Imperial Copper Company, which re-opened the Old Boot mine in the Silver Bell district to the southwest of Tucson, and has already brought its output up to 200 tons of ore per day. None of the old mines show any signs of decay or decrepitude; but only the Old Dominion mine and the Copper Queen have notably increased their output. Development work is being prosecuted as actively as it was last year by the group of Lake Superior and Pittsburg companies in the Warren district (Bisbee) with, in some cases, positively favorable results, and, in most, with promising prospects. Although the Calumet & Arizona smelter is being enlarged to meet future exigencies, none of the newly developed properties have yet turned out any copper. Nor in the Clifton district has the New England Company, which is a consolidation of the old Copper King with other claims, nor any other of the recent organizations, contributed independently to the production, which still depends on the works of the Arizona Copper Company, the Detroit Copper Company and the Shannon Copper Company.

Northern Sonora, whose copper passes, whether as ore or as bar, to the market through Arizona, has not during the year added any new source of supply to its already large output, though the Transvaal Company is erecting works near Cumpas to the south of Nacozari, to treat copper and lead ores. The Greene Company re-

duces most of its ore to copper at Cananea, but ships a notable quantity of its mineral and furnace by-products to smelter at El Paso. The total output of the Nacozari mines is shipped as concentrate for reduction by the works of the Copper Queen Company at Douglas, Ariz. These works also treat the ores of the Imperial mine. The Old Dominion company, which heretofore has not averaged from its smelter a million pounds of copper per month, is now turning out 2,000,000 lb., partly from its own mines and partly from the United Globe mines and from

tant points to centers where their mixture will make a smelting charge. Incidentally, one wonders whether a law endowing a central bureau in Washington with rate-making power will aid or retard such a movement, which depends for its helpful application upon intimate knowledge of local conditions.

The output for the past year from Southern Arizona has been approximately:

From the Warren (Bisbee) district, 45,000 tons; this includes copper from ores produced by the mines of the Copper Queen, the Calumet & Arizona

extension will become operative in 1905. The Old Dominion concentrator will, it is hoped, commence active work during the coming summer, and the Old Dominion smelter will probably increase its output to 2,500,000 lb. per month.

Fortunately, mining in the Southwest has been relieved from the destructive drains which litigation has made on this industry in Montana. Both in the Clifton and the Bisbee districts the large companies work harmoniously side by side, and by giving their agents access to one another's underground workings, aid each other in the development of their adjacent properties. This application of the golden rule is the result of abrogation by agreement of the law of the apex.

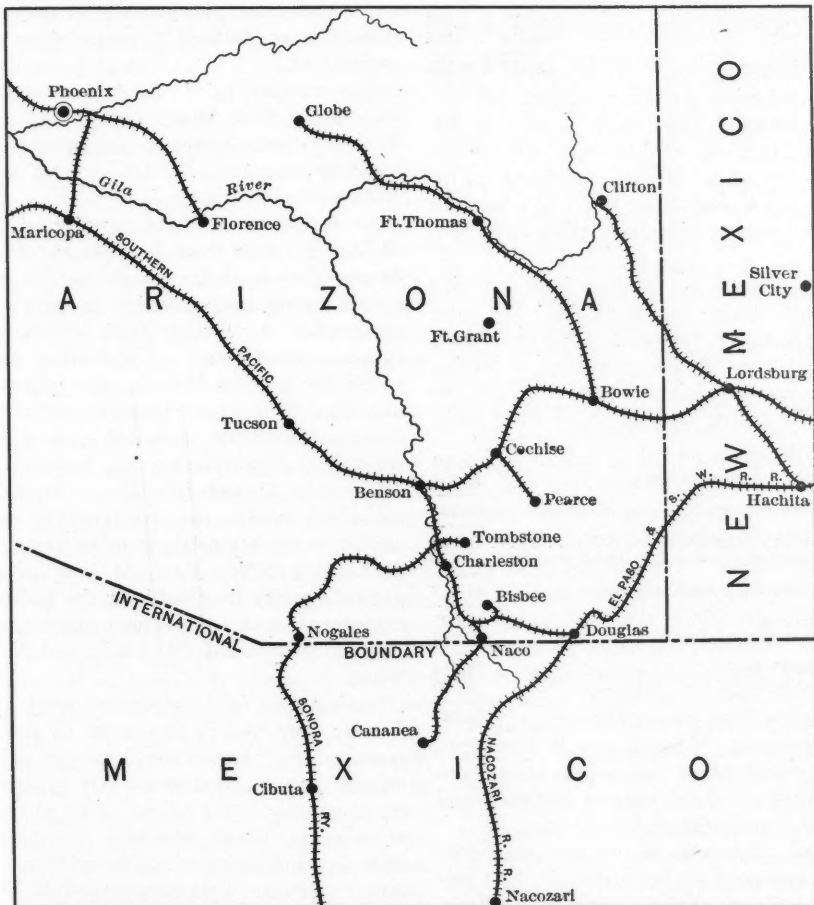
**Lead.**

By W. R. INGALLS.

The lead business has been without any extraordinary features in 1904. The control of it by the American Smelting & Refining Company is so firm that production can be closely regulated to the consumptive demand and price adjusted so as to get the maximum possible out of the business. This is profitable to the company, but is also profitable to the miners, who, so far, have escaped any such low range of prices as there used to be. This community of interest between the smelting company and the more important of the silver-lead mining companies is recognized in the long-time contracts between them. The existence of these contracts relieves the smelting company to a large extent from the danger of competition.

At the present time, the only silver-lead smelters outside of the trust, between the Mississippi river and the Pacific coast, are the Ohio & Colorado Smelting Company, of Salida, Colo., and the United States Smelting Company, of Salt Lake, Utah. The latter company, which is a branch of the United States Mining Company, erected in 1904 a lead-smelting annex to its copper smelter and entered the general market for ores, its position being fortified by the possession of galena, pyrite and silicious ores in the mines of the same ownership in the Bingham and Tintic districts. This materially increases the competition against the American Smelting & Refining Company in the Salt Lake district, where the other copper smelters were already powerful bidders for certain competitive classes of ore.

The Coeur d'Alene has continued to be the largest lead-producing district of the United States; some promising new discoveries have been reported therefrom in 1904. Following the Coeur d'Alene, the second place is occupied by Southeastern Missouri, as usual. The conditions in that district have been quite unsatisfactory as an aftermath of the recent labor troubles, and although the production continues to increase, the proportion of profit has been diminished and is not what it ought to be,



ARIZONA.

purchased ores. This new activity is primarily due to the erection and operation of a new smelter with its converter department; but the advantages of smelting and bessemerizing, over the old and wasteful practice of direct reduction to black copper in the cupola, could not have been secured had not the railroads so reduced their freight rates as to make possible the interchange of low-grade ores. At present Globe finds a profitable market for its infusible lean oxidized ores as converter lining in the Bisbee district, and receives back from the Copper Queen and other mines, tributary to the Southern Pacific, the sulphur ores, which are as yet scarce in, and near, Globe. The more liberal policy of the public carriers will undoubtedly help to develop the resources of the Southwest by bringing together at profitable rates, refractory ores from dis-

and the Imperial, smelted at Douglas. The Clifton district has yielded, approximately, 28,000 tons; and the Globe district, 7,500 tons of copper.

Sonora has shipped about 35,000 tons through Arizona, but in estimating the total output of Northwestern Mexico, the production of the Boleo mines must be added, and a certain amount of low-grade ore forwarded in small shipments.

During the coming year Bisbee will probably turn out somewhat more copper from both the Copper Queen works and the Calumet & Arizona smelter at Douglas. The Clifton district is not making preparations for an increased output in 1905. The ores of that district are so lean that a large capital expenditure and much time is needed to prepare for a larger production, and none of the dominant companies expect that plans for contemplated

considering the high price for lead, the character of the orebodies and the large investments in mining and metallurgical plants. However, the St. Joseph Lead Company made extensive additions to its mining, milling and smelting plant during the year. The St. Louis Smelting & Refining Company (National Lead Company), which is the second largest producer of the district, completed its new smeltery at Collinsville, Ill.; this is of the Scotch-hearth bag-house type, which appears to be taking the lead for the smelting of these high-grade non-argentiferous ores. The Federal Lead Company, at Alton, Ill., which uses the same process, was a large buyer of ore in 1904, taking the products of some mines which shut down their own furnaces. At the Catherine mine, near Fredericktown, in Madison county, a valuable new deposit of galena disseminated in clay, overlying the limestone, was discovered early in the year. Later this property passed into new hands.

The producers of lead ore in the Joplin district received the full benefit of a high range of prices, galena concentrate fetching upward of \$50 per ton throughout the year, and made an important increase in output. There were some noteworthy features in the lead business of this district, such as the advent of the St. Louis Smelting & Refining Company as a buyer of ores, and the payment of \$63 per ton for one lot of ore in December, which is said to be the highest price in ten years. Another was the purchase by the Picher Lead Company of considerable ore from the Coeur d'Alene district in Idaho, this coming from a mine which produces ore high in lead and non-argentiferous in character.

At Leadville, Colo., and at some other camps in the same State, the producers of lead ore have been materially assisted by the increased demand for zinc ore, which they turn out as a by-product.

A matter of considerable interest during the year was the negotiation for consolidation of the United Lead Company and the National Lead Company, a project which has been under consideration for a long time. The negotiations finally fell through and there now appears to be no immediate prospect of their revival.

The production of lead in the United States in 1904 was approximately as follows, the statement being based upon the producers' returns for eleven months, December being estimated; the figures given are in short tons:

	1903.	1904.	Changes.
Desilverized.....	188,943	214,028	I. 25,085
Soft.....	78,298	87,942	I. 9,644
Antimonial.....	9,453	11,583	I. 2,130
Totals.....	276,694	313,553	I. 36,859

In addition to this production from domestic ores, works in this country turned out 86,800 tons of desilverized lead, from foreign ores and base bullion, chiefly the latter. The items of the foreign movement are shown in table following. It is

possible that the corrected figures will show a slight re-adjustment, as it is not always possible to separate exactly, at this early date, the output from domestic and foreign material. Nearly all the foreign lead refined in this country is re-exported.

Imports of lead into the United States in all forms, with re-exports of foreign lead, for the eleven months ending November 30, are reported by the Bureau of Statistics as below; the figures are in short tons, and the changes from 1903 are also given:

	1904.	Changes.
Lead, metallic.....	8,553	I. 5,729
Lead in ore and base bullion.....	94,825	D. 844
Total imports.....	103,378	I. 4,885
Re-exports.....	79,563	I. 2,682
Net imports.....	23,815	I. 2,193

In addition to the re-exports of foreign material, there were 35 tons of domestic lead exported in 1904. Of the imports in 1904, Mexico furnished 94,191 tons and Canada 8,283 tons; 99.1 per cent of the total coming from those two countries.

The reports so far issued do not give bonded stocks for November; we give, therefore, the following additional table, which shows the net movement of foreign lead in the United States for the ten months ending October 31, in short tons:

Imports:	
Metallic lead.....	7,991
In ores and base bullion.....	87,242
Total imports.....	95,233
Re-exports of foreign lead.....	74,194
Add smelters' allowance on lead re-exported.....	7,419
Total deductions.....	81,613
Net imports.....	13,620
Add lead in bond, Jan. 1.....	10,694
Total supply.....	24,314
Deduct lead in bond, Oct. 31.....	9,725
Approximate consumption of foreign.....	14,589

Estimating November and December, this would show an approximate consumption of 17,500 tons of imported lead in the United States for the year.

**Lead Pigments.**—From the most eminent authority we learn that the lead pigment industry of the country is in a flourishing condition. The percentage of increase over the figures of the previous year ranges from 1 per cent, in the case of dry white lead, to over 12 per cent in that of lead oxides. The production for 1904 is estimated at: White lead in oil, 89,900 short tons; dry white lead, 28,180; red lead, 13,800; litharge, 14,200; orange mineral, 800 short tons.

#### THE NEW YORK LEAD MARKET.

The average price of pig lead during the year under review was only slightly higher than that for the preceding 12 months. Consumption has been very heavy, the demand for electrical purposes, cables, etc., especially showing a large increase. On the other hand, production has been fairly well under control, the American Smelting & Refining Company exercising its influence to maintain an equilibrium between supply and demand.

It has also continued its policy to centralize the smelting of lead ores and the refining of lead bullion. The independent producers, mainly in Missouri, again benefited largely by the high values ruling during the year, and the output in that producing center is still on the increase.

January opened at the same quotations as ruled at the end of 1903, 4.17½ St. Louis, 4.25 New York. A very heavy demand on the part of consumers caused the American Smelting & Refining Company to raise its prices on January 13th to 4.32½ St. Louis, 4.40 New York, which was followed by another advance of \$2 a ton a week later. On January 30, the quotations were reduced to those fixed on January 13.

The market ruled steady throughout February, but on March 1 the advance of \$2 a ton was restored, the quotations standing at 4.42½ St. Louis, 4.50 New York.

No further change was experienced until May 20, when there was a reduction of \$3 per ton, no doubt caused by the low prices ruling abroad which brought the importation of foreign lead within the range of possibilities. The further drop of \$2 per ton on May 24 was probably prompted by a desire to make assurance doubly sure and to work off some stocks which had accumulated in the meantime.

On June 14 and July 25, prices were again reduced \$1 a ton each time, the quotations on the latter date standing at 4.02½ St. Louis, 4.10 New York. At these values, a good inquiry developed on the part of consumers, and prices were raised on August 29 to 4.12½ St. Louis, 4.20 New York.

During the fall, consumers were extremely busy, and in the course of a few months the Trust became swamped with orders. It tried to stem the tide by booking them only at the prices ruling at time of shipment, which, naturally, was taken as a sure indication of an impending advance in prices. This materialized on December 1, values being raised to 4.52½ St. Louis, 4.60 New York, which are the closing quotations of the year.

#### Monthly Average Prices of Lead in N. Y.

Month.	1903.	1904.	Month.	1903.	1904.
Jan.....	4.075	4.347	July....	4.075	4.192
Feb.....	4.075	4.375	August..	4.075	4.111
March....	4.442	4.475	Sept....	4.243	4.200
April....	4.567	4.475	Oct....	4.375	4.200
May.....	4.325	4.423	Nov....	4.218	4.200
June....	4.210	4.196	Dec.....	4.162	4.600
			Av., year	4.237	4.309

The many changes which occurred during the year—although very often due to natural causes—at times produced serious hardship to the independent consumers; that is, those not included in the United Lead Company, which is supposed to be closely allied with the Trust. However, in the course of time the number of smelting works not controlled by the Trust will increase, thus giving a new stimulus to mining operations and assuring wholesome competition.

### The Cœur D'Alene.

By STANLY A. EASTON.

Returns from the several producers in this district show the production during 1904 to have been 107,560 short tons of lead, and 6,141,426 oz. of silver.

This production exceeds that of any previous year, despite exceedingly low water during the entire summer and fall—so low that one of the largest individual mines—the Morning, at Mullan—nearly suspended production for several months, and other mines were also compelled to reduce their output for the same reason. Excepting this unfortunate condition, the Cœur d'Alene region has just closed a year of much progress and of great financial prosperity to all.

The older mines have maintained their output and spent large sums in improving and perfecting their operations, and the younger mines, notably the Hercules, Hecla and Snowstorm, have developed a great deal of new ore. The last-named is a lode of peculiar interest; it is seemingly a member of the general vein-system of the district, heretofore known only as lead- and silver-bearing; it is farther to the east than any of the demonstrated mines, and carries a silicious copper ore containing silver. It is impossible now to give the production of the Snowstorm for the year, but the tonnage shipped was limited only by the capacity of the smelters to accept this class of ore. A leaching plant to treat the lower grade material, is now being erected. The shaft at the Hecla is being sunk to the 900-ft. level. The electric hoist installed late in 1903 has proved most satisfactory; electric pumps are used exclusively in this mine, and the mill is also operated by that power. The further development of the Hercules, through the adit, and its equipment with electric locomotives for hauling, has been pushed vigorously. This profitable mine continues to produce only high-grade ore, which is shipped without concentration. Of the older properties, the Federal Mining & Smelting Company continues to produce the usual tonnage from its four mines. The consolidation of operations at the Standard and Mammoth was completed during 1904, and these mines are now worked as one property. The Morning mine is installing an electric-driven air-compressor which will relieve the older equipment when scarcity of water prevails. The Bunker Hill & Sullivan Mining & Concentrating Company has added to its fine concentrating machinery and power equipment during the year; in the mine orebodies have been opened up on the Kellogg tunnel level 2,000 ft. below the surface, larger and of higher grade than heretofore known in this property. The 90-mile electric transmission line from Spokane Falls, has been in successful operation, and of great benefit; approximately 2,000 h. p. is transmitted and, with water, furnished almost all the power of the dis-

trict. Steam is almost entirely superseded.

Labor conditions probably have been better than in any mining district in the West. A very high degree of efficiency is reached. Nearly 80 per cent of all men employed are native-born Americans, the remainder being mostly English and Welsh, with a few Irish, Scandinavians and Germans.

It is estimated that the net earnings of all the mines during 1904 amount to \$2,800,000. Dividends declared by the incorporated mines amount to \$1,911,000.

### Southeast Missouri.

By H. A. WHEELER.

The output of pig lead from the southeastern or 'disseminated lead' district of Missouri, approximates 73,000 short tons, an increase of 10 per cent over that of 1903, the previous maximum. With an average value of 4.4c. per pound, this gives an estimated value of \$6,424,000 in the St. Louis market. Of this non-argentiferous production, 88 per cent came from St. Francois county, about 9 per cent from the adjoining Madison county, and the balance from innumerable small scattered mines or 'shallow diggings' in Washington, Jefferson and Franklin counties, which fringe the 'disseminated' belt.

1904 has not only been the best year as regards output at excellent prices, but it also saw the complete defeat of the first miners' union organized in this district. While this proved costly to the company that overthrew the union, it is an event which will contribute greatly to future prosperity. For this district had been fortunate in successfully wading through the troubles due to labor agitators, until some three years ago, when its placid record attracted the attention of the union leaders. Delegates were sent to organize lodges, at first with such discouraging results that the attempt was about to be abandoned; but a renewed, more energetic campaign finally won over a majority of the men, and then the remainder quickly joined the union like sheep. As wages were the highest and hours the shortest ever enjoyed by the district before the union obtained control, the officers had to find a pretext for its existence and to maintain the loyalty of the men in paying their dues; for the latter was a new feature that was by no means popular. A trivial pretext was found at the Central mine in December, 1903, when the union determined to assert its authority, and to dictate the employment of workmen; the result was a strike and the complete tie-up of a large property. Not even the pumps were allowed to be run by the union officials; consequently the chief mine and the principal producer of this company was promptly drowned, and the lives of the mules underground were barely saved. In fact, it was the outcry of the Society for the Prevention of Cruelty to Animals that caused the officials of the union to allow

the engineers to hoist them out of the mine. But while this society saved some fifteen mules, worth about \$2,000, it could not rectify the flooding of a \$500,000 mine that threw 500 men out of employment in mid-winter. After nearly three months' idleness, in which the men had ample time to discover that they had no grievance and had been duped by agitators, they gladly left the union and returned to work under the old conditions. Since then the union has been rapidly disintegrating, and it is to-day one of the most unpopular institutions in the district—with workingmen as well as employers—thanks to the firmness, grit and clear head of the manager of the Central Lead Company.

No new discoveries or new shafts have been reported in 1904; and the increase in production is due to greater activity in the old mines, which have more than offset the shrinkage resulting from the strike at the Central and the shutting down of the Columbia mine. Nor has the limit of production been reached, as the output in 1905 is likely to be at least 80,000 tons of pig lead, or another increase of 10 per cent.

The old St. Joe mines, which are now 35 years old, have greatly increased their output. Part of this is due to an enlargement of their old Bonne Terre mill and an increase in the underground force at the old mine, and part is due to the completion of a new mill at the Hoffman shaft. One-half of this new plant, or an additional capacity of 500 tons per day, has been utilized; but 1905 will undoubtedly see the entire plant completed and in full operation. This new mill treats the ore from the Hoffman and Hunt shafts on No. 11 and 12. The smelting facilities have been enlarged at Herculaneum, where several new roasting furnaces have been added, and a large, modern water-jacket is now being erected that will nearly double the smelting capacity. Many other improvements have been made at the mines and smelting plants. The closely related Doe Run Company has had a quiet but busy year, and more than maintained the usual large, regular output. The Desloge Lead Company increased its milling capacity about 50 per cent, and is now receiving a large tonnage of ore from the new No. 4 shaft; this shaft, though close to Big river, is not proving very wet. The Central Lead Company lost over three months from the strike last winter, and has not attempted to pump out its large mine since then. It has been able to keep up a fair production from the Theodora shaft, which is a dry mine. By sinking two new shafts, this company could triple its present production, and this is now under consideration. The National Lead Company completed its new smelter at Collinsville, Ill., where its concentrate is now shipped. The mine enjoyed a very steady, successful year. The Federal Lead Company has begun to be an important pro-

ducer and its output is growing, under more efficient management. The Columbia Lead Company's property was operated on a small scale under lease, in the early portion of 1904; but, when the lease was abandoned, the company shut down the No. 2 shaft and continued work in a desultory way at the No. 1 shaft. Work has since been entirely abandoned, and the property is now lying idle. The old Mine la Motte property has only slightly increased its production, though the energetic advertising of its promoters promised much greater results. A small, new mill was started on the western portion of the tract, and there has been talk of its becoming an important cobalt-and-nickel producer, but thus far on only the limited scale that has been characteristic of this property. The North American Lead Company made some improvements in its mill, at Fredericktown, and has settled down as a steady producer. The Catharine mine closed down in the summer from internal dissensions, and has since been sold to eastern parties, who have reopened the mine and again started the mill. Before the shut-down some very rich ore was produced.

The mines named above comprise all the producers in the 'disseminated lead' belt; the Union, Penicaut, Manhattan, and Elizabeth properties, in St. Francois county, have not yet been developed to the producing stage.

### Antimony.

There was no production of antimony in the United States from domestic ores. Most, if not all, the yielding mines are so situated that they cannot compete with imported ores, owing to their distance from market, or cost of working. About 900,000 lb. of metallic antimony was made in this country from imported ores.

In addition there was produced 11,583 tons of hard, or antimonial, lead. This lead contains from 18 to 27 per cent antimony, and is used in making alloys, such as bearing metals, where antimony is an important constituent. A part of this antimonial lead was from foreign material. It is impossible to determine how large a proportion was of domestic origin.

The imports of antimony in all forms for the eleven months ending November 30, with the changes from the preceding year, were, in pounds:

	1904.	Changes.
Metal and regulus. . . . .	3,418,850	D. 1,589,065
Antimony ore. . . . .	2,033,451	D. 637,671

As the ore imported usually averages not far from 40 per cent metal, the total receipts for the eleven months were equal to 4,232,230 lb. metallic antimony.

Sir Oliver Lodge has well said that there are two types of man to be avoided: the cultured man without knowledge, and the knowing man without culture.

### Zinc.

By W. R. INGALLS.

The statistics of spelter production in 1904 will show an increase over 1903. This is pointed out by the increase in the ore production of the Joplin district, which rose from 235,000 tons in 1903 to 262,500 tons in 1904. Although Joplin no longer holds its former position as the sole source, of any great consequence, of Western spelter, it is still, nevertheless, the most important source, about 75 per cent of the metal originating within its limits. The increased production of spelter has been absorbed by an increased consumption, especially during the second half of the year, during which there was a strong rise in price.

The statistics will probably show the largest production of spelter on record in the United States; also the highest range of ore prices over a long period, the average for ore containing 60 per cent zinc, at Joplin, having been about \$37.40 per ton. The prosperity has not been, however, so great as the statistics might be construed as indicating, because the cost of production has increased in the Joplin district, where the miners have to obtain a price that is high compared with a few years ago, in order to realize any profit from the average class of mines. Nevertheless, the year was certainly profitable to the miners, while to the smelters it was rather unfortunate, the margin between zinc in ore and as spelter not having been so small in any year since 1899, when the pinch was of much shorter duration.

The causes for the situation in 1904 were quite evident. In the first half of the year the consumptive demand was sluggish and the price for the metal ranged low in consequence. It could not go very low, as compared with former records, because of the increased cost of production, both mining and smelting. It is probable that 4.5c. for spelter at St. Louis is about bed-rock under present conditions, a point at which there is no money for any of the Kansas and Missouri interests; a point from which a further decline would begin to restrict materially the Joplin production. Spelter fell to that point about the middle of 1904. Caught between a metal market that would not rise and an ore market that could not fall, the smelters competing among themselves to secure the ore requirements for their furnaces, had to see their margin for profit dwindle to nothing.

The strength of the European market during midsummer relieved the situation somewhat, a rise in the London price to about the American level enabling the smelters to sell for export a considerable portion of the stocks of metal which they had been carrying since the end of 1903. The market was brought thereby into a good position for a sharp rise, when the demand for domestic consumption began

to strengthen, in the early autumn; but the competition among the smelters for ore caused the price for ore to advance correspondingly, so that many of the smelters were no better off than they had been.

The producers of western spelter are by no means on an equal footing. Some produce only prime western spelter; others produce special brands of spelter, which command a premium; others produce sulphuric acid as well as spelter. Formerly the advantages of some of these concerns were offset by the relative cheapness of smelting with natural gas in Kansas. This difference is not now what it used to be, the cost of smelting in Kansas having increased because of the greater cost of the natural gas and some other items; wherefore the concerns which extract the most value from the ore are able to make the market for it, and compel the other smelters to go elsewhere for their supply. The direct cause of this has been, of course, the insufficiency of the Joplin ore supply to meet the present demand for spelter for consumption.

There have been in 1904 about 20 blocks of furnaces in Kansas on ore from west of the Rocky Mountains, chiefly from Colorado. This signifies the smelting of about 100,000 tons of ore during the year. It is the development of this new ore supply that has enabled several of the smelters to live. Although it is a lower grade and more impure ore than the Joplin product, costing more per ton to smelt, and giving a lower percentage of extraction, it can be bought delivered at the works at prices which afford a larger profit than can be had from the Joplin ore under present conditions. There is strong prospect, therefore, that the use of this new ore will continue to increase. The spelter made from it is, in the main, equal to the ordinary brands of prime western.

Beside the Kansas smelters, there was a considerable use of the Rocky Mountain ore by the Mineral Point Zinc Company and the Grasselli Chemical Company; also by the United States Zinc Company, which succeeded in putting its works, at Pueblo, Colo., into successful operation, overcoming the initial difficulties, and became an important factor in the Colorado ore market.

The increase in the demand for zinc ore from the districts west of the Rocky Mountains naturally stimulated great activity in all of them. Leadville continued to be the chief point of production, but important supplies were drawn from Creede, Kokomo, the San Juan, and Clear Creek cañon, in Colorado; from Magdalena, N. M., where the Kelly and Graphic mines were large producers, and from the Slocan, in British Columbia. Preparations were made to concentrate the ore at Park City and Horn Silver, Utah, and at the Alice and Emma mines, at Butte, Mont., and those mines will probably be

producers in 1905, as will also one or two mines in the Wood River district of Idaho.

East of the Rocky Mountains, there has been greatly increased activity in the old Wisconsin zinc region, the output of which will show a noteworthy gain in 1904. The prospects of this region are excellent, and its mines being able to produce a high grade of ore, now that the problem of efficiently separating the associated blende and mundic has been solved, will satisfactorily augment the supply of that kind of ore. The mines of Arkansas failed again to come to the front in any remarkable manner. Considerable new work was done in Kentucky. Some explorations with churn drill were made in the Holston River district of Tennessee, it is said, with satisfactory results; but no important production was derived from that source in 1904. In Virginia, some new developments were carried on by the Bertha Mineral Company. In New Jersey the Franklin mine was alone operated, the scheme of delimiting the great ore-body by means of stope-drifts being further prosecuted; it is still a year or two short of completion.

The new plants of the United States Zinc Company, at Pueblo, Colo.; the Grasselli Chemical Company, at Clarksburg, W. Va.; the Cockerill Zinc Company, at Altoona, Kan.; the Laharpe Spelter Company, at Laharpe, Kan.; the Chanute Zinc Company, at Chanute, Kan., and Wm. Lanyon, at Caney, Kan., were completed in 1904 and were put more or less into full operation. The Mineral Point Zinc Company planned to erect a new plant at Depue, Ill., near Lasalle-Peru.

The production of spelter in the United States, as shown by the returns of producers, estimating the output for December and the total production of a few minor plants, was 176,849 short tons, showing an increase of 18,347 tons over the preceding year. The total for 1904 was the largest on record. The greater part of it, however, was absorbed by the productive industries of the country.

**Zinc Oxides.**—The output of zinc-white during 1904 was 58,808 tons, an increase of 4,774 tons over the year 1903. Nearly all of this was made directly from ore in New Jersey and Wisconsin. The production of zinc-lead pigment amounted to 6,781 tons, an increase of 2,281 tons as compared with the previous year.

The exports of zinc and zinc ore during the 11 months ending November 30 were as follows, with changes from the previous year, in short tons:

	1904.	Changes.
Spelter.....	8,863	I. 7,578
Zinc ore.....	28,755	D 2,033

The increase in exports was caused by the sale of some 6,000 tons in Germany, as mentioned above. The exports of ore were chiefly to Belgium.

THE NEW YORK ZINC MARKET.

The year under review was a fairly prosperous one for the zinc industry of the United States, home consumers absorbing practically all the metal that was produced, and it was not until late in the fall that some stocks began to accumulate. At that time a sale of about 6,000 tons for export was consummated, and shortly after this transaction had become known values advanced sharply; and when the iron and steel industry became more active, the demand for home consumption grew so large that at the end of the year a rising market existed.

Galvanizers, brass mills and sheet-zinc manufacturers have been very busy throughout the year, and a fair quantity of spelter was again used for electrical purposes.

Production has about kept pace with the consumption. While the output of zinc ore in Missouri does not show much change, larger quantities of Colorado ores are being used by the domestic smelters, with the result that the exports of this class of material will no doubt fall off considerably in the future. Two new works were built in the Kansas gas belt, and an old plant which had been idle was started up again.

The year opened with spelter quoted at 4.70 St. Louis, 4.87½ New York. During January, the market ruled quiet and steady, but in February an upward movement commenced, which in the first place was started by the higher ore prices caused by a reduced output in consequence of cold weather, but which was, later on, accentuated by a large demand on the part of consumers, especially for galvanizing purposes. The advance culminated in a quotation of 5.05 St. Louis, 5.22½ New York, by the end of April.

As May progressed, it became evident that the iron and steel business did not come up to expectations, and this fact naturally reflected on the spelter market. Producers became demoralized, and by the beginning of June values had declined to 4.57½ St. Louis, 4.75 New York, at which quotations the market remained steady throughout the month.

MONTHLY AVERAGE PRICES OF SPELTER.

	—New York.—		—St. Louis.—	
	1903.	1904.	1903.	1904.
January.....	4.865	4.863	4.689	4.673
February....	5.043	4.916	4.681	4.717
March.....	5.349	5.057	5.174	4.841
April.....	5.550	5.219	5.375	5.038
May.....	5.639	5.031	5.469	4.853
June.....	5.697	4.760	5.537	4.596
July.....	5.662	4.873	5.507	4.723
August.....	5.725	4.866	5.550	4.716
September..	5.686	5.046	5.514	4.896
October.....	5.510	5.181	5.350	5.033
November...	5.038	5.513	4.886	5.363
December...	4.731	5.872	4.556	5.720
Year.....	5.375	5.100	5.191	4.931

A curtailment in the ore output caused a small advance during July, but sales were rather slow and stocks began to accumulate in the hands of smelters. At the end of August it transpired that an export sale had been made, and this news suddenly changed the aspect of the market. Prices

advanced quickly to 4.85 St. Louis, 5c. New York. It also developed that home consumers were rather poorly supplied, and as the iron and steel trade showed signs of improvement, purchases were freely made for spot as well as future delivery. The consequence was further sharp advances which culminated in a price of 5.87½@5.92½ St. Louis, 6.05@6.07½ New York, which are the closing quotations of the year.

The Missouri Ore Market.

By JESSE A. ZOOK.

The highest price paid for zinc ore during 1904 was \$52.50 per ton, in the week ending October 1. The price of zinc ore at the latter end of 1903, began dropping from \$40 in October to \$35 at the close. The past year began with the price at \$36, and it advanced through the first four months to \$40 in April, when a decline set in, continuing until \$35 was reached at the end of June. The policy of restricting the output to the needs of the smelters, maintained for two weeks in July, sent the price to \$41 in three weeks, continuing, with an occasional drop backward, until it reached \$52.50 in October. The smelters seemed to have scared themselves and they dropped the price to \$49 and to \$44 the succeeding two weeks. This price ruled for three weeks, then it went up to \$46 and the following week to \$50, where it remained.

Lead began the year at \$54 per ton, advanced to \$60.50 three weeks later, and in three weeks more was down to \$55.50, climbing back to \$60.50 the second week in March. This price was maintained for three weeks, and in the succeeding three weeks it declined to \$56; then went up three weeks to \$58 for two weeks, \$56 two weeks and then down to \$53, where it remained for six weeks. The last week in July it was down to \$52, holding at this price throughout August. All through September and October it was \$53.50, the next two weeks \$54, then \$55.50, closing November at \$60.50. It touched the top at \$62 per ton the second week in December, after which \$60 was paid.

For 51 weeks of 1904 the zinc shipment aggregated in value \$9,135,730, and approximating the balance of the year would give a total zinc value of \$9,614,210. The lead shipment for 51 weeks sold at \$1,804,570, with an approximation that will bring it to \$1,892,390, giving a total value for the two ores of \$11,476,500, an increase over 1903 of \$2,005,000, and over the previous record-breaking year of 1899, of \$761,200.

The shipment of zinc ore averaged by weeks was 5,047 tons, selling at an average of \$179,171 per week. The lead average was 635 tons, selling at an average of \$35,383 per week, giving \$214,554 as the value for each week of the year. The average price of zinc ore for the year was \$45.50 and of lead ore \$54.75 per ton.

**Alaska.\***

By ALFRED H. BROOKS.

Those who have expected a rapid increase in Alaska's mineral output will be disappointed. It must be remembered that exploitation is much slower than in more accessible regions; and, unless another Klondike be found on the Alaskan side of the boundary, an unlikely event, the mineral production will increase but slowly.

The value of the gold output for 1904 will be about \$9,000,000, showing an increase of \$500,000 over 1903. Of this amount a little over one-third is produced by lode mines, chiefly by the Treadwell group. The placers of the Seward peninsula contributed between four and four and a half million, the Yukon about a million, while the balance comes from the smaller placer camps.

The mines of southeastern Alaska produced a small quantity of silver, about \$30,000. One copper mine on Prince William sound has continued regular shipments of ore to Puget Sound smelters, and a few tons have been shipped from other mines. Some stream tin has been exported from the York district. Beside the metals, a few thousand tons of coal are annually mined for local use. Among mineral resources hitherto unproductive is petroleum, for which the prospects are still good, and marble.

Lode mining, except for the Treadwell group, is still unimportant, but it is undergoing steady development. At the Treadwell a depth of 1,000 ft. has been reached, and the width and value of the ore are maintained. The half-dozen properties, tributary to Juneau on the mainland, have continued at work; but the extensive developments anticipated have not been pushed. There has been active prospecting at Whindham bay, 40 miles south of Juneau; the mine at Snettisham has maintained a small production; but at Sumdum work has been abandoned. Between Juneau and Berners bay, auriferous lodes at several localities are promising, and their development is progressing favorably. Probably the most important event in the Juneau district is the cross-cutting of the gold-bearing vein of the Kensington mine, at a depth of 800 ft., on Berners bay; current reports indicate that this will become an important gold producer. The Jualin and neighboring mines have continued productive, without developments of moment.

On the islands west of Juneau, prospecting continues. The apparent collapse of a large, ill-advised enterprise on Rodman bay is a noteworthy event; it appears to have been the result of large investment in equipment before a workable orebody was opened up. In the Wrangell district, south of Juneau, the one producing gold mine closed down. There are a number

of prospects; some of these yield chalcopyrite and pyrrhotite in commercial quantities; others contain gold and silver ore. To the south is the Ketchikan district. Though this region first attracted attention some years ago as a prospect for gold and silver lodes, more attention is being given to its copper, which is yet undeveloped. Several gold veins were worked in a small way during 1904. Of more import, however, is the systematic development of a copper property at Niblack Anchorage, on the east side of Prince of Wales island. Kasaan peninsula, 20 miles north, is also the scene of active development of copper properties; and on its north side a 400-ton smelter has been erected. Another smelter, with a capacity of 250 tons, has been erected on the west side of Prince of Wales island, to treat the ore of the Copper Mountain property. In the latter, a tunnel is being driven, destined to cut the orebody 1,100 ft. below its outcrop.

Lode mining is practically confined to southeastern Alaska. The Gladhaugh mine, on Prince William, is the only copper mine in Alaska which has reached the productive stage. The ore is chalcopyrite; and the mine, being on a good harbor which is open throughout the year, has the same low freight rates which are enjoyed by the tidewater mines of southeastern Alaska. The same district contains other bodies of copper ore, many of which were prospected. The Apollo mine is on Unga island; it has been a large producer in the past, and after several years of small production is reported to have taken a new lease of life. The ore is free milling. The Big Hurrah quartz mine, about 40 miles east of Nome, has attracted attention, because it is the only lode deposit in this placer district which has reached a productive stage. It appears to be an example of the success possible for careful management, even under adverse conditions. The capacity of the mill has been increased to 20 stamps, while the mine workings have reached a depth of nearly 150 ft. The attention of mining men at Nome has been given mainly to the placers, with their promise of sure and quick returns; and but few attempts at lode prospecting have been undertaken by experienced men. Many abortive attempts at lode exploitation have resulted; these are rather on the increase.

Tin-bearing gravel is being exploited on Birch creek, in the York region, and small shipments have been made. There do not appear to be any deposits large enough to warrant extensive operations, though, with the wide distribution of stream tin, it is possible that such may be found. For lode deposits, the outlook appears more hopeful. Prospecting, in the Lost River region, has developed good surface showing, which, if maintained in depth, will become profitable. At Cape mountain, some

drifting has been done along the periphery of a granite mass. Ore of low grade has been found, beside some richer material. Tin lodes are also reported at Ear mountain. All this goes to show that there is a legitimate field for the tin prospector.

The placers of Alaska produced between \$5,500,000 and \$6,000,000. Of this about \$4,500,000 came from the Seward peninsula, \$1,000,000 from the Yukon district, and the balance from the Cook Inlet, Copper river, and Juneau regions. Placer mining in the Seward peninsula was hampered by a dry season; work by small operators was, in many instances, entirely interrupted, while none of the ditches could furnish the expected supply of water. In the entire peninsula there has been feverish activity in ditch construction; as a consequence, a number of ill-conceived enterprises have been inaugurated. Many appear to believe that it is impossible to mine placers without ditches and hydraulic elevators. Miles of ditches have been constructed for the purpose of hydraulicking shallow gravel-beds which could be more economically mined by other methods. The companies suffer from bad management; there are relatively few experienced mining engineers in the entire district, fully 50 per cent of the enterprises being in charge of men who are utterly unfit; some have come from the placer fields of California; and these, when they have adapted themselves to the new conditions, are usually successful; but large sums of money are being squandered by men of no experience. As the Seward peninsula opens up, the transportation problem becomes more serious. All freight must be landed on the beach with lighters, at a cost of \$5 per ton; while storms often interrupt traffic. During dry seasons it is possible to haul good loads with horses to almost any point in the peninsula, but a rainy season makes the country impassable for wagons. The Nome Arctic Railway gives adequate service to the creeks which it touches in its nine miles of track. The Council City & Solomon River Railway is steadily pushing its construction inland, and at the close of the season, had about 16 miles of track completed; this railway, when completed to Council, will open up a region well nigh inaccessible under present conditions.

The practice of mining deeply buried pay-streaks by drifting, is increasing. Most of this work is done in the winter when there is no surface water to contend with, and when wages are 50 per cent less than in summer. The dumps, accumulated by winter mining, are sluiced in the spring, when the thawing of the snow assures a water supply; by this means probably over \$1,000,000 was taken out during the winter of 1903-1904. A significant feature of recent development is the successful operation of a steam shovel on Anvil creek, by the Pioneer Mining Company. It ap-

\*Published by permission of the Director, United States Geological Survey.



pears that the steam shovel will find more extensive use in the future, though it is not applicable to frozen ground. Several companies have been formed to exploit the gravel plain or 'tundra' placers, lying within a few miles of Nome. These are rich, but up to the present they have been worked only in a small way, either by rockers and hand-shoveling in summer, or by shafting and drifting in winter. The problem of extracting gold from these deposits, which lie at or below sea level and frequently in frozen ground, is not an

done on Dorothy, near the head of Nome river. Deep mining during winter was pushed in the high-bench gravel of the Anvil-Dexter divide; eventually this whole mass, in places over 100 ft. deep, will be removed by hydraulic methods; but, in the meantime, the rich pay-streaks are being followed by drifting. This method is made expensive by the fact that the pay-streaks are exceedingly irregular in their course, and much labor is lost in attempting to trace them.

In the Solomon River region, develop-

be productive, despite difficulty of access. The Topkok company has extended its ditch to obtain more water. This enterprise is successful by reason of cheap hydraulicking.

The Council region is progressing. Ophir creek has been the steadiest gold producer and still contains a large reserve of gravel. The company, operating the dredge on the Niukluk river, went to pieces before the profitable exploitation of these fluvial placers had been demonstrated.



ALASKA.

easy one; steam shovels have to be preceded by stripping and thawing; while hydraulic methods involve a large outlay for ditches, and the use of elevators for the disposal of tailing. Late in the fall some phenomenal placers were found on Little creek, a stream which flows across the tundra near the base of the highlands. This occurrence has been interpreted by some to mark the former course of Anvil creek; but the coarseness of the material would indicate a local source of the gold; it is important as showing that the possibilities for new discoveries have not been exhausted, even in the region close to Nome.

Beside the operations immediately in the vicinity of Nome, there has been activity on Osborn creek, east of Nome river, and in the Penny river region, west of Snake river. Hydraulicking was also

ments have been rapid, stimulated by the construction of the Council City & Solomon River Railway. Three or four long ditches have been built, and several smaller ones are in operation on Shovel creek. Two dredges have been operated throughout the season on the main river; and on a number of claims hydraulicking was carried on. Winter work was more extensive than during any previous season. The completion of the railway, as planned, will make accessible the extensive gravel-deposits of the Casa de Parga. These were abandoned by the pick-and-shovel men over three years ago for want of transportation facilities. Some large enterprises have been planned for this district, which promises to become an important producer.

Across the divide to the northwest are the Iron creek placers, which continue to

The Bluestone and Grantley harbor regions, northwest of Nome, continue to make a fair output, considering that no large plants have been installed.

In the Kugruk region more activity was displayed, two ditches having been completed, and several more started.

The Fairhaven district, including the northeastern portion of the Seward peninsula, is isolated; and, consequently, progress is very slow. Miners are here at work under the most adverse conditions, and yet exploitation of some of the placers has been profitable. Despite scarcity of fuel, winter work was carried on. Among other ditch projects, surveys have been made which contemplate the tapping of Imuruk lake and hydraulicking the bench gravels along the Inmachuk river.

A broad belt of mineralized rock stretches, westward from the international

boundary near Dawson, to the Yukon below the Arctic Circle. Gold has been found widely distributed in the stream gravels, and scores of creek placers are productive. With the development of the region the rapid journey and careless search of the pioneer is succeeded by the systematic prospecting of the trained miner, and often with ample reward. It is no uncommon occurrence for placer gold to be found in stream gravel which was prospected and abandoned a decade ago. There is always the hope that another Klondike will be discovered. Nor is this hope altogether vain, for the same conditions repeat themselves on the Alaskan side of the boundary which are found in the famous Canadian district.

Meanwhile, well established districts, such as Fortymile, Birch Creek and Rampart, continue to produce from \$150,000 to \$200,000 each year. Unfortunately the one attempt at large-scale operation, which had for its purpose the exploitation of the river gravel at the "Kink" was ill-advised, and work has ceased. Plans have been formulated for bringing water, under heavy head, to hydraulic the benches on Chicken creek. The Fortymile district supported a mining population of over 500 men, and produced about \$175,000. This has been chiefly taken from Chicken, Wade and American creeks, and from Discovery and Walker forks.

The Birch Creek district proper has made little progress, and the output is about the same as that of Fortymile. Scarcity of water and low stream-gradients hinder hydraulicking; nor has the presence of rich bench-gravel been established.

Placer gold has been found in the Beaver creek basin, about 50 miles northwest of Birch creek, and about 20 miles from the Yukon. This discovery was made by a small party of prospectors late last August; but there was not time to reach bed-rock before the season closed. A number of men are wintering in this district, and more definite evidence will be available in the spring.

The Fairbanks placer district, because of the increase of its output from \$40,000 in 1903 to about \$400,000 in 1904, has become the local point of popular interest. This gold has practically all been taken from three creeks, Pedro, Cleary, and Fairbanks, and their tributaries; but pay gravel has been reported from a dozen other streams. Roughly outlined, the present known gold-bearing area embraces at least 500 square miles, and is about equal to that of the Klondike. The producing creeks all lie within 25 miles of steamboat navigation on the Tanana, and the topography is such that railway and road construction will not be expensive.

Fairbanks, a town of several thousand inhabitants, situated on a slough navigable for large steamers only at high water, is the chief supply point; while Cluna, a

smaller settlement, is on the main Tanana river. Both these places are about equally distant from the gold-producing creeks. At the close of the season, freight rates ranged from 10 to 20c. per lb., the winter rates being about one-quarter of this.

The district is connected by military telegraph with Seattle, and telephone lines are being installed, which will afford direct communication with the creeks. Railway supplies were shipped into the country in the late fall; and the promoters contemplate the connection of the settlements on the river, with the creeks, by a narrow-gauge line. Fairbanks can be conveniently reached, via Dawson, by steamer during the open season, from about the middle of June until the middle of September. Freight and passengers can also be carried to Fairbanks by way of St. Michael, though this route will take a little longer. A winter dog-trail has been established from Valdes to Fairbanks, by a route about 275 miles long.

Pedro, Cleary and Fairbanks creeks are all less than 10 miles in length and carry 100 to 200 inches water, with gradients not over 100 ft. per mile. The gravel is usually frozen to bed-rock. All development has been confined to the creek beds, or to low benches; as, in adjacent regions, gold has been found in high gravel, it would appear that the prospector might well search for high benches in this district also. On Pedro creek the gravels are 8 to 30 ft. deep, the pay-streak is 1 to 4 ft. and 40 to 200 ft. wide. The bed-rock, chiefly mica schist, is deeply decomposed, and from 1 to 5 ft. is frequently mined. The yield of pay-streak is estimated at 5 to 25c. per pan.

On Cleary creek, the depth to bed-rock has been found to vary from 14 to 80 ft., with an average of over 50 ft. Of this, 20 ft. is gravel, covered by a heavy overburden of muck. The pay is found in 1 to 7 ft. of gravel, and at a depth of 1 to 4 ft. in bed-rock.

Mining extended about four miles along Fairbanks creek during the past summer. The depth to bed-rock varies from 15 to 60 ft., and the pay-streak from 1.5 to 7 ft., with a width of 45 to 250 ft. The average was about 5 to 10c. to the pan.

The larger valleys of the district are heavily timbered, so as to afford fuel and lumber. In 1904, in spite of the local supply from several sawmills, lumber brought as high as \$200 per thousand. Wages are usually not over \$5 per day, with board.

The extent and yield of the gravel deposit is such as to assure a good future for the district. The depth of gravel, and scarcity of water, have prevented rapid development. Drifting with steam-points has been the favorite method of mining. But few mechanical contrivances have been used, nor have hydraulic methods been introduced. The expense of mining

has probably consumed from one-third to one-half the output.

The large influx of miners to Fairbanks has led to prospecting in the adjacent country, especially south of the Tanana valley. Along the northern base of the Alaskan range there are extensive deposits of overwash glacial gravel, and these are known to be auriferous. In my explorations no workable placers were found, but it appears not improbable that there are localities where the gold may be sufficiently concentrated to be workable. Certain it is that there exist heavy gravel deposits, aggregating in some instances hundreds of feet, which from their topographic position may be regarded as worthy of the attention of the hydraulic miner, who must, however, first satisfy himself of their gold content. The streams which rise in the high mountains to the south will furnish ample water, and under sufficient head.

The Rampart district, the most westerly in the Yukon-Tanana region, lies in the elbow between the Lower Tanana and a part of the Yukon rivers. For over a decade, the gold placers in the basin of Minook creek have made a small but steady output. During the past season, half a dozen tributaries of this stream have been worked. On Hunter creek, a hydraulic plant has been installed, fed by a ditch a mile long, which carries 300 in. at a head of 75 ft. On Hoosier, Ruby and Big Minook, similar plants are being installed. The southern part of the Rampart district embraces a number of streams, tributary to the Lower Tanana, which are yielding placer gold. Among these is Glenn creek, which has produced over \$250,000 in the past three years. No extensive mining plant is being installed in this southern area; but many creek placers are being worked in a small way. The working expenses range from one-third to one-half of the output.

The Koyukuk district, north of the Arctic Circle, is also in the Yukon region. Current reports indicate an unfavorable season. No new discoveries are reported; inaccessibility has been a hindrance to large operations. There is no question, both of the wide distribution of gold and its occurrence in commercial quantity.

In the Cook Inlet district, several hydraulic plants are in operation. A railway, the Alaska Central, is under construction; this will give communication with Resurrection bay, on the Pacific side of the Kenai peninsula, where there is an excellent harbor, open throughout the year, with ample wharf facilities. The railway project is planned to tap the Yukon placer field, near the mouth of the Tanana, which will require about 300 miles of track.

The Chistochina district is the only one in the Copper River basin which made any considerable output of gold. The Nizina and other districts are, however, not abandoned, and await exploitation.

**Colorado.\***

Notwithstanding labor disturbances and general political unrest, the condition of the mining industry is healthy and the outlook is good. Gold mining still centers at Cripple Creek, where operations are now proceeding smoothly, with excellent reports of new discoveries in a large number of mines. The higher price for silver is stimulating exploration at Leadville, where several notable developments have occurred recently. The output of lead is incidental to the precious metals and tends to diminish as the upper ore measures of Leadville become exhausted. Copper is a minor product in Colorado, accessory to the other metals. The production of zinc exhibits a large increase, by reason of metallurgical success in the treatment of large bodies of complex ore carrying that metal. Coal and iron tend to grow steadily in importance as basic industries. Exploration for rare metals has been stimulated by the successful exploitation of vanadium and wolfram deposits. On the whole, despite serious hindrances, progress has been unmistakable and dividends are large. An important feature is the fact that new mining enterprises are largely financed by local people, so that success leads the way to further activity.

The higher prices for the metals have encouraged development and the steady decrease in treatment charges on certain ores has helped to resuscitate old mines. The Argo smelter, for instance, gives a \$3 to \$4 rate on the pyritic ores of Gilpin county. The smelter at Golden, which resumed work in October, also helps the old districts of Clear Creek and Gilpin. Improvements in milling, by chlorination and cyanidation, enable the larger custom plants to quote rates which encourage the miner to exploit low-grade deposits.

Among the important events of 1904 may be mentioned the construction of the new Denver-Salt Lake railroad; rails have been laid across the Front range as far as Arrowhead, in Grand county, whence mineral products are now being shipped. This Moffat railroad, as it is best known, will stimulate prospecting in a part of Colorado hitherto handicapped by lack of transport facilities; it will render available the low-grade silver-lead ores of Middle Park, the coal of Leyden and Yampa, and the gilsonite and elaterite deposits near the Utah boundary.

Colorado has ever been the cradle of new processes. Among new methods, the Crane washer is an improved form of the old barrel machine for cleaning ore preparatory to sorting on a traveling belt. This process of coarse crushing, washing and sorting was developed at Cripple Creek, and is now being applied to old dumps in the San Juan region and elsewhere. The need of fine grinding for certain ores is now recognized, and in the

\*Based upon data kindly furnished by Messrs. Go. J. Beacroft, Forbes Rickard, Philip Argall and Ben S. Rvett.

Liberty Bell mill at Telluride experiments are being made which will prove far reaching in their usefulness, particularly because fine grinding appears to permit of a good silver extraction with weak cyanide solution. The tube-mill is being introduced in Colorado and is to be installed in conjunction with the Hendrix agitator and the Moore filter. Should tests prove successful, as appears likely, this departure will greatly benefit numerous mines carrying gold and silver ores too poor to smelt and not suitable for water concentration by ordinary methods.

The year has seen the introduction, in Colorado, of numerous useful machines; among them are several new drills. What the industry needs most is cheaper mining; in this respect, milling is far ahead. The new drills are a step in the right direction. Carey Bros. are introducing the Shaw drill, which resembles the old pneumatic riveter; it is a light, cheap machine that can be carried around in one hand, and does great execution for its size. The Johnson-Ilers drill is a similar machine, only a breast-rest and crank are provided, similar to the old-fashioned brace and bit. The Box electric drills have been improved, and are becoming popular. The Stearns Roger Manufacturing Company has brought out a small, light, pneumatic-hammer drill, which, among other advantages, has a hollow bit so that water or exhaust air may be forced to the bottom of the hole to clean it. The drill is called the 'Little Jap,' and is coming into general use for stoping. Among several new concentrators the new Bartlett table of the Colorado Iron Works, and the Card table of Hendrie & Bolthoff, are worthy of mention. The Elspass is a Chilean mill, the bed of which revolves; it is made by Fairbanks-Morse. The centripact screen of Traylor is also a notable invention. The Leyner Engineering Works erected a large factory near Denver. There are five buildings, aggregating 6,000 sq. ft. of ground area. The company manufactures the Leyner water-drill, together with hoists and air-compressors. Development of local manufacture is a step in the right direction.

Cripple Creek continues to be the most important mining center. Leasing is responsible for much healthy activity; in fact, the lessees have demonstrated that they can work mines with better results, both in economy and discovery of ore, than large companies. Despite serious interruptions early in the year, the output of the district, aided by a large production during recent months, is not less than \$16,000,000, an increase of \$3,000,000 as compared to 1903. Production is now at the rate of 55,000 to 60,000 tons per month.

Among noteworthy features are the discoveries in the mines of Beacon Hill, due largely to the lowering of the general water-level of the district by the drainage adit. An unusual number of surface dis-

coveries have been made, affording the basis for new exploration. In some of the older mines, such as the Portland, Elkton, Gold King, Gold Coin and Blue Bird, new orebodies have been uncovered at the deeper levels. Apart from successful mining, there has been greater activity in local cyanide practice. The Homestake mine is treating 200 tons of \$2.50 ore from a large quarry, 1,500 ft. long and 700 ft. wide. This mill is to be increased to 1,000-ton capacity. Over a large area of Ironclad hill there exists an enormous quantity of low-grade oxidized material, which can be mined and cyanided at a minimum cost. Other mills are likely to be erected for this purpose.

Leadville has reason to be proud. A new lease of life has been given by the Reindeer and Coronado discoveries. The first is on a lease held by the Campion brothers; it indicates the southwest extension of the Rock and Dome shoot. Shipments of 2,000 tons monthly are being made and increased production is assured. The second important development was made by lessees in the 'downtown' territory, where the Coronado shaft penetrated a fine body of ore under the parting quartzite and below the Elk fault, apparently the western extension of the Henriett-Maid shoot. The wide bearing of this discovery has been confirmed by drill-holes. The ore is a typical silicious Leadville carbonate, but it carries copper. Among other promising events, the old Iron Silver mine has come to the front with discoveries of sulphide ore in the Moyer. The Yak Tunnel has become a large producer, sending out 3,500 tons per month; enormous bodies of sulphide ore have been cut and A. R. Meyer is erecting a 200-ton concentrator at the entrance of the adit. During the year the production of Leadville has been at the rate of 50,000 tons per month, of which 30,000 tons have gone to the American Smelting & Refining Company, 15,000 tons of zinc ore and concentrate have been sent to Canyon City, Pueblo, Kansas and abroad, while the Salida smelter has secured the remaining 4,000 to 5,000 tons.

The San Juan region has maintained its output except at Telluride, where work has been hindered by labor disturbances. But Telluride continues to be a progressive center; the Gold King has installed four flint-mills for fine grinding and has made a successful trial with the De Laval steam turbine; at the Liberty Bell, slime treatment has been carefully investigated and improved methods have resulted. The Smuggler-Union is said to be yielding a profit, since the adoption of the leasing system. At Ouray, the Camp Bird maintains a gold output of \$130,000 to \$150,000 per month, and has met with success in exploratory work. At Silverton, the Silver Lake suffered by the burning of the middle tramway station, which interrupted production for several months. The Gold

King continues to open up well and the capacity of the mill has been increased. The Ledge mine, of the San Juan company, has become an important producer. At the Mayday, in the La Plata mountains, Mr. A. E. Reynolds has developed a promising prospect, which will contribute to the production of 1905.

In the old districts of Gilpin and Clear Creek there has been healthy activity, stimulated by favorable smelter rates. Northern Gilpin and Boulder have benefited by new railroad facilities. In Gilpin county, the Old Town Mining & Milling Company, the Kansas-Burroughs group and the Running Lode mine have been the mainstays of production. The Old Town Mining & Milling Company declared two dividends during the year. The most conspicuous improvement, however, comes in connection with the working of the old Gregory-Bobtail property for the Boston owners. This mine is now doing remarkably well through the ore discovery that was made by cross-cut from the Cook shaft to the main Mammoth-Fisk-Gregory-Bobtail vein system. If this ore shoot proves extensive it will mean the resuscitation of the whole Bobtail group.

At Breckenridge important discoveries have been made in the Gold Dust, Puzzle and Union mines. There has been an awakening across the range near Alma. The old London property gives promise of being a big mine. In Buckskin gulch the zinc deposits of the lower limestone of the Leadville formation are being exploited with success.

Placer mining is increasing again. The Keystone Company at Telluride has secured handsome returns; the Snowstorm and other placers in the Fairplay and Alma districts have had a good season; at Breckenridge, the American dredge has worked satisfactorily and a new dredge of the double-lift type is being erected on French gulch; on Clear creek two electric dredges of the single-lift type have been installed and commenced operations; the Twin Lakes placers have had a satisfactory season and the general outlook for gravel mining is promising. In this connection it is interesting to note that Mr. Henry Wood is making successful experiments in the separation of platinum and osmiridium from the 'black sand' of gravel deposits; he recently made a five-pound bar of these metals.

Scattered discoveries all over the mountainous parts of Colorado demonstrate the extent of its mineralized area. A large number of finds have been made in isolated spots and the reports from some of these indicate that the exhaustion of older camps is likely to be compensated by the development of new districts.

Of 46 papers briefly reviewed in a recent number of the *Zeitschrift des Vereines Deutscher Ingenieure*, 21 were from American and English publications.

### California.

By CHARLES G. YALE.

Steady progress is being made in most branches of the mining industry, although less than half the total mineral output is now derived from gold mining.

Of the gold yield, about 76 per cent comes from quartz mines, 8 per cent from dredging, 6 per cent from hydraulic operations, the balance from drift and placer mining. In quartz mining there is no apparent extension of the productive area; though a number of old districts, more particularly in the southeast, are being re-opened. In most of these cases the mines were at one time active producers; but high cost of transport, supplies and labor, led to abandonment. These discarded camps are being searched and the old mines prospected, re-timbered and explored. The greatest development has been in established districts; this is especially true of the Mother Lode region. It is now possible, with improved appliances, to handle ore with profit which 25 years ago could not be touched. Capitalists evince a preference for old mines, over those recently found; the older ones have sufficient development to show that, properly equipped and managed, they may be made profitable. The annual yield of gold continues to be between \$17,000,000 and \$18,000,000; but a material increase is likely within the next two years. This will be due to the opening of new mines, to the larger quantity of ore crushed by mills recently erected, and to the success of dredging. It is in dredging that most marked changes are noticeable. The gold obtained from this source has doubled, the total output of the dredges being now equal to the combined yield of both hydraulic and drift mines. The application of these machines is being extended, and their size so materially increased, that it is not difficult to foresee the time when their combined output will equal that of the quartz mines of the State. Dredging operations, at first confined to the river bottom near Oroville, in Butte county, are now being carried on in Yuba, Trinity, Sacramento and Shasta counties; in El Dorado, Amador, Calaveras, Sutter, Plumas and other counties, there is active prospecting of possible dredging land. Large tracts have been placed under bond for this purpose at many distant points. Not only are the river-bottoms and valley-lands suitable for dredging, but even in the more mountainous districts there are numerous small valleys and wide cañons where this method is practicable. All such available land brings good prices. The latest machines have double the capacity of those formerly used; and some of the companies have three to four of them in operation. In addition to those at work, a dozen or more of the largest size are being built. This form of gold mining possesses one special advantage which makes it attractive to investors, namely, the ground may be pretty thor-

oughly prospected in advance of any permanent investment.

While gold continues to be the most important of the mineral products of the State, there are some 44 other substances now being mined or commercially utilized. The relative order of the principal products, in point of value, is now: 1st, gold; 2nd, petroleum; 3rd, copper; 4th, clays and their products; 5th, quicksilver. In 1903, the last year for which complete statistics are available, the petroleum output of the State was 24,340,839 bbl., valued at \$7,313,271. The yield for 1904 should show some increase, but not much, as prices have been low, and consumption has not increased in proportion to the output; in fact, the disposal of stocks at a profit is a pressing question. It is true that railroads and manufacturing enterprises on the Coast are using large quantities for fuel, and many thousand barrels are shipped to other States and abroad for the same purpose; much is also being refined, and the number of refineries in California is on the increase; nevertheless, the output is difficult to market. Kern and Fresno counties in the north, and Los Angeles, Ventura and Orange in the south, are still being exploited for new wells; and the older wells keep up their yield. Owing to low prices, and the difficulty of sale at a fair profit, many of the smaller companies have reduced their production. Several pipe-lines have been constructed, or are being built, to bring the oil of the interior counties to tidewater; this means of transport is expected to relieve the situation in time. Kern county continues to be the largest producer, yielding over 18,000,000 bbl., as against about 6,000,000 bbl. by all the other counties combined.

The most marked feature in the petroleum industry is the rapid development of the Santa Maria and other fields in Santa Barbara county. A number of new wells of large productive capacity have 'come in' during the latter part of 1904; many more are being bored. Heretofore the production of oil in this county has been practically confined to the Summerland district on the ocean beach near Santa Barbara. None of the projects in any of the counties north of Fresno has come to fruition, notwithstanding large sums spent in prospecting. There is a small output from Santa Clara county, but none has yet been made in Santa Cruz, San Benito, Contra Costa, Marin, Colusa, Shasta or Mendocino, where many wells have been sunk without result.

The copper mines are not expected to show an increase in yield. Over 16,000,000 lb., out of the total of 19,000,000 lb., come from Shasta county; the next in rank being Calaveras, with over 2,000,000 lb. to her credit. In the latter county, the old mines at Copperopolis, worked with profit 40 years ago, are being systematically re-opened and equipped on an extensive scale. In Shasta county, the Mountain Copper

and Bully Hill continue to be the principal mines and the largest in the State; but none of the other much-advertised enterprises have, as yet, completed smelters or commenced active production.

The importance of California clays and their products, namely, brick, pottery, sewer-pipe, terra-cotta, etc., is constantly increasing with the building up of cities and towns on a more substantial basis. More granite, sandstone and marble are being quarried than ever before. The product of lime and limestone is increasing rapidly; and there is a steady demand for new quarries near transportation facilities.

average of \$44 to \$45, but quotations are now only \$39 and \$40 per flask of 75 lb. A further drop will close some of the smaller properties, and even larger ones which exploit low-grade ore. If the producers obtained, on an average, the price of the local market, they could do well; but they do not receive it. As is generally understood, the total output is pooled; and when much has to be sold abroad at low prices, this reduces the general average received by the miners, as compared with the price quoted in American papers.

There is a large increase in the output of cement, three large concerns being en-

to 5,000 tons a year; one mine alone, in the San Joaquin valley, produces this, and could quadruple the output should a demand arise. Freights are too high to ship this substance East and compete with the Grecian magnesite coming in by sea. More slate is being quarried than formerly, there being more of a demand for it. The output of natural soda remains about the same. In gem mining, there is increase of interest in tourmaline, turquoise, chryso-prase and kunzite; and closer search is being made for these substances. The mines are confined to San Diego and San Bernardino. Some opals have recently been found in the latter county.

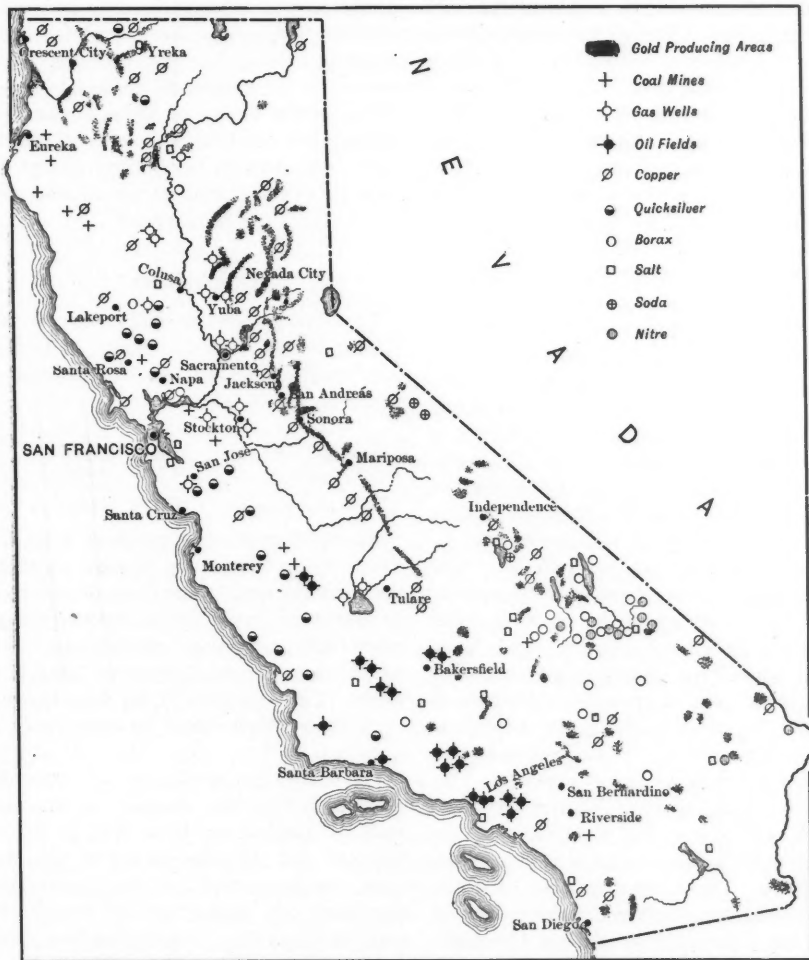
The total value of all mineral substances produced in California has been increasing about \$2,000,000 per annum since 1893; then the sum was \$18,811,261, while in 1903 the aggregate was \$37,759,040. This shows that from 1893 to 1903 inclusive, the total mineral output of the State has been \$307,702,667. This includes gold, silver, copper, quicksilver, oil and all mineral substances mined or quarried.

From these official figures it will be noted that the mining industry of California is in a progressive condition. As this is the oldest of the mining States west of the Missouri river, and one having a record for gold alone of a total output of \$1,395,746,672, it is pleasant to note that after all these years it is not retrograding. On the contrary, as more and more mineral substances are utilized, and larger operations are conducted, the annual output continues to increase. The mineral output for 1904 will have an aggregate value of about \$40,000,000.

**Bismuth.**

In 1904 the United States re-entered the list of producers, reporting 61 short tons of bismuth ore, as compared with 37.5 tons in 1902, and 318.6 tons in 1901. The 1904 output, analyzing from 7.5 to 15 per cent metallic bismuth, with some gold and silver, came from the Big Six and President leases in Leadville, Colorado, and from a new mine, near Banning, in Riverside county, California. A new discovery has been made 40 miles west of Tonopah, Nevada, where the ore occurs as bismuthinite and as oxychloride of bismuth, assaying 4.48 to 4.83 per cent bismuth, 7 to 80 oz. silver, with a trace of gold. A small production is reported annually in Saxony, Germany, Australia and other countries. Bismuth is used mostly in the manufacture of readily fusible alloys and solders. The war in the East has stimulated demand for bismuth subnitrate and similar compounds for medicinal and surgical purposes. The United States imports annually about 200,000 lb. metal, and a small quantity of bismuth salts in pharmaceutical compounds.

The production of platinum in the U. S. is about 100 oz. troy, annually.



CALIFORNIA.

Much larger quantities of macadam and rubble are quarried.

There is no marked change in the production of quicksilver or in the number of mines yielding that metal. A few more enterprises have reached a productive stage, and a number of others are prospecting and equipping themselves. This increase in number of mines, however, is not likely to continue, as there has been an over-production for some time; as a result, prices have been low and unsatisfactory, and continue so. This country will take only so much quicksilver yearly; the surplus must be shipped abroad to be sold in competition with the European product at a much lower price than it brings here. In the home market the metal has brought an

gaged in this manufacture. One of the large quarries is in San Bernardino, one in Napa, and one in Solano county. The asphalt output is also on the increase, large quantities now being made by the oil refineries handling the California petroleum, which has an asphalt base. Some of the oils carry as high as 20 per cent asphalt. The yield of borax is not more than in 1903, no new properties of any size having been opened. The demand for California coal is not as great as formerly, and the two largest mines are briquetting their product with the idea of popularizing this class of fuel, so as to increase the consumption of local coal.

The yield of magnesite has not been enlarged, as the Coast will take only 4,000

### Nevada.

By C. C. BURGER.

The most important developments have been in the Tonopah and Goldfields districts. At Tonopah, the chief event has been the completion of the railroad connecting the mines, through the Carson and Colorado branch with the main line of the Southern Pacific. Apart from the assurance of cheaper supplies, ore can now be shipped which formerly it would not pay to haul. The branch line is 60 miles long and narrow-gauge; the Carson and Colorado railroad, by reason of the greatly increased traffic, has been compelled to broad-gauge its track.

Development of the mines has been held back pending the completion of the railroad. Since then shipments of ore have been lively. The Tonopah Mining Company is prepared for the extraction of ore on a large scale, and is now making a large output. The Tonopah Extension and the Montana-Tonopah companies have made good progress. Exploratory work in the Tonopah-Belmont property, adjoining the Tonopah Mining Company on the east, has disclosed good ore. This company also has been shipping since the advent of the railroad.

The early days of Tonopah were beset with difficulties. The camp was in an isolated situation, without water, fuel or transportation, and much of the ore was unsuited to ordinary milling. The transport problem has been solved, likewise the question of water, which is obtainable in the town and by the mines from an organized water company. Experimental wells, 14 miles from town, in the valley traversed by the railroad, have demonstrated the existence of a sufficient quantity of water for milling purposes on a large scale. The ore output is treated by the smelting companies at fair rates, and, when the broad-gauging of the Carson and Colorado railroad is completed, there remains but one thing to facilitate the turning into money of the ore-reserves in the mines, and that is the erection and satisfactory operation of a local milling plant of a size commensurate with the amount of low-grade ore available. This should be the chief event of 1905. The Midway Company's 10-stamp mill has been helpful, but this plant is merely a forerunner of custom work on a large scale.

The most important developments in Nevada have been at Goldfields. This new district is about 23 miles southeast of Tonopah, and was discovered in the late spring of 1903; it was first named Grandpa. During 1904 exploratory work has been highly successful. The formation is rhyolitic in character; the orebodies occur in cracks in this rhyolite and are exceedingly irregular. The irregularity is particularly noticeable in the outcrops, which may have any shape, sometimes lenticular and intermittent, and again nearly circular. Mining exploration is yet too limited to afford a comprehensive idea of the structural

conditions underground. The most striking feature of the district is the exceeding richness of the ore, practically all in gold. Several of the mines have now reached water-level, and it is said that the unoxidized ore encountered there is also high in value.

Among the principal mines is the Jumbo Mining Company, recently involved in litigation over the division of ownership. A receiver was applied for and obtained, but the receivership has been vacated and the lessees are again at work. The property has three shafts upon it, the deepest of which is 250 ft. Water has been encountered, and it is said that the sulphide ore is high grade. The width of the vein is given as six feet, a considerable portion of it being shipping ore. The production of this property during 1904 is given at about \$1,500,000. Another prominent enterprise is the Combination Mining Company. The mine is opened up to a depth of 320 ft., and the shaft is about 50 ft. below water-level. The unoxidized ore is said to be of good grade. The total production is estimated at \$400,000. It is a noteworthy fact that very little waste has been extracted in the course of development work, most of the ore on the surface showing gold by panning. This company is erecting a 10-stamp mill, which is expected to be in operation shortly. The Goldfields Mining Company, owning the celebrated January claim, is also prominent. This mine is opened up to a depth of 280 ft., and is just reaching water-level. The total production is estimated at \$1,000,000. The lease under which the mine has been worked expires on January 5. This mine also is notable for its high-grade ore. The Sandstorm mine is opened to a depth of only 80 ft., but the ore is the richest in the district. The lessees have shipped ore running as high as \$5,000 per ton. The property of the Kendall Mining Company is also looking well, and the lessees of this property have also shipped some high-grade ore. There are a number of other prospects undergoing development; among these the Diamondfield Mining Company owns a prospect three miles from Goldfields, which contains some high-grade ore and a considerable width of milling ore. It is opened up to a depth of 100 feet.

A number of small lots of rich ore have been shipped, and it is said that the production of the camp has averaged about \$200 per ton. A branch line from the Tonopah railroad is under discussion, and it will doubtless become an accomplished fact during 1905.

The advance of this district in a period of less than a year is, in some respects, the most noteworthy feature of mining in the United States during 1904. A town has been built up, and it has now a population of from 5,000 to 6,000 people, where a little more than a year ago there was nothing but the desert.

Attention has been attracted to another

district, known as Bullfrog, about 70 miles from Tonopah. The Bullfrog Mining Company is at present prosecuting surface work on a vein which is said to outcrop distinctly for a long distance. In the extreme south of the State, in Lincoln county, the Searchlight district has continued to be prominent. The Quartette mine is the principal property, and developments are said to be favorable. Other properties are also undergoing development in the same vicinity, and, in general, it seems to be a district worthy of attention. The construction of the San Pedro, Salt Lake & Los Angeles railroad is stimulating exploration in southern Nevada, and vigorous prospecting may be looked for in the country adjacent to this railroad. With regard to the Comstock, there has been a flurry in the stocks of some of the companies, but conditions in general remain about the same as heretofore, though the treating of the dumps by the cyanide process is assuming prominence.

### Quicksilver.

The production of quicksilver in the United States, with the month of December, 1904, estimated, was as follows, in flasks of 76.5 lb. each:

	1903.	1904.	Changes.
California.....	32,094	37,295	I 156
Texas.....	5,029	5,336	I 583
Total.....	37,123	43,631	I 739

No production was reported from the Black Butte district in Oregon. Almost the entire increase came from the mines in Brewster county, in Texas, where development still continues encouraging, and where several new discoveries have been made. This is evidently the growing district, from which future increases may be expected.

The California producers last year decided to reduce the standard content of a flask of quicksilver from 76.5 to 75 lb. We are not informed whether this has been strictly carried out, but understand that there has been a general compliance with the new rule. Texas producers, however, still report their output in flasks of 76.5 lb.

Exports of quicksilver for the eleven months ending November 30 were 1,280,298 lb. in 1903, and 1,479,298 lb. in 1904; an increase of 199,000 lb., or 15.5 per cent.

The books used to tell us that when an acid and a base neutralize each other, a salt is formed, and water is the side product. The great advance in recent physical chemistry may be summed up in the reversed statement, that, when an acid and a base unite with each other, water is formed, and the respective salt is the side product. The proof is various; but mainly, the hydroxyl of the base and the acidiphaneous hydrogen of the acid unite to form water, with an approximately constant heat evolution.

**South Dakota.**

By **JESSE SIMMONS.**

That southwesterly portion of the great agricultural and stock-raising State of South Dakota known as the Black Hills is a mountainous region only 40 miles broad by 80 miles long; nevertheless the vigorous manner in which the mines are exploited enables South Dakota to rank third among the gold-producing States of the Union.

The annual production of the Black Hills has been growing rapidly; and, judging from the rate at which new capital is seeking investment in the mines, this increase is likely to be maintained. Moreover, the enlargement of operating plants and the improvement in metallurgical processes are helping the older mines.

The gold output for the past year is estimated as follows:

Black Eagle.....	\$6,500
Clinton and Portland.....	3,937
Clover Leaf.....	166,200
Cochran.....	3,500
Columbus Consolidated.....	36,000
Dakota.....	90,955
Extreme.....	2,500
Golden Crest.....	33,815
Golden Reward.....	414,190
Hidden Fortune.....	136,000
Homestake.....	4,950,558
Horseshoe.....	412,837
Imperial.....	239,800
Lundberg, Dorr & Wilson.....	142,000
A. Maitland.....	315,078
Monarch.....	2,208
National Smelter.....	45,056
Spearfish.....	236,000
Wasp No. 2.....	111,000
Placer.....	10,000
<b>Total.....</b>	<b>\$7,258,134</b>

For some of these figures I am indebted to the State Mine Inspector's report. The table reveals the preponderating importance of the Homestake output. There are in course of construction the following plants, the figures representing their estimated capacity per diem: Branch Mint, 900; Globe, 100; Eleventh Hour, 150; Victoria, 200; Queen of the Hills, 100; Puritan, 100; Ruby, 40; Lucky Strike, 250; Golden West, 150. During the year the following mills were put in commission: Hidden Fortune, 120; Homestake (increase), 400; Lundberg, Dorr & Wilson, 100; Gilt Edge-Maid, 150; Black Eagle, 60; Horseshoe, 400 tons per day. Aside from the producing companies, at least a quarter of a million dollars has been spent in development and equipment of prospects. Among the prominent companies which have installed machinery for development purposes are: Elliptic, Dizzy, Goldstake, Lucky Strike, Puritan, Big Four, Hidden Treasure, Dakota, Horseshoe, Black Eagle, Grand, Deadwood Standard, Queen of the Hills, Gopher, Mainstay, Ivanhoe.

Results generally have been gratifying from the standpoint of both the investor and the metallurgist. Horseshoe and Hidden Fortune, two companies that a year ago were in serious financial difficulty, are to-day operating their mills steadily and successfully. It is only recently that the Hidden Fortune has been getting a good extraction; prior to that time much of

the work was in the nature of experiment. The indebtedness of the Columbus Consolidated has been paid off, and the officials are now endeavoring to secure funds for the construction of a large mill, such as is warranted by the mine development. Spearfish has been aggressive. Early in the year a large air-compressor was installed, and mining costs have been reduced. Dividends have been paid regularly to the amount of \$90,000. Homestake added 100 stamps to the equipment, increased cyanide plant No. 1 to handle the additional tonnage, improved the No. 2 cyanide plant materially, reached the 1,250-ft. level in the Ellison, beside recording the largest production in its history. Dividends amounted to \$814,000. All things considered, the Black Hills district has been most prosperous. Conditions generally have been favorable to the investment of money in the mines, and the result has been the promise of many new mills for this year. The annual production is growing to handsome proportions, and, with the immense bodies of ore which the various companies have in sight, a maintenance of profits is assured.

**Spodumene.**

According to Mr. Geo. F. Kunz, in his monograph on precious stones, prepared for the Geological Survey, there have been recently some important new discoveries of this mineral. It is a silicate of alumina and lithia, rather complex in constitution and peculiarly liable to alteration. It is found in small quantities in New England, South Dakota and California, in the United States; also in Peru and Brazil, in South America; in Sweden, Ireland, Scotland and the Tyrol, in Europe. The discovery recently of transparent lilac spodumene in California adds a new and elegant stone of purely American production to those used in jewelry. It has also scientific interest from some remarkable properties which it possesses in connection with the action of the Roentgen rays, and those of radium and radio-active substances. The first of the large and beautiful crystals found was obtained in 1903, in the immediate neighborhood of a deposit of colored tourmaline, which is itself of notable interest. The claim is known as the Pala Chief, and is 1.5 miles northeast of the town of Pala, in San Diego county, in California. It is, moreover, only a half mile northeast of the well-known rubellite and lepidolite mines near Pala, where recent developments have also brought to light great quantities of amblygonite. It may, therefore, be said that the locality is unequalled in the world for its abundance of lithium minerals. Crystals of spodumene have been found there weighing from 7.7 to 31 oz., and varying in dimensions from 13 by 6 by 2.52 cm. to 23 by 4 by 2 cm. These are the largest and finest crystals of this mineral that have ever been obtained.

**Montana.**

By **B. E. ST. CHARLES.**

The mining companies and individuals owning mines in Montana have had a prosperous year. Omitting the Gagnon, Pennsylvania and Parrot, all the large properties in the Butte district were operated continuously, the gold-and-silver mines on a small scale, and the copper-silver extensively. The Gagnon was closed three months, the Pennsylvania five weeks, and the Parrot three weeks, to permit of needed repairs in the shafts. Some changes in the ownership of property took place; the Amalgamated company bought the Taylor & Brunton sampling works at Butte, and the Indian Queen group of mines and smelter, in Beaverhead county; the Speculator bought the Jesse from the Lewisohn estate for \$300,000; the Butte Copper & Zinc Company acquired the Emma mine; the Montana Zinc Company secured a five-year lease on the 60-stamp mill of the Alice company for \$50,000, and the United Copper, or Heinze interest, took an 18 months' lease-and-bond on a portion of the Lexington. Several new companies were organized, among them the Montana Zinc, Butte Zinc & Copper, Raven, and Ada. The Amalgamated closed its Colorado smelter, but operated the Washoe, Butte & Boston, and Great Falls plants continuously.

**Copper.**—Omitting the product of the mines worked by lessees and small companies, which aggregated 250 tons per day, the total quantity of ore shipped by the Amalgamated, United Copper, Speculator, and Clark mines aggregated 4,106,650 tons, of which the Amalgamated is credited with 3,217,400; United Copper, 438,000; Clark, 360,000; and the Speculator, 91,000; Amalgamated, which comprises the Anaconda, Boston & Montana, Butte & Boston, Parrot, Colorado, and Washoe, used 53,000,000 ft. of lumber, exclusive of round timbers and lagging poles. The shaft of the Anaconda was sunk 200 ft., making it 2,400; the Parrot, 100 ft., giving it a depth of 1,700 ft.; and the Never Sweat 200, making it 2,200 ft. The Mountain View is being equipped with a hoisting engine to work to 3,000 ft. The orebodies in the lower workings of all the Amalgamated mines are opening up well and promise an enormous yield during 1905. The company is employing 6,870 men in Silver Bow county and paying them \$1,000,000 per month in wages.

The United Copper, comprising the Montana Ore Purchasing, Johnstown, Cora-Rock Island, Hypocka, and Basin Reduction companies, made average monthly shipments of 30,000 to 35,000 tons. By assignment from Adolph Victor, of New York, this company secured a lease-and-bond on part of the Lexington property; but the workings will have to be unwatered below the 550-ft. level before work can begin. The shaft on the Lexington is 1,465 ft. deep; and the openings below the

550-ft. level are enormous. The Lexington company has been mining its copper vein and will continue to do so during the life of the bond; it is now extracting 50 tons of ore per day.

W. A. Clark mined and treated 30,000 tons per month, producing 21,000,000 lb. copper. He has employed 1,000 men, to whom he paid \$100,000 per month. At the smelter, the blister-copper furnace was closed several months ago; but three converters will take its place in the spring. The larger part of the ore came from the Original, and West Steward mines. The vein of the former is 27 ft. wide at 1,800 ft.—the deepest workings.

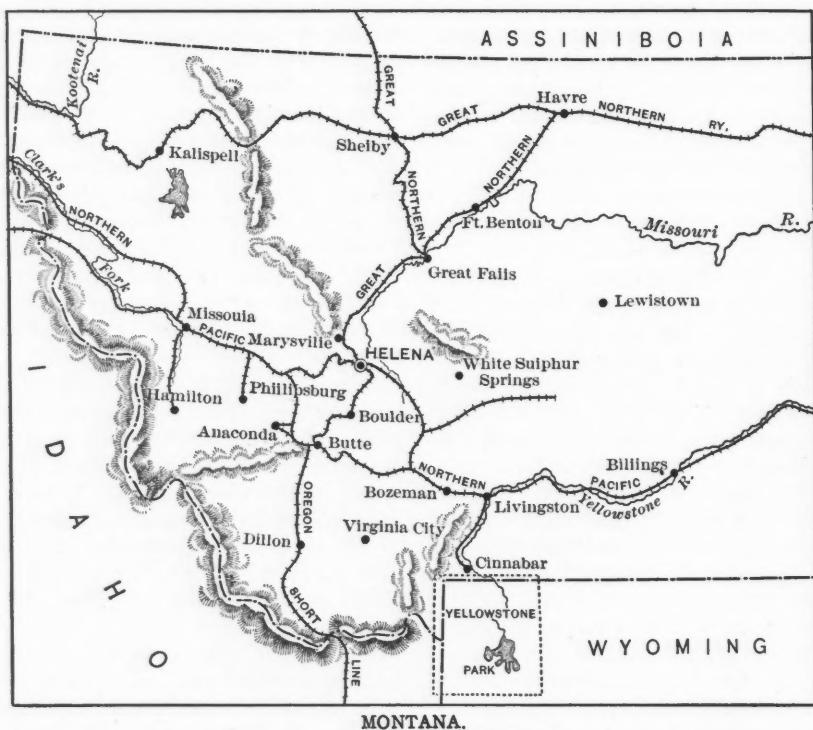
The shaft of the Reins Copper Company was sunk 400 ft. and opened up an 8-ft. body of copper-silver ore at the 800-ft.

extracted. The Amalgamated now owns this property and intends to develop the mining claims on an extensive scale; but the smelter will not be utilized, as it has a capacity of only 30 tons per day. The Cataract Copper Company, owning property on Jack creek, Jefferson county, completed its smelter, but did not operate more than two months on account of the expense attached to securing supplies from the railroad, eight miles distant.

**Gold.**—The mines of Fergus county have done well. The Barnes-King, at Kendall, mined and treated 6,500 tons of ore per month, did a lot of development work, and installed a 75-h. p. motor with which to operate the mill. An adit was started to traverse the entire length of the property, a mile; and two shafts are

down 27 years, was placed in commission last spring, with F. L. Sizer in charge. A two-compartment shaft has been sunk 400 ft. At the Big Indian, four miles south of Helena, 300 tons of ore per day were treated in the 60-stamp mill, run by electricity. Cleveland men have taken hold of the Messenger or Columbia group of 21 claims near York, 20 miles north of Helena; they have commenced development at the point at which work was stopped several years. A few months ago Allen C. Mason began developing the Park and New Era group in Broadwater county. He is now building a concentrator having a capacity of 100 tons per day. The Inter Ocean Company has driven an adit 1,500 ft. into Red mountain near Rimini, cutting several veins. The Blackhawk Company has built a 10-stamp mill on its property near Norris. The company made several shipments of ore the latter part of the year, the last averaging \$29.25 per ton. The plant of the American Smelting & Refining Company at East Helena received 2,000 tons of ore per month from Butte. Other supplies came from Madison, Jefferson, Broadwater, Lewis and Clarke, and Cascade counties, Montana; and from the Coeur d'Alene district of Idaho. The company spent \$10,000 in improvements, and opened up its own limestone quarry near the smelter. R. A. Bell resumed work on the East Pacific mine in Broadwater county last July; this mine had been closed two years. Shipments from the Southern Cross mines, 17 miles west of Anaconda, during the last six months aggregated 60 tons per day, the average value of which was \$25 per ton. The company has recently erected a 60-ton concentrator. In Madison county, the Leviathan Company mined and treated 5,000 tons of \$10 ore during the last eight months. The Montana-Revenue Company started its new 60-ton mill in October. The Green-Campbell Company sunk the main shaft 250 ft., and opened up the vein sufficiently to warrant the erection of a mill. The Bismarck-Nugget Gulch Company, near Sheridan, deepened the workings 250 ft., making them 700, and opened up a vein of gold-silver-lead ore. It has been crushing 100 tons of ore per day since July. The Watseka Company, near Rochester, mined and milled an average of 125 tons of ore per day and sunk the main shaft 150 ft., finding ore at the lower levels. The Conrey Placer worked two dredges continuously at the mouth of Alder gulch, and has commenced the building of another boat.

**Silver.**—The Granite Mountain-Bimetallic kept one-half its 100 stamps supplied, crushing about 100 tons per day. The Alice, under tribute, produced an average of 30 tons per day, and the Goldsmith yielded 50 tons per day. At the Liverpool, in Jefferson county, an average production of 10 tons of high-grade ore per day was maintained from development work.



level. This property is likely to be a heavy producer in 1905. The Speculator maintained an average output of 250 tons of ore per day with 250 men. The shaft was deepened 200 ft., making the total 1,600 ft.; the Jesse vein was cut by a crosscut at the bottom. The product was sold to the Amalgamated. The Raven company, organized a few months ago, has struck a new shoot of copper-silver ore in the 700-ft. east level. Shipments for the year averaged 60 tons per week.

The Pittsburg & Montana Company has pushed development work; 300 ft. was added to shaft No. 3, making it 1,200, and a crosscut 2,150 ft. long connected shafts 2 and 3. The smelter was given a test run of two weeks and many surface improvements were made. The company expects to commence making copper April 1. The smelter will have a capacity of 400 tons of raw ore per day.

The Indian Queen Company shipped matte from which 576,000 lb. copper was

being sunk to ventilate. A depth of over 700 ft., on the dip of the lode, has been attained. At the Kendall mine, owned by the company of that name, 9,000 tons per month were mined and treated. The orebody has been prospected to a depth of more than 1,000 ft. with a diamond drill. The Whisky Gulch mine, near Gild Edge, yielded 3,000 tons of ore per month, and the Gold Reef, 4,000. The McGinnis mine, near Maiden, was bonded a few months ago; and some promising orebodies have been opened. In the Little Rocky district of Choteau county, the Barnes-King Company extracted 3,000 tons per month from the Alder Gulch mine. An adit has been started to tap the orebody below the old workings, 250 ft. deep. Two other companies were organized to operate in this district; they are now building mills, each of which will have a capacity of 3,000 tons per month.

The Whitlatch Union mine, in Lewis and Clarke county, after being closed



## Utah.

By L. H. BEASON.

Dividends are not up to the record of 1903, but the production of ore and bullion has been increased. The output of the metal mines will aggregate at least \$30,000,000. Dividends amount to \$4,273,500, the principal contributors being Silver King, with \$1,300,000; Daly-West, with \$1,044,000, and Utah Consolidated, with \$900,000. Four mines paid their first dividend; these were the United States, Victoria, Tetro and Salvator, all situated in Tintic district save the Salvator, the output of which is to be credited to both Bingham and Tintic. The Ontario, Consolidated Mercur and Butler-Liberal, which paid in 1903, did not respond, while the Daly-West, Sacramento, Century, Utah and Annie Laurie made reductions. The Mammoth, at Tintic, after an interval of over a year, resumed payments. The year 1905 opens with bright prospects for bigger dividends, the constructive period having ended at some of the largest copper mines; among these are Bingham Consolidated, Columbus Consolidated, and Bingham-New Haven.

Progress has been marked everywhere, but the best results are apparent in the copper districts of Bingham and Alta and in Beaver county. Bingham produced close to one million tons of ore. The Utah Consolidated, which owns the original Highland Boy mine, leads in output and in dividends. Up to July this company sent to its smelter, near Murray, about 500 tons per day; but since that date, owing to an enlargement of the smelter, the output has been 700 tons per day. The year's output is about 15,000,000 lb. copper bullion; but, with additional facilities, the production is now 50,000 lb. daily. At the mine the policy has been to keep development far in advance of extraction. The United States Mining Company has turned out between 11,000,000 and 12,000,000 lb. copper from the smelting of its own and custom ores. Difficulties in operating the smelter at Bingham Junction have been overcome, and the plans, outlined some time ago, to enter the lead smelting business in competition with the American Smelting & Refining Company, are about to be carried into execution. A lead smelter of 400-ton capacity has been completed. Developments in the mines owned by the company have been most satisfactory. Heavy shipments have been made from the Centennial-Eureka mine, the control of which is in the hands of this company. The main shaft is being sunk to open up the orebodies under the present lowest workings. An equally energetic campaign is being pushed in the Bingham properties. A case involving title to the Kempton lode was decided in favor of the company by the United States Court of Appeals in November. If sustained by the United States Supreme Court, possession to valuable territory will be obtained. The

Mammoth mine, in Shasta county, California, was purchased; it is to be provided with a smelter. The Yampa mine, situated in Upper Carr Fork of Bingham, near the Highland Boy, has been vigorously developed, with results so satisfactory as to warrant the manager, Mr. Walter S. Kelley, in enlarging the smelter at lower Bingham. This is the only smelting plant operated in the Bingham district. As originally planned, the plant was to consist of one roaster and one blast furnace; but it was found that the ore was not suited to blast-furnace treatment, by reason of the fine. Therefore, the plant was completely overhauled, and at great expense new equipment has been installed. This consists of a second blast furnace, a reverberatory, also a roasting furnace of large capacity. When the new equipment is ready (in February), the capacity will be 600 tons of ore per diem.

The Utah Copper Company has achieved success with the low-grade ore of the Bingham 'porphyry' belt. In April a new 400-ton concentrating mill, erected at a cost of \$200,000, was placed in commission. It has proved so successful that additional equipment was provided, increasing the capacity to 700 tons per day; the enlarged plant was started in October. Concentration is in the ratio of 22 to 1, making a 33 to 35 per cent copper product, beside \$5 in gold and a little silver. Another mill is to be built, with four units of 600 tons each, so that the company will be able to treat 3,000 tons of ore daily. The Utah copper mine is now the largest in the State. New workings aggregate 22,000 ft. The surface is being stripped over a large area, preparatory to quarrying ore on an extensive scale. The output for 1904 was 126,000 tons of ore.

The Bingham Consolidated increased its output of copper by 3,000,000 lb., making 11,500,000 lb. A new furnace has been added to the smelter. By an arrangement with the American Smelting & Refining Company, a part of its copper ore is secured; the smelter trust, in return, receives the Bingham's lead-silver ore. The Dalton & Lark mine, owned by this company, has made a fine showing. On the 1,150-ft. level an orebody has been cut, averaging 7 per cent copper and 60 oz. silver; at present the output is 200 tons per day. Another property, the Eagle & Blue Bell mine, in the Tintic district, supplies the smelter with 75 tons of ore daily, while the Commercial mine, at Bingham, contributes 200 tons. From the company's own properties the smelter is supplied with 15,000 tons monthly, beside 5,000 tons of custom ore.

Adjoining the Utah Copper is the Ohio Copper Company, which purchased the holdings of the Columbia Copper Mining Company, at Bingham. Developments have demonstrated that this property will soon become one of Bingham's most important producers. The company leased

the old Winnemuck mill, remodeled it, and now treats 120 tons of ore per day. In November the Winnemuck mill and mine were purchased by the Ohio company; additional equipment has been added, so that an output of 200 tons per day can be handled. The erection of an entirely new plant is contemplated, with a capacity of 500 tons. The Ohio properties are capable of furnishing a big tonnage, the ore averaging 5 per cent copper. This company also owns a large area of the copper-bearing porphyry which is being worked so successfully by the Utah Copper Company.

The Boston Consolidated sent 40,000 tons to the Bingham Consolidated smelter. This company also owns a large slice of the porphyry belt, and a concentrating mill is under consideration. The output from the Boston will be greatly increased during 1905. It has been estimated that there are over two million tons of ore available, carrying from 3 to 6 per cent copper, \$3.50 in gold, and some silver. The Bingham-New Haven is a new enterprise. The Utah-Apex is conducting an extensive campaign of development. An adit 3,000 ft. long will tap the orebodies at a depth of 1,000 ft. The New England Gold & Copper Company has operated a 50-ton concentrator with success, and the development of the mine justifies further enlargement, which is contemplated.

In Beaver county, the Newhouse Mines & Smelters Corporation has expended \$2,000,000 on the Cactus mine. The first 800-ton unit of a concentrating mill is nearing completion. An extension (7½ miles long) of the San Pedro, Los Angeles & Salt Lake railroad from Frisco was completed in September. A model town has been built; it is supplied with water through a large pipe-line from Wah Wah springs, 9 miles distant. An adit 5,980 ft. long is nearly finished; this will connect with the 600-ft. level of the mine and will serve as the exit for all ore going to the mill. The Cactus milling ore carries from 3 to 6 per cent copper, the concentration being about six into one. The Majestic Copper Mining & Smelting Company has survived its financial troubles and is pushing exploration with satisfactory result. A concentrator for the output of the O. K. mine is also likely to be built shortly. The Frisco Contact Mining Company, which acquired ground covering an extension of the Horn Silver mine, intends to instal powerful hoisting machinery. A plant costing about \$250,000 is being built at the Horn Silver mine for the treatment of zinc ore.

At Mercur conditions have improved. The Consolidated Mercur, while not treating more than half the tonnage that it did formerly, has overcome metallurgical difficulties and is making money; not enough, however, for a dividend. The Sacramento just about paid expenses with the gold obtained from its cyanide mill;

about \$45,000 more, was realized from the sale of the quicksilver which the mine now produces.

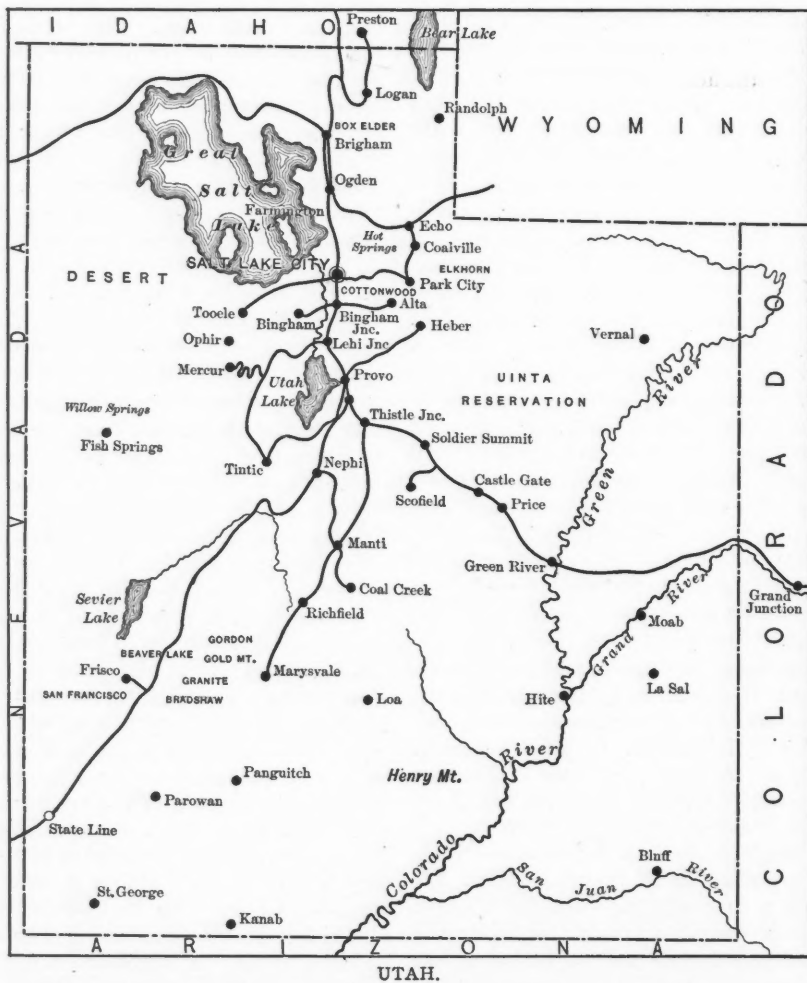
Several important developments are reported from the Alta district. The Columbus Consolidated mines were equipped with electric power and a concentrating mill of 150-ton capacity was erected. Extensive bodies of copper-bearing millstuff are developed, besides a quantity of high-grade shipping ore. The Continental-Alta mines are being equipped with a 100-ton mill, now nearly completed, and a five-mile aerial tramway is in course of erection. Other properties likely to market ore in 1905 are the Albion, South Columbus and Alta-Quincy. An effort is being made to revive the old Flagstaff mine.

reka, Silver City, Monmoth and Robinson, has had a prosperous year, with increased output. Over 250,000 tons have been marketed from this camp. The heaviest shippers were the Centennial-Eureka, Gemini, Grand Central and Mammoth, the first furnishing about one-third of the total; the product went to the United States smelter, at Bingham Junction. Other heavy shippers were the Yankee Consolidated, Eagle & Blue Bell and Uncle Sam Consolidated. The last is operating a mill on low-grade ore and paying a \$5,000 dividend monthly. Important discoveries were made in the Victoria, May Day, Uncle Sam, Centennial-Eureka and Tetro. Victoria and Tetro paid their first dividend.

The Daly-Judge Mining Company explored its virgin ground with flattering results. The Ontario is operating a new concentrating mill at a small profit, but the cost of mining is excessive. The hoisting works were burned down during the summer; they were replaced in a little over a month. The West Quincy is to be developed by means of a cross-cut from the main shaft of the Little Bell. Encouraging developments have been made in the New York Bonanza, Comstock, California, Scottish Chief and Wabash.

The camp of Stateline, in the western part of Iron county, has been practically abandoned, owing to the closing of the Johnny gold mine. Except for annual assessment work, nothing has been done there for several months.

At Ophir, the Ophir-Hill Mining Company, owned by W. A. Clark, of Montana, has been carrying on a vigorous exploration, but the mill has been running on old tailing. The Buckhorn mine has been opened again by the Western Exploration Company, of Salt Lake, and will market a large tonnage in 1905.



**Idaho.**

We are indebted to Mr. Robert N. Bell, State Inspector of Mines, for an estimate of the metal production of Idaho for 1904. An unexpected and unusually dry season during the last half of the year cut the output down, especially in the Coeur d'Alene. Notwithstanding this, the production shows a very encouraging increase. The gold reported is 84,462 fine oz., or \$1,745,830; showing an increase over the previous year of 8,493 fine oz., or \$175,430. Silver production also shows a notable gain, the total reported being 8,284,639 fine oz., and showing an increase of 1,777,239 oz. The output of lead was 226,261,728 lb., which is a gain of 5,403,728 lb. This is comparatively small, for the reason mentioned above. The copper output more than doubled, being 5,422,007 lb., or 2,898,007 lb. in excess of that reported for the preceding year:

**Nickel.**

The production, or rather refining, of nickel in the United States, continued to be almost entirely from foreign ore and matte. The matte is brought here from the Sudbury district in Canada and some ore comes from New Caledonia. The only ore mined in this country is a small quantity in the Mine la Motte in Missouri.

Exports of nickel, nickel oxide and nickel matte—which are all classed together in the returns—from the United States, for the 11 months ending November 30, were 1,963,898 lb. in 1903, and 7,061,405 lb. in 1904; an increase of 5,097,507 lb., or 259.6 per cent. Imports of nickel ore and matte for the same period were 6,116 tons in 1903 and 7,441 tons, 1904.

In Park Valley, the Century and Iowa mining companies have pushed development.

In the Gold Mountain district, the Annie Laurie Mining Company has completed the No. 5 tunnel, the lode being cut at 3,000 ft., and at a depth of 426 ft. below the old workings. The lode is 23 ft. wide, and better than at the shallow levels. This adit will be equipped with electric haulage. The capacity of the mill has been increased. The Sevier Consolidated Company owns the second largest mine in the district; a mill has been erected.

Tintic district, which comprises Eu-

At Park City the output of ore has been about 150,000 tons, Daly-West leading, with Silver King a close second. In dividends, the Silver King is first in the State, with the 'Christmas extra' of \$100,000, the total reached \$1,300,000. The Daly-West cut its dividend from \$108,000 to \$72,000 per month; the company is preparing to explore deeper, and to this end arrangements were concluded a few months ago with the Ontario Silver Mining Company for an extension of the Ontario adit. This work is now going forward, and when completed will give the Daly-West several hundred feet of additional 'backs.'

### The Klondike.

By J. P. HUTCHINS.

The gold production of the Klondike district was between \$9,000,000 and \$10,000,000, or a million less than that of 1903, although this last season has been exceptionally favorable. It was possible to begin sluicing the winter dumps of the material mined during the winter of 1903-1904, and ready to be washed with the water from the melting snow, about two weeks earlier than usual. Another favorable condition was slow melting of snow. There was no loss, as sometimes occurs, when rapidly melting snow causes high water in the creeks, and washes away material dumped in the creek bottoms. This slow melting of a more than normal snowfall rendered unnecessary the overloading of sluices, which occurs in seasons when there is a lack of water for a time sufficient to wash all the dumps.

A deal of stripping of muck and other overburden from creek, hillside and bench claims was possible, by ground-sluicing with this large amount of spring water, and a large volume of material was prepared for working during the later months. There was a heavy rainfall in spring and summer, with unusually cool weather. The creeks at their lowest contained from four to five times as much as the minimum flow of the previous year. A cold fall caused a cessation of operation slightly earlier than usual. With this exception the season was remarkably favorable.

The development of valuable claims in the Tanana district induced some operators and laborers to leave the Klondike for the new diggings. In some instances this resulted in claims remaining unworked; however, the output was not seriously affected. One cause for the smaller production was the fact that on account of success with the hydraulic method, a number of claims which ordinarily would have been 'drifted' were reserved for 'hydraulic' whenever a supply of water should be available.

There were no important discoveries of rich placer ground, nor was any unusually rich ground worked, as during the previous year, when five 'laymen' (or 'tributers'), by winter drifting on Bonanza creek, cleaned up over \$200,000, an average of about \$1 per pan. Several deposits of pay-gravel have been developed under material which has slid into the creek bottom off the adjacent hillside. It is probable that there will be other developments of this sort; but it is not likely that any extensive deposits will be found, nor will such discoveries be numerous. A 'second bed-rock' was suspected at a considerable depth. The finding of much shattered bed-rock, with large slabs not in place, led to this belief, which is not warranted.

Some work has been done on several veins, with hope of developing gold-bearing quartz. There has also been a dis-

position to hunt for 'the mother lode,' as has been done before in other regions. The fact that the placer gold has been concentrated from an enormous volume of presumably low-grade material is not sufficiently recognized. There are no paying quartz mines in the Klondike district.

During the past year more than ever before the value of the so-called 'worked out' ground has been demonstrated. These claims were worked in the early days, five and six years ago, and such mining was carelessly done; but recent operations in many cases have shown them to possess value. Secondary terraces, or benches, on the rim of the 'white channel' have not been found, though this deposit has been thoroughly drifted. There is the possibility of such 'peneplains' with valuable content. The 'white channel' is what is left of the ancient creek-bed; it has a course approximately parallel to and at an elevation of 150 ft. to 300 ft. above the present creek. Where it has not been eroded it usually appears as a bench deposit with one rim completely removed.

It has been demonstrated that the Klondike district is one of unusual concentration; that is, there is a very slight dissemination of gold in the upper gravel. A heavy rainfall permitted hydraulic and ground sluicing. Most of this work was done on deposits which had been quite thoroughly drifted, and the result was poor. It has been well shown during the past year that there is much lateral concentration; pay-streaks are, in general, narrow and irregular.

Mining methods have not been greatly modified. Hydraulic was more general during the past year. Much ground, such as has been drifted, has been reserved for exploitation by the hydraulic method, and installations of machinery have been made. Water grants (some of them, unfortunately, conflicting) have been issued, and numerous ditches have been excavated.

The topography of the Klondike is such that it is not possible to bring in sufficient water throughout the summer season without building long ditches over unfavorable ground, with long flumes and inverted siphons. Water is now obtained from watersheds of limited area. Many of the larger gulches have a minimum flow of less than one cubic foot per second, with a maximum flow, for a short period during the spring thaw and after heavy rains, of about 20 cu. ft. per second. These gulches have been denuded of timber, and there is a little undergrowth to conserve water. The wet season, at best, is short and unreliable, and hydraulic mining will be on a small scale until long and expensive ditches shall be built. Not more than 1,000,000 cu. yd. were washed by the hydraulic process during the year. Attempts have been made to conserve water from the melting snow, but there are no good reservoir sites. During the summer

the highest dam yet constructed in the Klondike was built. It was made of earth and rock and is 40 ft. high, forming a pond estimated to contain 26,000,000 gallons. Another will be 70 ft. high, and will hold 160,000,000 gal. These figures will indicate how unfavorable are the best reservoir sites available. Hydraulic with pumped water has been conducted on a larger scale than before. A pump weighing 114 tons, and throwing about 5 cu. ft. per sec. to an elevation of 350 ft., was in operation. Water lifted by this pump had already been used many times for sluicing, and carried 1.75 oz. solid matter, largely quartz, per gallon. This method is too expensive to be profitable. A high duty, more than 5 cu. yd. per miner's inch per 24 hours, was attained in several cases. It was possible to use a grade of eight per cent, and the gravel washed rapidly when thawed. The comparative absence of large boulders, without excess of fine sand, contributed to this result. Large thawing surfaces are essential; a face covering 50,000 sq. ft. should be allowed, on the shady side of hills, for 200 to 250 miner's inches; much less will suffice on a sunny slope.

About 15 miles of ditch, carrying 750 miner's inches, and many more systems with a capacity ranging from 50 to 200 inches, have been built. Construction costs have been high and not much water is available. These conditions will make the cost of hydraulic (including amortization, etc.) high, namely, about \$0.20 per cubic yard.

In mining the creek-beds there is little new to note. Winter drifting is still largely done by 'laymen,' on 'lays' varying from 50 to 80 per cent of the output. The larger number of these men are miners who work for wages during the summer, and take 'lays' during the winter, for want of something better to do. There is little summer drifting done in the creek-beds, except where the depth of overburden renders the open-cut method unsuitable. No drifting is done on the benches, except where hydraulic is impossible.

Most of the creek-bottoms are worked by open-cutting. The overburden is stripped, either by ground-sluicing, steam or horse scraping, or by steam-shoveling; though some hand-shoveling is still done. The more common method is by steam scraping; larger scrapers, with much more powerful engines, were used during the past year. For getting the pay-gravel and the bed-rock to the sluices numerous different arrangements were used. Shoveling to platforms, then to sluices; shoveling to wheelbarrows, wheeling to bucket, raising on inclined cableway to sluices; shoveling into cars, hauling on inclined track to sluices; steam-shoveling into cars, hauling on inclined track to sluices; steam-shoveling direct into sluices, were some of the various methods employed. Shoveling into wheelbarrows, wheeling to bucket

and hoisting on inclined cableway was the most generally practiced method of getting 'pay-dirt' to the sluices. In open-cutting, except where mechanical excavators, such as steam-shovels and dredges, are employed, little steam-thawing is required, the overburden being scraped, and the gravel shoveled as it thaws by exposure to sun and air. Steam shovels and dredges do good work in thawed material. A dredge with buckets of 3 cu. ft. capacity has been in operation most of the last two seasons in ground, much of which had been worked by drifting and open-cutting. A prospecting dredge having buckets of 2 cu. ft. capacity has been at work during the latter part of the season on the Klondike river, near its confluence with Bonanza creek. Two steam-shovels have been employed, one for stripping, on ground little of which has been drifted; two others have been digging in ground which had already been mined by other methods. The lowest cost for working the creek-bed, if only the actual operation be included, was that for dredging.

A good class of labor is available, and no strikes have taken place. Wages are still high—\$0.40 per hour and board, for common labor, was the ruling rate. Fuel is costly. During the past season wood cost from \$10 to \$16 per cord, in 16-ft. lengths, the price varying with the amount of hauling. Coal from several mines, two of which are more than 200 miles up the Yukon river from Dawson, was tried. It was found to have low calorific value, and its use was discontinued, wood proving the cheaper fuel. Excellent roads have been built and maintained by the Territorial Government on all the more important creeks. This policy has been of great benefit to the Klondike. Large loads, often 20 cwt. per animal, are hauled.

The law still requires \$200 worth of work per annum on each placer claim or fractional claim; this is called 'representation.' Title cannot be obtained, but claims are leased by the Crown to licensed 'free miners' from year to year, as long as regulations are followed. A new regulation allows the holder of a water grant to sell surplus water; this has benefited operators unable heretofore to get water. The former regulations made it compulsory to use water on claims named as appurtenant to it in the water grant. The penalty for infraction was forfeiture of the water right. A large area in the Klondike is included in concessions. There has not been much work done on these during the past year.

**FERRO-TITANIUM.**—Professor Vogt of Christiania proposes to use ferro-titanium to remove the nitrogen from the Bessemer and Martin baths in the manufacture of steel, relying on the well-known affinity of titanium for nitrogen. He suggests a ferro-titanium with manganese and silicon.

### Cyanidation in the United States.

By CHARLES H. FULTON.

While no startling innovations are to be recorded, general progress has been made. Experiments are being conducted which promise decided improvements.

**Electrical Precipitation.**—At the present time there are two such plants in the United States and one in Mexico. This recovery does not compete with zinc precipitation, as applied to ordinary gold-bearing cyanide solution; it finds its application to foul solutions carrying much base metal, such as are obtained from weathered tailing, or from silver ore, where the bulk of the precipitate becomes very great. The Malm process is in use by the Gold Cord Mining Co., treating the old tailing of the Empire mine, near Marysville, Mont., and is described by Matt. W. Alderson. The precipitation takes place in boxes (9 by 19 ft. in cross-section, and 5 ft. deep), divided longitudinally into three compartments. All electrodes are of No. 18 iron. The sub-plates are coated on the positive side with graphite. The current density is 0.25 amperes per sq. ft. of cathode surface. The solution does not circulate through the boxes, but is permitted to stand in contact for 1.5 to 2 hours, when it is drawn off and replaced by fresh solution. The deposit forms in flakes on the negative side of the sub-plates, adhering to them loosely. It consists on the average of 51 per cent copper, 3.2 per cent gold and silver, some arsenic, antimony, lead and considerable lime. Mr. E. M. Hamilton<sup>1</sup> describes electrical precipitation in the Butters plant at Minas Prietas, Mexico; this process is also used at the Butters plant at Virginia City, Nev. The Mexican plant treats 9,000 tons of old tailing per month; this contains much silver and some copper; precipitation occurs in six boxes, the bottoms sloping to one side, like spitzkasten, to facilitate the clean-up. The solution passes through two boxes consecutively. Two Siemens & Halske dynamos, each of 250 amperes and 30 volts, furnish the current. The current density is from 0.2 to 0.25 amperes per sq. ft. of anode surface, and the voltage between electrodes is 3. The anodes are of 0.185 in. lead plates, coated with lead peroxide, and not enclosed in any way. The cathode is tin-plate, with an iron strip rivetted at the top for support. The precipitate is deposited as a mud on the cathode and falls to the bottom of the box. Squeezers are used to clean the cathodes every two days. The rate of flow of solution from sand is 216 tons per 24 hours over 6,950 sq. ft. of anode. The anodes are coated with peroxide by immersion in a 1 per cent solution of potassium permanganate, the anode being attached to the positive pole. The current density for this coating is 1 am-

peres per sq. ft. The advantage of this over the Siemens method is that the anode and cathode are practically indestructible, the precipitate being collected as a mud, which can be refined in the same manner as the zinc precipitate.

**Crushing of Ore.**—For ore amenable to direct cyanidation and requiring coarse crushing only, dry reduction by rolls has not been improved upon; if it requires to be finely comminuted, crushing at once in cyanide solution is becoming standard through the western States. It is true that when crushing in cyanide solution with lime, the separation of sand from slime becomes more difficult; but this trouble is being overcome. Even where amalgamation precedes cyanidation, crushing in cyanide solution may be adopted. At the Hidden Fortune mill, at Deadwood, S. D., this practice has been in successful operation for a year. The ore is crushed by stamps in a 1.5 lb. solution, amalgamation being effected inside the mortar by means of chuck-blocks, and outside by silvered copper plates. No difficulty has been experienced, the plates keeping clean, although a little harder than usual, but efficient in saving free gold. Before amalgamation was tried lime was added to the battery to coagulate the slime; but with amalgamation the lime seriously interfered. It is now added to the elevating pump which raises the pulp to the classifiers. From 1 to 3 per cent of mercury is found in the precipitate from the zinc-box; but this does not interfere with the clean-up. Chilean mills are finding increased application, both for large and small units, even replacing stamps. This is true both for mills which cyanide direct and also for those which amalgamate previous to cyanidation. The roller mill presents the advantages of lower cost of installation, less power consumption, and large crushing capacity for small space. When they are used, rock breakers and coarse rolls prepare the ore for subsequent treatment.

**Treatment of Slime.**—The ordinary decantation process, or some modification of it, is still standard in this country. But its imperfection, involving the loss of soluble gold and cyanide, is becoming recognized, and experimentation points to filter-pressing. La Lustre mill, in Mexico; Tres Amigos mill, in Costa Rica; the Confidence mine, in California; the Greenback mine, in Oregon, all use presses. The Echo mine, at Mojave, Cal., is installing a 5-ton Perrin press, with hydraulic closure. In South Dakota, the Horseshoe mill has made experiments with a small press, and is installing a large 5-ton hydraulic closure press (similar to the Dehne presses used in western Australia), to give the method a more thorough trial. The Hidden Fortune company, at Deadwood, is also experimenting. The Homestake company, at Lead, has been using a filter-press on its low-grade slime (0.80 to \$1.10 per ton).

<sup>1</sup> *Journal, Chemical and Metallurgical Society of South Africa*, February, 1904.

The press (the special design of C. W. Merrill) is very large, and provided with a device in each compartment to sluice out the pressed cakes after washing, thus avoiding that big item in filter-press cost, namely, discharging. A number of these presses are now under construction.

Fine grinding, for high extraction and quick solution of gold and silver, has been emphasized recently; instead of the prevention, the production of slime seems to be favored. In this connection, however, the question arises: What method of slime treatment is available? With most ores, the slime will have a higher value than either the sand or the original ore, and unless the filter-press commends itself on the score of cost, excessive sliming presents a doubtful advantage, owing to the loss of dissolved gold inherent in the decantation process; in the Black Hills the loss in dissolved gold ranges from 5 to 9 per cent of the assay value. This fact has cooled any ardor to crush finer, and with ore that is too low grade to permit filter-pressing, the production of an excessive amount of slime is to be avoided. It is probable, however, that the filter-press will be modified in the near future so as to reduce the cost of operation and make it available for low-grade slime.

*Precipitation and Treatment of Precipitate.*—For large plants, zinc-dust recovery is finding increased application. It has the advantage of facilitating and shortening the clean-up with large amounts of solution. The precipitate is compact, the excess of zinc being small. The method, however, takes more skill than the ordinary precipitation by means of shavings. G. H. Cleverger<sup>2</sup> proposes to distil the precipitate obtained by zinc in a retort under reducing conditions, leaving the gold and silver as a residue to be smelted into bullion bars, and collecting the zinc as dust to be used again in precipitation. Experiments on a small scale showed great promise.

*Sodium Cyanide.*—Sodium cyanide is replacing the mixed sodium and potassium salts. In cyanogen, pure sodium cyanide is equivalent to 132.6 per cent of potassium cyanide; the product now on the market has a strength of from 120 to 125 per cent of potassium cyanide. The sodium cyanide is also purer, containing no soluble sulphides (which contaminate the mixed salts); it is also more soluble and gives more rapid action.

*Review by States.*—Arizona shows an increased application. Most of the cyanide mills are in Mohave and Yavapai counties, with a few in Maricopa. In Mohave county, the Gold Roads mine, at Acme, has operated its dry-crushing plant; at Gold Basin, the Gold Leaf mine is installing a 200-ton plant; the Great West mine has erected a 25-ton plant, and the Monmouth mine, at Burro Creek, has a new

plant in operation. The Jacobson mine, at Gold Basin, is successfully operating a 25-ton plant, and the Mohave company and the Leland mines, at Milltown, have each erected cyanide plants. The Arizona and Minnesota company will treat 5,000 tons of tailing in a 30-ton mill. The large plant of the Congress mines has also been in operation. In Yavapai, the Iron King mine, of the American Copper Company, near Blanchard, has a 20-stamp mill, treating its oxidized ore by amalgamation, concentration and cyanidation. The Monica mine, northeast of Yarnell, has erected a cyanide plant. In Maricopa county, the Arizona Reclamation Company is operating a new cyanide process on slime from the old Vulture dump, near Wickenburg.

In California the number has increased, this being especially noticeable in the desert counties of Kern and San Bernardino. In the last-named the Gold and Silver Extraction Company is enlarging its mill and cyanide annex, and the Southern Lone Star mine, 60 miles from Barstow, is erecting a plant. The Ivanhoe mine, at Dale, is constructing a 30-ton plant; the Supply mine, at the same place, has erected a 60-ton plant, and the Seal of Gold mine is erecting a 10-stamp mill and cyanide annex. The Chase and Bagdad mines have been treating some cupriferous ores successfully. This plant treats about 100 tons per day, from which about 8 lb. copper per ton is recovered, aside from the gold and silver. In Kern county, the Sunshine, Exposed Treasure, Queen Esther and Echo mines have been in operation. A feature of cyanidation in the desert is the scarcity and expense of water, which costs 25c. per gallon. The consumption for stamp-milling and cyanidation is 75 to 90 gal. per ton of ore, at a cost of 20c. per ton. This is the figure for 30-mesh screens with the Godbe process of slime agitation.<sup>3</sup> In Mono county, the Standard, at Bodie, is considering the installation of the Moore process, the tailing (sand and slime) to be hereafter directly treated as it comes from the plates, instead of settling it first in dams as heretofore. In Tuolumne, the Vine Spring, near Columbia, and the Mount Jefferson mine, near Groveland, are installing new plants, using Chilean mills. In Inyo county, at Ballarat, the Arondo company has put up a cyanide plant. In Plumas, the Five Bears mine, at Genessee, is erecting a cyanide plant, using stamps and a Kinkead mill for crushing. In Shasta, the Midas company, near Harrison, has erected a plant, and the Sunnyside is erecting a stamp-mill with cyanide annex. In Lassen county, the Golden Eagle is operating a large dry-crushing plant, and in Sierra, the Sierra Buttes mine is putting in a cyanide plant.

Conditions in Colorado show no marked increase. The most interesting development is the increased application to low-

grade oxidized ore, at Cripple Creek, the mills being placed at the mines. For higher-grade mill ore, chlorination is practically the only process employed. Only one cyanide plant—the Dorcas—is competing with chlorination. This cyanide plant receives about 2,800 tons per month, as against 40,000 tons per month treated by the chlorination plants. The United States Reduction Company has built a cyanide plant to treat the tailing of the old Colorado and Philadelphia chlorination mill. The cyanide process is also to be tried again in Clear Creek county. Here the Ward mine has erected a plant containing six steel tanks, 6 by 30 ft., crushing in a 10-stamp mill, and amalgamating, with subsequent cyanidation. In Gilpin county cyanidation is also to be tried. The Gold Dirt has erected a 15-stamp mill, and will cyanide the tailing from five stamps. The Kokomo-Dumont company, in the Russell district, will treat the tailing from amalgamation and concentration. At Ouray the Camp Bird company has installed an additional 10 stamps and increased the capacity of its cyanide annex. In Summit county, the Masontown, at Frisco, has erected a 20-stamp mill and cyanide plant. In Boulder the Wano has a cyanide mill, using stamps crushing in cyanide solution, treating the sand and slime in the usual way. The Nellie Bly mine, at Magnolia, concentrates ore and cyanides tailing. In San Miguel, the Smuggler-Union and Liberty Bell mines use cyanide. At the latter 83,373 tons of ore were milled, having an average value of \$8.88 per ton; 51,994 tons were treated in the cyanide plant, and 29,008 tons of slime were treated in the canvas plant; 50 per cent of the assay-value is recovered by amalgamation, 12 per cent by cyanidation, 11 per cent by concentration, and 5 per cent by the canvas plant. During 1903 interesting filter-press experiments were made by F. L. Bosqui; the slime, which is treated unsatisfactorily by the canvas plant, constitutes 38 per cent of the ore crushed, and has a value of from \$3.90 to \$4.87 per ton, being richer than the sand. The slime has a dense, clayey nature, and a great part of the value is in silver. Filter-pressing was found to be of doubtful application, owing to the large equipment required; the time of washing in the press was long, and for successful pressing a cake only about one inch thick could be made.<sup>4</sup> In La Plata county, the Bonnie Girl mine has erected a small stamp-mill and cyanide plant. In the Cripple Creek district there are five coarse dry-crushing cyanide mills, of which two have been but recently completed; these are the Homestake, the R. E. & A., the King and Craig, the Cripple Creek Cyaniding Company and the Lois. The total daily capacity of these mills is 750 tons. The Homestake is constructing a 1,000-ton addition to its plant. The

<sup>2</sup>Transactions American Institute Mining Engineers, February, 1904.

<sup>3</sup>Private communication from H. H. Ames.

<sup>4</sup>Transactions American Institute Mining Engineers, October 1903.

treatment is simple, the crushing coarse (between 4 and 8-mesh), the cyanidation being carried on by percolation with weak solution.

In Idaho there has been more activity. In Blaine county, near Hailey, the Nooksack company has erected a 200-ton mill and cyanide annex. In Idaho county, at Buffalo Hump, the Hogan mine has purchased the cyanide plant of the Republic mine, in Washington. The Mayflower, near Warren, is erecting a concentration and cyanide plant, and the Hawkeye group is being equipped with a cyanide plant. In Washington county, the Gold Coin company is installing a 200-ton plant. In Canyon the Dewey, at Thunder Mountain, is installing a 100-ton plant. In Lemhi county, the Kittie Burton mine has a 30-stamp mill in operation, cyaniding the concentrate from Wilfley tables. In Custer, the Valley Creek has a 20-stamp mill and cyanide annex in operation, and will enlarge its cyanide department. In Boise county, the Golden Rod, near Placerville, operates an 80-ton amalgamation, concentration and cyanide plant.

A number of new mills have been erected in Montana. In Madison county, at Norris, the Revenue-Montana company has erected a 75-ton dry-crushing plant. It was on this property that the first cyanide plant in Montana was erected. At Virginia City, the Alder Mining Company has erected a 60-stamp mill at the Kearsarge mine, the ore being treated by amalgamation, followed by concentration on Wilfley tables, the sand of the tailing being cyanided. Near this plant is the new plant of the U. S. Grant mines, similar in design, but with a capacity of only 30 to 40 tons. At the Easton and Pacific mines a cyanide plant is in operation on silver, the only ore of this type in Montana. At the Surprise mine, at Parrot, a 30-ton plant has been erected, using a Chilean mill as a crusher, de-slimes on a Wilfley table, and treating the sand by percolation. In Granite county, in the Red Lion district, the Milwaukee Gold Extraction Company has installed a 60-ton mill, crushing in a 6-ft. Chilean, and treating the sand in 12 steel vats by percolation. A slime plant is also to be installed at once. Near Cable, the Southern Cross mines have put into operation a 90-ton dry-crushing plant, roasting the ore in Brückner furnaces. In Beaverhead, the Watseka mine, at Rochester, is operating on a novel scheme, namely, crushing dry with rolls, cyaniding by percolation, then re-crushing the tailing, and amalgamating and concentrating. This mill has a capacity of 100 tons per day. The Green Campbell mine, at Silver Star, is erecting a 50-ton dry-crushing mill. In Park county, the 120-ton cyanide annex of the Kimberly-Montana was in operation until interrupted by litigation. In Lewis and Clarke, the Montana company is treating old slime by agitation and decantation, precipitating on zinc dust.

The Belmont mill has installed a plant to treat slime, which was previously run to waste. The slime, after separation from the sand, is run over 20 ft. of amalgamated plates to the agitators. The Gold Cord, at Empire, is treating old tailing and using electrical precipitation. The Gloster, near Marysville, has erected a cyanide mill to treat tailing, and the Umattilla mine has also installed a plant. Most of the cyanidation of the State is done in Fergus county. The Barnes-King and the Kendall properties have been very active, as has also the Gold Reef, at Gilt Edge. The New Year has been operating intermittently. An interesting development in the Butte district is the experiment of treating tailing from the Lexington mill by cyanidation. The writer is indebted for information concerning Montana to Mr. P. C. Waite, of Bozeman, and to Mr. Matt. W. Alderson, of Bald Butte.

In Nevada, the Bamberger-De Lamar mill, in Lincoln county, has been in operation, treating 300 tons per day. The ore is crushed in 12 Chilean mills with weak cyanide solution, and a separation of sand from slime is made by classifiers. The practice resembles that of the Black Hills. Zinc-dust was employed for precipitation until recently, when shavings were substituted. The Shawmut-Nevada crushes 60 tons per day in a Chilean mill, amalgamates the pulp and treats the tailing by cyanidation. Zinc-dust is used in precipitation. The Newport-Nevada mill crushes the ore in a Chilean, with cyanide solution. In Esmeralda county, cyanide tests have been made on the Goldfields ore by F. L. Bosqui. At Virginia City the Butters tailings plant has been in operation.

In Oregon some new mills have been erected. In Baker county, near Sumpter, the Blue Bird and the Alamo mines will install cyanide plants. The North Pole, at Bourne, one of the oldest cyanide plants in this country, has been in operation, crushing 120 tons per day with 30 stamps, amalgamating, concentrating and cyaniding. The Columbia has its mill in operation, crushing 60 tons per day, and treating in the same way as the North Pole. The Bourne company is operating the Excelsior and Eureka mines; it operates a 20-stamp mill and treats the ore as above. The Greenback is dropping 40 stamps and operating its cyanide annex. In Josephine county, at Grant's Pass, the Oro Fino is installing a cyanide plant.

In Washington but little cyanidation has been done. In Ferry county, the Hendryx process has been tried at the Mountain Lion mine, with what results is not known. It avoided electrolytic precipitation, zinc shavings being used. The Bodie mine has erected a small cyanide plant. In Whatcom county, the Nooksack is erecting an 80-stamp mill with a 200-ton cyanide annex.

No new mills have been erected in Utah. In Piute county, the Annie Laurie mill, in

the Gold Mountain district, has enlarged its capacity to 300 tons per day, additional crushing and roasting facilities having been installed. The Sevier Consolidated has put its new mill in operation. The Godbe slime process is used. In Iron county, the Johnny mine, at Stateline, has operated a 10-stamp cyanide mill, crushing through a No. 9 slot-screen, amalgamating over plates, making a separation of sand and slime, percolating the sand, and treating the slime by decantation in conical-bottom slime vats. In Tooele county, the Consolidated Mercur has discarded the Moore process after several months' trial; the former method has been resumed, but some change has been made in charging the vats, giving a product leaching more evenly. The tailing now runs 85 to 90c. per ton, whereas a year ago it carried \$1.40 per ton. The mill at the Overland mine was put into operation in September. The Manning mill is to work on the dump again under lease.

Cyanidation has been very active in South Dakota. Eleven cyanide plants have been in continuous operation; nine of these have operated on refractory silicious ore, and two on Homestake ore. The two Homestake tailing plants have been enlarged, and now treat approximately 2,800 to 3,000 tons of sand per day. The recovery of bullion by cyanidation is close to \$2,600,000, with a total production of \$7,090,000 for the year. Two new cyanide plants have been erected; the Gilt Edge Maid, of 150 tons, recently put into operation, and the Branch Mint mill, in the Galena district, not yet completed. Several new mills are projected.

In North Carolina the cyanide process is beginning to find successful application on low-grade gold ore. In Montgomery county, the Iola mine has erected a 50-ton plant and is producing bullion. In Randolph county, the Southern Homestake has a 100-ton mill and cyanide annex ready to begin work. The Colossus company, 20 miles north of Charlotte, has a 100-ton plant in successful operation on the tailing of the Howie mines.

**SAMPLING MACHINES.**—These machines are usually based on either one of two principles, namely: (1), To cut all the ore-stream a part of the time: (2), to cut part of the stream all the time. The former is regarded as reliable. The Vezin sampler is an illustration.

**MAGNETISM.**—Para-magnetic substances arrange themselves parallel to the lines of force in the magnetic field; here are included iron, nickel, cobalt; and in a less marked way, manganese, platinum, palladium, chromium, titanium, aluminum, etc. Dia-magnetic substances tend to arrange their axes at right angles to the lines of force of the magnetic field; they include bismuth, antimony, zinc, tin, lead, silver, copper, gold, arsenic, mercury, etc.

### Metallurgical Progress in Africa and Australia.

BY ALFRED JAMES.

The most noteworthy event of 1904 has been the stimulus to re-grinding, due to H. S. Denny's work. Dissatisfaction with existing methods, coupled with definite improvement in concentrate treatment by re-grinding, have been far-reaching, and now there is apparently no one at Johannesburg who defends the long percolation treatment of spitz-sand (concentrate), although at the time of Mr. Denny's writing this was generally followed.

*Re-grinding.*—At the Robinson Deep the extraction on spitz-sand is 73.5 per cent by the long treatment, at a cost of \$2.50 per ton; on this basis, Mr. Caldecott says that re-grinding shows an extra profit of \$2,400 per month; or, in other words, by re-grinding 30 per cent of the mill-product, the total extraction can be increased from 90 to 95 per cent (50c. per ton on 10-dwt. ore), at an increased cost of only 25c. per ton, leaving a clear 25c. profit. If it is assumed, however, that the increased cost of 25c. refers only to the tonnage actually re-ground, then the total profit would be increased accordingly. At the Glen Deep, the re-grinding of the coarse sand was found to yield an increased recovery of 3 dwt. per ton on the plates alone, apart from any higher extraction obtained from the final sand in the cyanide vats. Speaking generally, re-grinding, apart from yielding an additional 5 per cent extraction, should lessen the equipment for the same tonnage by 20 per cent; by doing away with the vats at present used for the long treatment of concentrate, the shortening of the time required for the extraction of the finer sand would permit the treatment of the re-ground concentrate with the sand. Thus, at present the usual 200-stamp installation is provided with 20 cyanide vats, of which two pairs are given over to the treatment of concentrate. It is estimated that future plants for the same tonnage need not have more than 14 or 16 large vats.

An examination of the Glen Deep results shows that, with a normal output per stamp, through 28-mesh, of 4.9 tons per diem, the duty was increased to 6.5 tons with 15-mesh, 7 tons with 12-mesh, and 10 tons with 8-mesh screening. Normally, 10 per cent of the sand is separated by the spitz as 'concentrate,' and 25 per cent is classified as 'slime,' the balance being cyanided; but by re-grinding the coarse sand, 96 per cent passes 60-mesh, as against only 6.6 per cent before re-grinding. Curiously enough, the substitution of coarser screening did not materially modify the percentage of fine (all passing 60-mesh). In each case this was about one-half the total output, so that, taking 60-mesh as the standard of efficiency for cyanide work, it appears that one-half the output must be re-ground, no matter what the size of screening used;

but closer examination shows a material difference in the coarseness of the rough particles. Thus, with 15-mesh, 3.6 per cent of the product was too coarse to pass 20-mesh; with 12-mesh, the proportion of rough was 9.9 per cent. This was increased to 15.3 per cent with 10-mesh, and no less than 25 per cent of rough remained on the 20-mesh when the 8-mesh was used on the battery; it is this rough product which increases the wear and tear of re-grinding.

It follows from these experimental data that, apart from wear and tear and subsequent extraction, the stamp capacity can be doubled by the use of one tube-mill using 40 h. p. per 20 stamps. Assuming the stamp to crush normally five tons per diem (that is, 100 tons for 3 h. p. per stamp), then 40 h. p. additional gives a further 100 tons at a saving of 20 h.p.—less the amount used for returns, if the return system is practiced; and, as the tube-mill is cheaper in first cost, requires less supervision, is cheaper to run, and requires less repair and renewal than a stamp, the recent enthusiasm is not difficult to understand.

But, despite this enthusiasm, it is not probable, at present, that serious attempts will be made to double the mill output. The cost of grinding the very coarse particles is relatively too great. Tube-mills are not crushers, but grinders; and large quartz particles are not an economical or suitable feed; under such conditions one has to contend with abnormal cost and wear. Normally, with quartz sand one can calculate on fine-grinding one ton of 12 to 20-mesh sand down to, say, 60-mesh for 0.33 h. p., at a cost of two cents for wear of flints, and one cent to six cents for liners. Of course, in England or America, with cheap flints and liners, the figure would be much less than this. Labor and supervision is but a small item, one man attending a number of machines. The variation in the cost for different liners is extraordinary. Flint has so far proved the cheapest and most durable, lasting six times as long as iron. Steel and chilled-iron liners wear as smooth as glass, diminishing somewhat the duty of the mill.

The total cost of grinding (60-mesh) normal sand with horse power at 50c. per diem comes to: Power, 12c.; flints, 2c.; liners, 2c.; labor, 0.5c., and repairs, 0.5c.; making 17c. per ton. Fine sluicing at Kalgoorlie (200-mesh) comes to double the above figures.

At Kalgoorlie there has been practically no development in tube-mill work in 1904. It has even been claimed that pans with wear-compensating shoes are superior as slimers. That pans may grind coarse particles more economically is admitted in certain quarters; but the mere fact, that the claim for superiority in sliming should be put forward, proves that Kalgoorlie tube-mill work must be capable of further

improvement; and, in this connection, I ask why is it that the Hannan's Star mill, the first one laid down, should be still doing the best work, while the Ivanhoe mill has been thrown out? The Australian theory of short tube-mills—they cut lengths off their 16-ft. mills to reduce them to 13 ft. with the object of getting off their slime as soon as it is formed—has apparently much in its favor, but it has yet to be proved correct. The longest and oldest mills, those at the Hannan's Star and the old Brownhill, exhibit the best results. With all mills working under precisely similar conditions, there should be no difficulty in settling the question.

*Slime Treatment.*—The completion of recent slime-plants at Johannesburg, and the appearance of Mr. Laschinger's paper on the subject of decantation, mark possibly the culmination of this method. The Robinson plant is an example of the fulfilment in practice of theoretical possibilities. I was impressed by the extraordinary simplicity of these huge plants working silently and almost automatically. It is now possible on the Rand to obtain an extraction of 80 per cent and upward at a working cost of but little over 50c. per ton; or as high as is being obtained on the sand, at a less cost. At the low-grade Langlaagte Deep, an extraction of 85 per cent has been obtained at a cost of 45c. per ton. This is probably a record and one of which the father of decantation—Mr. J. R. Williams—may justly be proud. When, however, one is confronted with the first cost of these huge installations, the inclination is to find some cheaper method of treatment. Thus, the Robinson plant cost \$143,000 and was treating 160 tons of current slime per day. With a slightly less extraction, the same plant would probably treat 200 or 240 tons per day, but even at this figure the redemption of capital alone amounts to no less than 25c. per ton of slime treated. And this to recover, under the best circumstances, only 90 per cent of the gold dissolved, that is, to leave in the residue 10 or 12 per cent of unrecovered gold which has been actually dissolved, in addition to the unextracted gold still left in the residue!

Improvements have been tried in two directions. Denny has sought to secure a more simple plant at the Van Ryn by continuous settlement, solution, and decantation in conical vats. So far, however, it appears he will have to resort to some direct method of recovering his gold-bearing solution, an unduly large proportion of which would flow with the slime to the dam, did he not recover this by settling and pumping back. The other direction, in which improvement is sought, brings us to filter-pressing. It is calculated that a complete filter-pressing installation could be erected at Johannesburg for two-thirds the cost of the present decantation equipment; and that such a filter-pressing installation should recover 98 per cent of

the dissolved gold—a total extraction of over 90 per cent, or 10 per cent better than the decantation process. As the cost of filter-pressing in Western Australia has been reduced to 40c. per ton (omitting cyaniding), it is not surprising that in South Africa increased attention is being paid to the process, and that Messrs. Denny, Williams, Robertson and Darling should be either working or preparing to work filter-press plants. At the Nigel, Mr. Williams appears to be obtaining extractions of over 90 per cent, while his costs have proved to be less than estimated.

At Kalgoorlie pump-filling of filter-presses has now come into general use; besides being more economical it is found to possess the advantage of filling the cakes more evenly than montejus. Filling presses by montejus costs 11.5c., against 5c. per ton for pump-filling. In this connection Mr. Sutherland, of the Golden Horseshoe, has some cause for congratulation, not only in having been the first to fill his presses by pumps, but also for adhering to this method throughout the monteju-filling boom prevailing later at Kalgoorlie. Mr. Marriner, of the Great Boulder Main Reef, has carried out some interesting investigations as to the method of formation of filter-press cakes and their thorough washing; and he shows clearly that the uneven content of the residue is owing, not to insufficient washing, but to the action of the montejus, in which the heaviest particles settle so as to be first blown up the pipe and form the bottom and outside of the cakes.

The evolution of a continuous method of pressing, or one which shall not require the opening out of the frames, has attracted much attention, and efforts in this direction are apparent all round. The most notable are:

1. The Argo, or continuous-belt-over-vacuum-box. This method does not yet appear to have been operated with success in practice, owing to mechanical difficulties.

2. The Moore, or grouped-frame-filter method. Success has been claimed at the Consolidated Mercur and elsewhere, but on investigation the inventor does not appear yet to have overcome the numerous difficulties inseparable from this type of machine. Sloppy cakes, which have to be scraped from the interstices of the frames, scarcely make for successful work.

3. The continuous machine at the Treasury (Johannesburg). This was on the type of a Moore filter enclosed in a heavy casting. By increasing the pressure it was hoped to force the cakes off the frames and to let them fall into the lower part of the casting, from which the pulp would be forced by a screw. In practice this has not proved successful.

4. The Prichard method is to force slime through a cylinder with a regulated impeded discharge. The walls of the

cylinder support a filtering medium, the slime being forced through with a screw. Wash-water and compressed air are supplied from the opposite ends of a perforated tube running through the axis of the cylinder, with a block conveniently placed in the tube interposing between the air and water. Baffle-plates are added, to prevent the sludge rotating. This scheme also fails to overcome the mechanical difficulties.

5. Finally, another similar method is being exploited at Kalgoorlie, the gold solution being extracted by centrifugal force. Details are not yet available.

In spite of the ingenuity and labor expended, it is only too evident that the filter-press is not yet displaced.

*Residue Treatment.*—The Stark process at the Crown Reef is said to be yielding good results. The process consists in pumping on the top of the tailing heap a solution of niter cake, potassium sulphocyanate, and potassium chlorate, deep channels being prepared to catch the drainage, which is conducted to precipitation boxes containing old iron screens and wire-rope. Precipitation is by no means complete, and probably will be improved. At the Pioneer a site has been carefully prepared with asphalt, and the tailing has been transferred to this from the old dump. Three hundred tons of water are pumped on daily, containing 400 lb. niter cake, 40 lb. potassium sulpho-cyanate, and 40 lb. potassium chlorate. The Crown Reef latest returns show \$49,920 for three months' run, of which \$38,400 was profit.

*Concentration.*—The only novel feature of the year seems to be Caldecott's figures, showing that the gold contents of the sand and slime do not vary greatly in proportion to their pyritic content; and from this I assume that a concentration method of overcoming the slime-treatment problem is not likely to be successful in practice, for even a perfect separation of the pyritic particles themselves does not prevent the slime or sand from retaining a quantity of gold by no means negligible.

*Handling.*—Belt-conveyors are being more generally adopted for moving tailing. In designing these, care has to be taken to arrange for the proper distribution under the vat, otherwise it is apt to be flooded with tailing, which has to be dug out later. The 'tripper' is found to wear the belts rapidly; a more economical substitute is desirable. But, in spite of this, belts have proved much less expensive than the other methods. The long-looked-for Blaisdell excavator has at last arrived at the Robinson, but so far details of results are not yet to hand, except for a horsepower consumption and wear and tear rather heavier than anticipated.

*Roasting.*—There has been very little new of interest. Simpson has improved the Merton furnace for concentrate work

by increasing the size of the finishing hearth, and adding two additional water-cooled rabbles. The three finishing rabbles revolve at a greater speed than those on the other hearths. The same authority has recently accomplished some interesting tests on the losses assumed to take place in roasting. Careful tests at Kalgoorlie have failed to prove any loss, even with concentrate averaging nearly 20 oz. per ton. The matter has been investigated by careful assaying of the concentrate, weighed both before and after roasting; and also by condensing, in water, the waste gases from the furnace. The latter is not usually efficient, but the former method should be absolutely reliable. On the other hand, Mr. Simpson contends that the loss at the smelters, in cupelling lead bullion containing tellurium, is far greater than that of any possible loss in roasting furnaces. He claims that by the roasting process 98 per cent of the gold is recovered at a cost of not more than \$5 per ton; whereas the expense of smelting is not less than \$22.50 per ton for a recovery of under 94.2 per cent. While on this subject one cannot but be amazed at the tremendous waste of tellurium which is volatilized at Kalgoorlie. It could be recovered quite cheaply, if there were only some commercial use for it.

*Cleaning-up.*—Tavener's method has not yet made the progress hoped for it. The drawbacks appear to be the large size of the smelting furnaces employed, which are peculiarly liable to expansion and contraction, owing to the intermittent nature of the operation; the difficulty of procuring suitable bottoms; and the liability of the melt to freeze in the cupel. It is suggested that smelting and cupelling in oil-burning furnaces (the former preferably tilting, or with crucible-hearth) would obviate this difficulty.

*Costs.*—South African tube-mill costs have already been given. West Australian costs, at first sight, do not appear to have come down as much as in previous years; the 1902 record was \$4.94 per ton at the Great Boulder Main Reef; before Mr. Simpson left the Great Boulder Main Reef his costs were down to \$3.54 per ton; at the Ivanhoe recent treatment costs are under \$2.40 a short ton; at Lake View, \$3.30, and at Oroya-Brownhill, \$3.84. The following data represent two typical mines:

	Per ton.	
Crushing . . . . .	\$0.16	Oroya Brownhill
	0.08	Lake View Consols
Milling . . . . .	0.54	Oroya Brownhill
	0.52	Lake View Consols
Fine grinding (per ton milled) . . . . .	0.32	Oroya Brownhill
	0.64	Lake View Consols
Cyaniding by agitation (per ton cyanided, omitting bromo-cyanide and royalty) . . . . .	0.66	Oroya Brownhill
	0.48	Lake View Consols
Filter-pressing (per ton pressed) . . . . .	0.42	Oroya Brownhill
	0.46	Lake View Consols
Disposal of residue . . . . .	0.08	Oroya Brownhill
	0.12	Lake View Consols

Kalgoorlie may well be proud of its success in such treatment.



**Mexico.**

By JAMES W. MALCOLMSON.

Mining has prospered exceedingly. The production of silver is now greater than that of any other country, and as a producer of copper, Mexico is second only to the United States.

With the exception of Pachuca, the silver mining industry is in a much more prosperous condition in northern Mexico than in the South. The districts in successful operation there are reached by

Monte paid large dividends during 1904, and all these properties show excellent orebodies at the lowest levels. Twenty-five hundred electric horsepower is now being utilized by this camp, one-half being obtained from a waterfall 22 miles away, and the rest from the City of Mexico drainage overflow, near Tula.

**Guanajuato.**—Many of the old properties have been transferred to Americans. The famous Valenciana mine passed into new hands and is again being reopened. A new orebody was discovered in the

prosperous condition. The main shaft has now reached a depth of 1,000 ft., and excellent ore has been opened up in the lowest workings. The vein here is 35 ft. wide, 24 ft. being mill-ore; 500 tons are mined weekly. The Veta Grande mine was unwatered, and good ore uncovered. This property has been worked for many years on an inadequate scale, and it is hampered by litigation. In the San Rafael mines a project is on foot to drain the deeper workings, and there is reason to believe that this famous mine will again



MEXICO.

railroad, and the ore can be shipped to the smelters at Monterey, Aguascalientes, Torreon, Mapimi and El Paso, at rates which leave a fair margin of profit.

**Hidalgo.**—The principal silver mining district is Pachuca, now reached by four railroad lines. The output of Pachuca is equal to one-sixth of the entire silver production of the Republic, although the camp is one of the oldest in the new world. The mines of San Rafael, La Blanca, Santa Gertrudis and Real del

mines of the Guanajuato Consolidated Company, by cross-cutting into the walls of the old stopes. The orebodies of this district are of great size, though of low grade, and much depends upon their successful metallurgical treatment, which now seems assured. The electric transmission plant has proved an economic factor, some 4,000 h.p. being already in use.

**Zacatecas.**—The Bote mine, which has paid dividends since 1845, is still in a

become a producer. Considerable development work has been done in the Mala Noche mines. At Minillas, south of Zacatecas, the Santa Maria de Guadalupe mine weekly produces 500 tons of lead ore, carrying silver.

**Aguascalientes.**—In the Asientos district, production from the Santa Francisca silver-lead mine was suspended on account of a serious cave-in in the upper workings, but extraction on a large scale will probably be resumed shortly.

*Jalisco.*—Development work at the Santo Domingo property of the Amparo Mining Company has proved successful, and shipments of high-grade ore have been made to the smelters.

*Chiapas.*—The Santa Fé mine of the Chiapas Mining Company has been closed down after a long and unsuccessful struggle. The ore, containing copper, silver and gold, was concentrated, and the concentrate shipped abroad; but the ore itself was poor.

*Chihuahua.*—The principal silicious silver mining district of northern Mexico is Parral, which is now producing 15,000 tons of ore monthly, of which only a small fraction is treated locally. At the Quebradillas mine, on the Veta Colorada, development in depth has opened up ore assaying 30 to 40 oz. silver per ton. The ore itself is changing in composition in depth; near the surface it assayed 70 per cent silica and 8 per cent fluorspar; but at 1,000 ft. it assays 40 per cent silica and 25 to 35 per cent fluorspar. The principal producing mines of Parral were the Palmito, Refugio, Quebradillas, Muertos, Adela, Descubridora, Preseña and San Francisco.

At times the output from the immense deposits of Santa Barbara, San Francisco del Oro and the adjoining district reached 20,000 tons monthly; but, owing to the suspension of operations at the Tecolotes mill, the present output does not exceed 8,000 tons. The Tecolotes mill, with a nominal capacity of 12,000 tons monthly, is being radically altered, both the power plant and the method of concentration being defective. The Montezuma mill, with a nominal capacity of 10,000 tons monthly, has been continuously in operation. The ore, consisting of pyrite, blende and galena, assays 9 oz. silver, 0.1 oz. gold, 6 per cent lead, 11 per cent zinc, 48 per cent silica, 7 per cent iron, 5 per cent fluorspar and 14 per cent sulphur. This is concentrated from 12 to 1; the sulphide middling then undergoes a light roast, to render it magnetic, before treatment by the Wetherill process. A large deposit of zinc-blende was discovered in the San Diego mine of the Compania Metalurgica de Torreon early in 1904, carrying 40 per cent zinc; but later developments have opened up silver-bearing galena; a large output is maintained. A concentration mill will probably be erected on this property. At the Calera mine, near Miñaca, a large deposit of zinc-lead sulphide, low in silver, has been opened up, and several car-loads have been shipped to the United States for experiment in concentration.

Among the large producers in the Santa Eulalia district are the Chihuahua Mining Company, the Santa Eulalia Exploration Company, the American Smelting & Refining Company, the Prieto Estate, and the Potosi Mining Company. The output of Santa Eulalia has doubled in the last two years, and a great deal of successful ex-

ploration work has been done; 15,000 tons are shipped monthly, more than one-half from the Potosi mine. The Americana mine, at Terrazas, has been shut down on account of water: Pumps and boilers have been installed, and ore shipments will be resumed. The new silver-lead mining camp at Naica has undergone successful development. The heaviest producer is the Naica Mining Company, which has built a railroad 15 miles long to the Mexican Central Railway, and is shipping 1,500 tons monthly of high-grade lead carbonate. Other mines are producing ore of similar grade, the principal properties opened recently being the Lepanto and Corona. At Almoloya, east of Parral, a lead mine of importance, the Cigarrera, has been developed successfully, and is now shipping a large tonnage of oxidized lead ore. The ore is similar to that of Naica, but carries more gold.

*Durango.*—At Guanacevi good ore has been discovered in the Soto mine; 1,500 tons monthly are being milled locally in this district, and 300 to 500 tons are shipped to the smelters. On account of the distance of Guanacevi from railroads, ore assaying less than 100 oz. silver cannot be shipped with profit, and this whole district, including Indé and El Oro, is still handicapped by lack of transportation facilities.

At Mapimi, the Compania Minera de Peñoles maintains its output, and, according to its last annual report covering 1903, mined 160,841 tons of ore, containing 22,771 tons of lead; 241,000 tons of ore were smelted, with a net profit of \$2,303,990.44 (Mexican). The shaft is now 2,950 ft. deep. In 1904 approximately 175,000 tons of ore were mined, assaying 18 oz. silver, 0.15 oz. gold and 15 to 16 per cent lead; 240,000 tons were smelted, one-quarter being silicious fluxing ore purchased principally from Parral. Nearly one-quarter of the ore mined is sulphide. The Huntington-Heberlein process is now in operation, with a capacity of 300 tons daily. The Mapimi Mining & Smelting Company, operating the America mine, and the San Juan Mining Company, also operating at Mapimi, have both developed some ore. The discoveries in these two mines and in the Moreno have attracted attention to the district.

*Coahuila.*—In the Sierra Majada district, the principal producers are Fronteriza, San José, Veta Rica, Tiro Once, Fortuna and Exploradora. The production is 8,000 to 9,000 tons monthly of lead or lime ore, low in silver. The fire in the San Salvador, which has been burning now for four years, still continues; but work has been re-commenced, with the object of reaching the orebodies below the fire limit. At Norias de Bajan, the San Luis mine is the only property operated. The ore is a zinc-lead carbonate.

*Queretaro.*—The ancient mines of El Doctor, near Maconi, are being re-opened

by the United Mining & Development Company, of New York.

*Sonora.*—The Bufo mine has been developed with good results, and operations have been conducted at a profit. In the north of this State, the property of the Tigre Consolidated Gold Mining Company has shipped some high-grade silver-gold ore, and a milling plant is now in course of erection. In the Mexicana mine, near La Cananea, work has been re-commenced with the object of getting below the old workings. At the Picacho mine of the Phelps-Dodge company, gratifying results have been obtained, and high-grade shipments of gold-silver ore have been made.

Mexico is steadily gaining in importance as a producer of gold. Throughout Mexico, with but few exceptions, gold is found in the richer silver ores; for the year the output of gold was approximately one-half the value of the silver.

*Sonora.*—In the Minas Prietas district, the ore mined from the Grand Central mine is treated by the Butters process. At the Creston Colorado mine a new cyanide plant was erected. The silver-gold ore is crushed with cyanide solution, the sand and slime separated by hydraulic classifiers and spitzkasten, and the sand cyanided by percolation. The slime is raised to the agitator tanks by centrifugal pumps and agitated for 15 to 18 hours; then transferred to filter-presses by montejus, the small amount of solution remaining in the slime being lost after pressure. The extraction of both silver and gold is high, and 5,000 tons are milled monthly.

*Chihuahua.*—A somewhat similar process is in operation at Concheño, where over 4,000 tons are milled monthly; the ore assays 0.22 oz. gold; and 10.0 oz. silver. The extraction from the sand by percolation in 80-ton tanks is 74.2 per cent of the gold and 67.1 per cent of the silver; the extraction from the slime by agitators and presses is 77.3 per cent of the gold and 75.8 per cent of the silver. At Concheño an appreciable fraction of the gold-silver content is first extracted by a 2,000 to 1 concentration over Wilfley tables, the concentrate being worth \$1,500 (U. S.) per ton. The Zaragoza mine of the Concheño company has now been worked to a depth of 550 ft. on a strong vein.

The Lluvia de Oro gold mine has been opened up very successfully and promises to be one of the richest mines in northern Mexico. A mill has been erected and large additions are already contemplated. An entirely new orebody has been discovered and partially explored in the Cuatemoc ground. The ore is free milling and high-grade.

*Mexico.*—El Oro, the premier gold mining district of the Republic, has maintained its usual production. Re-grinding mills have been installed by El Oro Mining & Railway Company and at the Esperanza plant. This, together with the new 100-stamp mill of the first-named

company, now approaching completion, will increase the output notably in the near future. A great deal of development work has been done, opening up additional ground. Much surface improvement is going on, especially the erection of machinery for the automatic handling of tailing. A few miles from El Oro, in the State of Michoacan, the gold-silver mine of Dos Estrellas has maintained its phenomenally rich output. All these companies have under consideration the purchase of electric power from the Mexican Light & Power Company, whose generating station is at Nicaxa.

The English capitalists who have purchased the Dolores silver-gold mine, in the northwest of Chihuahua, have almost completed the erection of their mill, and soon will be earning handsome profits. This mine has developed very satisfactorily. At the Sahuayacan mine, operated by Pittsburg capitalists, a rich deposit of gold ore was discovered and is being worked profitably. In the Jesus Maria (Ocampo) district, experiments are being made with the object of changing from pan amalgamation to cyanidation for the treatment of the gold-silver ores. The Waterson mines started up in December, after being closed down for four months. The mill at Pinos Altos is being overhauled, and development work is being done in the lower, or seventeenth level of the mine. The Palmarejo mines, after a long period of unsatisfactory results, have been operated with a substantial profit, mainly due to the introduction of the cyanide process.

**Sonora.**—The gold mines of Cerro Boludo, in Chihuahua, and Mulatos, in Sonora, have been secured by Cananea capitalists, and extensive developments are soon to be made. South of the Cananea copper mines, a new company, the Greene Consolidated Gold Company, has secured an area of placer ground on the Santo Domingo river, a large plant of machinery is to be erected, and operations will be commenced shortly.

The production of copper during 1904 has drawn more attention to Mexico than that of silver, although its value amounts to less than one-quarter. Copper mining on a large scale is, however, the youngest industry in the country, and its growth has been so remarkably rapid that the output is now equal to one-fifth that of the United States.

**Sonora.**—The Greene Consolidated Copper Company, operating the Cananea mines, is the principal agent in this growth. This company has enjoyed a prosperous year, producing over 30,000 tons of copper, equal to one-half of the entire production of Arizona. The newly discovered Massey orebody promises to be the largest copper deposit ever opened in Mexico. The concentrator, which will now treat 2,000 tons of ore daily, handled 209,868 tons during the fiscal year ending July 31. The present production of Can-

anea is 2,800 tons of copper monthly, extensive alterations and additions having been made. The Phelps-Dodge company has resumed work on the Indiana-Sonora properties, which adjoin those of the Greene Consolidated Copper Company, and the litigation, which has been pending so long, has been successfully terminated by a compromise. In the Nacozari mine of the Moctezuma Copper Company a new orebody of importance has been found, and production will be increased materially. On the completion of the railroad from Douglas to Nacozari, the smelter at the latter point was shut down, and the concentrate shipped to the Copper Queen smelter, at Douglas. An enlargement of the Nacozari concentrator is under consideration.

**Lower California.**—At Boleo satisfactory developments have been made, and the mine is in a prosperous condition. The output of metallic copper for the year is approximately 11,500 tons. Much searching for copper has been carried on in the Yaqui river district of Sonora, and some prospects are being exploited. At Triunfo, the Progreso mine, one of the oldest in Mexico, has resumed the payment of dividends, and, in addition to an output of silver, there have been developments of gold ore, which promise well.

**Chihuahua.**—The Las Vegas copper mine, near the Conchos river, has been rendered more accessible by the building of the Kansas City, Mexico & Orient Railway to Las Trancas. At Los Reyes, near Jiminez, the Gibosa mine has kept up its usual production, and extensive development work is being carried on. The Jesus Maria copper mines, at Baguerachic, on the line of the Kansas City, Mexico & Orient Railroad, has been explored by an American company; this property was operated in 1864 by Baron Necker, and trouble regarding ownership was an excuse for French intervention. The mine is still handicapped by its distance from a railroad; but as the main line of the Stilwell road, now building, passes over the claims, it will in time become a producer of importance. This railroad between Urique and Choix passes through a district in which other large copper deposits have been discovered. Northwest of Ahumada, on the Mexican Central, San Antonio capitalists are opening a new district, and have already found some oxidized ore assaying 10 per cent copper.

In **Coahuila** a light railroad has been built from Otto station, on the Mexican Central Railroad, to the mines of the Jimulco Mining Company. The line is operated by a Shay locomotive, 60 tons of ore being shipped daily to Aguascalientes, containing 0.15 oz. gold, 15 oz. silver and 16 per cent copper.

**Durango.**—At Avino irregular shipments of copper ore have been made to Aguascalientes. At this property a silver lixiviation mill has also been in operation.

The Descubridora mine, at Conejos, has been worked intermittently, but it is now closed down. In Guanacevi some promising copper ores, carrying gold and silver, have been opened up near the town. At Velardeña the copper deposits of the Velardeña Mining & Smelting Company have proved to be extensive. Gas producers and engines of large capacity are being installed, and the enterprise is being developed rapidly. Plans have been prepared for the construction of a new smelting plant, but work has not yet been started. Large bodies of silicious ore are also being opened on the Teneres mine, and on account of the successful result of the tests made on the San Nicholas lead sulphide ores, a mill is to be built at once to handle a large tonnage. Improvements and development work for 1905 will entail the expenditure of \$2,000,000.

**Michoacan.**—Development is again being carried forward energetically by the French company operating the Inguaran mine, the orebodies being of great size; they assay approximately 5 per cent copper, but better railroad facilities are required for the final success of the enterprise. Surveys have been made with the object of securing an outlet to the coast at Sihuatenajo, in Guerrero.

**Puebla.**—The principal copper property in operation in the southern part of the Republic is the Teziutlan; the railroad has been completed to the smelter, and additional machinery installed.

**Guerrero.**—The Campo Morado property is still in process of development, a large additional tonnage of copper-iron ore having been opened up. The La Dicha mine of the Mitchell Mining Company, 55 miles east of Acapulco, on the Pacific coast, has been actively exploited. Much work has been done at this property, and a smelter with a 200-ton daily capacity is almost completed.

At Mazapil operations are prosperous, the copper matte produced being shipped to Aguascalientes, while exploration work is active. North of Zacatecas, the Magistral mine is shipping 100 tons of copper ore weekly, and a mill has been erected on the Zaragoza mine, at Zacatecas, to concentrate 200 tons weekly of 4 per cent copper ore.

**Aguascalientes.**—The Cobre mines, at Tepezala, have again resumed shipments of copper ore, and extensive exploration work is in progress. The Fortuna mine is making its regular production of 800 tons monthly of silicious copper. The Merced mine, shipping 600 tons per month, is also in a prosperous condition.

The Aguascalientes Metal Company, operating the San Simon and Merced mines, at Asientos, Aguascalientes, have installed a De Laval steam turbine, and operate a Cameron electric sinking pump successfully. They are shipping monthly 1,000 tons of ore, carrying, in addition to the usual silver value of the district, some gold.

Attention has been directed to zinc. The

ores are usually intimately mixed with lead and silver, and the problem of separating the zinc from this complex has not yet been solved. The mines of Prieta, Tajo, Santa Barbara and San Francisco del Oro, at Parral, the Calera mine, at Miñaca, and that of Charcas, San Luis Potosi, are among the more important properties containing a high percentage of zinc, with a large tonnage. Experiments on these ores with magnetic separators have been made on a large scale.

**Antimony.**—The mines of San Luis Potosi and Queretaro are still operated successfully, despite the low price. For several years Mexico has been the leading producer of this metal, the ore assaying over 50 per cent antimony, and smelting works have been in regular operation for some time at Wadley, on the Mexican National Railroad.

**Quicksilver.**—Renewed attention was paid to the important quicksilver resources of the country. The more notable of these deposits are at Guadalcázar, in San Luis Potosi, Huitzoco, in Guerrero, Ranas, in Queretaro, and at Batuc, in Sonora.

**Coal.**—The Las Esperanzas coal-fields, in Coahuila, have increased their output of both coal and coke, 3,000 tons of coal and 500 tons of coke being shipped daily. Four hundred Japanese miners are now employed and are giving good satisfaction. Exploration and development work has been going on at Sabinas with encouraging results. The future outlook for the Coahuila coal-fields is extremely promising.

**Rhodesia.**

The gold production for the year 1904 will be about 224,500 fine oz. (\$4,640,415), an improvement on all previous figures. About 40 mines are making returns, but many are small properties.

The principal producers for Matabeleland, are the Globe & Phoenix, the Selukwe, each with 40 stamps; the Wanderer, a low-grade mine using dry-crushing with 100 stamps. In Mashonaland, there are the Ayrshire with 60 stamps; the Penhalonga with 45 stamps, and the Rezende with 20 stamps.

To encourage small mines, the British South Africa Company have recently modified the mining ordinance. Now small mines can be worked on a royalty on the gold procured. The royalty is fixed on a sliding scale; up to 750 oz. per month 2.5 per cent of gold; 1,150 to 1,500 oz. pays 7.5 per cent.

In spite of the large amount of gold produced (nearly a million sterling), the profits are small and dividends are uncommon. Costs average 24s. 9d. per ton, excluding development and London expenses.

Some excitement was caused by reported discoveries of "banket," similar to that of the Rand in the Lomagunda district, and to gold-bearing alluvial in the Victoria district.

**The Transvaal.**

By W. FISCHER WILKINSON.

The value of the gold produced in the Transvaal will amount, in round figures, to sixteen million pounds sterling or \$78,000,000, an amount which is about on a level with the gold of the record year, 1898. Below will be found a table showing the gold production since its commencement.

During 1904 the monthly yield of the Witwatersrand rose from £1,184,552 in January, to £1,333,481 in October, and is now not far behind the record established in August, 1899, shortly before the out-

expenditure of nearly £37,000,000 for 111 companies. The following is a summary of the report of the State Mining Engineer:

The year 1904 opened with 52 companies on the active list, and up to October six other mines had commenced milling, the number of stamps being increased from 4,367 in January, to 4,905 in October. The accompanying table gives full particulars of the monthly returns.

It will be noticed that the value of the yield per ton (38.5s) for the year 1904 shows a decrease; but this falling off does

Year.	Witwatersrand District.			Outside Mines Value.	Transvaal Total.
	Tons Milled.	Value.	Value per Ton Milled		
1884-9. ....	1,000,000	2,440,000	48.8	£ 238,231	£ 2,678,231
1890. ....	730,350	1,735,491	47.4	134,154	1,869,645
1891. ....	1,154,144	2,556,328	44.2	367,977	2,924,305
1892. ....	1,979,354	4,297,610	43.4	243,461	4,541,071
1893. ....	2,203,704	5,187,206	47.0	293,292	5,480,498
1894. ....	2,830,885	6,963,100	49.2	704,052	7,667,152
1895. ....	3,456,575	7,840,770	45.2	728,776	8,569,555
1896. ....	4,011,697	7,864,341	39.2	739,480	8,603,821
1897. ....	5,325,355	10,583,616	39.74	1,070,109	11,653,725
1898. ....	7,331,446	15,141,376	41.3	1,099,254	16,240,630
1899a. ....	6,639,355	14,046,686	41.14	661,220	15,728,693
1899b. ....	233,395	1,020,787	.....	.....	.....
1900. ....	459,018	1,510,131	65.82	.....	1,510,131
1901. ....	412,006	1,014,687	49.25	81,364	1,096,051
1902. ....	3,416,813	7,179,074	42.00	74,591	7,253,665
1903. ....	6,105,016	12,146,307	39.79	442,941	12,589,248
1904e. ....	8,014,000	15,454,000	38.5	500,000	15,954,000

(a) January to October. (b) November to December, supplementary (incomplete). (c) Estima d.

break of the war. The following table gives the figures for the two periods:

	Aug. 1899.	Oct. 1904.	Per ct.
Number of stamps.	5,970	4,905	82.1
Tons milled. ....	812,469	701,729	86.3
Value of yield. ....	£1,642,025	£1,333,481	81.2

Many stamps are still idle owing to shortage of unskilled labor, but as this difficulty is now being surmounted, a constant increase in the output may be expected.

The number of mines that make returns is small, compared with the number of

not necessarily mean that the mines are getting poorer. This is due largely to the reduced expense of working; with lower costs it becomes profitable to mine a grade of ore which would otherwise be left in the mine, and probably lost for all time. The grade most profitable to maintain, having regard for the life of a mine, is a nice point involving elaborate actuarial calculations. In general, it may be said that the managers strive to approach the economic limits as closely as possible, so that a low-

**Transvaal Gold Production for 1904.**

Month, 1904.	Witwatersrand Mines.					Outside Mines, £	All Transvaal, £
	No. of Cos.	Tons Milled.	No. of Stamps.	Fine gold Ozs.	Value, £.		
January. ....	53	606,389	4,367	278,867	1,184,552	42,294	1,226,846
February. ....	55	607,703	4,565	282,436	1,199,712	30,014	1,229,726
March. ....	56	653,675	4,688	299,625	1,272,726	36,603	1,309,329
April. ....	56	640,294	4,710	297,470	1,263,572	36,004	1,299,576
May. ....	57	672,974	4,810	306,586	1,302,294	33,582	1,335,826
June. ....	58	652,050	4,790	299,913	1,273,949	35,282	1,309,231
July. ....	57	661,069	4,705	298,825	1,269,328	38,293	1,307,621
August. ....	57	678,684	4,760	301,113	1,279,047	47,421	1,326,468
September. ....	57	666,026	4,785	301,131	1,279,123	47,382	1,326,506
October. ....	58	701,729	4,905	313,928	1,333,481	49,686	1,383,167
November. ....	.....	724,000	.....	324,011	1,376,311	51,636	1,427,947
December. ....	.....	759,000	.....	335,000	1,420,000	51,636	1,471,636
Total. ....	.....	8,014,593	.....	3,638,905	15,454,000	499,784	15,953,879

mining companies that have been formed. A recent report of the State Mining Engineer, gives a total of 224 gold mines, of which 56 were producing, 38 developing and 130 not working on June 30, 1903, the date to which the returns were made up; the same report gives some statistics of the amounts expended on development and equipment, the figures of which, however, do not agree with those presented to Mr. Chamberlain by the Chamber of Mines, on the occasion of his visit to South Africa, in 1902. That statement gave an

ering of costs has the effect of preventing a waste of mineral wealth.

A study of the returns shows a marked decrease in working costs since the war, partly due to the lower price of dynamite and coal, and partly to the attention that is paid to economy in every department. It is difficult to make comparisons at any mine for different periods, and still more so to compare one mine with another, because so many factors have to be taken into consideration, such as the scale of operations, cost of labor and material,

width of stope, etc. The data supplied by the Rand Mines, Ltd., are valuable in this connection:

Company.	1899.		1903.		Reduction.	
	s.	d.	s.	d.	s.	d.
Glen Deep	26	7	24	6	2	1
Rose Deep	22	9	17	8	5	1
Goldenhuis Deep	21	4	19	5	1	11
Jumpers Deep	28	10	22	11	5	11
Nourse Deep	30	6	27	10	2	8
Crown Deep	23	7	18	10	4	9
Langlaagte Deep	28		23	10	4	2
Durban Roodepoort Deep	36	6	27	10	8	8

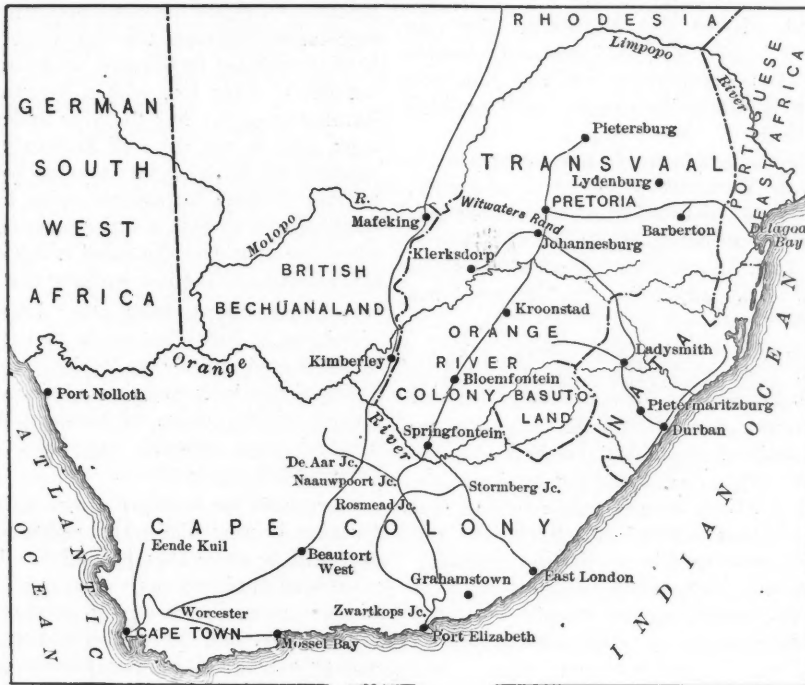
These figures are a healthy sign, because, as has been pointed out so often, the

in every direction, for, as more stamps were dropped, so additional employment was found for the white population. On this point some instructive figures may be quoted from a letter written by Lord Milner, to a correspondent at home, and published in the English newspapers. He calculated that the introduction of 7,000 Chinese, which was about the number employed during August and September, had led to the increase of 1,000 white workmen,

1904.	Natives.	Chinese.	Total Colored Labor.
January	68,767		68,767
February	69,966		69,966
March	72,340		72,340
April	72,577		72,577
May	70,778		70,778
June	68,857	1,004	69,861
July	67,294	1,384	68,678
August	65,848	4,947	70,795
September	68,545	9,039	77,584
October	71,661	12,968	84,629
November	74,223	19,316	93,549

The Chinaman has proved himself to be a good workman; he makes rapid progress in learning to drill, so that in a short time he can do as much as the best Kaffir. He has given very little trouble since his arrival, and is settling down to his new life with contentment. Great pains have been taken to make his life comfortable and to give him the food to which he is accustomed in his own country. As to the expense of procuring this labor, no exact statistics have yet been published; but estimates have been made ranging from £12 to £25 per head. The contract is for three years, so that the expense per annum may be taken at about £7 or £8, without allowing for the expense of repatriation.

Turning now to the subject of white labor, I may draw attention to the fact that the conditions of living are now far more favorable than they were before the war. At that time there were comparatively few married men living with their families in South Africa. The conditions have so far changed that many men have their families on the spot, and intend making the Rand their home. The mining companies are encouraging their employees to do this, and are erecting comfortable cottages with small gardens attached. In connection with this point, some instructive figures were given recently by Mr. Samuel Evans at a meeting of the Langlaagte Deep Gold Mining Company: "In 1899 there were on the property only two families (including the manager's), and



SOUTH AFRICA.

future of the Rand is bound up with the possibility of working the low-grade ore, which is widely distributed over the Transvaal.

The most important event of the year has been the arrival of the Chinese miner. It was not without a great deal of opposition that the importation of indentured labor was allowed. The question whether it was either necessary or wise to introduce a foreign element was hotly debated in England and South Africa; the most violent opponents of the scheme looked upon it as a return of the slave trade, while the majority regarded it as necessary to the very life of the mining industry; the industrial backbone of the country, which was not expanding owing to the lack of unskilled labor. The ordinance to regulate the introduction into the Transvaal of unskilled, non-European laborers, was passed in the Legislative Council at Pretoria on February 10, 1904, by an overwhelming majority.

The Chinese commenced to figure in the returns during June, when 1,004 were employed, a number which was increased in November to 19,316. This welcome addition to the labor supply caused a corresponding increase in the gold production, and had the effect of stimulating business

and assuming that half of those were married, and had families of four children on an average, the direct result of the employment of these Chinese was an increase of 3,000 in the whites employed, not to mention the livelihood given to a larger

	Number of mines making returns.	Share capital issued.	Amount expended on shafts and development.	Amount expended on equipment.
<b>Gold Mines.</b>				
Witwatersrand.				
Producing, dividend-paying	25	£11,833,750	£2,593,713	£5,371,193
Producing, non-dividend paying	23	10,915,108	2,927,727	5,197,963
Developing	29	13,148,592	2,825,696	3,985,635
Mines not working	96	29,513,040	1,421,076	2,555,495
	173	£65,411,490	£9,768,212	£17,110,286
Outside Districts.				
Total	51	10,738,780	670,960	1,405,460
Totals for gold mines	224	£76,150,270	£10,439,172	£18,515,746
<b>Coal Mines.</b>				
Producing	12	£3,609,880	£140,163	£573,980
Non-producing	5	625,250	25,980	25,935
Total for coal mines	17	£4,235,130	£166,143	£599,915
<b>Diamond Mines.</b>				
Total	6	856,375	14,547	46,041
Grand totals	247	£81,241,775	£10,619,862	£19,161,702

number dependent on the activity of the mines.

The number of whites employed on the mines in October, 1904, was 14,525. The ratio of white to colored labor being 1 to 5.82. In July, 1899, the ratio was 1 to 8.578. The statistics of colored labor for the year are as follows:

no children. To-day the figures as regards our white employees are:

Number married and housed on property (number of children 66)	39
Number of married employees who live with their families off the property	12
Number of married employees whose families are in England	37
Number of single men living at the mine	124

"We recognize that we have everything to gain by doing all we can to make the lives of our white employees happy and cheerful. The houses we have built for them are very comfortable four-roomed cottages, with bathroom, pantry and from 3,000 to 3,400 sq. ft. of garden and yard space. We propose erecting more of these cottages, as we want the 49 married men whose families are living elsewhere, to be housed on the mine. It is a wise policy on our part to do all we can to induce our white employees to bring their families out and make this country their home, as the married man who is comfortably settled with his family, is by far the best and most reliable workman."

On the same occasion Mr. Evans gave an interesting estimate as to the annual expenditure required for an importation of 50,000 Chinese.

Wages of white skilled laborers.....	£2,000,000
Wages of Chinese unskilled laborers....	1,500,000
Cost of procuring Chinese (spread over three years).....	200,000
Explosives.....	575,000
Fuel.....	670,000
Stores and supplies purchased through local dealers.....	1,795,000
Taxes paid to the Government.....	255,000
Sundry expenses and stores purchased outside of S. Africa.....	290,000
Total.....	£7,285,000

This works out at £146 per annum per unskilled laborer. It will be seen that the estimated cost of importing a Chinaman is £12 per head, per annum.

Turning now to the progress of the industry in technical matters, mention must be made of the introduction of tube-mills for fine grinding. This machine has been used for some time past on the gold mines of Western Australia, where the ores have been ground finer than has been the practice on the Rand. Experiments have shown that finer grinding than has been customary will pay, and it is claimed that the finest grinding can be done better by the tube-mill or some other form of grinding machine, than by the stamp. On several mines tube-mills have been installed, and many more have been ordered. To what extent machines supplementary to stamps will be introduced, or what is the best machine, has not yet been determined. It may, however, be said that changes in the ordinary practice are taking place and that the standard plant of the future will probably be a combination of stamps and fine grinders. Experiments are also being made in the use of filter-presses, and provided a rapidly discharging press is found, this method, for which quicker treatment and higher extraction are claimed, may take the place of the decantation process in the treatment of slime.

As regards the effect of these changes on the economical results, it has been calculated that on an average 10-dwt. ore an additional extraction of 50c. per ton may be made, giving a net profit of 25c. per ton. On last year's tonnage of 8,000,000 tons, this would mean a saving of \$2,000,000.

The total dividends for the year cannot

be given as yet, as many companies do not make a declaration until the new year arrives. It is possible, however, to estimate them roughly from the figures of the first half year, during which 31 companies declared dividends amounting to £1,999,825; from which it is inferred that the total for the year will exceed £4,000,000.

There has been great activity in boring, especially at the eastern end of the Rand, with the result that much information has been obtained regarding the extension of the mining area. While the Witwatersrand district is responsible for the great bulk of the gold produced, outside districts have also made a considerable contribution, to the extent of half a million sterling.

Besides gold, the Transvaal promises to be an important producer of diamonds, one mine, the Premier, having yielded during the period of July 1, 1903, to March 31, 1904, 195,730½ carats, valued at £264,649. The output for the Transvaal has been:

	Carats.	Value.
Year ending June 30, 1903....	33,572.57	£46,358
Year ending June 30, 1904....	497,917.14	685,720
July, Aug. Sept. Oct. 1904..	366,310.94	491,064

Mining for base metals has not yet reached large proportions, but with the influx of population and a reduction in the cost of living, there is reason to hope that before long mining for copper, iron and other ores, may be carried on. Speaking generally, the mining industry is in a healthy condition, with promise of a considerable expansion in the coming year.

**CALCIUM CARBIDE IN VENEZUELA.**—By reason of the high price of gas and electric light in Venezuela, acetylene is commonly employed. The importation of calcium carbide to that country for this purpose, in 1904, amounted to about 1,500,000 kilograms.

**SIZING.**—Concentration implies accurate grinding; but this in turn implies accurate sizing; otherwise a large light particle may be classified mechanically with a small heavier particle of the same total weight. Hence, recent milling practice has witnessed great improvement in the direction of better screening, sizing, and classification.

**RADIUM EMANATIONS.**—These are classified as follows: (1) The alpha-rays, which are comparatively coarse particles of matter, being about the size of two atoms of hydrogen, carrying a charge of electricity, and traveling at a 20,000 mile rate per second; they have slight penetrating power. (2) The beta-rays are much finer, being only one-thousandth the size of a hydrogen atom; they are identical with the 'radiant matter' of Crookes—or the 'cathode rays'; they carry negative electricity, travel at a rate of 160,000 miles per second. (3) The gamma-rays, which are not matter, but only pulses in the ether.

## New Zealand.

By E. W. BONWICK.

The following review covers the period for the twelve months up to August 1, the latest date for which complete returns were obtainable.

**Dredging.**—The southern rivers of the South Island have long been the scene of extensive operations; but, in 1902, local investors, encouraged by the steady and remunerative returns obtained by several dredges, began to invest largely in new ventures. Despite the usual proportion of speculative schemes, the net result has been to increase the number of producing dredges to over 100, with a satisfactory increase in gold. For the year under review, gold to the value of \$2,183,935 was obtained by dredging, the average weekly earning of some 100 dredges being in the neighborhood of \$450, a satisfactory figure, when one considers the small initial capital required and the low working cost.

Dredging differs from other branches of mining in New Zealand in that it has been fostered entirely by local enterprise. Some of the later machines designed by Messrs. Cutten Bros., of Dunedin, have been of large capacity and capable of handling low-grade gravel.

As regards the southern rivers at least, dredging is near high-water mark. The statement is made that ground has been re-dredged profitably more than once; but this is a process that cannot be repeated *ad infinitum*, and it is certain that the most promising areas are now under operation. Speaking generally, the standard, both as regards design and construction of dredges and the handling of them, is high; and the difference, between the capital necessary to exploit a dredging enterprise in New Zealand, and one operated from London, is very marked, the comparison being greatly in favor of the former, not only as regards cost, but also in adapting the machine to varying conditions.

The quartz mining of the Hauraki peninsula may be divided into three districts—the Thames, Coromandel and Ohinemuri. Enormously rich surface deposits characterized early mining on the Thames, and Coromandel also had palmy days in the past. Their output at the present time is insignificant, the Ohinemuri district being the only field of importance. Unlike the high-grade, generally free-milling ores of Thames and Coromandel, the Ohinemuri deposit is low grade, of large size and of complex composition.

In 1895 and 1896 the Hauraki peninsula received a large influx of English capital, mainly upon the strength of returns from the Waihi mine, and the possibility of treating (by cyanide) ore hitherto regarded as unprofitable. The results from large prospecting and development have been disappointing. Of the numerous properties worked during this boom, not one per cent reached the milling stage;

while of those equipped by London, practically only two—the Talisman and Komata Reefs—are now making profitable returns.

The bright spot in Ohinemuri is the manner in which the Waihi mine has opened up. Of the \$4,337,750 produced by the peninsula (during the 12 months under review), this property must be credited with \$2,900,165, or over 66 per cent of the whole. The Talisman is showing regular monthly returns (in the neighborhood of \$40,000), and will probably shortly join the ranks of the dividend-payers. The Woodstock, once a steady producer and dividend-payer, has shut down, owing to low value at depth, and its equipment was sold to the Talisman; the Crown, which also formerly occupied a similarly satisfactory position, has fallen upon bad times, its orebody having greatly decreased in value with depth. The Waitekauri, notwithstanding vigorous prospecting work, has been unable to resume continuous milling, its plant having been idle for some 2½ years, consequent upon a complete cutting-off of its rich quartz vein by barren calcite.

At the Waihi there was initiated a policy too long deferred, viz., development in depth. A new Hathorn-Davey compound pump has been installed, capable of handling 1,500 gal. of water per min., and a vigorous policy has been commenced. During the 12 months under review 115,178 tons were crushed, for a return of \$2,900,000, or at the rate of over \$25 per ton. At the writer's last visit to the mine, the cross-cut from the shaft at the lowest level traversed 80 ft. of solid quartz, all of which was payable. The mine is equipped with 300 head of stamps, split up into three mills situated at considerable distances from each other. Given vigorous development and a concentration and increase of milling plant, the Waihi should stand prominent among the great mines of the world.

The geology is interesting from the close relation between vein values and a certain country rock. The peninsula, with the exception of some limited volcanic rocks, is a series of andesite flows; the ore is closely dependent upon the extent of decomposition of the andesite. Generally speaking, the greater decomposition the better value. A disagreeable feature in connection with several Ohinemuri deposits has been the occurrence of horizontal zones of barren ore in the pay chutes. New Zealand mines are not characterized by extensive ore-reserves, and the striking of such a floor means, in most cases, an interruption of milling, and the raising of capital for further development at greater depth.

As regards milling, Ohinemuri ore is generally heavily mineralized sulphide, containing a large proportion of its value in the form of silver sulphide; the bullion varies from £2 10s. down to 10s. per

ounce, silver running sometimes as high as 30 parts to one of gold. Copper and manganese, and sometimes nickel, are associated. The general scheme in the mills is wet crushing with heavy stamps (1,250 lb.); after fairly fine breaking the pulp passes over amalgamated plates, then over concentrating tables (generally Union or Frue, although Wilfley is making its appearance), sometimes preceded, and sometimes followed, by separation of slime and sand. This slime and sand is charged into vats and treated direct with strong cyanide solution (as high as 2½ per cent), weak solution such as characterizes South African practice being useless. The ore frequently requires long treatment, sometimes 11 or 12 days. Both decantation, and filter-pressing after agitation of slimes, are used. The latter gives higher extraction and less mechanical loss of cyanide, but is at present the dearer process.

As regards cost, information is difficult to obtain, but Messrs. Bewick, Moreing & Company have reduced working expenses at the Talisman below \$5 per ton, a creditable figure considering the difficult ore and troublesome labor.

The future of Ohinemuri, taking the present as a guide, is dependent largely upon the mines surrounding the Waihi. In some of these diamond drilling has discovered the extension of the Waihi reef. Heavy expenditure on pumping machinery will be necessary before development can be done; this is an expenditure too heavy for local investors, and it must eventually be borne by London, which, with 1905 and 1906 in mind, is not evincing unseemly haste. However, the Waihi district has great possibilities.

The gold product for the South Island, excluding dredging, was \$1,150,810, and was derived from widely differing sources. The Progress, operating on a quartz vein, contributed \$534,860, or nearly one-half of the whole. The remainder came from hydraulicking on the cement bed of the West Coast, from alluvial diggings in the Nelson and other districts, and from small quartz mines locally owned.

With the exception of the Progress (which is controlled by the Exploration Company of London), and dredging, there has been no feature of importance.

Complete figures for the whole of New Zealand for 1904 are not yet available. For 1902 the total production of gold and silver was \$9,737,165; for 1903, \$10,189,155. There will be no decided increase for 1904.

Plato clearly outlined the three great entities of knowledge, culture, and character, which he called the true, the beautiful, and the good. Civilization may be defined and measured by its appreciation and use of these.

### Eastern States of Australia.

By F. S. MANCE.

It is anticipated that complete returns will show that the total mineral production of the eastern States of Australia varied but little from that for 1903, which was:

State.	Value.
New South Wales . . . . .	\$28,380,537
Victoria . . . . .	16,231,296
Queensland . . . . .	17,693,261
Tasmania . . . . .	6,254,021
South Australia . . . . .	2,802,845
Total . . . . .	\$71,361,960

Gold falls short, as does coal; but these decreases are compensated somewhat by the greater value of the silver and lead; in both copper and tin a slight advance is exhibited; while the augmented production of other minerals, more particularly wolfram, goes far toward making good any deficiency in the total output.

Gold.—The position of the industry in the several States and in New Zealand, may be gathered from the following table, the estimates being based on the actual yield for the first ten months of the year:

State.	1903. oz. fine.	1904. oz. fine.
Western Australia . . . . .	2,064,801	1,995,250
Eastern States		
Victoria . . . . .	767,351	762,250
Queensland . . . . .	668,546	634,600
New South Wales . . . . .	254,260	242,750
Tasmania . . . . .	59,891	66,400
South Australia . . . . .	21,195	23,250
Commonwealth . . . . .	3,836,044	3,724,500
New Zealand . . . . .	479,748	483,000
Total for Australasia . . . . .	4,315,792	4,207,500

Victoria maintains the lead as a gold producer, this branch of the industry being followed more closely than in the neighboring States. Bendigo has been the chief center of activity, and the output, which has not been exceeded during the past thirty years, amounts to 240,000 oz. The line of workings extends for ten miles, and payable returns have been obtained at depths varying from 500 to 2,815 ft. The most noteworthy results have been secured by the South New Moon Company; the yield for the twelve months ending with November, was 36,143 oz. from 27,357 tons, the cost being \$3.78 per ton. Prospecting is being pushed with encouraging results at a vertical depth of over 4,020 ft. At Walhalla and Berringa, the mines have been energetically worked, the Long Tunnel, Extended, and Birthday companies standing out prominently as regular dividend payers. The Long Tunnel, at Walhalla, has produced more gold than any mine in Victoria; but work has been suspended for two years past to enable the necessary development (including the sinking of a new shaft to a depth of 2,880 ft.) to be carried out. The reef was intersected in November, and this mine has again become productive. The general results from Ballarat approximate those of the previous year. The average yield for the September quarter, fell to 5.21 dwt. per ton; and it speaks well for the management that the principal companies were able to declare substantial dividends. The

majority of the companies working the Berry, Duke, Chiltern, and Rutherglen deep alluvial leads, have obtained satisfactory returns; and this fact, coupled with extensive explorations on other leads, has given a decided stimulus to this class of mining. The dredges working at Castlemaine, Bright, and Creswick have also had a profitable year.

In Queensland, the mines have been unable to maintain the large yield recorded for 1903. Charters Towers maintains its position as the premier goldfield; the aver-

Morgan mine shows decided improvement, the yield for the twelve months, ending June, amounting to 109,902 oz. fine. This company is erecting a complete plant to deal with the extensive deposits of copper-gold ore occurring in the lower levels. Boring operations have proved the existence of 1,046,000 tons, averaging 3.5 per cent copper and 8 dwt. gold, and other further large bodies of less value. A feature of the industry in this State was the alluvial gold rush at Dee river, Rockhampton, where numerous nuggets were

arrangements to treat the ore; although the gold average is the same, the increase in copper necessitates treatment other than by cyanide. The Wyalong district made a satisfactory output. As in Victoria, the numerous dredges operating on the alluvial deposits have done well, and the gold obtained from this source forms no inconsiderable proportion of the total yield.

In Tasmania, the gold comes chiefly from the refining of blister-copper and silver-lead bullion; but there are several productive gold mines, notably the Tasmania at Beaconsfield, and the New Golden Gate at Mathinna. The record of the Tasmania mine, to the end of June, 1904, shows that 516,998 tons of quartz were treated for a yield of 588,789 ounces.

South Australia comes last as a gold producing State. Good progress is being made in opening up several fields, notably at Tarcoola, Arltunga, and the MacDonnell ranges; the output from these has increased. As a stimulus to the industry, the State Government has established crushing and cyanide plants in the principal districts.

*Silver and Lead.*—Broken Hill is the greatest mining center in Australia. The improvements effected in ore treatment, the economies in mining, and the increase in the price of lead and silver, have all had the effect of placing the mines in a most satisfactory position. Those companies, which had suspended operations for several years past, resumed productive work; and the number of men employed along the line of lode was greater than any year since 1900. The success achieved, and the good work done by the several processes designed for the separation of the zinc from the tailing, afford ground for congratulation, and a large source of revenue has now been opened up to the several companies. From the Yerranderie mines (also in New South Wales), improved returns were obtained; the general prospects of this field are encouraging. The mines at Zeehan and Dundas, on the west coast of Tasmania, also register an output well in advance of 1903. The value of the products from the silver-lead mines in the eastern States, including the silver refined from copper produced by the Mount Lyell and Chillagoe companies, is estimated for the year at \$15,300,000.

*Copper.*—Satisfactory results were obtained in copper mining. The largest output is credited to Mount Lyell in Tasmania. The production of the Mount Lyell company amounted to 8,250 tons, and the profits show a gratifying increase. The ore-reserves are sufficient to enable operations of the present magnitude to be continued for several years. In South Australia, the York peninsula contributed approximately 6,000 tons of copper, the bulk of which was supplied by the Wallaroo and Moonta mines. Operations were greatly impeded by the fire at the Wallaroo, which entailed the direct expenditure of \$264,000. In New South



THE EASTERN STATES OF AUSTRALIA.

age output during each month of the past year has approximated 22,000 oz. fine, while the dividends averaged \$156,000 per month. The ore raised during 1904 was of lower grade, and the yield consequently is less, but the financial results were better. The Queen Cross Reef Company has maintained a monthly dividend of \$96,000; other consistent dividend payers were the Brilliant St. George, the United, and the Brilliant Central. The next field in importance is Gympie, which at the end of October had been worked for 37 years and had produced 2,509,075 oz. fine. Here, also, the quality of the ore declined; and, notwithstanding an increased tonnage, the yield fell off. Returns from the Mount

found, ranging from several ounces to 182 oz. in weight. Encouraging results were obtained from Croydon, and the output was larger.

New South Wales holds the first place among the eastern States for its production of minerals; but, as the returns indicate, gold mining is a minor industry. The scene of the largest operations is at Cobar, the chief producers being the Mount Boppy Company, and the Cobar Gold Mines Limited. The Great Cobar Company also contributed, the gold being refined from the copper. The total production from this district suffered because the Cobar Gold Mines Limited has been compelled lately to limit productive work, pending



Wales, the Cobar mine has fully maintained its position; and the extensive additions and improvements made to the plant enabled an increased output to be successfully handled. In this district several mines of considerable promise are being developed. The Burruga mine, which has been one of the most consistent producers in New South Wales, shut down in July, because the ore was not rich enough to cover working expenses; the miners refusing to submit to any reduction. Development work was carried on, meanwhile, with a limited staff, and with such a measure of success, that operations were resumed lately. At one time, the closing down of the smelting works and mines of the New Chillagoe Railway & Mines Company, in Queensland, also seemed inevitable, earnings being insufficient to meet interest on the debenture debt. The position was, however, tided over and work proceeded on the usual scale. The Cloncurry field is attracting much attention, and proposals are in hand for extensive development, on orebodies which are said to give a return of 25 per cent of metal.

**Tin.**—Good progress can be recorded in this branch; the principal mines are in the satisfactory position of being able to augment their output still further. In Queensland, the mines on the Walsh and Tinaroo field have developed well, and supplied regular quantities of ore, the principal contributors being the Stannary Hills, Lancelot, Vulcan, and Smith's Creek companies. In Tasmania, the Mount Bischoff company has carried on operations uninterruptedly, and the year's work shows much better financial results. At the Briseis and New Brothers Home mines, the removal of the greater portion of the massive rock and overburden, which had a thickness of as much as 136 ft., has been completed; and the companies are now able to attack the enormous bed of tin-drift which is about 145 ft. thick, with a width of from 250 to 300 ft. In New South Wales, a satisfactory yield continues to be obtained from the stanniferous drifts in the New England district. The dredges, particularly those working on the Queensland border, are an important feature. Dredging for tin is also followed with payable results in Tasmania. An exceedingly rich deposit of stream tin was discovered and worked by some Chinese at Port Darwin in the Northern Territory; the area of the deposit, however, appears to be limited.

**Coal.**—The production of New South Wales, as already mentioned, is less. The output for 1904 is estimated at 5,733,000 long tons, which is a decrease of 622,000 on 1903. The principal falling off occurs in the export trade, and is particularly marked in respect of shipments to the west coast of America. This industry has been greatly hampered by labor troubles; and the owners contend that, owing to the

excessive hewing rates they have been compelled to pay to the miners, they have been unable to compete successfully for trade. The opening up of the large and easily worked seams in the Maitland district has led to the diminished trade being more widely distributed; and this has also militated against the prosecution of profitable operations. In Queensland, a number of mines have been profitably worked, and the prospecting and opening up of other seams have also engaged attention; but the outlay of considerable capital will be necessary before these mines can successfully enter the lists against the collieries more favorably situated on

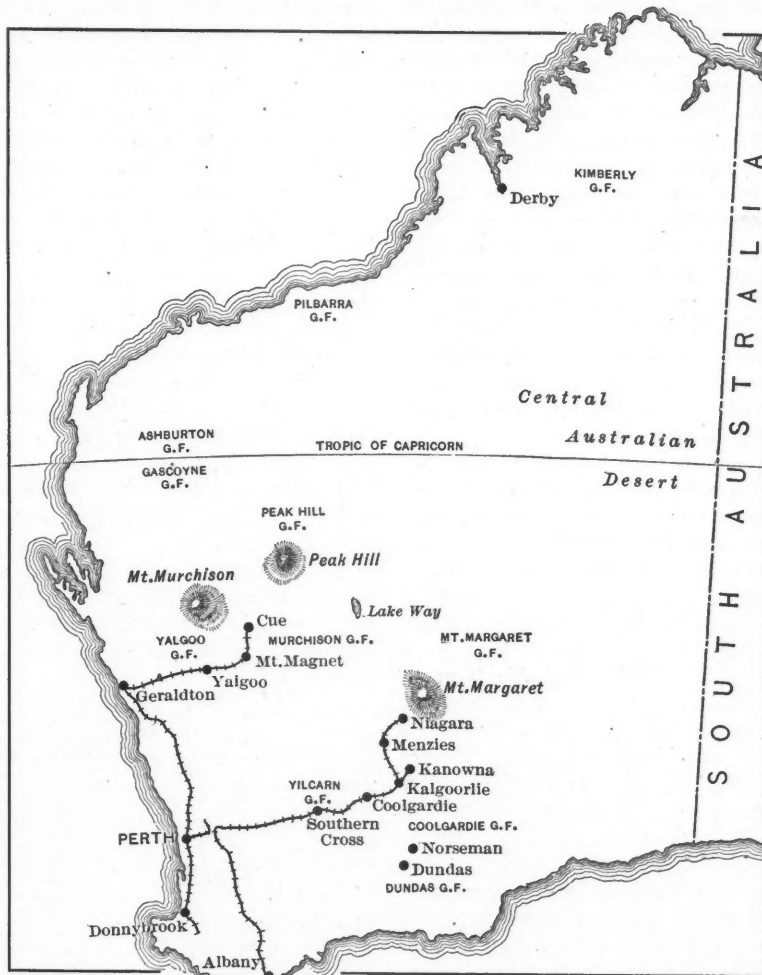
**Western Australia.**

By H. C. HOOPER.

The production for the year, month by month, as compared to 1903, is as follows:

	1903.	1904.
	Oz.	Oz.
January . . . . .	210,450.92	211,373.35
February . . . . .	192,397.38	194,320.69
March . . . . .	104,723.39	163,728.59
April . . . . .	208,626.94	216,573.61
May . . . . .	207,500.75	191,732.08
June . . . . .	208,059.45	200,356.82
July . . . . .	212,501.46	192,306.51
August . . . . .	206,617.27	201,536.71
September . . . . .	201,404.79	198,449.00
October . . . . .	190,784.61	208,926.00
November . . . . .	201,173.54	196,153.00
December . . . . .	202,070.40	197,515.00
Total bullion . . . . .	2,436,310.80	2,373,021.36
Equivalent fine gold . . . . .	2,064,801.40	1,983,845.86

It will be seen that the total production



SKETCH MAP OF WESTERN AUSTRALIA.

the seaboard. The long-standing labor difficulty, at the Outtrim mines in Victoria, has been settled; but, in this case also, the fact that these seams are situated some distance from the industrial centers is a serious handicap in the competition for trade.

**Other Minerals.**—The mining for wolfram in Queensland, reached large proportions, and the value of the output amounted to \$528,000. The extent of the deposits and the activity of the miners, resulted in over-production. The mining for precious opal at White Cliffs, in New South Wales, is still a lucrative industry, and supports a large population.

shows a decrease of 80,955 oz. fine gold. This decrease has been pretty evenly distributed over the entire State, and does not apply to any particular district. It is probable that a further reduction will take place, barring new discoveries; during the past two or three years a large percentage of the production has come from ore extracted from above water-level by prospectors, and milled at Government batteries and customs mills. This is, of course, a transitory production, as a great number of the mines which are thus worked, do not warrant equipment for further operation in depth. The backbone of the industry is the yield derived from

about 16 large mines. These mines treated roughly 1,300,000 tons of ore in 1903, and 1,600,000 tons of ore in 1904, in both years furnishing close to 60 per cent of the total production. There is not likely to be further increase from this group, as the mines are pretty well equipped to their limit. I estimate the total dividends paid, and to be paid, on account of 1904, at £2,050,000, as against £2,024,152 in 1903. In addition to this, amounts aggregating probably £300,000 will be added to reserve funds during the year. There should be an increase in dividends during 1905, as in 1904 very large sums have been expended in extension of equipment.

There has been no great change in working methods during the year. The re-grinding of sand by tube-mills, or otherwise, as a means of increasing the stamp duty, and as an aid to extraction, has made steady progress. In the practical development of this feature of gold metallurgy, this State can fairly claim to have been the pioneer, and the method is now finding rapid favor in South Africa, Mexico, etc. Practically every large stamp-mill in Western Australia is now partially or wholly equipped for the re-grinding of sand, and the stamp-duty now averages well over 6 tons per diem, and 7 tons is not considered by colonial metallurgists as being beyond attainment. It is, of course, possible to increase the stamp-duty even further by the re-grinding of coarser screen products, but there is an economic limit, not very well defined yet, as to what proportion of sand and of what coarseness, it is profitable to re-grind. The problem of fine grinding is considerably complicated by the slime question. In the case of some ores, it is highly desirable from an extraction point of view, that the sand should be ground to slime, and in some mills in this State, the whole of the product is thus reduced. In other mills, a practically equally efficient extraction is secured by percolation, when the question of expense of re-grinding slimes is considered. It is not always easy to determine to what extent it pays to grind to slime, in order to secure an increased extraction, and the problem has been approached in most cases by gradually re-grinding an increased proportion of the sand to slime, until the economic point is reached.

In underground methods, there has been but little change, except for the tendency to put levels at a greater distance, now from 150 ft. to 250 ft. apart, instead of the old arbitrary interval of 100 ft. A number of mines whose reefs are adaptable to the purpose, are initiating shrinkage stoping, in order to do away with the costly filling hitherto rendered necessary by the scarcity of timber.

More careful and economical practice throughout all the leading mines, has resulted in the reduction of expenses, and an increase in the percentage of extraction, until Western Australia can be considered

from a working standpoint to have reached a very satisfactory footing. Accurate comparative statements are difficult to prepare, because of the wide variety in the character of the ore-deposits, in the metallurgical character of the ore itself, the size of the mines, and in their situation. The minimum necessary expense on simple ores is exemplified by the Great Fingall and the Cosmopolitan mines, which are working quartz reefs of fairly large and regular size, the ore from which presents no special metallurgical difficulties. The process employed at these mines is wet milling, concentration, treatment of concentrate by roasting, fine-grinding and cyanidation, separating the coarse sand and re-grinding portions of it, the treatment of sand by percolation, the treatment of slime by agitation and filter-pressing. Exploitation under more complex conditions is best represented by the Oroya Brownhill, Associated and Lake View mines, where the ore occurs in disconnected bodies, difficult of access and costly of development, the ore itself containing quantities of tellurides which necessitate special treatment. In the case of the Oroya Brownhill, treating telluride ore, the ore is milled wet, concentrated, the concentrate is treated by roasting, fine-grinding and cyanidation, the coarse sand is ground in pans, and the entire product passed through tube-mills, where it is ground to an absolute slime. The slime is agitated with bromo-cyanide and the solution separated in the filter-presses.

The following tables of expenditure on the Great Fingall and the Oroya Brownhill, for the last quarter, include the total expenditure, except taxes on profits and London office:

	Oroya Brownhill. 50 stamps.	Great Fingall. 100 stamps
Development .....	\$1.5600	\$0.6000
Breaking ore .....	0.8720	1.1592
Supporting stopes .....	0.1594	0.0330
Trucking and haulage .....	0.6516	0.3994
Rock-breaking .....	0.1572	0.0922
Ore transport .....	0.0876	0.1102
Milling .....	0.5442	0.8276
Concentrating .....	0.1412	0.1050
Roasting concentrate .....	0.1628	
Fine grinding .....	0.1144	0.0856
Cyaniding .....	0.1044	
Fine grinding sand .....	0.3216	
Cyaniding by percolation .....		0.2560
Cyaniding by agitation .....	1.6172	0.2240
Filter-pressing .....	0.3992	
Precipitation and smelting .....	0.2526	0.0732
Disposal of residue .....	0.0578	0.2920
Realization of bullion .....	0.1734	0.1808
Total .....	\$7.3766	\$4.4382

These figures indicate in a general way the costs of working in the State at the present time; they include distributed management, superintendence and royalties.

**IRON-NICKEL SEPARATION.**—A clean separation of iron from cobalt and nickel, as recommended by the *Chemiker-Zeitung*, is found by the use of ammonium formate. The iron falls down, and should be re-dissolved and re-precipitated to remove traces of nickel and cobalt. Precipitation, filtration and washing should be done in the heated condition.

## Oil and Gas in Kansas and Indian Territory.

BY ERASMUS HAWORTH.

During the year 1904 oil and gas development in Kansas and the Indian Territory was unusually vigorous. At the beginning of the year there was a total of a little less than 1,600 wells producing oil within the entire area; at the close there was fully 4,000. The total production of oil for the area by the month, and the daily average for each month, were as follows:

	Total.	Daily average.
January .....	282,309	9,107
February .....	313,556	10,813
March .....	338,274	10,912
April .....	348,791	11,627
May .....	383,514	12,371
June .....	355,740	11,858
July .....	508,996	16,416
August .....	548,276	17,686
September .....	531,611	17,720
October .....	600,737	19,378
November .....	636,193	21,206
December .....	754,966	24,353
	5,602,963	15,287

Of this amount Kansas produced about 4,000,000 barrels and the Indian Territory the remainder. The production, therefore, at the close of the year is at a rate of almost 9,000,000 barrels per year, and bids fair to increase greatly during the next two or three years.

The areas most productive in Kansas are located principally in Allen, Neosho, Wilson, Montgomery and Chautauqua counties. Early in the year there was great activity in the Bolton field near Independence, in Montgomery county. Also there was rapid development in all of the other counties named, particularly Chautauqua. By the end of the year general activity had checked to a considerable extent in all parts of Kansas except in Chautauqua county.

The new outlying fields which were developed during the year within the State were two, one in the vicinity of Erie in Neosho county, and one in the vicinity of Paola in Miami county, figures from neither one of which are included in the total above given. Some oil developments began about Erie in 1903, but during the year 1904 a good supply of oil was obtained from many different wells. This has scarcely been marketed at all, on account of a lack of facilities for transportation. Activity about Paola began in earnest in midsummer, 1904, and continued to the end of the year. Here a shallow oil sand is found at a depth of about 350 ft., which seems to be as productive as the average oil sand of Humboldt and Chautauqua. The Standard Oil Company has promised Paola a pipe-line.

Oil development at Coffeyville began during 1903 and continued throughout 1904. A fair amount of good oil was found in shallow sands from 350 to 500 ft. deep. This territory seems to be very spotted, so much so that during the latter part of the year prospecting was not

crowded. Oil was found also about Tyro, nine miles east of Caney, near the southern part of the State. That field, likewise, is spotted, some wells flowing as much as 250 barrels a day, while others near by may be dry. A fair pool was opened up during the year in the vicinity of Wayside, on the Santa Fé railway, about six miles southwest of Bolton, or 12 miles from Independence.

In Chautauqua county there seem to be three well-defined pools; the Spurlock-Blundell pool near the southern line of the county, south and a little west of Peru; the Hoffman pool from three to five miles south of Sedan, and the pool immediately under the little town of Peru. The Spurlock-Blundell area had the greater development early in the year, but during the latter part the Hoffman field became the most active. It bids fair to develop into the best oil field yet opened up in the State. More than a hundred wells were put down on town lots in Peru. They started with a capacity of from 20 to 30 barrels per day, but are now almost exhausted. In the vicinity of Humboldt and Chanute, oil is obtained at from 700 to 900 ft.; in the Bolton-Wayside area from 800 to 1,000 ft.; at Coffeyville oil thus far found is shallow, from 350 to 500 ft.; at Tyro it is from 1,050 to 1,200 ft.; at Caney near 1,400 ft.; in the Spurlock-Blundell pool, oil is usually found at 1,100 to 1,150 ft., and in the Hoffman pool at about 1,200 to 1,300 ft. deep.

Throughout more than half the year development in the Indian Territory was confined principally to the lands belonging to the Osage Indians, on account of difficulties in the way of obtaining leases elsewhere. The Indian Territory Illuminating Oil Company has a blanket lease on the entire Osage lands and sub-leases to actual operators. Development was confined principally to the extreme eastern portion of the Osage lands until near the close of the year. In September a good oil well was brought in at Cleveland, in Oklahoma Territory, just across the Arkansas river from the Osage lands. This resulted in a great rush to all lands adjacent, both in Cleveland on the south and in the Osage nation on the north, and at present many drills are in operation on both sides of the river. It is reported that leases there are higher than anywhere else, excepting immediately adjacent Bartlesville. Development was also carried on throughout the year in the vicinity of Muskogee, Chelsea, Tulsa, Red Fork and Bartlesville.

Later in the year the Secretary of the Interior began confirming leases within the Cherokee territory, and immediately drilling began with great activity, so that at the present time derricks are being erected and drills are in operation in many places. A few small areas were leased previously, notably, Section 12, including nearly all the town-site of Bartlesville

which was leased to the Cudahy Company; and an area of 12 sections near Chelsea leased to the Cherokee Oil & Gas Company. A part of the town-site of Bartlesville was deeded outright, so that the owners can lease or drill at their pleasure. Since Cherokee leases have been confirmed, drilling has become very active in the vicinity of the little town of Alluwe, about 30 miles south of Coffeyville, and also at the villages of Dewey and Lenapah, the former being four miles north of Bartlesville, and the latter ten miles south of Coffeyville. At the close of November Chelsea had about 96 producing wells, Red Fork 50, Cleveland 10, Muskogee 35 or more, Bartlesville nearly 200, and other points within the Osage territory 75 or 80 more.

At Chelsea and Alluwe the wells are from 300 to 600 ft. in depth; at Red Fork and Tulsa, from 700 to 1,000 ft.; at Muskogee, 1,000 to 1,200 ft.; at Bartlesville, about 1,100 to 1,400, and at Cleveland, 1,600 to 1,700 ft., the deepest of any in the entire Kansas-Indian Territory field.

Kansas and the Indian Territory to-day probably have a greater production of gas than any other equal area in the world. Gas has been in use in a dozen or more towns within the State for twelve or fifteen years, during which time an enormous amount of it has been consumed. The largest factories which are great consumers are zinc smelters and the Portland cement factories at Iola, and zinc smelters at Neodesha, Cherryvale and Caney, the enormous brick-yards here and there all through the gas area, and the glass factories at Coffeyville, Independence and Caney. Already the original gas-field at Iola is beginning to weaken, but a new field was developed late in the year, lying to the north of the old, which has gas sufficient to keep Iola going for an indefinite period. To the south the largest gas-fields are in the vicinity of Cherryvale, Neodesha, Coffeyville, Independence, Caney, and in the Indian Territory at Bartlesville and Ochelata. In Chautauqua county there are two principal gas-fields, one to the south of Peru, and the other adjoining the Hoffman oil-field on the east. The most remarkable gas yet discovered in the State was developed during the year from four to seven miles south of Independence. Here are a number of wells with a flowing capacity of more than 20,000,000 cu. ft. per day each; one of these is reported to have been bought recently, after careful measurement, on a basis of a daily capacity of 33,000,000 cu. ft. It is hardly probable, however, that the wells are quite as strong as popularly reported. It is said that while this well stood wide open with gas issuing out of a 6¼-in. pipe, the flow exerted a pressure on the mouth of the closed tube equal to 35 lb. per square inch. Robinson's tables include estimates for no pipe larger than 6 in. But after

making corrections for position of mouth of closed pipe, a flow of 35 lb. pressure is equal to about 31,000,000 cu. ft. daily capacity by the tables.

Early in the year a well was drilled at Caney, which found a body of gas at a depth of about 1,600 ft. This gives a static pressure of more than 600 lb. and a flowage of 21,000,000 cu. ft. Very recently some strong wells have been brought in at Bartlesville and further south in the vicinity of Ochelata.

Recently there is great agitation about piping gas outside the State. Already a pipe-line is nearly completed to carry gas to Joplin and other points in the zinc-fields, and it is reported a right of way has been secured for a pipe-line to Kansas City. In the mean time local citizens are doing everything they can to prevent gas being piped out, resorting to legal obstructions wherever possible, and even to more severe measures. What the final outcome will be, cannot now be told, but probably resistance will be futile and the gas will be piped out.

With the exception of Muskogee, throughout this entire area, oil and gas are obtained from sandstones lying within the Lower Coal Measures. Muskogee has a productive sand lying some 600 or 800 ft. below the base of the Coal Measures. Its exact geological properties are not yet determined, but provisionally it may be classified as Lower Silurian.

#### Arsenic.

Although the United States consumes about one-half of the world's production of arsenic, chiefly in the manufacture of Paris green for coloring and for agricultural purposes, the production in this country was only about 498 short tons, valued at \$29,504. The greater part of this was recovered at the Everett smelter, in Washington, owned by the American Smelting & Refining Company, and was a by-product in reducing arsenical pyrite. Some 60 tons were made by the new works at Brinton, in Virginia, and this product will in all probability be largely increased during the present year, as the supply of arsenical pyrite is known to be large, and works for its reduction have been built on a considerable scale. The Brinton deposits and the works of the company have been fully described in the columns of the JOURNAL, July 21, 1904.

The imports of arsenic into the United States in 1904 are estimated at 4,000 short tons. They come from Great Britain, Germany, Spain and Canada. It should be mentioned that the arsenic referred to is not the metal which is a fairly common product, but arsenious acid—As<sub>2</sub>O<sub>3</sub>—which is the white arsenic of commerce. Smaller quantities of red arsenic, which is used principally in coloring glass and other substances, are imported chiefly from Germany.

### Ontario.

By THOMAS W. GIBSON.

The mining industry in the Province of Ontario during the year 1904 has maintained a considerable degree of activity.

Certain mineral products are practically peculiar to this Province, at any rate so far as this continent is concerned. One of these is nickel, which is found abundantly in the Sudbury district, north of Lake Huron, where the industry has now become firmly established. The ore is essentially a pyrrhotite, part of the iron being replaced by nickel, but occasionally some of the richer nickel minerals are also encountered. Copper, chiefly in the form of chalcopyrite, is also a constituent of the ore to about the same extent as the nickel. The main operators at the present time are the Canadian Copper Company and the Mond Nickel Company. The former, whose works are on much the larger scale, has been overhauling and remodelling its plant, which had rather grown up with the development of its business than been erected on a systematic plan, and replacing it by modern reduction works with the latest improvements and labor-saving devices. The old smelting furnaces of 150 tons daily capacity have been discarded for furnaces capable of treating four times the quantity of ore. The ordinary or low-grade matte, containing about 30 or 35 per cent of nickel and copper, which is the first product of these furnaces, was formerly re-treated and enriched to say 75 or 80 per cent by crushing, grinding, calcining and re-smelting; it is now subjected to a bessemerizing process in converters of the ordinary type. The Canadian Copper Company—which is the producing member of the International Nickel Company—owns a large number of mining properties in the nickel field, some of which have been worked for years, while others are held in reserve; but practically all the ore now being used comes from one mine—the Creighton—without doubt the greatest nickel mine in the world. From the huge deposit of nickel-copper ore which comes right to the surface, there is being quarried about 1,000 tons per day, and the ore easily in sight is estimated to be equal to 20 to 25 years' supply. Not only is the orebody very large, but it is unusually rich, carrying from 6 to 10 per cent of the two metals, nickel largely predominating. The Mond Company's mines were idle for the greater part of the year, and part of the smelting plant was leased to the Canadian Copper Company, but recently the owners have resumed possession, and are again at work. The bessemerized matte made at this company's works, is refined at Clydach, Wales, by a process of Dr. Mond's own invention. Owing to the interruptions due to these changes, the actual output of nickel and copper from the Sudbury mines will in all probability be less than in 1903. For the nine months ending September 30, about

3,500 tons of nickel (in matte) had been produced, as against 6,998 tons during the whole of 1903. The Lake Superior Corporation, whose widespread operations suffered so disastrous a collapse nearly two years ago, has not done much work at either the Gertrude or Elsie mine since these properties were shut down. The diamond drilling done at the former, disclosed, it is said, a considerable body of good ore.

The bulk of the copper raised in Ontario comes from the nickel-copper ore of Sudbury, but west of that district there are many copper sulphide prospects and mines which seem capable of considerable production. They are at present handicapped by the want of capital on the part of their owners and also by the lack of smelting facilities. Taking account of all sources, for the nine months ending in September, about 1,750 tons of copper were produced, mainly in the form of matte, although a few tons of blister copper were reduced at the Mond Nickel Company's smelter from ore taken from the Massey Station mine. At the Massey mine an Elmore oil-concentrating plant has been installed, which it is expected will be successful in saving the finely disseminated copper pyrite characteristic of the orebody. The Hermina prospect, situated not far from the Massey mine, has shipped some good ore to the United States for treatment.

The quantity of iron ore raised in the Province in 1904 was less than in 1903, the figures being about 100,000 tons for the former as against 208,154 tons for the latter year. The cause of this reduction is found in the idleness of the Helen mine until the month of July last. Since that time the mine, under improved management, has been yielding about 1,000 tons of ore per day, and promises to be a large producer in 1905. In former years complaints were not lacking that the ore as shipped was not uniform in quality; but cargoes during the past season proved very satisfactory to blast-furnace men, demonstrating that greater care is now being taken in mining and classifying the ore. The last shipment was made from Michipicoten about the end of November, at which time navigation was practically closed, but the mine is being operated this winter and the ore stock-piled. The Williams mine (hematite) north of Sault Ste. Marie, and the Radnor mine (magnetite) in Renfrew county, also contributed to the total production. The latter mine is owned by the Canadian Iron Furnace Company, whose works are situated at Midland, Ont., and Radnor, Que. Prospecting was carried on during the year on a number of the iron ranges in Ontario, including the Animikie at Loon Lake and the Temagami at the lake of that name. There is no reason to doubt that at Moon Lake a very considerable body of hematite exists in a rock formation practically indistinguishable

from the Mesabi in Minnesota. There are two ore-beds, one above the other, the uppermost being a few feet only below the surface, and an estimate of 5,000,000 tons of ore has been made on the rather insufficient data yet obtained. Deep water in Lake Superior is close by, and the Canadian Pacific Railway runs through the deposits, so that shipping facilities are all that can be desired. In quality the ore varies from a first-class bessemer down, but practically all will be merchantable. A diamond-drill plant on an outcropping of the Temagami range encountered a very strong flow of artesian water, and much loose, fine, cherty material at a depth of about 190 ft., and before the iron formation was struck. Drilling in this hole, which was regarded as likely to give definite results, has therefore been suspended for the time being. The Atikokan range, about 200 miles west of this point, is being connected with the Canadian Northern railway by a three-mile siding, and shipments may be expected from these deposits as well.

The pig iron turned out by the blast furnaces of the Province will be in excess of the output for 1903. For the first nine months of the year the quantity made was 84,000 tons, as compared with 87,000 tons the year before. There are now four furnaces, an addition of one during the year. The new plant is one of the four stacks partially constructed by the Lake Superior Company at Sault Ste. Marie before its failure. This one has since been completed and is now in operation, making pig iron of excellent quality, and using coke as fuel. A charcoal furnace is also approaching completion, and will probably be blown in early in January. The pig iron made at the Sault, together with pig from other Canadian and American plants, is being converted into steel rails at the Lake Superior Company's steel plant. These rails are of first-class quality, answering every test, and a fair list of orders has been booked by the company from the leading railways and also from the government. The metallurgical situation at Sault Ste. Marie is good. Steel billets continue to be made at Hamilton in about the same quantities as last year, by the open-hearth process.

Near Haileybury, on the Temiskaming & Northern Ontario railway—the new government line—the remarkable finds of native silver and cobalt-nickel arsenides found in 1903 have undergone considerable development. The veins, though narrow, averaging not more than 8 or 10 in. in width, are exceedingly rich; seldom has native silver been found anywhere in greater profusion. From one of the veins, found in the spring of 1904, a carload of ore weighing 20 tons, 200 lb. was recently shipped to New York, and the owner, Mr. W. G. Trethewey, received a return of \$37,500, being at the rate of nearly \$1 per pound of ore. Shipments have been made

from several other properties, also high in silver. The principal value at present is in the silver, but the ore is essentially an arsenide of cobalt and nickel, and it is believed that the deposits will produce largely of these metals, especially of cobalt which runs from 12 to 15 per cent in weight of the vein contents. The rock in which the ore is found is slate or slate-breccia, apparently not differing in character from much of the Lake Temagami region, but broken by dikes of diabase. New York parties have become heavily interested in these cobalt ores. Owing to the proximity of the railway, which passes within a few yards of one of the mines, the shipping facilities are very good, freight to New York being about \$7 per ton.

Gold mining operations have been confined very largely to the extreme western portion of the Province, where, on the Lake of the Woods, the old Sultana mine is again in commission on a new strike of good ore. A 10-stamp mill is going up on the Cameron Island mine. In the Lake Manitou region, the Twentieth Century 20-stamp mill and mining plant have been moved to the Laurentian claims, owned by the same interests, and the Big Master management has been overhauling the mill and machinery, and also endeavoring to raise funds for further development work. On Sturgeon lake, the Jack Lake Mining Company has put in a 10-stamp mill on the St. Anthony reef, and at the Redeemer mine, near Dryden Station, a 10-stamp mill has also been put in. At the Sunbeam, or A. L. 282, west of Port Arthur, a 10-stamp mill ran for three months or so, and a 5-stamp plant is now going up at the Shakespeare, near Webbwood, on the north shore of Lake Huron. In eastern Ontario all the gold mines are closed down, for the present at any rate.

Another of Ontario's distinctive, if not peculiar, minerals is arsenic, of which there are large stores in the mispickel deposits, mostly auriferous, of the Hastings county region. These are for the moment lying unworked; but the arsenic resources of the Province have been enlarged, not only by the discovery of the arsenides of cobalt and nickel at Haileybury, already described, but by the exploitation of mispickel bodies on Net lake near Lake Temagami, where several large bodies of this ore are undergoing development.

Iron pyrite exists at many and widely separated points in Ontario, but last year actual production was confined to one company, which raised a considerable quantity of ore in Hastings county, and shipped it to the United States for the manufacture of sulphuric acid. Some new finds of this mineral have been made in eastern Ontario, and also in the Lake Temagami region, not far from the mispickel bodies already mentioned. These are being stripped and opened up preparatory to production.

The amber mica of Ontario and Quebec

bears an enviable reputation for use in electrical apparatus, and a very large proportion of the quantity required for such purposes in America is extracted from the mines of this Province. The best known property is the Lacey mine near Sydenham, owned by the General Electric Company, believed to be the largest producer of first-class mica in the world.

Corundum is another mineral found abundantly in Ontario, but of comparatively uncommon occurrence elsewhere. The nepheline syenites of Renfrew and Hastings counties are in places prolific of corundum of first-class quality for abrasive purposes. The Canada Corundum Company, which was the first mining concern in the field, has replaced its original mill by one having a capacity to treat 200 tons of corundum-bearing rock per day, and the Ashland Emery Company has taken over the property of the Ontario Corundum Company, and is producing a good article of grain corundum. One or two other concerns, among them Corundum Refiners, Ltd., have entered the business, but so far have not reached the producing stage. The output of corundum increased in value from \$6,000 in 1900 to \$87,600 in 1903, and it is likely the production for 1904 will exceed that of last year.

Other mining industries, smaller themselves, but of considerable importance, have to do with the extraction of feldspar, which is quarried in the Kingston region and exported for use in the potteries of the United States; and with the production of graphite, actinolite, talc, gypsum, lead and zinc and other materials. Most of these industries have been prosecuted with about the same degree of energy in 1904 as in 1903.

The manufacture of portland cement is extending rapidly in Ontario. In 1903 the production was 695,260 barrels, and no doubt this figure will be materially increased by the output of 1904. Both shell-marl and clay are abundant, and at the outset the business of making portland cement was very profitable. Competition from domestic and foreign sources has lowered prices somewhat, but the demand is constantly growing. One or two new plants have gone into operation during the year, and others are being equipped with machinery. In certain of the newer factories limestone is being substituted for marl as an ingredient.

Other materials of construction, such as building stone, brick and lime, have been produced probably in greater quantity, or at any rate to greater value than formerly, due no doubt to the fact that building materials of all kinds have gone up materially in price during the past year or two.

Salt and gypsum are among the mineral products of the southwestern peninsula of Ontario, and both continue to be won, the former in considerable quantities, the latter on a meager scale.

The petroleum fields of Lambton county,

which have been so prolific of oil, have for several years shown a diminution in yield. This may be counteracted to some extent by the new wells struck, mainly in the southeastern townships of Essex county, in the neighborhood of Leamington, where drilling has been active for two or three years. The bounty of 1.5c. per imperial gallon given by the Dominion Government since June 8 last had a tendency to increase the production of domestic crude.

Extensions of the natural gas areas have been made of late years, mainly in the neighborhood of the mouth of the Grand river in Haldimand county. It is proposed to pipe gas from this field to the city of Hamilton, and pipes are now being laid down for this purpose. The city of Brantford is now being supplied with natural gas from wells bored in that neighborhood, chiefly on Bow Park farm, where it is found in the white Medina strata. The city of Niagara Falls is also now using natural gas as fuel; it is supplied by the Provincial Natural Gas & Fuel Company from the wells in the county of Welland.

Altogether, mining in Ontario during 1904 was fairly active, and the developments under way are such as to lead to the confident hope that in a few years the industry will attain to large dimensions.

**GOLD IN ELECTROLYSIS.**—V. Lenher has shown that from a gold anode, in dilute sulphuric, nitric, or phosphoric acid, none of the metal passes to the cathode; the cathode becomes covered with a layer of gold oxide. But in concentrated sulphuric or phosphoric acid, the gold anode is regularly transported to the cathode, and more easily with increasing temperature. In the electrolysis of solutions of sodium or potassium hydroxide, the gold of the anode is very slightly transferred to the cathode, a gold oxide covering the metal at the anode.

**COPPER SULPHATE AS A GERMICIDE.**—It has been known for some years that copper sulphate is exceedingly active, both as a germicide and as an algicide. Recent and numerous experiments confirm this. It appears that one part of copper sulphate in eight million parts of reservoir water will prevent and destroy all microscopic growths; and, after two or three days, the copper is removed by automatic precipitation. There is no danger from poisoning, as the dilution is so great that one would have to drink forty gallons a day to obtain a medicinal dose. It is probable that the typhoid germ may be killed by one part of copper sulphate in two millions of water. The discovery is largely due to Drs. Moore and Kellerman of the Department of Agriculture, and Mr. F. H. Pugh has conducted corroborating experiments on the water supply of New York. Thus again there is shown a connection between metallurgy and organic chemistry.

**British Columbia.**

By E. JACOBS.

Mineral production for 1904 made the record in the history of the province. In 1901 the total was \$20,086,780; in 1902, and again in 1903, it fell a little below \$17,500,000. An estimate for the year just closed gives about \$21,000,000. The most marked increase is in coal and coke, which together show an advance of about \$2,000,000 over the production of 1903. Lead, under the stimulating influence of the bounty granted by the Dominion Government, made an advance of about \$750,000. Gold increased by nearly \$400,000—placer gold making about \$80,000, and lode gold the remainder. Silver was about \$350,000 better than last year. Copper alone, of the metals, appears to have lost in value, though not in quantity, the year's production having been higher. A new

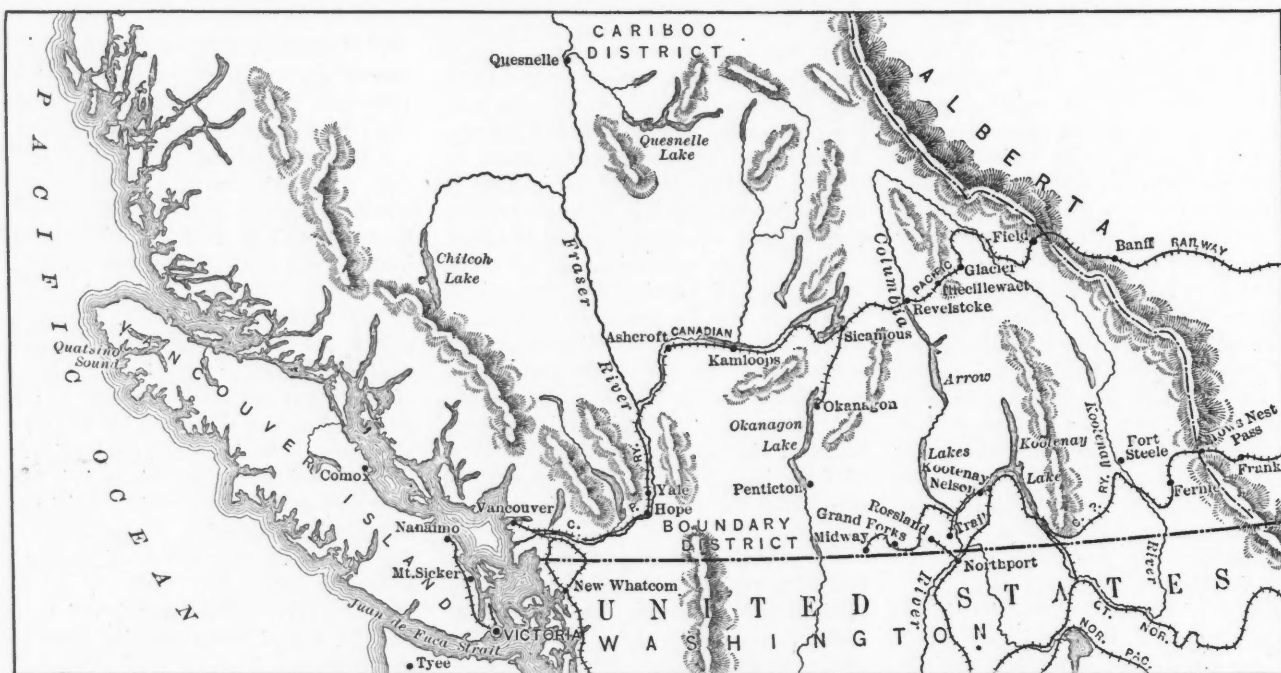
The tonnage of ore as published throughout the mining districts is misleading in some cases. For instance, wherever there are concentrators, as in the Slocum silver-lead-zinc sections, the figures given represent the tonnage of concentrate and crude ore shipped, while other districts are given credit for the full quantity of ore milled. Metals produced show the following approximate figures:

	1903.	1904.
Gold, placer.....Oz.	53,021	57,050
Gold, lode....."	232,831	256,135
Total gold....."	285,852	313,185
Silver....."	2,996,204	3,505,805
Copper....."	34,359,921	36,088,580
Lead.....Lb.	18,089,283	37,000,000
Coal.....Tons.	1,163,184	1,068,000
Coke....."	165,543	272,400

In lode gold, copper, coal and coke, the quantity produced in 1904 was higher than in any previous year; but in placer gold and silver, some years have seen a much

**Copper.**—There was an increase both in the Boundary, and on Vancouver Island. The increase in the former district was not proportionate to the larger tonnage of ore smelted, showing that the low costs of mining and smelting there are admitting of lower grade than heretofore. On Vancouver Island the Tye Copper Company's works were kept going nearly all the year; but those at Crofton were shut down early in the spring, for lack of ore.

**NEW USE FOR TITANIUM.**—Titanium is not really a rare element, for it has been shown to be more abundant in the crust of the globe than carbon. It has for years seriously interfered with the use of certain ores for the manufacture of iron and steel, in the formation both of trouble-



THE MINING REGIONS OF BRITISH COLUMBIA.

feature, though of only prospective importance, as yet, is zinc ore, of which some 7,000 tons were mined and sold, adding about \$100,000 to the year's total.

The production is valued as follows:

Gold placer.....	\$1,141,000
Gold lode.....	5,123,000
Total gold.....	\$6,264,000
Silver.....	1,898,000
Copper.....	4,540,000
Lead.....	1,415,000
Zinc and iron.....	100,000
Total metalliferous.....	\$14,217,000
Coal.....	\$5,004,000
Coke.....	1,362,000
Building materials, etc.....	550,000
Total non-metalliferous.....	\$6,916,000
Total.....	\$21,133,000

Production by districts was as follows:

Cariboo.....	\$500,000
Cassiar.....	520,000
East Kootenay.....	4,813,800
West Kootenay.....	6,266,600
Lillooet.....	25,000
Yale.....	4,025,900
Coast (mainland and Vancouver Island).....	4,431,700
Miscellaneous.....	550,000
Total.....	\$21,133,000

larger quantity, while lead was below that of 1900, which was the record year.

**Gold.**—The increase in placer gold came from the Cariboo and Quesnel divisions of Cariboo district, and from the Atlin division of Cassiar. At Quesnel, the Consolidated Cariboo Hydraulic Company recovered about \$90,000, as against less than \$45,000 in 1903; while the estimate for Atlin shows an increase of \$60,000. Most of the increase in lode gold is credited to the Similkameen, where the Nickel Plate joined the producers.

**Silver.**—The increase came from East Kootenay, the St. Eugene mine, after three years' idleness, having resumed operations, consequent on the granting of the lead bounty. Its silver output was about 540,000 oz. The Silver Cup Mines, Ltd., started its silver mill late in the spring, and produced a large sum from dump ores, which took the place of higher grade shipped the previous year.

some nitride and cyanide, and also of certain infusible slags. It now appears that use may be made of the element in the reduced form of sodium-titanous sulphate,  $Na^2Ti_2III(SO_4)_4 \cdot (H_2O)_x$ . This is a soluble crystalline substance of a lilac color, and may be produced commercially by electrolysis of a sulphuric acid solution of the basic sulphate, with sodium sulphate. It may be used as a chemical reducer, as in discharging coloring matters from textile fabrics (patent No. 758,710, N. Spence, Manchester, England). It is interesting to know that this titanous compound carries the element in the same tantalizing condition that used to annoy us as we attempted the test in the old days of our qualitative analysis. It should be remarked that, while ordinary titanium bears itself as a stable tetrad, the titanous compounds show the element masquerading as an unstable triad. Other titanous salts may also be derived, as the acetate.

**Coal.**

The production of coal in the United States, though still far in advance of that of any other country, showed a slight decrease, as compared with the previous year. The total is estimated at 343,524,884 tons, all returns being reduced uniformly to short tons of 2,000 lb. each. Of this total, 273,774,922 tons were bituminous coal, and 69,749,962 tons were anthracite; the proportions of each to the total being 79.7 and 20.3 per cent, respectively. As compared with 1903, the total shows a decrease of 2 per cent, or 6,851,435 tons only.

In computing this production we have neglected the few thousand tons produced in Alaska, and consumed close to the point of origin; a few thousand tons of lignite mined in Idaho; and the production of Georgia and North Carolina, which probably amounted to 300,000 tons, but concerning which no figures could be obtained. These items, however, are entirely insignificant, as compared with the total.

The production of coal received a great impetus during the prosperous years from 1901 to 1903, and in the last named year it reached a record which showed in some degree the capacity of our coal mines, with their present equipment. During this period many new mines were opened, including a number of large operations equipped with the latest machinery, and with every facility for a great production. To this fact it is probably due that the total in 1904 showed so very small a decrease, in the face of a lessened demand in many parts of the country, at least during the first six or eight months of the year. In the closing months there was a strong reaction, and an increased demand which increased requisitions upon the mines to a point almost as high as in the boom time of 1903. Nevertheless, it is quite probable that there was a certain amount of over-production last year, which was at times reflected in competition among mines and among different districts, and in resulting low prices. This was especially the case in some of the central States of the West, such as Indiana, Illinois, Iowa and Missouri; also to some extent in Ohio and West Virginia.

It may be said that the great production made last year could probably be increased by 20 or 25 per cent, without much enlarging the number of mines, or their equipment, in case of an intensified demand. Few large mines—and indeed not many small ones—are worked to their full capacity. The returns of the States where careful reports are made show that averages of from 210 to 225 working days in the year are general. It would appear, therefore, that the increase named—of 20 or 25 per cent—could be obtained simply through more continuous working with only such stoppages as are absolutely necessary. Such an increase, however,

would involve improvements in railroad facilities and equipment for handling coal, since at different times during the year the coal trade of important sections was embarrassed by delays in shipment and the failure of the railroads to respond fully to the demands upon them.

The decrease in the case of the great majority of States was not large, and in some there was an actual increase. The most marked falling off, perhaps, was in Pennsylvania, where the great production of 1903 was reached under the stimulus of extreme activity in the iron and steel trades. In Illinois, which is the second State as a producer, there was, on the

PRODUCTION OF COAL IN THE UNITED STATES.

State or Territory.	1903. Short Tons.	1904. Short Tons.
Bituminous:		
Alabama . . . . .	11,700,753	12,250,000
Arkansas . . . . .	2,300,000	2,350,000
California . . . . .	93,026	93,000
Colorado . . . . .	7,651,694	7,000,000
Illinois . . . . .	(a)34,955,073	37,077,897
Indiana . . . . .	9,972,553	9,000,000
Indian Ter. . . . .	3,243,692	3,000,000
Iowa . . . . .	6,365,233	5,728,700
Kansas . . . . .	5,875,000	5,950,000
Kentucky . . . . .	7,075,000	7,000,000
Maryland . . . . .	4,400,000	4,350,000
Michigan . . . . .	1,581,346	1,341,375
Missouri . . . . .	4,265,328	4,300,000
Montana . . . . .	1,600,000	1,472,204
New Mexico . . . . .	1,323,909	1,613,334
North Dakota . . . . .	300,000	300,000
Ohio . . . . .	24,573,266	25,000,000
Oregon . . . . .	50,000	94,638
Pennsylvania . . . . .	103,000,000	98,000,000
Tennessee . . . . .	4,810,758	4,590,000
Utah . . . . .	1,845,550	1,563,274
Virginia . . . . .	3,500,000	3,500,000
Washington . . . . .	3,190,477	2,990,500
West Virginia . . . . .	26,882,526	30,500,000
Wyoming . . . . .	4,602,929	4,800,000
Total . . . . .	275,088,113	273,774,922
Anthracite:		
Colorado . . . . .	20,000	22,500
New Mexico . . . . .	(a)35,621	25,942
Pennsylvania . . . . .	75,232,585	69,701,520
Total . . . . .	75,288,206	69,742,962
Grand total . . . . .	350,376,319	343,524,884
(a) Fiscal year.		

other hand, a considerable gain; the same was the case in West Virginia, which is the third on the list; while in Ohio, the fourth State, production was about the same.

In several of the western States slight decreases were due to the greater consumption in the large cities of the higher grade coals shipped from Ohio, Pennsylvania and West Virginia, and also to the better supplies of anthracite which were obtainable.

Pennsylvania continues to be by far the most important producer, supplying about one-half of all the coal mined in the country. It produces practically all of the anthracite, and about 27 per cent of the bituminous coal, and therefore remains the leading factor in the coal trade of the country.

No definite figures are obtainable as yet for the production of coke, owing to the delay of some of the chief producers in completing their figures. In 1903 the output of coke was 25,262,360 short tons. An approximate estimate would put the coke production for 1904 at 23,200,000 tons, in the manufacture of which some 35,000,000 tons of coal were required.

While there were local labor troubles in

various districts during the year, especially in southern Illinois, and a general strike in Alabama, the year was measurably free from labor troubles in the coal regions. The western bituminous schedule was settled by a compromise, and a two years' agreement was made covering several important fields. The anthracite mines were free from strikes or labor troubles of consequence.

The money return received for the coal mined by operators was somewhat less than in the previous year. On anthracite the amount received per ton must have been very nearly the same, the falling off being proportionate, of course, to the decrease in production. Owing to a complete organization of the trade, and the steady demand, there is very little variation in the values received for this class of fuel. In the western markets, however, as shown by the reports which follow, there was a pressure to sell, and a reduction in prices, which was not favorable to the producers.

In one respect the record of the year has not been a good one. So far as returns have been received, they indicate an increase in the number of accidents, the loss of life, and injury to person in coal mining. This is probably due to the intensified working of the past two years, the opening of new mines, and the employment of new men.

*Foreign Countries.*—In most European countries there were not the same reasons for a decrease in coal production which were found in this country. In Great Britain, which is, next to the United States, the largest producer, the output increases rather slowly, but there is every reason to believe that in 1904 it reached a total of fully 240,000,000 long tons, which is equal to 268,800,000 short tons. It was, therefore, less than our own production by 74,724,000 tons, or somewhat over one-fifth. In one respect the United Kingdom differs from other countries; it is the great coal exporter among nations. In 1904, estimating the month of December, the total British exports, including the coal furnished to steamers engaged in foreign trade, was 65,500,000 long tons, or 27.3 per cent of the total production.

In Germany, estimating November and December, the coal production was 166,700,000 metric tons, equivalent to 183,703,400 short tons, or a little more than half of our own output. This was an increase of about 8 per cent over the previous year.

The total coal production of the world was reported on the best authority for the year 1903 to be 881,737,550 metric tons. Reducing this to our own measure it was 971,939,300 short tons. In 1904 the production undoubtedly reached one billion tons. Of this our own country may be credited with about 35 per cent, Great Britain with 27 per cent, and Germany with 18 per cent; the three countries together supplying about 80 per cent of the world's vast demand for mineral fuel.

## THE ANTHRACITE COAL TRADE.

Probably there has been no year which has shown the effect of centralized control in the anthracite trade so plainly as the one just closed. Throughout the year trade has been remarkably even and free from disturbing conditions. It had been generally supposed that the enormous tonnage, which, in 1903, followed the close of the great strike, would hardly be approached in 1904. It is true that shipments were somewhat less, but nevertheless they made a very close approach to the record year, and exceeded the anticipation of some of the oldest observers in the trade. While the full returns for December are not yet in, there is no doubt that, allowing for the holiday stoppage, the shipments for the month exceeded 5,000,000 tons. This will make the total for the year approximately 57,500,000 tons, or only about 2,700,000 tons less than the enormous output of 1903.

The reported shipments of anthracite coal for the eleven months ending November 30, with the proportions originating on each of the lines, were as follows, in long tons:

	—1903.—		—1904.—	
	Tons.	Per ct.	Tons.	Per ct.
Reading.....	10,641,874	19.3	10,343,278	19.7
Lehigh Valley..	9,060,408	16.4	8,717,519	16.6
N. J. Central...	6,864,136	12.5	6,576,157	12.6
Del. Lack. & W.	8,829,967	16.0	8,546,309	16.3
Del. & Hudson..	5,457,922	9.9	4,837,197	9.3
Panna. R.R. ....	4,210,128	7.6	4,363,603	8.3
Erie R.R. ....	5,990,432	10.9	5,221,145	9.9
N. Y. Ont. & W.	2,572,177	4.6	2,410,719	4.6
Del., Sus. & Sch.	1,536,039	2.8	1,413,431	2.7
Totals.....	55,163,083	100.0	52,429,378	100.0

The changes in tonnage, and in proportion of shipments, are shown in the following table:

	Tons.	Per ct.
Reading.....D.	298,596	I. 0.4
Lehigh Valley.....D.	342,889	I. 0.2
N. J. Central.....D.	287,979	I. 0.1
Del., Lackawanna & Western.....D.	283,658	I. 0.3
Del. & Hudson.....D.	620,725	D. 0.6
Pennsylvania R.R.....I.	153,475	I. 0.7
Erie R.R.....D.	769,237	D. 1.0
New York, Ont. & Western.....D.	161,438	.....
Del., Sus. & Schuylkill.....D.	123,608	D. 0.1
Total.....D.	2,733,705	

The decreases shown in this table are in no case large. The most considerable changes in the proportion of shipments are an increase of 0.7 per cent by the Pennsylvania railroad; a decrease of 1 per cent by the Erie, and a loss of 0.6 per cent by the Delaware & Hudson. The last named change was due in large part to the falling off in shipments to Canada during the early part of the year, when the Northern lines were seriously hampered by severe and stormy weather.

The New York harbor trade, so far as the domestic sizes were concerned, continued very even throughout the year, demand being steady, and deliveries generally good. Parallel conditions obtained in Philadelphia, which is, next to New York, the most important delivery point on the coast. Schedule prices were generally maintained at these points. The plan of offering a discount of 50c. per ton from the schedule price on all purchases during the month of April, gradually decreas-

ing the discount by 10c. each month, until it disappeared in September, was again adopted. It was found to work well, as in the preceding year. The object of this discount is, of course, to promote the purchase and storing of coal by retail dealers and by householders through the spring and summer months, and so maintain the tonnage which would normally be lower during those months, and even up as far as possible, the demands on the railroads. To a very large extent this was found to be the case; though with householders early purchases were less the rule than in 1903; when the memory of the strike year and its coal famine was still fresh. Moreover, there seemed to be a general feeling that the very severe winter of 1903-4 would be followed by a milder season—an anticipation which has so far proved fairly correct.

The demand for the small or steam sizes was not as even as for domestic coal. The business depression of the early part of the year, and the extremely low prices at which bituminous coal was for some time sold at tidewater points, caused a smaller demand for these sizes, and in many cases, they were sold at considerable discounts, while large quantities had to be stocked for a time. It must be remembered that the production of a certain proportion of the small sizes is a necessary accompaniment to the preparation of the larger sizes, so that the output cannot be reduced, when demand falls off. At this period of the year pea coal was in the best demand, probably from the fact—which is not generally alluded to in public—that many retail dealers are in the habit of buying a certain proportion of pea, which they mix with the chestnut coal sold to householders. The other sizes, buckwheat, rice and barley, felt the depression very considerably. Later in the year, however, when business began to improve, and manufacturing establishments extended their purchases of coal, there was a marked betterment in trade. Prices improved, stocks were worked off, and long before December the small coal trade was in excellent condition, with prices well up the companies' schedules. This movement was assisted, in some degree, by the stricter enforcement of the ordinances against smoke, and the consumption of bituminous coal in New York, Boston and other large coast cities. There had been a considerable relaxation during the anthracite strike, and apparently it took a year or more for city officials to realize that the emergency was entirely over. When they did, however, they made up for lost time by greater strictness than had ever been known before.

Transportation was generally good throughout the year after the first quarter. The hard winter lasted until well on in March, with the necessary accompaniments of delays in traffic, the enforced haulage of smaller trains, and similar difficulties. From March on, however, there

was very little complaint, and coal moved freely and steadily.

The coastwise trade was generally good. The only interruption was some controversy over the bill of lading and demurrage question. The supply of vessels was, for the most part, good, so that New England ports found little difficulty in securing their full supplies. All-rail trade with New England points was not quite as satisfactory; especially in the later months of the year, there were annoying difficulties and delays in delivering coal to points in central and western New England, which are dependent upon the New York, New Haven & Hartford and the Boston & Maine railroads for their supplies. In December the connecting lines west of the Hudson were obliged to declare an embargo against the New Haven road on account of the great delays on the part of that road in returning cars. This was enforced for several weeks, when the transfer of coal cars to that road at New York harbor and at Newburg, were either stopped altogether or very much restricted. These delays, however, applied only to points east of the Hudson river. It may be said that the New Haven road is now making considerable improvements in the way of increased trackage facilities and more motive power, so that it is hoped there will be no recurrence of these troubles.

The course of the anthracite trade in Chicago and other western territory, is shown in the local reports which follow. Some falling off from the extraordinary shipments of the previous year was natural; but the loss was less than had been expected. Buffalo is the chief shipping port for the anthracite which goes up the Lakes; and its total for the year was 2,855,000 tons, a decrease of 345,000 tons, or 10.8 per cent. This is a moderate falling off, when the circumstances of the two seasons are considered. It may also be noted that toward the close of the season, when the shipments were heaviest, there was some interruption, due to shortage of cars, and to congestion in the receiving yards. The reports from the upper ports reflect this decrease also. Thus receipts by Lake at Chicago were 950,000 tons, a decrease of 226,000 tons, or 19.2 per cent. Those at Milwaukee were better, having been 865,000 tons, a decrease of 94,000 tons, or 9.8 per cent. The anthracite passing the Sault for Lake Superior ports reached a total of 991,228 tons, a decrease of 157,777 tons, or 13.7 per cent.

Some of this decrease may very possibly be due to the fact that many consumers were forced to turn from anthracite to bituminous during the strike, some of them have continued its use, finding it quite available for their purposes. This has promoted the use of the better grades of bituminous coal in many western cities.

The most important incident of the year



was undoubtedly the purchase of a controlling interest in the New York, Ontario & Western railroad company by the New York, New Haven & Hartford railroad company. The Ontario & Western, taking into consideration its coal lines only, and not considering the line to Oswego, or the western connections, has an important interest in the upper or Wyoming division of the anthracite region. Its shipments amount to about 2,800,000 tons of anthracite yearly, or 4.6 per cent of the total. Its line reaches tidewater at Cornwall, on the Hudson river, and from that point its trains run to Weehawken over the West Shore division of the New York Central, its delivery point for tidewater trade being at Weehawken, though it has also a shipping dock at Cornwall which is available, except for three or four months in the winter. The important point, however, is its connection at Maybrook and Campbell Hall, with the Poughkeepsie Bridge line, control of which was acquired by the New Haven company a year and a half ago. The Poughkeepsie Bridge line is not an ideal one for coal transportation, having many heavy grades between the Hudson river, and its eastern terminus at Hartford, but there is also available the short line, which connects the Poughkeepsie Bridge with the New Haven's western division—the old New York & New England road—near Fishkill. Two motives seem to have been prominent in this purchase; the first being a desire to secure business for the Poughkeepsie line, which has never been very prosperous; the second, and possibly the stronger, was the desire to control, as far as possible, the coal supply of the large district in western and southern New England served by its line. The policy of the New Haven road has always been the absolute control of traffic, and the coal trade is no exception. Heretofore, the coal supply of western Connecticut and Massachusetts has been received principally by water, to some of the Long Island sound ports, and thence by rail, giving only a short haul to the railroad lines. Hereafter, a much greater proportion of the coal for this section will probably be shipped all-rail, as soon as necessary improvements in the lines can be made.

This incident also derives considerable importance from the fact that it is the first time a New England company has acquired any direct ownership in the anthracite fields. The New York, Ontario & Western has been an independent company, in so far that it was not controlled in any way by the dominant interests which have in recent years practically unified the management of the anthracite coal business. While independent, however, it has always found its interest in acting with the other companies. Whether there will be any change in this policy under the New Haven management remains to be seen. Probably there will be none; but

the possession of the road and of its coal will be an important factor, in case differences should arise, or the New Haven company should wish to keep intruders out of its territory.

Near the close of the year an arrangement was made under the leadership of a Philadelphia banking house, to pool the stock of the old Lehigh Coal & Navigation company, and it was said that an option on the property had been given to a prominent company which was not named. This movement was successful, so far as securing the deposit of a large part of the stock was concerned, but before the transaction was closed, it was announced that the whole matter had been postponed. The then recent purchase of the Ontario & Western gave rise to rumors that the New Haven company was the prospective purchaser in this case also. The Lehigh Coal & Navigation lands are in the Lehigh field, and to connect them with the Ontario & Western would have required the construction of 35 or 40 miles of road through a rather difficult country. The coal property of the company is valuable, and it is one of the few surviving anthracite companies which bought their land at low prices and at an early date, and has been able to pay dividends on their mining operations throughout. It was also reported that the control had been taken by some of the older anthracite companies in order to prevent a further extension of the New Haven interests. Neither story has been confirmed, however, and the whole matter rests for the present.

The Hearst complaint to the Interstate Commerce Commission against the anthracite carrying roads, came forward again. The courts finally decided that the representatives of the companies must answer certain questions and give certain information, which they had refused to furnish the commission at the original hearings. Some sessions of the Commission were held in New York to receive this information; but it added little, or nothing, of importance to the evidence previously taken. The Commission has not yet rendered its decision in the case.

The conciliation board, provided for in the settlement of the anthracite strike, has had a number of minor cases before it. The most important one, at least that which caused the most feeling and was most strongly contested, was that relating to the payment of check-weighmen, which was fully discussed in the columns of the JOURNAL. In this, as in several other cases, the board failed to agree, and the final decision had to be made by the arbitrator, Carroll D. Wright.

It may be said that the anthracite trade was generally free from local strikes and small labor troubles. At one time a strike seemed imminent over the check-weighman question, but the matter was finally settled.

#### THE SEABOARD BITUMINOUS COAL TRADE.

If one should draw on the map a line from Baltimore to the head of the Cumberland valley, from thence to Hornellsville in New York, and thence to Buffalo or Dunkirk on Lake Erie, the region included between that line and the seacoast would form the district in which anthracite coal may be considered a necessity of life. More than 90 per cent of the anthracite mined is consumed in that section of the country; less than 10 per cent goes west or south of the line above given, and the greater part of that small proportion follows the line of the Lakes and is consumed in the larger cities and towns, either directly on the lake, or within a short distance of some port. Everywhere else, bituminous coal is supreme. Even in the district so delineated, it is only as domestic fuel that anthracite has an exclusive hold. For steam coal and for manufacturing purposes, except in a few large cities where it is prohibited by law, a very large proportion of the fuel used is bituminous. The same may be said of the considerable quantities which are furnished to steamships engaged in foreign trade and in coastwise navigation. Even the steamboats employed in local trade, use bituminous coal with the sole exception of the passenger boats plying on the Hudson river, on Long Island sound and in Boston harbor. The result is a large and important trade in coal of the bituminous variety to seaboard points, which comes mainly from the Clearfield, the Beech Creek, and the Broad Top regions in central Pennsylvania, the Georges Creek and Cumberland districts in Maryland and West Virginia, and the New River and Pocahontas fields, also in West Virginia. Comparatively little coal reaches the seaboard from the Pittsburg district or from Western Pennsylvania, with the single exception that mines of the Berwind-White Company in the western Pennsylvania district, supply a considerable share of the bunker coal which is sold to steamers in the port of New York.

In former years the seaboard bituminous market resembled a battlefield, in which the contending forces were not arrayed in orderly lines, but were fighting, every man for his own hand. In the past three or four years a good deal of this has disappeared, principally to the control which Pennsylvania railroad interests have obtained over some of the more important competing lines, such as the Baltimore & Ohio and the Norfolk & Western; nevertheless, there are still strong independent interests, especially in the Clearfield and the West Virginia districts, and among these occasionally there is active competition. The year just closed saw one of those periods of competition and consequent low prices, to get at the causes of which it is necessary to go back a little.

There is no question that the anthracite strike of 1902 unduly stimulated produc-

tion throughout the district which supplies the seaboard trade. There was a large increase in the production of coal in the districts serving the seaboard, and some of the producers seem to have formed the idea that this increase would be permanent. The result in 1903 was an over-production of coal, and considerable competition, in the course of which some of the Clearfield operators managed to secure large contracts by cutting under the prices upon which they had previously agreed with the West Virginia interests. In the early part of 1904, when long contracts for the delivery of coal to manufacturers and consumers were generally made, it was understood that the price on the basis of good average Clearfield should be \$1.25 at the mines. The West Virginia operators, however, embittered at the results of the previous year, and seeing also that demand was declining instead of increasing, promptly cut prices, and offered coal on the basis of 90c. at the mine, when the Clearfield operators were looking for \$1.25. The result was that they got the best orders, and the Clearfield men had to cut prices to the lowest figures known since the famine year of 1899. Sales were made as low as 60c. a ton at the mines, a price which was certainly not remunerative. This unsatisfactory condition of affairs continued through a large part of the year, and in fact it was well on towards August before there was any improvement. At the close of July, average Clearfield was selling at \$2.25 to \$2.35 per ton, f. o. b. New York harbor points, and at corresponding rates all along the coast.

In August, however, business began to improve, and with it the demand for coal. Many manufacturers found that their contracts, made when prospects did not appear good, were below their requirements. Moreover, production had been in some degree restricted, partly by the enforced closing down of some smaller operations, partly from the long drought, which interfered with work at the mines, and partly from inadequate transportation. The consequence was an advance which began in September, and which continued through the later months. The year closes with the lower grades of Clearfield selling at \$2.75 to \$3, and the better class of steam coals at \$3 to \$3.50, f. o. b. New York harbor; with corresponding prices on Baltimore and Philadelphia deliveries. Operators are feeling much better, and are looking forward to another period of prosperity in 1905. Whether this feeling will obliterate the old enmities remains to be seen.

This competition did not materially affect the Cumberland and George Creek operators. The quantity of that coal upon the market is necessarily limited, and its quality is such that it commands a special trade of its own, which is not subject to much competition.

The drought above referred to, proved

to be a considerable hindrance to shipments of bituminous coal in all of the last third of the year. An almost unprecedented period elapsed without rain. In some sections of Pennsylvania and West Virginia the supply of water for the mine boilers could not be had. Attempts were made to run with water pumped from the mine. These were occasionally disastrous, as the mine water was so impure that scale and corrosion were found to be weakening the boilers to a dangerous point, and the attempt had to be abandoned. On the railroad lines also, transportation was restricted because it was impossible to get water enough to run the full complement of locomotives. The first sign of relief came with a snowfall in December, which was very general throughout the region. This gave little help at first, but fortunately, it was followed by a general thaw, and by rain which filled the streams and furnished the much needed supplies.

In the early and middle part of the year, when the trade was on a lower basis, there was little trouble with transportation from the mines to tidewater, and to points in what is known as the all-rail trade. In the latter part of the year, however, many delays occurred, some caused by the drought, others by short car supply on the railroad lines. These delays hampered the trade a good deal, and caused much annoyance both to operators and consumers.

The coastwise trade was generally good, and vessels were in good supply throughout the year. Vessel freight rates were low throughout the year. In late November and early December, there was a period of stormy weather, as a result of which many wrecks and losses were reported.

Export trade is referred to elsewhere. Apart from this export trade proper, there were considerable sales, chiefly of West Virginia coal for shipment to the Philippines, for local supply and for the use of government transports.

Upon the whole, in the competition between anthracite and bituminous for the manufacturing trade of the East, neither side can be said to have gained or lost materially during the year. Delays in transportation and delivery of bituminous undoubtedly assisted the trade in the anthracite steam sizes to some extent, but with this exception the two fuels stand about where they did at the opening of the year.

The Western coal markets are treated in the letters of our correspondents which follow.

#### FOREIGN COAL TRADE.

The foreign coal trade is insignificant in comparison with the total production. Exports of coal and coke from the United States for the 11 months ending November 30, are reported as follows:

	1904.	Changes.
Anthracite.....	2,110,544 I.	210,952
Bituminous.....	5,861,227 D.	42,461
Total coal.....	7,971,771 I.	168,491
Coke.....	478,033 I.	97,414
Totals.....	8,449,804 I.	265,905

Coke exports were chiefly to Mexico, with a small quantity to some Canadian furnaces. The coal exports were distributed as follows:

	1904.	Changes.
Canada.....	6,135,685 D.	79,895
Mexico.....	823,621 I.	67,405
Cuba.....	457,026 I.	68,335
Other West Indies.....	219,561 I.	27,498
France.....	10,694 I.	5,641
Italy.....	69,116 I.	19,897
Other Europe.....	60,462 I.	36,051
Other countries.....	195,606 I.	23,059
Totals.....	7,971,771 I.	168,491

In these figures both anthracite and bituminous coal are included. The exports of coal to Canada, in detail, were:

	1904.	Changes.
Anthracite.....	2,081,260 I.	205,966
Bituminous.....	4,054,425 D.	285,861
Totals.....	6,135,685 D.	79,895

Canada, naturally, is the heaviest consumer, and, in fact, is the only country that uses any great amount of our anthracite.

The increase in exports last year was chiefly in shipments to Cuba, the West Indies and other countries, a classification which includes chiefly the South American countries.

The imports of coal returned very nearly to their normal proportions. They were chiefly from Canada, Great Britain and Australia. With the exception of some Nova Scotia coal, which goes to Boston, the imports were almost entirely at California ports. That State depends in large part upon coal from British Columbia and Australia, with some receipts from Great Britain, the latter coal being taken at very low rates by ships coming to the coast for wheat cargoes. The imports given from Japan are chiefly received at Manila.

Imports of coal into the United States, during the 11 months ending November 30, 1904, are reported as follows:

	1904.	Changes.
Canada.....	1,106,361 D.	350,104
Mexico.....	221 I.	216
Great Britain.....	116,799 D.	1,180,773
Other Europe.....	50 D.	381
Australia.....	213,419 D.	218,796
Japan.....	44,829 D.	14,205
Other countries.....	759 D.	260
Total.....	1,482,438 D.	1,764,303

Of the imports, 66,214 tons were classed as anthracite. The large decrease shown is due to the fact that in the early part of 1903 there were heavy imports from Great Britain to Atlantic ports, owing to the deficiency in coal supply here caused by the anthracite strike.

A sense of humor is a great blessing and a business gift. The busy man who can show the self-control of humor, can be trusted to handle great enterprises with judgment and moderation. Not for nothing is the mission of nonsense.

## ALABAMA.

By L. W. FRIEDMAN.

The mines of Alabama in 1904 presented the anomalous condition of an increase of production, in spite of a strike which lasted half the year. The production of coal in 1903 amounted to 11,700,753 tons; in 1904 the State mine inspector and other good authorities estimate the total at 12,250,000 tons; and this is considered a rather conservative figure. A number of new mines were developed during the past 12 months, and the operation of a large part of the mines has been steady.

The strike which was called by the United Mine Workers of America on July 1, was the result of a refusal of the large companies to grant an increase in the minimum mining rate. This rate in Alabama has been for a number of years based on the selling price of pig iron, the original reason being the fact that a very large proportion of the coal mined in the State is used in the iron manufacture. The immediate stoppage, therefore, affected only the mines operated by these companies. The commercial coal companies, selling their coal to outside parties, generally made a temporary agreement under which current wages were to be continued and a final settlement made on whatever basis should be agreed upon by the mine workers and the furnace companies. As the strike progressed, and there was no prospect of an early settlement on the part of the miners, the companies finally withdrew all offers and declared themselves in favor of the 'open shop,' saying that they had no further negotiations to make. The year closes with the strike still on. Several of the company mines, however, are operated by convict labor, and in these, of course, there was no stoppage. In the later months of the year a number of men from other States were brought into Alabama and put to work; so that there seems to be little prospect that the strike will succeed.

The only shortage felt at any time was in coke for the use of the furnaces. Some of the mines most directly affected by the strike were those producing the best coking coal; and, at several times during the year, coke had to be brought into the State from West Virginia. The supply of coal for general purposes has been sufficient. There has also been a considerable increase in exports of Alabama coal. These have gone chiefly to Mexico, where some important contracts were secured by Alabama operators. This coal is shipped chiefly through the port of Pensacola. There was an increase also in the shipments of coal over the Southern Railroad to Greenville and thence down the Mississippi. This trade was favored by the low water in the Ohio during the second half of the year, which resulted in a shortage of Pittsburg coal in the river towns.

Prices of coal through the year were generally satisfactory to those operators

who sell their coal. The cost to the furnace companies was possibly increased a little by the strike, but, on the other hand, the price of pig iron was low for a large portion of the year, so that the mining rate was at the minimum point.

There was, unfortunately, a decided increase in the number of accidents in the mines, which may have been partly due to the employment of unskilled men, and partly also to the number of new mines opened and the rush of work in them. In 1903 the number of deaths from accidents in Alabama was 57, while the report for 1904 shows that over 80 lost their lives in the coal mines.

## CHICAGO MARKET.

By E. MORRISON.

Probably no previous year has been so generally unsatisfactory to the Chicago coal trade as 1904. From beginning to end, the year has been one of slack demand, over-production and profitless competition. And the prospects for 1905 do not seem bright to experienced wholesale dealers, who have seen the storms and the sunshine of many seasons.

Through the stimulus given to the consumption of bituminous coal by the great strike in the anthracite region in 1902, new mines were opened throughout the bituminous fields. These mines have since been in operation and their products have flooded the Chicago market. A large number of new selling firms and agents were created by this influx of new producers, some of them without the necessary capital for doing business in competition with older firms. Through the operation of the law of the survival of the fittest, the weaker firms have been eliminated or they have changed the nature of their business, and in this respect the coal trade of Chicago is better off than it was a year ago.

In anthracite business there has been of course comparative stability. The wholesale trade has been in the hands of a few firms. But to these the inertia of the consumers of anthracite has been a preventive of good business. Dock stores are large at the beginning of the new year, because, although about 190,000 tons less anthracite was received in 1904 than in 1903, it has not been drawn upon to any considerable extent for the wholesale trade. This is partly due of course to the fact that the winter, up to January 1, 1905, has been mild.

Total receipts of coal by lake at Chicago were 1,074,853 tons in 1904, against 1,250,615 tons in 1903. In the records of the United States Treasury Department, no division of anthracite and bituminous coal received is made, but it is estimated that about 85,000 tons in 1903 and 100,000 tons in 1904, of these totals, were bituminous. The receipts of anthracite, on the basis of these figures, were about 975,000 in 1904 and 1,165,000 tons in 1903.

Business in Eastern bituminous has been better than in Western bituminous throughout 1904. Smokeless, especially has gained in popularity and, from being weak at the beginning of the year, has become strong. Shipments of smokeless have been much hampered by the railroads, and the same, though in a less degree, is true of Hocking, which has been in steady and good demand. Gas coals were quiet for most of the year.

Prices have been uniformly low throughout the year, on bituminous. The packing-house strike, in the summer, sent the price of screening below the cost of the freight on the coal to Chicago. Eastern bituminous in this respect was better off than Western, but prices of Eastern were not high at any time. Anthracite continued the same as in 1903—\$6.50 base price, with a discount ranging, by 10c. graduations per month, from 50c. in April to nothing in September and the following months. This system of discounts apparently has not fulfilled its purpose—the distribution of buying over the year. Shipments of anthracite from Chicago to the West have been, it is estimated, about 250,000 tons less than the shipments of the previous year.

## PITTSBURG DISTRICT.

By S. F. LUTY.

According to the most reliable data available, the production of coal in the Pittsburg district in 1904 did not exceed that of the previous year, and may fall a trifle short, when official statistics for December are compiled. The production for the year is estimated at 30,000,000 t.r.s. While the business was not as profitable as in 1903, leading producers declare that under the conditions that prevailed it was a very satisfactory year.

The Pittsburg Coal Company had more competition than formerly, and in the early part of the year the demand was light, owing to depression in the iron and steel trade. The company also was greatly handicapped by the strike of the masters and pilots, by which it lost the first 50 days of the lake shipping season. As a result its shipments to the northwestern markets did not exceed 4,000,000 tons, being over 500,000 tons short on contracts taken at the opening of the season. Compared with 1903 its production was fully 1,000,000 tons less. The total production of the company for the year, with December estimated, is given at 14,500,000 tons. This does not include 1,600,000 tons mined by the New York & Cleveland Gas Coal Company, and 400,000 tons by the Mansfield Coal Company, both of which concerns are controlled by the Pittsburg Company. It also controls the Monongahela River Consolidated Coal & Coke Company, the river coal combination. Production of this company fell off fully 1,000,000 tons, as the Ohio river was not navigable during the second half of the

year. Some shipments were made to the lower markets on July 12, but the next rise did not come until December 26, when a good tonnage was shipped. The total production for the year was about 6,500,000 tons. Of this 2,000,000 tons were shipped by rail, 2,500,000 tons by river to the Pittsburg markets, and 2,000,000 tons to down-river ports.

The Pittsburg Terminal Railroad & Coal Company, which was formed in 1903 and opened seven mines, became an active competitor of the leading producer for the lake coal trade in June. The production of these mines in 1903 amounted to 400,000 tons, which was increased to nearly 2,000,000 tons in 1904. Early in September, the Wabash Railroad bought the entire properties of the Pittsburg Terminal Company, including 15,000 acres of coal, seven mines and 36 miles of Terminal railroad. The former transfer was made in October and a month later the Pittsburg Coal Company obtained possession of the mines and coal land. The terms of the deal were not made public, but it is given out that the company got a straight lease for 40 years and will pay the Wabash a royalty for the coal mined. Another important deal was made by the Pittsburg Coal Company, which greatly strengthened its position in the Pittsburg district. Early in December it bought the Rachel and Blanche mines of the Pittsburg-Buffalo Company, and entered into a contract with that company to handle all of its lake coal for a period of three years. The Pittsburg-Buffalo Company also agreed to make no further new developments of coal property for a term of years. This deal removed a formidable competitor, as the company was preparing to engage in the lake trade. The Pittsburg Coal Company has made a number of contracts with independent operators for coal for the 1905 lake season, and about December 1 placed a contract with the American Car & Foundry Company, for 2,000 steel coal cars, which are to be delivered in the spring and will increase the company's individual cars to 6,000. The Pittsburg-Buffalo Company continues to be the largest independent producer in the Pittsburg district, but will not double its capacity, as had been intended. Its output for the year was 1,500,000 tons and it will continue to operate three large mines in this district and two at White Rock. The production of the company in 1905 will be about the same. The production of other large independent coal companies during 1904 was about as follows: J. W. Ellsworth & Company, 1,250,000 tons; United Coal Company, 1,250,000 tons; Hazel Kirk Coal Company, 400,000 tons; Carnegie Coal Company, 300,000 tons; Patterson & Robbins, 400,000 tons; Meadowlands Coal Company, 300,000 tons; other independent concerns whose annual production does not exceed 150,000 tons, about 1,000,000 tons.

Prices in 1904 were much lower than in the previous year. A fair average for the year is about as follows: Run-of-mine, \$1.05 per ton; ¾-in., \$1.15; 1 ¼-in., \$1.25, all f. o. b. at mine. Some sales were made at a higher figure, but several large contracts for run-of-mine coal were made as low as 90c. Better prices were obtained for all coal shipped to the northwestern markets and to river points below Pittsburg.

A strike was threatened early in the year in the four large bituminous coal mining States, Pennsylvania, Ohio, Indiana and Illinois, parties to the inter-state agreement. At the joint convention held at Indianapolis in January, the operators demanded the 1902 scale, which was based on an 80c. pick-mining rate, and the miners insisted on a continuation of the 1903 scale, which was based on a rate of 90c. a ton for pick-mining. The question was left to a special joint committee and the convention adjourned. The committee could not agree and the joint convention was reconvened on February 29. The operators receded from their demand and offered to compromise at 85c., or a general reduction of 5.55 per cent, and to enter into a contract covering a period of two years from April 1, 1904. The convention of miners decided to submit the question to a referendum vote of the membership. The vote was taken on March 15 and all the mines were closed on that date in order to give all miners an opportunity to vote. The compromise proposition of the operators was accepted, the vote being 98,514 for, and 67,373 against.

#### THE LAKE COAL TRADE.

By GEORGE H. CUSHING.

The movement of the two staple products of lake commerce, coal and ore, during the season which has just closed, has been beset with numerous difficulties. Greatest of these has been the strike of the masters and pilots on the lake boats, which kept commerce on the lakes tied up until well on toward the middle of June. By dint of steady plodding the coal movement was slightly increased over that of 1903, while the ore movement showed another fall, which does not speak well for the comfort of the ore consumers during the coming winter. The last few months of the season showed haste to get ore to the lower lake docks, which spoke something of the nervousness which consumers felt as to the supply at their furnace stock-piles for use during the winter.

The total tonnage of coal passed through the Sault Ste. Marie canals during the season, with the changes from the preceding year, were as follows:

	1904.	Changes.
Anthracite . . . . .	991,228	D. 157,777
Bituminous . . . . .	5,463,641	D. 324,987
Total . . . . .	6,454,869	D. 482,764

In part this decrease was to be expected, as the opening of 1903 found the northwestern docks bare, and coal had to be

rushed up the Lakes to supply immediate needs; the consequence being a very heavy record for the season. In 1904 the late opening of navigation interfered with the traffic, and it shows the capacity of the Lake fleet, which was able, in a little more than five months, to handle a tonnage only 7 per cent less than the extraordinary shipment of the previous year.

It was the condition of the coal trade which had the most interest throughout the year. Shippers of coal began to realize from the outset that, with the shipments held up until June, whatever advantage they had gained by a heavy movement last year, had been more than lost by the delay in starting. Usually, the opening of the season of navigation comes early in April, and surely not later than April 20. At that time the shippers of coal usually have boats loaded at Lake Erie ports for movement to the head of the lakes. Requests upon the railroads to begin the movement of coal to the lakes usually come about March 15, and this year was no exception. But at that time the railroads heard the mutterings among the men on shipboard and expected not one, but many, strikes which would tie up the boats for some time to come. Shippers were importunate and demanded the immediate movement of coal to the lake ports. But the vessel owners were apathetic. The best that they could figure out would be a poor year. They saw that their main source of revenue must lie in the ore trade, and this was anything but promising. Their only hope lay in a shorter season of navigation which might possibly bring about better rates.

Seeing a feeling of discontent and a desire among their men to hold out for higher wages, which they could not pay, with their lessened prospects of earnings, the vessel-men gladly accepted the combat, and the result was an enforced idleness of the boats for at least two months after navigation was open. From this standpoint another thing was favorable to the lake vessel-owners. Last winter was one of unusual severity and the ice was not cleared out of the channels between the upper and the lower lakes until well on toward May. The situation was distressing to the shippers of coal, who began to fear that they were losing ground which could not easily be regained. The season of 1903 had been one of prosperity for them; prices had been satisfactory and the movement was very heavy. During that year the shipments by very small boats—into shallow harbors of small ports—had been heavier than in any previous season. Northwestern Canada, and especially that part of it along Georgian Bay and Sault Ste. Marie, has been taking an increasing amount of Ohio coal for the past five years. The demand during 1903 was very large. In addition there had been an increased shipment into the Northwest, where dock facilities had been increased and the railroads were disposed to use

more of this coal. It is also to be taken into account that the Northwest, finding itself compelled to go without hard coal, for a part of one year, due to the strike, began to find bituminous coal cheaper and equally satisfactory, and turned to the use of that coal permanently. This being the case, it is understood why, though the shipments increased during 1903, there was beginning to appear a serious shortage of coal in the upper lake regions at the beginning of this season of navigation. The coal which had been sent up the year before was rapidly melting away under heavier consumption, and, whereas it might have been supposed that no shipments would be urgently needed until May 15 or June 1, consumers began to call early for fresh supplies. Shippers found themselves absolutely helpless in the face of this demand, their dependence being on the boats between Lake Erie ports and the Northwest, since all-rail rates made a direct shipment by that route out of the question. Meanwhile the mines began to feel some of the stress of the situation. Their dependence during the winter is in the main in the increased consumption by the railroads and the various industrial plants. Railroads and power-houses had been compelled during the winter to use an increased amount of coal, owing to the stress of weather, and the difficulty of keeping engines and traction cars moving over the lines. With the milder weather of the late spring, this excess demand died away. It is also to be recalled that the depression in business reached its acute stage between May 15 and August 1, and the consumption of coal by industrial plants was greatly lessened. In addition, furnaces began to go out of blast and the demand for coking coal was much less. The mines had been running at top speed and their production was heavy. The sudden letting up from all of the local sources of need and the absolute shutdown in the lake trade, brought about a situation which was extremely unpleasant. About the time this situation was acutely felt by the railroads and the coal operators, the miners of the eighth district of Ohio raised a question of taking up the bottoms. The whole southeastern section of Ohio was just about that time putting into effect machine mining scales in the sixth, seventh and eighth districts and a labor question was raised in the eighth district which would decide for the three districts involved. The miners saw that the new system was cutting down their forces, and for that reason they ought to stand out against the introduction of machines, or make some ruling which would preserve at least a part. They insisted that extra men ought to be introduced to take up the bottoms instead of leaving that work to the machine men. The question was vital. It proved an unexpected boon for the lake coal operator, because he saw a chance to restrict production when more coal was not needed, and so the association of coal

operators held a meeting in Cleveland and made a decision which really forced a strike upon the coal miners. This lasted for several weeks, during the period of greatest stress in the coal situation. Meanwhile some of the other mines found that their production was over large and they had to curtail their force. For the month of June and a part of July the production all through this territory was limited, and it did not begin to revive until after the difficulty with the lake vessel-masters had been adjusted and coal was started up the lakes. The labor difficulty was settled just before the middle of June, and there was a desultory movement for the last two weeks of that month, but the full swing of the lake coal movement did not get under way until well on toward July.

Ordinarily July and August are slack months in the coal trade on the lakes. The first rush of material to the head of the lakes has been seen and the docks are already becoming congested. But that condition did not prevail at the beginning of last July. There was a rush to get coal up the lakes. Shippers usually take advantage of this slack period to haggle with the ship-owners over rates; this year no contests were waged, and few conditions were raised. The shippers were not in position to pay high rates, but fortunately the vessel-owners did not expect them. A satisfactory arrangement was made on the basis of 1903 rates and the movement started with a rush. There was never after that time an abatement. The situation at no time was interesting from a news standpoint. The only thing which came to disturb the regular movement was in the month of September, when the railroads found their equipment delayed at the Lake Erie docks, owing to congestion at the upper lake ports, and withheld shipments until the situation became cleared up. Two weeks of heavy movement by the Northwestern railroads brought the situation upon its feet again. By November the shippers had made up what they lost earlier in the season and the movements up the lakes were almost equal on November 1 to what they were at that period a year ago. In November a 10 per cent increase was recorded. The early part of December also found a small increase. The figures show that the movement for the season of navigation of 1903 was 15,640,000 tons. For 1904 the total movement from the Ohio mines to the head of the lakes was approximately 9,800,582 tons, or, in round numbers, a gain of about 160,000 tons. The figures are not as accurate as might be desired for the movement by the roads from the Pittsburg and the West Virginia fields, but they indicate a movement of 6,500,000 tons, or a gain of nearly 500,000 tons from that territory. This brings the total shipments for 1904 by lake to the Northwest up to about 16,300,000 tons, as against 15,640,000 for the period of 1903, which shows an increase for the season of about 660,000

tons. A part of these figures are estimated on weekly movements.

#### IOWA COAL.

The coal production of Iowa in 1903, as finally reported by the State Geological Survey, was 6,365,233 tons, the average value at the mines being \$1.64. Of the coal mined in that year, 5,485,249 tons were shipped away from the mines, 734,231 tons were sold to employees, or to local trade, and 145,751 tons were used for steam purposes at the mines. For the year 1904 the estimated production is 5,728,700 tons; showing a decrease of about 10 per cent. The greatest shrinkage occurred in those counties which have the largest local trade. The average price of coal at the mines for the year was \$1.49 $\frac{1}{4}$ ; showing a reduction of about 9 per cent in value. The rate of decrease in price shows considerable variation. It was from 15 up to even 20 per cent in the counties which produced the largest quantities of domestic coal, but was much less, possibly as low as 3 per cent, in the districts which sold chiefly to the railroads. The average number of days worked, as reported by the mines, was 232 in 1903, and 218 in 1904; showing a falling off of about 6 per cent in the time in which the mines were active. Most producers agree that the coal trade was lighter.

It is not fair, however, to infer from these changes that the coal industry of Iowa is in a declining condition. The far-reaching effects of the anthracite strike created an abnormal, or unusual, demand for western bituminous coal in 1903, especially in the earlier part of the year. Much coal was sold to points outside of the State, where the demand for bituminous had to be supplied, in order to make up the deficiency in anthracite and other eastern coal. In 1904 the industry returned to its normal condition, and supplied its ordinary markets only.

#### OHIO COAL.

In spite of the difficulties of the past year, the figures of that part of the Ohio production, which goes to lake ports and to the cities in the northern part of the State, show an increase. Returns from mines, covering about 63 per cent of the total production of the State, showed an output for the year—estimating two weeks in December—of 16,555,380 tons, against a corrected total of 15,511,191 tons. It must be remembered, however, that this does not include the district in which a strike stopped production for part of the year. One main reason for this growth is that a number of the mines included were not in active production in 1901 and 1902. The showing seems to be one of satisfactory growth. From other sections of the State, report is not so favorable, and it appears that shipments from southern Ohio and the Hocking valley region were lighter in 1904 than in the preceding year.

## WEST VIRGINIA.

By JAMES W. PAUL.

Normal conditions prevailed in this State throughout the year, and prices were at a figure that made it incumbent upon the operators to exercise every economy in the operation of the mines. The developments made in 1902 and 1903 have resulted in a demand by all operators for a more liberal supply of railroad cars, and a few mines have worked not more than half time for reason of transportation facilities not meeting all requirements. The mines in the State as a whole averaged 209 working days during the last fiscal year, and produced 30,222,880 net tons of coal, and the coke-ovens turned out 2,276,451 net tons of coke—an increase over the previous year of coal, 4,559,539 tons, and of coke, a decrease of 206,925 tons. For the calendar year the coal production will show, in round numbers, 30,500,000 net tons, and coke, 2,000,000 net tons. For the fiscal year ending June 30, the production of pick- and machine-mined coal was: Pick-mined, 20,907,065 tons, or 69.2 per cent, and machine-mined, 9,315,815 tons, or 30.8 per cent, respectively, of the entire production.

There were 28 companies whose combined output was 48.5 per cent of the entire production of the State, each one of which produced not less than 200,000 tons, as follows:

Fairmont Coal Company . . . . .	4,033,659
Davis Coal & Coke Co. . . . .	1,457,757
Kanawha & Hocking Coal & Coke Co. . . . .	956,815
Red Jacket Coal & Coke Co. . . . .	579,949
The New River Smokeless Coal Co. . . . .	574,878
Clarksburg Fuel Company . . . . .	530,028
Norfolk Coal & Coke Co. . . . .	521,940
United States Coal & Coke Co. . . . .	410,609
Pittsburg & Fairmont Fuel Co. . . . .	353,612
Houston Coal & Coke Co. . . . .	341,533
Southern Coal & Transportation Co. . . . .	331,354
McKell Coal & Coke Co. . . . .	319,723
Empire Coal & Coke Co. . . . .	316,558
Merchants Coal Company . . . . .	312,453
Davis Colliery Company . . . . .	305,948
Collins Colliery Company . . . . .	299,704
Gauley Mountain Coal Company . . . . .	298,653
Ashland Coal & Coke Company . . . . .	288,841
Turkey Gap Coal & Coke Co. . . . .	265,600
Pulaski Iron Company . . . . .	252,565
The Marmet Company . . . . .	250,518
Thacker Coal & Coke Co. . . . .	242,873
W. P. Rend . . . . .	239,352
Mill Creek Coal & Coke Co. . . . .	238,757
Elkhorn Coal & Coke Co. . . . .	237,526
Crozer Coal & Coke Co. . . . .	232,125
White Oak Fuel Company . . . . .	230,944
Boomer Coal & Coke Co. . . . .	226,537
Total net tons . . . . .	14,663,793

This is the first year for which there has been reported a production by the United States Coal & Coke Company, from its mines in the Tug River country, and its tonnage appears high up in the column of large producers.

There are 49 companies, each of which produces over 100,000 tons, but less than 200,000 tons, and 46 companies which produce each between 50,000 and 100,000 tons; and of the 538 shipping mines in the State the average production per mine is 56,176 net tons, but many mines exceed this tonnage and a greater number produce less.

The machines in use have increased in number from 795 in 1903 to 988 in 1904, and gave an increased production of 2,245,-

374 tons. The use of machines for mining is constantly growing, especially in the Kanawha Valley, where the electric machine has the preference, and along the Norfolk & Western, where the air puncher has the preference. The tonnage mined by machines is now greater than the entire production of all the mines in the State for 1892.

As this State consumes practically no coke, a market has to be found elsewhere, and as the iron and other furnaces throughout the territory which affords this market, have been less active, there has been a decrease in the production of coke to the amount of 206,925 net tons. The State now has a total of 15,857 coke-ovens, principally of the beehive type. Of this number, 8,536 were in use an average of 222 days during the year.

There were employed inside of the mines 18,880 pick miners, 8,395 machine men and 9,041 laborers, making a total of 36,316, and on the outside of the mines and at coke-ovens 9,176, or a grand total inside and outside of 45,492 employees. This is a gain over the previous year of 6,040 employees.

The mines were operated an average of 209 days during the year, and the coke-ovens 222 days, or a change of 4 days less at the mines and 1 day more at the ovens from the previous year. The amount received by the miners per ton of 2,240 lb. was 49.5c. for run-of-mine coal, the same as the previous year. The average price received at the mines for coal shipped was \$1.05 per ton of 2,240 lb. for run-of-mine, and coke sold for \$1.835 per short ton. The prevailing price at the close of the year is 85c. to \$1 for coal.

During the year 140 lives were lost within and about the coal mines. Ninety-five of these were caused by falls of roof; 22 by mine cars; 3 by gas explosions, and 20 from all other causes. Thirty-one lives were lost by falls for each one lost by explosions of gas, although there are quite a number of gaseous mines in the State; but very few require the exclusive use of safety lamps. Many accidents might have been prevented through the exercise of proper care on the part of those injured and killed.

Only two consolidations of consequence were consummated during the year, and they were made largely in consequence of the interests of each individual operation being held by the same persons. The first is the New River Smokeless Coal Company, which absorbed the properties of the Effinger-Howald-Laing interests in the New River field, and the second is the Pocahontas Consolidated Company, which absorbed the Jone-Buck-Mann, and other interests in the Pocahontas field.

The operators in the Kanawha valley, and those in particular who are operating in the Kanawha River series of coals, signed a scale of wages with the miners'

organization in April, the agreement to terminate in 1906. With the exception of the Cabin Creek operations, this agreement has been operative throughout the year. During November and December a strike of the miners was in progress in the the Cabin Creek operations, this agreement in the interpretation of a part of the agreement.

The year has witnessed considerable activity in railroad construction, all brought about through the growth of the coal industry in the State. The Coal River & Northwestern has been completed up Coal river from St. Albans to Briar creek, where a number of coal leases have been made, and mines opened preparatory to shipping as soon as branch lines are completed. The work on the Coal & Coke Railway has progressed, and the line is in operation from Charleston to Gassaway, within a few miles of Sutton. Another year may see this line running trains direct from Charleston to Elkins. The Norfolk & Western has within the past month started freight traffic over its Big Sandy extension from Naugatuck to the Ohio River. This company has in contemplation the extension southward of the branch, which intercepts the main line at Iaeger, for the purpose of developing a large coal area. The Deepwater Railroad has graded many miles of road-bed through Fayette, Raleigh and Mercer counties, which will make possible a connecting line between the Chesapeake & Ohio and the Norfolk & Western. In Kanawha county the Imboden & Odell has done much grading along Blue Creek. This will furnish an outlet for a large coal and timber territory.

Ultimately West Virginia may secure its just share of railroads, but at present some sections of the State are lamenting the inactivity of the Wabash, which has done much work on its grade in several counties.

**SULPHURIC ACID.**—It is interesting to note how metallurgical and manufacturing chemistry cling to the fundamentals. For over a century, sulphuric acid has been unquestionably the most important commercial chemical. In making fertilizers, in purifying oil, in producing soda; in fifty other ways, sulphuric acid is king. He does not seem inclined to abdicate.

**CALCIUM.**—Now that such an abundant element as calcium can be produced by electrolysis, it becomes interesting to inquire what will be the use for it. Calcium is very unstable in the free state; even its alloys would not be permanent. But it is a strong chemical reducer; and it is not improbable that, like other similar metals, it will play an important role in metallurgy, as a specific for sulphur, phosphorus, arsenic, or for any one of a dozen similar evils to which the various higher grades of steel are constantly exposed.

ILLINOIS COAL.

Mr. David Ross, Secretary of the Bureau of Labor, has supplied us with the statistics of coal production in Illinois during the fiscal year ended June 30, 1904, in advance of the official report. Coal mined in the State amounted to 37,077,897 short tons, valued at \$40,774,223, an increase of 2,122,497 tons over the output of the preceding year. A distinction is made between the commercial, or shipping mines, and those which are worked sporadically to supply a local demand, thus:

	No.	Tons mined.	Average.
Commercial mines . . . . .	380	35,779,517	94,157
Small mines. . . . .	552	1,298,380	2,352
Total . . . . .	932	37,077,897	96,509

It will be seen that the large mines supplied 96.5 per cent of the whole production, the same proportion that they furnished last year, although their number has increased; while the small mines are fewer than they were the preceding year. The disposition of the output was this:

	Tons.	Per ct.
Sold and shipped from mines. . . . .	31,778,260	85.7
Supplied to locomotives. . . . .	1,223,099	3.3
Sold to local trade. . . . .	2,521,612	6.8
Used, or wasted, at mines . . . . .	1,554,926	4.2

The amount and average value per ton of the grades into which the output was sized were as follows:

	Tons.	Per ct.	Value.
Run-of-mine . . . . .	10,627,904	28.6	\$1.03
Lump. . . . .	16,888,010	45.6	1.37
Egg. . . . .	1,014,700	2.8	1.39
Nut. . . . .	1,602,383	4.3	1.05
Pea. . . . .	5,751,570	15.5	0.56
Slack. . . . .	1,193,330	3.2	0.33
Total . . . . .	37,077,897	100.0	\$1.10

In 66 mines, 609 coal-cutting machines were in use, giving 7,400,343 tons, or 20 per cent of the whole output, a decrease of about 2 per cent from the previous year. The average price paid per gross ton for machine-cut coal was 46.6c.; for pick-mined, 59.3c. The total number of miners employed was 37,987, assisted by 11,374 men and boys working underground, and 5,413 on surface.

Fatalities numbered 157, showing a rate of 2.87 deaths per 1,000 men employed. Accidents, entailing the loss of at least a month's time, occurred to 507 men, or to 9 out of every 1,000 employees.

**NEW ZEALAND STEEL.**—The black sand at Taranaki is still attracting attention. A year ago it was announced that the Rouse-Cohn process of concentrating and briquetting had given promising results. Since then the tests of smelting in the electric-furnace have been so far developed as to furnish a steel that is said to be equal to the best Dannemora. The requisite capital has been secured, at least to the extent of meeting this requirement, if other conditions can be adjusted. One difficulty is connected with the importation of fifty skilled Yorkshire steel workers; and this involves permanent work, and freedom from interruption by various unions. Whether this can be done is not clear.

Iron and Steel.

By FREDERICK HOBART.

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. The change in methods of building and in the size of structures, which is found in all our large cities; the almost complete substitution of steel for wood in bridge construction, and other changes of this kind, fully account for the tremendous growth in the demand for iron and steel in all forms. Even the receding wave never reaches as low a point as its predecessor.

As our records show, the last half of 1903 appeared to be the beginning of one of these periods of recession. For nearly three years the iron industry had been extremely prosperous, and it looked to those who do not go below the surface, as if no recession was possible. The check to business, which really began with the confusion caused by the great anthracite strike, became not only apparent but menacing. The over-confident feeling which prevailed began to be replaced by a vague sentiment of distrust. The assertions—which were really believed by many—that the great consolidations of the boom time would steady and equalize trade, proved to be largely without substantial base, and it was seen that the trust could do no more to create demand—perhaps less—than the companies which had preceded it, and which now form part of it. The year 1904 opened at almost the lowest point of depression. Furnaces had gone out of blast, mills were closed, and there were gloomy anticipations of still further decline in trade. Very soon after the beginning of the year, however, observers began to realize that matters were not as bad as they had for a short time seemed to be. There was still a substantial amount of wealth in the country, business was in fairly sound condition, and there was every reason to believe that even the traditional depression of a presidential year would have a far less unfavorable effect upon the trade than in 1896 and 1900. Matters at issue in the election were not such as to cause any real apprehension of business disturbance. Others

began to realize that the depression had been exaggerated for the purpose of affecting speculation on the stock exchanges. Almost from the very first of the year there was an improvement, gradual and rather slow at first, but still perceptible, and by the time mid-summer was reached, there was a considerable advance both in production and in prices. Furnaces were going into blast again, and mills resuming, in order to meet their contracts. This process continued, with very few checks, throughout the second half of the year; and 1905 opens with general anticipation of further improvement and activity.

**Iron Ore.**—The production of iron ore in 1903 was less than the maximum attained in 1902, though it is not believed that many of the furnaces entered 1904 with excessive stocks. The reserve in sight, however, was somewhat larger than is generally the case, and this proved to be a fortunate circumstance, as the various delays in the opening of Lake shipments made it impossible to bring forward new supplies until an unusually late date. The following table shows approximately the production and consumption of iron ore in the United States for 1904; comparison being made with the figures for the preceding year given in Volume XII, of 'The Mineral Industry':

	1903.	1904.
Lake Superior shipments. . . . .	24,099,550	21,726,654
Southern mines. . . . .	5,889,000	5,450,000
Other States . . . . .	2,483,000	2,190,000
Production . . . . .	32,471,550	29,366,654
Decrease in Lake stocks. . . . .	703,000	.....
Imports . . . . .	980,440	438,000
Total supplies . . . . .	34,154,990	29,804,654
Increase in stocks. . . . .	.....	45,907
Exports . . . . .	80,611	221,000
Deductions . . . . .	80,611	266,907
Consumption. . . . .	34,074,379	29,537,747

The details of the Lake movement are given in the special report which follows. The stocks, to which reference is made in the table, are those which are actually in sight, that is, on the lower lake docks; there is no means of ascertaining, with any degree of accuracy, the stocks which are widely distributed in furnace yards. There is reason to believe, however, that these were greater at the beginning of 1904 than they had been a year before. Whatever their amount, the later movement has practically absorbed the greater portion. In the other supplies the largest decrease was in the Southern States, where ore production keeps closely in line with the actual condition of the blast furnaces. The imports, which come mainly from Cuba, fell off more than one-half, partly owing to the condition of some of the Cuban mines, and partly to the lower demand in the furnaces of the Atlantic seaboard, which were more affected by the depression than those of the Central West. Exports showed a large proportionate increase, but were nevertheless only about 0.7 per cent of the production. Part of this increase was in shipments to

Canada, and part was due to exports of some special ores to Germany.

The Lake Superior region continued to maintain its pre-eminence as a source of supply. Between 75 and 80 per cent of the pig iron made in 1904 was from Lake ores. The average quantity used in making a ton of pig iron was, according to the estimates, 1.78 tons, against 1.86 tons in 1903. It is possible, however, that the difference was really less, and may be partly accounted for by the difference in furnace stocks, already mentioned.

The quantity of limestone and dolomite quarried in the United States for use as flux in blast furnaces, we estimate at 8,788,000 tons, which compares with 9,591,760 tons in 1903. The average consumption of limestone per ton of iron produced is between 1,150 and 1,200 lb. The limestone is almost exclusively used by the Northern and Western furnaces; most of the Alabama furnaces use dolomite, which can be obtained in great abundance in their vicinity.

**Pig Iron.**—Taking the capacity of the furnaces in blast each month, and making all necessary allowances for the increased number of furnaces which went into blast in December, we estimate the production of pig iron for the year 1904, as in the following table. The figures for the first half of each year, and for the second half of 1903, are from the reports of the American Iron & Steel Association. For the second half of 1904 the estimate is made up, as noted above:

	1903.	1904.
First half .....	9,707,367	8,173,438
Second half .....	8,301,885	8,390,500
Year .....	18,009,252	16,563,938

This shows for the first half of 1904 a decrease of 1,533,929 tons; for the second half there was an increase of 88,615 tons, for the whole year, therefore, the decrease in pig iron production was 1,445,314 tons, or 8.03 per cent. The production, despite this decrease, was greater than that made in any year prior to 1902.

Dividing the tonnage for the second half of the year in the same proportion as for the first half, we find that the production was distributed as follows:

	1903.		1904.	
	Tons.	Per ct.	Tons.	Per ct.
Foundry and forge .....	5,785,957	32.1	4,991,926	30.1
Bessemer .....	9,989,908	55.5	9,187,674	55.5
Basic .....	2,040,626	11.3	2,152,666	13.0
Spiegel and ferro .....	192,761	1.1	231,672	1.4
Total .....	18,009,252	100.0	16,563,938	100.0

The changes in tonnage and proportion are as follows:

	Tons.	Per ct.
Foundry and forge .....	D. 794,031	D. 2.0
Bessemer .....	D. 802,234	.....
Basic .....	I. 112,040	I. 1.7
Spiegel and ferro .....	I. 38,911	I. 0.3
Total .....	D. 1,445,314	.....

The proportion of bessemer, or low-phosphorus, iron was the same in both years. Not all of this is used in making bessemer steel, since a certain proportion is employed in the acid open-hearth fur-

naces, and some also in making malleable castings. A decrease in proportion is shown in iron classed as foundry and forge pig. Basic iron alone shows a small increase in actual production, and necessarily, therefore, a gain in its proportion to the total.

The decrease in the number of active furnaces at the beginning of the year was largest in those owned by the United States Steel Corporation, which, for reasons that are not clearly apparent, closed down at that time a number of furnaces which had to go into blast again soon after. Later in the year there was more closing down among the Eastern furnaces, which find their market only when prices are high and demand unusual. The charcoal-iron production remained fairly steady throughout the year. The Southern furnaces also maintained their production better than those in the North and West, only a moderate degree of curtailment having been made in the early part of the year.

**Steel.**—No exact figures are available for steel production, as in the case of pig iron, since the reports of the American Iron & Steel Association gives the steel output only for the year. We estimate, however, that the steel made in the United States last year was approximately 13,700,000 tons, or about 1,000,000 tons less than in the preceding year. The greatest falling off will be shown in the production of bessemer or converter steel. The production in 1904 was divided approximately as follows: Bessemer steel, 7,600,000 tons; acid open-hearth, 950,000; basic open-hearth, 4,950,000; crucible and special steels, 200,000 tons. The production of basic open-hearth steel held its own much better than that of any other description. The making of this variety in the South from Alabama pig has proved successful in the works at Ensley, and new works of the same kind have been started at Gadsden, also in Alabama. At the Ensley works rails are being made from basic open-hearth steel, the first of the kind manufactured in any considerable quantity in the United States.

**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 falling off in most of these products. The greatest decrease will be shown in the manufacture of rails. During the whole year the rail pool and the railroads were deadlocked on the question of price, the pool refusing to make any changes, while the railroads insisted upon some reduction. This, combined with a fear on the part of the roads of decreased business and earnings, cut down their orders to the lowest possible point, everything except absolutely necessary repairs being postponed. The deficiency in railroad orders was made up only in a small degree by the demand for rails from new

electric lines. In the latter half of the year considerable sales were made for export, and the fact that large orders were taken for Canada, and for the Far East, on a basis which worked out from \$8 to \$9 lower than the price asked for domestic contracts, did not improve the disposition of the railroads.

Structural steel also showed a considerable decrease, which was due in part to a falling off in new construction enterprises, but in larger degree to the serious labor troubles, which interfered with building in nearly all the large cities. In some other lines, such as bars, sheets and plates, the consumption will probably show only a moderate decrease.

**Changes and Consolidations.**—The condition of the industry naturally put a stop to the movement of consolidation, which played so active a part in the two or three previous years. The most important transfer was that of the Clairton steel plant, which was built and owned by the Crucible Steel Company of America, but which, after long negotiation, was sold to the United States Steel Corporation. This plant is referred to more fully in our Pittsburg report. Late in the year the Alabama Consolidated Coal & Iron Company, a corporation owning several furnaces, with iron ore and coal-lands in Alabama, was transferred by its Baltimore owners to New York parties. This gave rise to reports of a general consolidation of Southern iron companies, under the control of the Steel Corporation, but these have been positively denied. Negotiations for a consolidation of interests between the Tennessee Coal, Iron & Railroad Company and the Sloss-Sheffield Coal & Iron Company, progressed so far that appraisers were appointed to value the properties of the two concerns. No report has yet been made by these appraisers, however, so far as the public is informed, and nothing further has been done with regard to the consolidation.

As might be expected, there has been less new construction during 1904 than in several previous years. The large and important works of the Lackawanna Steel Company, at Buffalo, which were begun three years ago, were practically completed, and will be in full operation during 1905. These works are owned by an independent company, and their operation will be entirely outside of the control of the United States Steel Corporation. They add an important unit to the producers who are independent of the Corporation, and who can, if necessary or desirable, compete with it. Although located so far east, these works are included in the large group dependent upon Lake ores for their raw material.

**Metallurgical.**—Comparatively few changes in metallurgical practice can be recorded. Not much expenditure on new plants or on improvements has been made. The plant of the Lackawanna Steel Com-



pany, above referred to, includes provision for the generation of power from the waste gases of the blast furnaces on a large scale, and is the first important plant in the United States where this method of economizing power has been adopted, although it is now coming into extensive use in Belgium and Germany, and to a less extent in Great Britain. The practice of establishing blocks of by-product coke-ovens, where coke can be made in connection with furnace plants, has made little progress.

The most interesting metallurgical event was the experimental work done under the direction of Mr. James Gayley in drying the air used for blast in the furnace. A full account of Mr. Gayley's work was given in this JOURNAL on October 27 last. It seems quite probable that the next important steps in blast furnace economy will be taken in this direction.

The commission appointed by the Canadian government to investigate the present condition of electro-metallurgy, as applied to iron and steel, made a careful study of such work which is now in progress, chiefly in France and Sweden. The report of this commission, which was headed by Dr. Eugene Haanel, Dominion superintendent of mines, contained a careful summary of progress, and is an important contribution to metallurgical literature. The conclusion reached was that electricity could be profitably applied under certain conditions, such as the conjunction of iron ore deposits and water power in districts where fuel is costly. The special object of the investigation was to ascertain whether electrical processes could be applied in the utilization of the ore deposits of northern Ontario, and it is quite probable that some practical experiments in this direction will be made shortly.

**Exports and Imports.**—The exports of iron and steel from the United States, including machinery, are valued by the Bureau of Statistics of the Department of Commerce and Labor, for the eleven months ending November 30, at \$89,682,747 in 1903, and \$118,182,998 in 1904, showing an increase of \$28,500,251. The figures for the full year are, of course, not available, but it is certain that the month of December showed an increase of some \$5,000,000, so that the gain for the whole year will be over \$33,000,000. The principal items of these exports, with the increases, are given in the following table, in long tons:

	1904.	Changes.
Pig iron .....	45,884	I. 30,575
Bars .....	50,679	I. 16,580
Rails .....	395,799	I. 372,665
Sheets and plates .....	51,244	I. 34,860
Structural steel .....	49,778	I. 22,152
Wire .....	108,407	I. 9,845
Nails and spikes .....	39,732	I. 732

The most notable increase in this table is in steel rails, and shows the efforts which have been made to utilize the idle capacity of the rail mills, which was not required to fill home orders. The most

important exports of rails were 215,826 tons to Canada, and 62,231 tons to eastern Asia.

Imports of iron and steel, on the contrary, showed a decrease. The absence of the sharp demand which made necessary large purchases of raw iron and steel abroad in 1902, and in the earlier part of 1903, was principally responsible for this difference. The total imports for the eleven months ending with November are valued by the Bureau of Statistics at \$39,516,378 in 1903, and \$19,946,080 in 1904; showing a decrease of \$19,570,298, or very nearly one-half. The leading items of these imports in 1904, with the changes from the previous year, are shown in the following table:

	1904.	Changes.
Pig iron .....	73,685	D. 511,170
Billets, blooms, etc. ....	10,268	D. 249,866
Scrap iron and steel .....	12,434	D. 67,962
Bars .....	18,800	D. 20,608
Wire-rods .....	14,062	D. 4,950
Rails .....	37,444	D. 55,044
Tin-plates .....	64,946	I. 20,086

It will be seen that the large decreases were in raw material—pig iron, steel billets and blooms, and scrap. The only increase recorded in imports was in tin-plates, and this was due chiefly to the heavy purchases made in Wales by the Standard Oil Company.

**United States Steel Corporation.**—It is to be remarked that the business of this concern suffered to a somewhat greater degree than would be expected; that is, the decline was greater in its proportion of the trade than the total falling off. It was especially notable in the first quarter; but the recovery in the second quarter was not fully sustained in the third. The net earnings—from which interest on bonded debt, extraordinary improvements and dividends must be paid—were as follows, by quarters; the fourth quarter of 1904 being estimated, on the judgment of experts in the trade:

	1903.	1904.
First quarter .....	\$25,068,707	\$13,208,886
Second quarter .....	36,642,308	19,490,725
Third quarter .....	32,422,955	18,773,932
Fourth quarter .....	15,037,182	18,750,000
Total .....	\$109,171,152	\$70,223,543

The decrease for the full year was 35.7 per cent. Of course, this amount may be changed when the full report of the company appears. The corporation paid the full dividends of 7 per cent on its preferred stock, but made no payments on the common stock.

The tonnage of unfilled orders at the close of each quarter is given as follows, that at the close of 1904 being estimated by us:

	1903.	1904.
March 31 .....	5,410,719	4,136,961
June 30 .....	4,666,578	3,192,277
September 30 .....	3,728,742	3,027,436
December 31 .....	3,215,123	3,700,000

The Corporation made efforts at several times during the year to support prices, with varied success. At one time, by making large purchases of pig iron from outside furnaces, it aroused suspicion of a purpose to control the raw iron supply. If such an intention really existed, it was

probably abandoned later. The influence of the Corporation in the various steel pools has been frequently referred to in our columns.

**Foreign Countries.**—In most European countries the iron and steel production was about on a level with that of the preceding year, no notable increases or decreases being reported.

In Germany, the Iron & Steel Union reports the production of pig iron for the ten months ending October 31 as follows, in metric tons:

	1904.	Changes.
Foundry iron .....	1,532,919	I. 30,942
Forge iron .....	687,742	D. 29,132
Steel pig .....	515,606	D. 85,791
Bessemer pig .....	337,607	D. 25,937
Thomas pig .....	5,325,618	I. 115,347
Totals .....	8,399,493	I. 5,436

The export trade of Germany has shown a substantial increase during the year.

The British returns for the first half of the year show a decrease of 339,933 tons in the production of pig iron, which was 4,048,965 tons for the half year. As there has been little change in the activity of the furnaces, it is probable that the total output will be about 8,100,000 tons. The production of steel for the first half of 1904, however, was about the same as in the previous year. The total was 2,535,812 tons, indicating approximately 5,100,000 tons for the year. Of the steel made in the first half of the year, 865,683 tons were bessemer, 1,326,882 tons were acid open-hearth, and 342,247 tons were basic open-hearth steel. Nearly two-thirds of the steel produced in Great Britain is open-hearth metal.

Unlike Germany, Great Britain showed a decrease in foreign trade during the year.

In other European countries, so far as statistics are obtainable at this date, there has been comparatively little change in production. An important incident has been the conclusion of agreements by which the export trade in rails and in structural material is to be divided in agreed proportions among the German, the Belgian and the English makers. To a great extent these agreements are new experiments, and only the future can show their working. There have been reports of negotiations between these foreign combinations and the United States Steel Corporation, but the truth of these rumors cannot be ascertained.

The iron and steel industry of Canada was passing through a period of transition and re-organization, and did not make any progress, for that reason. The Dominion Iron & Steel Company has succeeded in adjusting most of its difficulties, and the works are now in steady operation. The mines at Bell Island, Newfoundland, have furnished a large part of the ore required, but this supply has been supplemented by imported ores, chiefly from Spain. The Lake Superior Company has nearly completed its re-organization, and the great

works at the Sault Ste. Marie were started up. The rail mill there is provided with contracts for a considerable part of the coming year. The proof that Canadian mills were ready to supply rails was sufficient, in the view of the government, to justify the imposition of the duty on foreign rails authorized by Parliament, and it was, accordingly, made effective by an order in council.

It may be said that the Canadian production of pig iron showed very little change from that of the preceding year. Some of this iron was made from ores mined in the United States, as at the Midland and Hamilton furnaces, in Ontario. The Nova Scotia Steel Company's furnaces used local ores, as heretofore. Radnor Furnace, in Quebec, was also run on local ores.

Apart from the Nova Scotia mines, the chief iron ore producer was the Helen mine, on the Michipicoten range, which sends most of its ore to the Sault. Exploration continued on the Atikokan and in other parts of western and northern Ontario, with varying results; but no new mines have been opened as yet. Mr. Obalski has continued in Quebec his investigations with regard to the iron-sand of the lower St. Lawrence. In the West there are promising developments in British Columbia, which may result in the establishment of an iron industry in that Province.

In Mexico the iron and steel works at Monterey are in operation. These, with the smaller works at Durango, constitute the industry in the Republic up to date.

#### THE IRON AND STEEL MARKETS.

The course of the iron and steel markets during the year is sufficiently shown by the special reports which follow. Pittsburgh is, of course, the great primary market, and Chicago the most important distributing point for the North and Northwest, while Birmingham represents the Southern industry. We give no special report of the New York market, since this city is only a distributing point for a limited territory in New York State and New England, and its variations in prices simply follow those of the more important centers.

The railroad demand—usually important in trade, though no longer the leader, as it once was—seemed conspicuously absent through the year. That this was partly a result of the deadlock over rail prices, there is no reasonable doubt; but it was also due, in part, to diminished earnings and to apprehensions of a still greater possible reduction. It was not alone that track repairs were postponed; the construction of new lines was limited to 4,100 miles, the smallest mileage recorded since 1897. Orders for new locomotives and new cars were less than 60 per cent of those reported in the previous year. Some large orders were placed late in December.

#### THE ALABAMA IRON MARKET.

By L. W. FRIEDMAN.

The fluctuations of this market during 1904 were very striking. The year opened on a declining market, with a curtailment of production, which followed the depression in the general situation throughout the country. In January the quotation for No. 2 Alabama foundry, which is accepted as the basis of prices, was \$10 per ton at furnace, with a declining tendency. In sharp contrast to this, the year closes with No. 2 foundry close to \$14, and with a very strong and active demand. Another depressing influence, which was felt to a certain extent, was the strike of the coal miners in July, which chiefly affected the mines owned by the large furnace companies. Although this strike appears to have failed practically, it was necessary at various times during the year to bring coke from West Virginia, adding to the cost of iron making. Fortunately, the iron companies generally were in a strong position, having not only made many improvements, but also accumulated considerable reserve funds during the previous years of prosperity, so that they were enabled to tide over the depression without undue difficulty.

Early in January the Alabama furnaces followed, in some degree, though not to a parallel extent, the policy of curtailment adopted by many of the northern furnaces. Advantage was taken of the stopping to repair, and, in some cases, rebuild furnaces, and this put the makers in better condition for operation. Notwithstanding the curtailment, there was some accumulation of iron, and at one time it is probable that fully 120,000 tons were stored in furnace yards awaiting purchasers. When the revival came, however, this iron was quickly cleared off, and the year closes with practically no unsold stocks on hand, and with orders for delivery running well into 1905.

As to the quotations, January and February saw a declining market, and at the end of the second month of the year the base price was \$9.50, and even \$9.25 for No. 2 foundry. There was some improvement in March, No. 2 foundry being quoted at \$10, a price which continued through April; but in May the market was very dull, and during that month and June No. 2 foundry sold at \$9, while there were reports of drawbacks on large orders. During July and August, business was still slow, but in the latter month there was a much firmer tendency. September saw a decided improvement—a much better demand, which was followed by an increase in production. The advance materialized in October, when No. 2 foundry ran up to \$10.50, while in November the price passed \$12, and in December it again advanced. The year closes with a firm quotation of \$13.75 to \$14 per ton at furnace. The net result is that production for the year was very little behind that of 1903.

One point which helped the trade, especially during the second half of the year, was the active demand for iron from the cast-iron pipe makers, whose business was better than in other branches of the trade. Large contracts for pipes were placed and filled, and there is abundant work on hand for the new year.

Steel production was fairly good in the first part of the year, and much better in the second half. The steel plant of the Tennessee Coal, Iron & Railroad Company, at Ensley, was run continuously, with the exception of a short stoppage for repairs. The monthly output was gradually increased until now, at the close of the year, it amounts to 20,000 tons of basic steel per month. The rail mill at Ensley is in active operation, with several heavy contracts to fill. It is the first mill in this country manufacturing rails from basic open-hearth steel, and the product has stood successfully most searching tests. The Alabama Steel & Wire Company during the year completed its steel plant at Gadsden and is operating it steadily, the finished products being steel bars, wire-rods, wire and nails, these finished materials being made in the company's mill at Ensley.

The rolling mills also saw their period of depression and of improvement, and at the close of the year five mills are in operation in the State. Foundry and machine shop trade for the year was fair, and most of the works kept a full complement of men employed. A good deal of sugar machinery for the South, and for Cuba and Mexico, is now made in Birmingham, and other heavy machinery is also supplied from the shops in this district.

#### CHICAGO IRON MARKET.

By E. MORRISON.

Considered as a whole, the year 1904 was very unsatisfactory to the local iron trade, but there is a disposition, at the close of the two prosperous months of November and December, to look charitably on the ten barren, profitless months preceding the revival of business. These ten months were good discipline; they taught both buyers and sellers many profitable things; but they probably represent the worst period of depression through which the Chicago trade has ever passed. The feeling of elation at the end of the year is due not only to a reaction from this depression, but also to general confidence in the permanency of the prosperity that has come so suddenly.

The year opened with a 50c. advance on Southern No. 2 pig iron, and a restriction of sales to the first quarter of the year, except on payment of 50c. to \$1 premium for later deliveries. For No. 2 iron the prices were: Northern, \$14.50@15; Southern, \$10@10.50 Birmingham, or \$13.85@14.35 Chicago. Finished products were weak; bar iron brought 1.30c.@1.40c.:

plates, 1.765c. (tank steel, 1/4 in. and over), and other shapes correspondingly low prices. There was little demand for structural iron, outside of a few large buildings for Chicago.

January started with the usual boom, but by the middle of the month the desire for business caused the Northern furnaces to cut their prices 50c., and Southern became weaker. Bars became active through the demand of the agricultural implement trade, and the price went up from 1.30c. to 1.50c. by January 20. By the middle of February Southern pig iron dropped to \$13.60, and declined by 25c. steps until February 20 it reached \$13.10. Northern producers met this with similar reductions, No. 2 Northern selling February 20, at \$13. The long contest for orders at profitless prices and a business, small both in size of orders and in aggregate tonnage, was on. It lasted until nearly the end of October.

The needs of the Southern furnacemen and their representations to the railroads led to an experimental cut of 35c. in the rate from Birmingham to Chicago territory that applied to all shipments between March 19 and March 31 inclusive. It did not affect business notably, as the Southern sellers advanced their prices to correspond, but a lower rate was plainly needed. It came April 25, when the Birmingham rate was reduced 20c., from \$3.85 to \$3.65, for Chicago and Mississippi river points. This rate, though first granted only until June 30, remained in effect up to the close of the year, and with the \$2.65 rate from Virginia furnaces will remain in effect until March 1, 1905.

The great reaction from stagnation in the market for both pig iron and finished products came in the week ending October 29. Without apparent reason, except a psychological one, consumers of iron began to buy freely. In a week the price of Southern iron advanced \$2 and the price of Northern \$1. By jumps of 50c. the quotations rose, until the last of December saw Northern selling at \$16.50@ \$17 and Southern at \$17.15@ \$17.65. Not only were prices advanced but sales became heavier, for longer terms, and general conditions were greatly improved. The close of the year sees the trade healthy and flourishing in most, if not all, important respects.

Highest and lowest prices for the year, with corresponding figures for 1903, are shown in the following table:

	—1903—		—1904—	
	Highest.	Lowest.	Highest.	Lowest.
Lake Superior charcoal...	\$26.50	\$16.50	\$18.00	\$14.50
Northern foundry No. 2...	23.50	14.25	17.00	13.00
Southern foundry No. 2...	23.15	13.10	17.65	12.65
Bar iron...	1.865c.	1.20c.	1.65c.	1.25c.
Tank plates...	2.00c.	1.75c.	1.865c.	1.565c.

Business in finished products followed the fortunes of pig iron, and could not be called good in comparison with years of recognized prosperity. Structural iron was weak nearly all the year, little busi-

ness being done outside of Chicago buildings. The iron bar business became light by the middle of February, and in the middle of May a reduction from 1.50c. to 1.45c., and soon after to 1.40c., was made. This did not stimulate business greatly, and the price declined until the first week in June, when quotations reached their lowest point for the year—1.25c.@1.30c. The end of the year sees the market a strong one for bars at 1.65c. Bar steel sold at 1.515 for the greater part of the year; in September it was reduced to 1.465 and shared in the sharp rise since, with the prospect of a considerably advanced price at the beginning of the year. Tank plates alone remained somewhat weak toward the end of the year, December quotations being 1.565, against 1.765@1.865 early in February, the maximum for the year.

Coke followed the fortunes of iron, and at the close of the year was in strong demand, at \$5.15@\$5.40 for 72-hour Connellsville. Throughout the spring and summer there was great demoralization of the market through over-shipments, to avoid demurrage charges. Connellsville 72-hour was sold in May as low as \$4.15, out of which came a \$2.65 freight rate.

PITTSBURG IRON AND STEEL MARKET.

By S. F. LUTY.

The year 1904 in the iron and steel trade had a weak opening and a strong finish. It was an unusual presidential year, in that business began to improve before the election, and at the opening of the fourth quarter there did not appear to be any doubt of continued prosperous conditions.

Early in the year pig iron began to drop, and strong efforts were made to keep up prices, but without success, although there were several temporary advances. Bessemer sold at the opening at \$13.85, Pittsburgh, and in December sales were made at \$3 a ton higher. The outlook was not particularly bright, and many iron pro-

ducers were prepared for a very dull and unsatisfactory year. Many predictions were made and few were verified. It was confidently stated that the ore movement would not amount to more than from 13,000,000 to 15,000,000 tons. The shipments by lake in 1903 were 23,649,550 tons, and by rail, 632,045 tons, a total of 24,281,595 tons. The highest prediction for 1904, as will be seen by the official figures, was about 7,000,000 tons too low, and that with 50 days of the lake shipping

season lost by the strike of masters and pilots. The ore shipments by lake officially recorded were 21,226,591 tons, and taking the same rail shipments as the previous year, official data not being announced at this time, swells the total movement for the year to 21,858,636 tons. Of the 41 blast furnaces in the Pittsburgh district 15 were in operation early in January, and at the close of the year 37 were running. The idle furnaces are one of the Lucy group which is being re-lined, one of the Isabella group, and the Neville Island furnace. All are expected to be going soon. The official report of the Bessemer Pig Iron Association up to December 1, showing the percentage of operation of furnaces tributary to the Lake Superior ore region, nearly 200 in number, is as follows: January 1, 35 1/2 per cent; February 1, 62; March 1, 72; April 1, 85 1/2; May 1, 89 1/2; June 1, 80; July 1, 65; August 1, 59; September 1, 72; October 1, 74; November 1, 75; December 1, 78 per cent.

The fluctuations in prices in several lines during the year were somewhat out of the ordinary. On January 27 the American Sheet & Tin Plate Company reduced the price of standard coke plates from \$3.60 to \$3.45 a box. In July another cut of 15c. was made, putting the price down to \$3.30 a box. On November 15 the \$3.45 rate was restored, and on December 22 the price was fixed at \$3.55. Sheet prices were cut in May. Black sheets, No. 28 gauge, were reduced from 2.30c. to 2.20c. and to 2.10c. in June; in November the price was advanced to 2.20c., and a further increase to 2.30c. was ordered on December 22.

The pool price of billets remained at \$23 a ton until September, although there was considerable shading during the summer. On September 19 the price of bessemer and open-hearth billets was cut to \$19.50, f. o. b. Pittsburgh, and sheet bars were reduced from \$24 to \$21.50. On

	Pig Iron		Gray Forge	Ferro-manganese	Bessemer billets	Steel Sheets	Tank Plate	Wire Bars	Nails		
	No. 2 Bessemer	Foundry							per keg.	Cut per keg.	
Jan.....	\$13.85	\$13.60	\$13.00	\$46.00	\$23.00	\$28.00	2.30	1.60	1.30	\$1.85	\$1.70
Feb.....	13.60	13.25	12.75	44.00	23.00	28.00	2.30	1.60	1.30	1.90	1.70
March.....	14.35	13.75	13.25	43.00	23.00	28.00	2.30	1.60	1.35	1.90	1.75
April.....	14.10	14.00	13.25	42.00	23.00	28.00	2.30	1.60	1.35	1.90	1.75
May.....	13.60	13.35	12.50	41.50	23.00	28.00	2.20	1.60	1.35	1.90	1.75
June.....	12.75	12.65	12.15	41.50	23.00	28.00	2.10	1.60	1.35	1.90	1.75
July.....	12.50	12.60	11.85	41.50	23.00	28.00	2.10	1.60	1.35	1.80	1.65
August.....	12.85	12.85	12.00	41.50	23.00	28.00	2.10	1.60	1.35	1.60	1.65
September.....	12.85	12.85	11.85	41.50	19.50	28.00	2.10	1.40	1.30	1.60	1.60
October.....	13.60	14.00	12.85	41.00	19.50	28.00	2.10	1.40	1.30	1.60	1.60
November.....	16.35	16.35	15.85	42.00	21.00	28.00	2.20	1.40	1.30	1.70	1.70
December.....	16.35	16.85	16.35	42.00	21.00	28.00	2.30	1.50	1.40	1.75	1.80

ducers were prepared for a very dull and unsatisfactory year. Many predictions were made and few were verified. It was confidently stated that the ore movement would not amount to more than from 13,000,000 to 15,000,000 tons. The shipments by lake in 1903 were 23,649,550 tons, and by rail, 632,045 tons, a total of 24,281,595 tons. The highest prediction for 1904, as will be seen by the official figures, was about 7,000,000 tons too low, and that with 50 days of the lake shipping

November 15 billets were advanced to \$21 and sheet bars to \$23.

Merchant pipe was advanced \$2 a ton on March 1, but the old price was soon restored, and reductions aggregating \$8 a ton were made at intervals up to July 1. On October 19 prices were advanced \$2, and a further advance of \$2 was made on November 1.

Wire products were advanced \$1 a ton in February, and no change was made until August 4, when a cut of \$2 a ton

was ordered. Trouble in the wire trade began soon after, when the Pittsburg Steel Company, a large independent wire producer, made a contract with the Republic Iron & Steel Company for 110,000 tons of billets on a conversion deal, deliveries to cover a period of 10 months. Under the contract the Pittsburg Steel Company got the billets delivered at its works at \$19.25 a ton, or \$3.75 less than the pool price. The deal was not approved by the leading interest, which at once ordered further reductions in wire products, \$4 a ton on wire nails, \$5 on plain wire and \$7 on barb wire. As the chief product of the Pittsburg Steel Co. is barb wire, it was believed the heaviest cut was made to prevent that company from realizing any benefit from the conversion deal.

On September 6 the beam pool cut prices of shapes \$4 a ton. The plate pool also made a cut of \$4 and the steel bar pool ordered a reduction of \$1 a ton on bessemer and open-hearth bars.

A series of steel meetings to further adjust prices began in New York on December 19. Contrary to expectations no change was made in prices of billets and sheet bars. Advances of \$2 a ton were made in plates, steel bars and structural shapes.

Various prices prevailed for pig iron during the year, from \$13.85 to \$16.85 for bessemer, and at times foundry No. 2 sold at a higher figure than bessemer. The prices given in the accompanying table represent the most popular rate each month, but in some instances sales were made at different prices than named. The pig iron market in the first three quarters of the year was very unsatisfactory. It had been strengthened in former years by the United States Steel Corporation making a heavy purchase. The corporation, however, did not enter the market until late in February, when it was announced that 187,000 tons of bessemer had been bought at \$13.85, Pittsburg. The reported tonnage was not correct, but the fact that the leading interest was buying outside iron had the effect of putting up prices to around \$14, but this rate only held during March and April, when prices declined, the lowest rate being in July, when sales were made at a trifle under \$12.50. The corporation took about 130,000 tons of bessemer iron up to March 10, and had options on a tonnage for April 10 which it did not exercise. It did not come into the market again until December, when 25,000 tons of bessemer were bought from the valley furnaces for the Carnegie Steel Co. at \$16.35. The Jones & Laughlin Steel Co. and the Lackawanna Steel Co. also were heavy buyers of outside iron during the last half.

Prices of steel rails, established April 1, 1901, on a basis of \$28 for standard sections, have continued, and in December were renewed for 1905. The steel rail

consumption in this country during 1904 fell considerably behind the two previous years, and according to the latest estimate will not exceed 2,000,000 tons. The output of the rail mills was much greater and a large tonnage was exported, principally by the United States Steel Corporation.

Owing to the unfavorable outlook at the opening of the year a general reduction in wages in the iron and steel mills went into effect on January 1, principally in the sheet- and tin-plate plants that are not governed by the annual scale of the Amalgamated Association of Iron, Steel & Tin Workers. The American Sheet and Tin Plate Co. made a cut of 20 per cent, and asked the Amalgamated Association for some concessions. A cut of 10 per cent in the wage scale of the sheet workers was accepted. Early in March the American company charged that deviations from the scale were being made by independent sheet- and tin-plate concerns, and insisted upon the same advantages. Several companies that had signed the scale had entered into private agreements with their men to let a portion of their wages stand, which would be given to them later if the earnings warranted. This was decided to be, clearly a violation of the wage agreement, and the general executive board met, and, although the action was illegal under the constitution, granted the American company an additional reduction of 10 per cent for the sheet mills and 20 per cent reduction for the tin-plate mills, and lowered the base of the tin-plate scale from \$4.20 a box to \$3.50 a box. The board, however, stipulated that the agreement could be terminated on April 2, and in the meantime the members were given an opportunity to vote on the proposed changes. The propositions were defeated and an expanded conference was called. This was the next highest body to the general convention of the association. After a session that continued for several days, a compromise was reached. An additional cut of 8 per cent was made in the sheet scale, and the tin-plate scale was cut 18 per cent. The sheet base was reduced from 3c. as the average selling price of No. 26, 27 and 28 gauges, to 2.30c. The tin-plate base was reduced to \$3.40 a box. At the Amalgamated Association convention in May it was decided to abolish the rebate collections in the tin-plate agreement, and to ask for a restoration of 8 per cent of the previous cut of 18 per cent in the sheet- and tin-plate scales. The existing iron scale was adopted for another year. At the close of the convention numerous conferences were held, but an agreement was not reached on the sheet- and tin-plate scales until late in July. The Amalgamated Association withdrew its demands, but the rebate collections were reduced from 3 to 0.5 per cent. The collections were sus-

pending on June 1, but were renewed on October 1. After many conferences with the Republic Iron & Steel Company on the iron scale the matter was left to a board of conciliation, and a settlement was made early in September on a basis of \$4.90 a ton for puddling, when the average sales of bar iron ranged from 1 to 1.40c. The old scale called for a base of \$5 a ton when bar iron prices ran from 1 to 1.20. and 25c. advance with each 1c. increase in price. Under the continuous agreement none of the mills closed on June 30 when the old scale expired. The average sales of bar iron up to September 1 were not below 1.30c., and the wages of the puddlers in the union mills from January 1 to September 1 were at the rate of \$5.25 a ton when the \$4.90 rate went into effect and continued throughout the year. The puddling rate at the opening of the year was 50c. a ton less than the rate for December, 1903.

On January 1 the American Sheet Steel Company and the American Tin Plate Company were consolidated under the name of the American Sheet & Tin Plate Company, and the offices were removed from New York to Pittsburg. W. T. Graham, president of the tin-plate interest, was made president of the consolidated concern. He retired on July 31 to take the presidency of the American Can Company, and was succeeded by John A. Topping.

The most important deal made by the United States Steel Corporation was the purchase of the Clairton Steel Company's properties from the Crucible Steel Company of America, the negotiations having been concluded early in May. The properties owned by the Clairton company included about 150 acres of land 17 miles from Pittsburg, on which there are now in operation three blast furnaces, twelve open-hearth furnaces, one 40-in. blooming mill, and one 28-in. billet mill, also shops, power plants, etc.; 2,907 acres of coking coal lands in Fayette county, Pa.; Champion Iron Co. properties on the Marquette range, including 20,000 acres in fee and a large tonnage of ore already developed; one-half interest in Clairton mine and other ore properties, and the total capital stock of the St. Clair Terminal Railroad Company.

**THE CENTRIFUGAL PUMP AS A CLASSIFIER.**—The use of centrifugal action in separating substances of different densities, demands liquid currents which can be perfectly controlled. M. Blanc, in the *Bulletin de la Société de l'Industrie Minérale*, suggests the use of the centrifugal pump to sort coal, metalliferous sand, and crushed ore. His results showed a low consumption of power and water, the removal of a clean tailing, and the saving of the value in the concentrate. The idea is worth considering, and may prove fruitful in special cases.

## THE LAKE ORE TRADE.

By GEO. H. CUSHING.

Since iron ore is one great staple of lake commerce, conditions at the opening of 1904 warranted caution on the part of the vessel owners. Both owners and shippers accordingly became ultra-conservative, and blindly so, as the final result shows. On May 1 there was more ore remaining on the Lake Erie docks than had ever been the case before, the total being over 4,500,000 tons. Under ordinary circumstances this amount was enough to meet all the demand from the furnaces until August. Moreover, the stocks included a balance of all grades, so that there seemed to be no probability of a shortage of any description.

Another circumstance which affected the trade was the fact that during the three years 1901 to 1903, inclusive, labor organizations on the lakes had been growing stronger and more inclined to assert themselves. In 1902 the Lake Carriers' Association was reorganized and prepared to fight the labor organizations, this step being compelled by the demands from the men. The climax was reached when masters and pilots, without whom no boats can be run, completed a union, and in the early part of 1904 demanded a re-classification of the vessels which would increase the pay of most of them, besides insisting on certain privileges, which would place the hiring of labor entirely in the masters' hands. The vessel-owners realized that further increase of wages would probably absorb all the profits of the season, and that a fight must be made then or never.

A further factor in the lake trade was the amount of shipbuilding in the previous two years, and the fact that the new tonnage was mainly of large boats, which could handle a high proportion of the business, and which, moreover, would put the older and smaller vessels at a great disadvantage as regards expense. The total carrying capacity available in the spring of 1904 was estimated at 30,000,000 tons of ore for the season.

The strike of masters and pilots was an obstinate one, and the result was that May was entirely a dead month, and it was not until near the end of June that the ore-carrying industry showed anything like activity; even then the business was very light. The curtailment of production by the furnaces made matters look as if the tonnage required for the year would not be over 14,000,000 or 14,500,000 tons; that is, less than half the capacity of the available fleet, even in a short season.

In February and March, after the depression became apparent, several meetings of the Ore Association were held. Originally a power in the trade, this association had lost much of its influence, owing to the purchase and control of iron ore lands by the big steel companies,

who handled their own ore and did not offer any for sale to outsiders. In these meetings the question of curtailing production was brought up, and it is understood that the steel companies refused to agree upon any *pro rata* scale of reduction, on the ground that they understood their own needs, and would not do anything to support independent shippers. The result was that the association finally dissolved, and the market was left an open one, though subsequently some understanding was reached about prices, not in time, however, to prevent a considerable decrease from those of 1903. The general scale, on which outside ore was sold during the year, was substantially \$3.25 per ton for bessemer old range, \$3 for bessemer Mesabi, \$2.60 to \$2.75 for non-bessemer old range, and \$2.40 to \$2.50 for non-bessemer Mesabi. These prices, it must be remembered, are for ore on lower lake docks.

All these things combined made a bad situation for the vessel owners; and, when shipments really began, contracts were made on the basis of 75c. from Duluth to Lake Erie ports, 65c. from Marquette, and 55c. from Escanaba. Wild rates were about the same. In August, however, matters began to improve, the demand for iron was evidently increasing, and, consequently, everyone began to realize that a much greater quantity of ore would be needed than had been anticipated. The mines, especially those on the Mesabi, were abundantly able to meet the demand, as most of them had large quantities of ore stocked. Early in September a rush began, and the remaining three months of the season showed midsummer activity. A mild fall favored the movement, which continued until the channels were actually blocked by ice, which did not occur until the middle of December. The vessel-owners, though they were favored with a greater amount of business, did not secure any advance in rates, and the figures given above continued in force until navigation finally closed.

The full figures for Lake shipments from upper ports are given in the review of the Lake region. The receipts of ore at the Lake Erie ports for the season were 17,452,914 tons, most of the balance going to Milwaukee and South Chicago. As compared with 1903, the Lake Erie receipts showed a decrease of 1,287,081 tons. The ore reported on docks at the opening of the season was 4,534,130 tons, while the quantity on December 1 was 5,669,895 tons, showing shipments from docks to furnaces during the season of 16,317,149 tons. This high figure made it evident that the rush of ore coming down in the last three months of the season was mainly shipped directly to furnaces, very little of it remaining in stock. In other words, the heavy stocks at the close of the season are in furnace yards and not on the port docks.

## The Lake Superior Iron Ranges.

By DWIGHT E. WOODBRIDGE.

President Jas. J. Hill, of the Great Northern Road, who has made a great many wise and forceful remarks, not long ago said that "the growth of our enormous iron and steel industries, which are pointed out as the result of our protective tariff, can be more surely traced to our magnificent reserves in the iron mines of Michigan and Minnesota than to any other sources. The cheap production of the highest grade of ore in these mines and the low rate of transportation to Lake Erie ports have done more to build up the iron and steel industries of the United States than any tariffs that have ever been placed upon our statute books. To-day, if these mines were closed, our superiority in the iron and steel trades of the world would be gone forever."

This article is a review of the progress of the Lake Superior ore trade for the year 1904, and not a discussion of protective tariffs, but it is well enough to preface it with a statement from one of the leading transportation men and business thinkers of this country, who, though he says nothing in this connection that has not been recognized and acknowledged, and stated again and again by writers on the Lake Superior mines, is worth quoting in almost anything he may utter.

Closely associated as it is with the steel-making trade of the United States, the Lake Superior region suffered in common with that end of the business from the unnecessary depression of late 1903 and early 1904. There was a sudden cessation of mining in the fall of 1903, and in mid-November the last cargoes of the year were being forwarded. Mines had unexpectedly large stockpiles in consequence, and there were few sales of ore for delivery in the spring of 1904. Therefore, they did not operate extensively during the winter. Men were discharged, and every corner was cut all along the line. The mining companies, at least the larger and more stable of them, did not cut wages, but retrenched in every other way, and increased the length of day's labor. With all this, it was hard to make both ends meet, and it is a safe assertion that half the ore mined for sale during the year 1904 did not bring a profit to the operator. There was no improvement in conditions until late in the summer, and then merely along the line of a slightly better demand and accession to the number of buyers in the market. Prices did not advance till late in the fall, when belated buyers, alarmed at the sudden increase of inquiry for finished material, entered the ore market for additional tonnage for delivery during the season of 1904. They were accommodated, but at a higher price, and many of

them paid 50c. a ton more than was offered only a few weeks earlier. Going prices for standard ores from Lake Superior for the better part of the year were from \$2.25 for Mesabi non-bessemer to \$3.10 and \$3.20 for old range standard bessemers, with special fancy ores bringing a little higher figures. Large tonnages of standard Mesabi bessemer of good physical character were sold for \$2.75. Vessel rates were at low ebb, and for part of the summer went as low as 65c. gross for the 1,000 miles from Duluth to Lake Erie ports. This included the unloading charge of 19c., and as the ships did not usually carry a return cargo, meant that the vessel got 46c. for carrying a ton of 2,240 lb. 1,000 miles, and going back after another.

The improvement that came in the fall was not only for ores, but for all connected branches. Vessels received higher rates and miners had concessions. As the fall happened to be especially warm and pleasant, it was possible to fill late orders, and the shipment of ore remained heavy until well on in December. The last cargoes left upper lake ports December 10, a later date than in any previous year. It was this alone that removed the danger that some independent—too independent—furnaces would be unable to find ores of the character best for their products in sufficient quantity.

With the improvement of the latter part of the year, and with the United States going into 1905 at a rate of consumption ahead of any record ever made, requiring up to 19,000,000 tons of pig iron annually, it is necessary for Lake Superior mines to produce the coming season at a rate that is above that of 1902, when 27,500,000 tons were shipped. Mines are preparing to do this. On every range they are extending their operations, and new properties are being opened. On the Mesabi this is especially true, and not far from ten new shippers will be in the field there in 1905. Several of these are planned for very large and important mines, open-pit and underground. The Steel Corporation alone has four new mines under development on the Mesabi, and will get a full season product from mines that were developed during the past year, but that did not commence business till late. Railroads, especially on the Mesabi, are preparing for a more active year than ever before, and the two lines controlled by the Steel Corporation alone will expend about \$2,000,000 for improvements and betterments, new docks, rolling stock, motive power, new trackage, etc. On old ranges there will be some betterments, including at Ashland a new dock for the Northwestern road. As the proportion of ore to be called from the Mesabi range will be greater than ever, it is but natural that the roads reaching that district should be more active than others in their campaign for betterments.

With the drying up of every other channel of activity, that of exploration suffered. Despite the dulness, however, some men had foresight enough to realize that conditions then extant could not last, and they continued operations. On the old ranges of Michigan, exploration during the year was in small volume, and confined to finding the extension of certain orebodies, the presence of which were known. In all there was little of this work. On the Mesabi range, where perhaps 200 drills had been busy the season before, three-fourths that number were laid by. A little work was maintained in the central part of the district, much of it for the purpose of determining the extent and character of orebodies previously discovered, in order to prepare them for mining in a rational and modern systematic method. On the western end of the range some exploration has been maintained all the year among the dry and sandy ores of the section, in the hope of finding large bodies that may be washed and mined successfully. This work has met with favorable response, and a large tonnage has been proved there, much of it, to be sure, prior to 1904, but a large share of it this season. The Canisteo Mining Company has a vast amount of ore in the ground that is believed to present no serious problem for mechanical concentration. The Oliver Iron Mining Company has secured some tonnage there, and recently closed a bond on one large property, where preliminary explorations, made by various parties in the course of a period extending over years, have shown up many million tons. These west Mesabi explorations, and the experiments that have been carried on in conjunction with them looking toward the elimination of sand, are to be ranked as easily the most important of anything done in the way of exploration and the extension of ore tonnage during the year. This is said with a full realization of work elsewhere. Baraboo, in south-central Wisconsin, has been the scene of some work in the way of development of existing orebodies and in drilling new ground for others, and not a little of value has been determined. Baraboo, as the result of this exploration, and the mining carried forward by the Illinois Mining Company throughout the year, has come to a defined and recognized position. The region is valuable chiefly for its effect on the manufacture of steel in the Chicago district. Its freights permit ore to be delivered in furnace stocks at Chicago for the same price as Mesabi ores can be delivered at Lake Superior ports. This is a great assistance, and if the ore was of equivalent grade, would make it an important and welcome addition to Lake Superior reserves, in so far as its tonnage permits. But Baraboo, as shown by the work of the Illinois Mining Company, contains a lens of ore from 20 to 30 ft. wide that can be mined to an average of about

56 per cent iron and non-bessemer. Some six or seven feet of this width is up to 60 per cent, the rest lower. The ore grades away from these better percentages until it is far too low to be mined. So far the Illinois Mining Company has had a pumping cost equivalent to 35c. a ton on its product, and, in the nature of the ground, this cost must be heavy for a long time. The size and formation of the orebodies are such that other expenses are not low, and the ore represents a considerable cost per unit when delivered to furnaces. But it is almost indistinguishable from a Marquette soft ore, and is excellent in its furnace properties. While drill-holes have been sunk at other properties in the district, some of them showing ore in quantity, no actual development has occurred elsewhere than in the Illinois mine. By the openings along the vein, by drill results showing its extensions, both on strike and dip, it is easy to say there are 9,000,000 or 10,000,000 tons available in this mine. While the probabilities are that the longitudinal extent of the district is much restricted, any region that has been so far developed that one mine can safely be estimated at such a figure, is not to be lost sight of or condemned.

Work has been carried on with drills in what is known as the Deerwood, or Aitkin district, 100 miles west of Duluth, on the line of the Northern Pacific road. It is possible that ore of economic value may be shown there; it is certain that large bodies of lean ore and paint rock have been cut by drills; but it is too early to say these explorations have resulted or will result in any addition to the reserves of merchantable ore in the Lake Superior region. The present winter may determine something as to this, but no very important assurances can be had unless work is conducted more heavily than so far.

A little drilling has been done on the Vermilion range, but with scarcely as high success as had been hoped. A drill or two have been operating in the Canadian fields, west of Lake Superior, but with no more than results enough to encourage further expenditures.

The output, or shipment, of the various ranges for three years is shown below. In this table the estimated all-rail tonnage for 1904 cannot yet be apportioned to the various ranges:

	1902.	1903.	1904.
Mesabi . . . . .	13,342,840	12,910,455	12,086,878
Vermilion . . . . .	2,084,263	1,676,699	1,299,265
Gogebic . . . . .	3,663,484	2,912,912	2,288,400
Menominee . . . . .	4,612,509	3,741,284	3,047,096
Marquette . . . . .	3,868,025	3,040,245	2,504,951
All-rail, 1904. . . . .			500,000
Total, U. S. . . . .	27,571,121	24,281,595	21,726,590
Michipicoten. . . . .	295,399	201,387	117,153
Total . . . . .	27,866,520	24,482,982	21,843,743

The year 1902 is included, because that season showed the highest production on record. The decrease from the high point then reached was 3,383,538 tons, or 12.1 per cent; in 1904 it was 6,022,777 tons, or 21.6 per cent. The decrease in 1904, as

compared with 1903, was 2,639,239 tons, or 10.8 per cent.

Port shipments for the season of 1904 are reported as in the table below; in this only the shipments from mines in the United States are given, the ore from the Michipicoten range, in Canada, which goes to the Sault, not being included:

	1904.	Changes.
Escanaba .....	3,644,267 D.	633,194
Marquette .....	1,907,301 D.	100,045
Ashland .....	2,288,400 D.	534,719
Gladstone .....	480 D.	85,336
Two Harbors .....	4,566,542 D.	554,114
Superior .....	4,169,990 I.	191,411
Duluth .....	4,649,611 D.	706,862
Totals, Lake .....	21,226,591 D.	2,422,959
Rail .....	500,000 D.	132,045
Total .....	21,726,591 D.	2,555,004

Gladstone, in 1901, ceased practically to be a shipping port, having sent out only one small cargo. Superior was the only port which showed an increase.

The haul of ore to the Lake docks is an important matter to the railroads, several of them deriving an important part of their revenue from that traffic. The distribution of ore tonnage in 1904 was as follows:

	1904.	Changes.
Duluth, Missabe & Northern .....	4,649,611 D.	706,862
Duluth & Iron Range .....	4,566,542 D.	554,114
Chicago & Northwestern .....	4,333,493 D.	1,205,051
Great Northern .....	4,169,990 I.	191,411
Lake Superior & Ishpeming .....	1,051,329 D.	47,250
Chi., Milwaukee & St. Paul .....	867,283 I.	107,000
Duluth, S. Shore & Atlan. .....	855,972 D.	52,795
Wisconsin Central .....	731,890 D.	69,963
St. Paul, Minn. & Sault St. Marie .....	480 D.	85,336
Ore not over docks .....	500,000 D.	132,043
Total U. S. .....	21,726,590 D.	2,555,005
Algoma Central & Hudson Bay .....	117,153 D.	84,234
Total .....	21,843,743 D.	2,639,239

The business classified as all-rail, or not over docks, while somewhat less last season than during the previous year, is increasing, and will probably show a considerable gain in 1905. This is due to the new furnaces in the Lake Superior region, especially those at Duluth and the Sault. The Northwestern road shipped 96,000 tons all-rail in 1904. The South Shore carried almost as much to the Sault; the Zenith furnaces, at Duluth, received about 100,000 tons, and much was sent to Chicago and to the small charcoal furnaces on the Michigan Hardwood. Some also went to the East.

Four of the railroads in the table above—the Duluth, Missabe & Northern and the Duluth & Iron Range, in Minnesota; the Lake Superior & Ishpeming, in Michigan, and the Algoma Central & Hudson Bay, in Canada—depend almost entirely on the ore traffic.

The shipments of the Oliver Iron Mining Company—the United States Steel Corporation's mining organization—which amounted in 1902 to 16,063,000 tons, or 57.6 per cent of the total, and in 1903 to 13,193,000 tons, or 53.9 per cent, in 1904 were 11,174,000 tons, or 51.1 per cent.

Only three mines in the Lake Superior country produced more than one million gross each in 1904, compared with five in 1903 and seven in 1902. These big mines

were the Mountain Iron and the Burt, of the Steel Corporation, and the Stevenson, of Corrigan McKinney & Co. The Adams-Spruce, if figured as one, would make a fourth, but there seems to be no more reason for such a classification than for doubling up other properties managed by the same interests.

What was done by other large shippers is shown in the following table:

	1904.	Changes.
Corrigan, McKinney & Co ..	2,454,000 I.	889,000
Cleveland Cliffs Iron Co. ....	1,226,125 I.	130,125
Pickands, Mather & Co .....	1,144,700 I.	44,700
Jos. Sillwood .....	766,804 D.	133,196
Jones & Laughlins .....	467,260 D.	173,140
Ferd. Schlesinger .....	257,744 D.	87,256
Republic Iron & Steel Co. ....	310,190 D.	41,810
Penn Iron Mining Co. ....	141,947 D.	202,053
Mahoning Ore & Steel Co. ....	707,500 D.	301,500
Biwabik Mining Co. ....	647,600 D.	160,400
Pewabic Mining Co. ....	361,814 D.	127,186
International Harvester Co. ....	244,403 I.	27,403

In the figures in this table, no credit is given the Steel Corporation for its Corrigan ore, nor for its share in Mahoning, Biwabik or Pewabic. The Penn Iron Mining Company also has an interest in Mahoning, while the Cleveland Cliffs has a quarter interest in Lake Superior and Regent.

### Cement.

One of the gratifying features is the expansion in the employment of reinforced concrete, not only in building construction, but also for other purposes where stone has been in universal favor. More attention is also being given to the use of cement in special industries, as in the manufacture of pigments, bricks, shingles, etc. Patents for new uses of cement are multiplying. Unfortunately, the industry both here and abroad has of late suffered heavy pecuniary losses, because of a relaxation in the demand in America—the largest consumer in the world. Prices are, however, slowly recovering, though the margin of profit is still small. In Germany 14 of the larger plants in Rhenish Westphalia have united to regulate production, fix prices, tax exports, carry a sufficient surplus to meet outside competition, and divide the balance of profits *pro rata*. Fully one-half of the 405,000,000 lb. cement imported into the United States in 1904 was from Germany, but compared with 1903 there was a marked falling off. The domestic production in 1904 was approximately 22,000,000 bbl. portland cement, and 5,000,000 bbl. natural hydraulic cement; together equivalent to 4,930,000 short tons. Adding this to the net imports of 193,500 short tons, we have a total of 5,125,000 tons for 1904, which compared with 5,700,630 tons in 1903, shows a decrease of 575,630 tons, or about 10 per cent. Most of this falling off in consumption has been felt by European exporters, notably in Germany, Belgium and Great Britain. The domestic production of slag cement has been curtailed somewhat by the depression in building operations in America; nevertheless the output in 1904 was something like 500,000 barrels,

### The Chemical and Mineral Trades.

BY CHARLES C. SCHNATTERBECK.

Consumption in most lines has been unsatisfactory and prices low, impairing profits. Imported products from Great Britain and the Continent are feeling the expansion in domestic production; thus, imports of chlorate of potash have fallen off this year about 82 per cent; caustic soda, 28 per cent; bleaching powder, 22 per cent; and soda ash, 14 per cent. Sal soda, however, showed an increase of 31 per cent in imports as a result of the heavy consumption. Cement receipts have been 62 per cent less than 1903, and domestic exports have increased 124 per cent. Imports of salt are 9 per cent larger than last year, while domestic exports show nearly three times this increase. Raw materials, notably nitrate of soda, continued high in price, and are reviewed separately in this issue.

Interesting developments during the year were the authorization of an additional \$6,000,000 in 8 per cent preferred stock to liquidate the loan made by the Virginia-Carolina Chemical Company; payment of 6 per cent dividend on the preferred shares of the American Agricultural Chemical Company; suspension of dividends by the General Chemical Company, because of a depression in business and serious loss by fire and flood; initial dividends of 5 per cent on the \$25,000,000 preferred stock of the E. I. Du Pont de Nemours Company, and 2.5 per cent on the \$9,000,000 common stock of the International Smokeless Powder & Chemical Company, which has a substantial government contract and is controlled by the powder trust; increase in capitalization of the Pennsylvania Salt Manufacturing Company from \$3,000,000 to \$4,000,000, yielding 12 per cent in dividends annually; purchase of additional salt lands at Delray, Michigan, by the Solvay Process Company; erection of new by-product coke-ovens by the Semet-Solvay Company, one of the largest producers of gas-liquor sulphate of ammonia in the United States.

In heavy chemicals the feature has been bleaching powder, which, since the signing of the triangular agreement among the manufacturers in Great Britain, the Continent and America, has advanced, selling at \$1.20 to \$1.25 per 100 lb. for prime brands on contract delivery. It is significant that the shipments from Great Britain to the United States have fallen off about one-third this year, in favor of the Continental makers. Total imports were approximately 88,587,628 lb., as against 113,285,240 lb. in 1903; showing a decrease of 24,697,612 pounds. Soda compounds have been steady, advancing for 1905 delivery. Caustic soda, of which imports were about 2,179,803 lb. or 790,983 lb. less than 1903, sold at \$1.90 to \$1.95 per 100 lb. for foreign, f. o. b. New York, while

domestic high-test brought \$1.75 to \$1.85 at works. Alkali, imported to the extent of 18,907,015 lb., as against 21,859,365 lb. in 1903, moved at 85 to 92.5c. per 100 lb. for foreign at New York, and 72.5 to 77.5 for domestic at works. Sal soda imports were 4,511,228 lb., against 3,454,005 lb. in 1903, while selling prices were 67.5c. per 100 lb. for foreign at New York, and 60c. for ordinary domestic at works. Chlorate of potash, of which the imports fell to 85,638 lb.—the smallest quantity on record—suffered a decline in price to 7c. to 8.75c. per lb. for foreign at New York, and 6.5 to 8.75c. for domestic.

Cyanide, because of competition, sold at 17 to 20c. per lb. at New York. Small exports have been made, principally to Mexico and Canada, at rather low prices compared to domestic deliveries. With an increased demand from the Transvaal gold mines, the European situation has improved materially.

Copper sulphate exports have increased, amounting to 25,650,000 lb., initiating an advance in price from \$4.90 to \$5.40 per 100 lb. for domestic deliveries, and from \$3.77 to \$4.81 for export. Small quantities of British blue vitriol have been imported, paying a duty of 0.5c. per lb., and selling at about domestic prices.

Acids were firm in price, because of the strength in raw materials. Oxalic acid, imported to the amount of about 5,500,000 lb. per annum, and soon to be made at a new plant in Pennsylvania, sold at \$5 to \$5.50 per 100 lb. at New York—a price that affords little profit. Nitric acid, manufactured on a large scale in this country, has been marketed at \$4.50 to \$5 per 100 lb. for 36° in carboys, f. o. b. New York; \$4.75 to \$5.25 for 38°; \$5 to \$5.50 for 40°, and \$5.375 to \$5.75 for 42°, the higher price ruling at the close of the year for 1905 shipments. Muriatic acid ruled steady at \$1.50 per 100 lb. for 18°; \$1.60 for 20°, and \$1.75 for 22°, f. o. b. New York. Sulphuric acid has been reviewed under 'Sulphur and Pyrite' in this issue.

Copperas, largely produced by steel-wire manufacturers, shows an increased consumption in the purification of water, preparation of pigments, etc. Being controlled by an understanding among makers, the price has been unchanged from 47.5c. per 100 lb. in bulk, and 52c. in barrels, f. o. b. New York.

Alum was in good demand, and contracts for 1905 have been booked at unchanged prices, namely, \$1.75 to \$1.80 per 100 lb. for lump, \$1.80 to \$1.85 for ground, and 90c. for paper stock. Tin crystals were advanced from 18c. to 22c. per lb., in barrels, suggesting that competition among makers has been quieted.

The barytes trade has seen keen competition, partly the result of expansion in the domestic production, over-supply of the poorer grades, and a scarcity of prime white. American crude No. 1, sold at

\$9.75 per short ton; No. 2 at \$8, and No. 3 at \$7; snow-white at \$15 to \$16; while foreign gray brought \$13.50; snow-white, \$17.25 to \$18.75.

Asbestos for fireproofing purposes has been in active demand this year, and besides meeting the domestic consumption, the United States has made exports to Europe at remunerative prices. As the crude mineral is largely under contract to a few manufacturers, market prices have ruled steady.

Asphalt, of which the United States consumes annually about one-third of the world's supply, shows a decrease of over 25 per cent this year, as a result chiefly of competition with other paving materials. Imports were approximately 123,500 tons, mostly from Trinidad, as trade with Venezuela has been interrupted by the litigation between the Castro government and the American company operating the Sucre deposits.

#### Nitrate of Soda.

The American consumption in 1904, principally in the blasting powder and fertilizer manufacturing industries, was the largest on record—275,000 long tons—withstanding the high prices of \$45.26 to \$53.20 per ton. The European deliveries, mostly to sugar-beet growing countries, were approximately 1,105,000 tons, being less than 1903 by reason of business depression in the distributing markets. About 28,000 tons were consumed by the powder factories of the nitrate companies in Chile, and by agriculturists in neighboring countries. The world's consumption in 1904 was somewhat less than the previous year, but production is so regulated by the combination that stocks in Chile do not accumulate to the detriment of market prices. In 1904 purchases were made alongside steamer in Chile at the equivalent of \$36.30 to \$44.00 per ton, while the ocean freight to distributing markets has been advanced by agreement from \$3.12 to \$4.80 per ton. Chile collects \$12.32 as duty on exports, and in 1904 this revenue amounted to more than \$17,000,000, which constituted about 70 per cent of all money received by the government.

There are now about 101 *oficinas* in the combination, and to provide for the new ones the quotas of all have been adjusted on the increased exports of 36,000,000 qtl., from April 1, 1904, to March 31, 1905. Of this quantity 80 per cent was to be shipped in the nine months of 1904, although, if exports were less the balance would be added to the 15 per cent allotted for the first quarter of 1905. This system has initiated stable market prices, and in the past year netted profits of \$3 to \$5 per ton to the producer, permitting the payment of dividends of 5 to 30 per cent, cancelment of debentures, and the addition of substantial amounts to reserve funds. Compared with the previous year net profits have

been impaired by the reduction made in individual quotas, and the advance of \$1.32 to \$1.76 in the cost of production.

A surprising feature is the expansion in operations in Chile of German agricultural associations, which, being the foremost consumers, have acquired extensive nitrate deposits. Germany now controls nearly one-third of the exports from Chile, indicating that British interests no longer represent over one-half the output, as was the case a few years ago.

#### Bromine.

A record production for the United States was reported in 1904, amounting to 897,100 lb., which includes the bromine contained in bromides, all of which was made in Michigan. As compared with the 597,000 lb. output of 1903, this shows an increase of 300,100 lb., or over 50 per cent. In the order of their importance, the producing States are Michigan, Ohio, Pennsylvania and West Virginia. It is noteworthy that in December the output was above the average, owing to the coal strike in the Ohio River district, by which all the furnaces in this section were affected from March until the middle of September.

The market for bromine and bromides has been good during the past year, and at times the urgent demand advanced prices. In addition to their medicinal uses, bromides are employed in the treatment of gold ore, it being customary for some mining companies to prepare their own bromocyanide. Prices at New York were 48c. per lb. for bromine in bulk, and 30c. for potassium bromide.

#### Fluorspar.

A notable expansion in the consumption of fluorspar in the United States is taking place, from which higher prices have resulted. Foundries find it advantageous to use more fluorspar for thinning their slag, thereby strengthening and purifying their castings, especially when much scrap is used. It is also used in making open-hearth steel, with excellent results. A further advance in price is expected during the ensuing year, as a result of the increased demand from cupolas. At present, Kentucky gravel fluorspar, unwashed, containing about 15 per cent silica and 73 per cent calcium fluoride, is quoted at \$3.50 per ton, f. o. b. at shipping point, carrying 80 per cent fluoride, at \$4; 90 per cent, at \$5; 95 per cent, at \$6.50; 98 per cent, at \$7.70 per ton. Ground mineral, 99 per cent fluoride, is worth \$12 per ton, and the pure mineral for acid making, \$15. Imported fluorspar is quoted at New York at \$8@ \$10 per ton for lump, and \$11.50@ \$13.50 for ground.

In addition to its use in the manufacture of hydrofluoric acid, the mineral is employed as a flux in metallurgy, for the manufacture of opaque and opalescent glass and enamels, for glazes and fireproof ware, and for cheap jewelry, vases, etc.



### Sulphur and Pyrite.

By CHARLES C. SCHNATTERBECK.

The most interesting feature in 1904 has been the development of the Louisiana sulphur industry. This has resulted in a reduction in the imports of brimstone, alarming the Sicilian combination, which, by exporting about one-third of its output to America at an advance of \$3 to \$7 per ton, has in eight years, increased its profits 221 per cent. Sulphur recovered from pyrite, produced largely in Virginia, and imported from Spain and Canada, duty free, is used chiefly in the manufacture of sulphuric acid for the fertilizer and petroleum refining industries, while the brimstone from domestic mines and imported from Sicily and Japan, also free of duty, is consumed by paper mills. Other sources of supply, promising expansion, are the recovery from smelter fumes, as is done at La Salle and Peru, Ill., and Argentine, Kan., and by the use of low-grade copper ores in California and pyrrhotite in Virginia. The consumption of sulphur as pyrite and brimstone in this country in the last two years is estimated as below, in long tons:

	1903.	1904.	Changes.
Sulphur, domestic . . . . .	34,396	191,250	I. 156,854
net imports . . . . .	186,237	129,454	D. 56,783
	220,633	320,704	I. 100,071
Pyrite sulphur, domes. . . . .	87,730	79,976	D. 7,754
net imports . . . . .	200,215	196,048	D. 4,167
	287,945	276,024	D. 11,921
Total consumption . . . . .	508,578	596,728	I. 88,150

Apparently brimstone furnished 53.8 per cent of the total consumption, and pyrite 46.2 per cent, which compares well with 1896—the first year of the Sicilian combination—when the ratio of consumption was 50.7 per cent for brimstone, and 49.3 per cent for pyrite sulphur. It is noteworthy that America, in 1904, produced nearly half the sulphur it consumed.

Imported brimstone, selling f. o. b. Sicilian ports at the equivalent of \$18.78 @ \$19.74 per long ton for best unmixed seconds in bulk, and \$18.18 @ \$19.14 for best thirds, paid an ocean freight to Atlantic ports of \$1.62 @ \$1.92. At New York, contracts for shipments were made at \$21.25 @ \$22.50 for best seconds, and \$20.50 @ \$22 for thirds—prices that have netted small profit to the importer. Domestic sulphur of prime quality, guaranteed 99.5 per cent, sold at \$21.50 @ \$21.75 per ton, f. o. b. New York; \$21.75 @ \$22 at Baltimore and Philadelphia, and \$21.65 @ \$21.90 at Portland, Maine. Domestic seconds, guaranteed 98 per cent pure, are adulterated prime quality, and are quoted at 30c. lower, though no business has been done in it as yet. Small lots of Louisiana sulphur have been exported to Europe, and sold at comparatively higher prices than domestic deliveries. It is said that, owing to the low cost of production and purity of this sulphur, it can be sold in Italy at the Sicilian's cost of mining and preparing for market. Approximately 106,294 tons of Sicilian brimstone have

been exported to the United States in 1904, as against 135,996 tons in 1903, and 168,919 tons in 1902. Some Japanese sulphur arrived at San Francisco for gunpowder and acid factories, notwithstanding the war with Russia. Sicilian brimstone rarely reaches the Pacific coast, because consumption there is limited and the ocean freight is about four times greater than to Atlantic ports.

The industry in Sicily has suffered from heavy rains during the fusion season, from intermittent labor troubles, and a smaller demand from America and Great Britain, though exports to vine countries, notably France and Italy, have increased. Fearing the growth of the American industry, the Chambers of Commerce at Girgenti and Caltanissetta have asked a government investigation, while the local press in Italy proposes to raise a fund of \$10,000 by public subscription, as a premium to the inventor of new uses for brimstone. Meantime the Anglo-Sicilian Company, controlling about 80 per cent of the sulphur stocks at seaports, amounting to over 365,000 tons—nearly a year's export—is promising the mine-owners more money if they will renew the agreement which expires in June, 1906, for another 10 years.

Trade in pyrite has been rather unfavorable as a result of keen competition and low prices in the face of a decreased consumption. New deposits are being opened in Alabama. Sales of 47 to 52 per cent imported ore, paying a freight from Huelva, Spain, of \$2.10 @ \$2.40 per ton, were made at seaboard points at 7.5 @ 12c. per unit (\$3.68 @ \$5.88 per ton) for fines, and 9.5 @ 13c. (\$4.66 @ \$6.37) for lump ore, according to quality and seller. Domestic ore, analyzing from 42 to 44 per cent sulphur, was marketed at 8.5 @ 10c. per unit (\$3.66 @ \$4.30 per ton) for fine, and at 10 @ 11.5c. (\$4.30 @ \$4.83) for lump, f. o. b. mines. Calculated on the sulphur content, and allowing for expense of burning, consumers of pyrite are paying from 25 to 50 per cent less than is charged for brimstone.

Sulphuric acid, the manufacture of which in the East is controlled by a few concerns who are on friendly terms, has held firm, 50° in bulk, selling at \$13.50 @ \$14.50 per ton; 60° at \$18 @ \$20, and 66° at \$21 @ \$23, f. o. b. New York. Acid in carboys is worth from \$3 to \$6 per ton more. Manufacturing costs have been reduced by improvements, and much attention is now being given to contact processes, while one American patent has been issued for an electrolytic method.

There are two branches of higher mathematics: the algebraic and the geometric. All geometry illustrates analysis: but all analysis does not find illustration in geometry. The greatness of Newton is shown in his ability to translate his analytical induction of gravitation into the geometric dialect of the Principia.

### The Phosphate Industry.

The enormous consumption of phosphoric acid, both here and in Europe, has initiated active mining and improved prices. In 1904 the production of phosphates in the United States, principally in Florida, Tennessee and South Carolina amounted to approximately 1,782,503 long tons, valued at \$5,703,582. This is an increase compared to 1903 of 212,275 tons in quantity, and \$709,670 in value. Exports in 1904, chiefly to Germany, France, Italy and Great Britain, totaled about 880,000 tons, as against 785,259 tons in 1903, showing an increase of 94,741 tons, or 12 per cent. The ocean freight was \$2.64 to \$3.72, equivalent to from one-third to one-half of the c. i. f. prices paid for the phosphates, which were \$9.84 to \$12.09 for Florida high-grade rock; \$6.39 to \$8.40 for land pebble; \$9.54 to \$11.40 for Tennessee rock; \$5.61 to \$6.88 for South Carolina rock. In competition with the American phosphates were exports of 775,000 tons from Africa, paying an ocean freight of \$1.44 to \$2.22, and selling in Europe at \$6 to \$7.60 for Algerian, and \$5.75 to \$6.60 for Tunis rock. There were also sent to Europe in 1904 some 125,000 tons high-grade phosphate from Christmas and Ocean islands, paying a freight of about \$6.48, and marketed at \$11.75 to \$14.45 per ton, delivered. Summed up, Europe imported from the countries named a total of 1,780,000 tons, valued at approximately \$10,375,683, of which \$5,105,650, or over 50 per cent, represented cost of freight.

The domestic trade, which takes little over half the production, showed some improvement in 1904, and prices ranged from \$6.50 to \$7.50 per ton for high-grade rock, f. o. b. Florida ports; \$3.75 to \$4 for Florida land pebble; \$4 to \$4.25 for Tennessee export rock, f. o. b. Mount Pleasant, and \$2.95 to \$4 for the various domestic grades; \$2.75 to \$3.50 for South Carolina rock, f. o. b. Ashley River.

The industry in Florida is gradually coming under control of a few large miners, and the affiliation of the Dunnellon and Buttgenbach concerns has greatly lessened competition in the export trade. The Dunnellon Company will soon erect the first superphosphate plant, to utilize the large stocks of 70 to 77 per cent rock in Florida; its initial capacity will be 30,000 tons acid phosphate per annum, to be enlarged gradually to four units. In Tennessee new capital has been invested in mining, and in South Carolina, because of the decadence of the river industry, work will be begun on the marsh lands on Morgan, Coosaw and Buzzard islands.

Undoubtedly the most gratifying feature of the phosphate industry to-day is the gradual elimination of speculative buying, and the introduction of economic management, which promises better profits for the future.

### The New York Stock Market.

By CHARLES C. SCHNATTERBECK.

For a presidential year, speculation has been unusually interesting, and the operations of 'pools,' especially between March and May, have been reckless, initiating heavy liquidation and low prices. The last quarter of the year, however, showed a substantial recovery in quotations, and the forecast is for a better stock market in the new year. Copper and steel were the sensational features in 1904.

Mining shares felt the improvement in metal prices and dividend payments; also the settlement of the Colorado labor troubles, and the progress made in unwatering the lower levels of the Comstock and Brunswick lodes. Amalgamated Copper still pays only 2 per cent per annum on par (\$100), although the lifting of the injunction on the Boston & Montana dividends has enriched its treasury. Fluctuations in the stock were erratic, \$43.125 being quoted on February 8, and \$82.75 on December 1, while a bear raid on December 8 initiated heavy sales and broke the price to \$58.50. Two days later there was a rally to \$71.50. Anaconda, paying the usual \$1 dividend, did a moderate business at \$15.25@30.22. Heinze's United attracted little attention, the common selling from \$6 to \$12.50, and the 6 per cent preferred from \$60 to \$62. Greene Consolidated, of Mexico, strengthened its management, raised its share capital from \$7,200,000 to \$8,640,000 to pay debts, increased its copper output, and paid 13 per cent on the \$10 shares. From \$11.50, in January, the price of the stock rose to \$34.75 in November, but on December 13 there was a slump to \$18.50, followed immediately by a strong recovery to \$27. Tennessee, held largely by investors, paid only one semi-annual dividend of 2.5 per cent, because of costly improvements made in its property and plant. The \$25 par value shares advanced to \$43.75 on December 5, but later fell to \$34, and closed the year around \$36. White Knob, of Idaho, has been unfortunate, being obliged to shut down, preparatory to reorganization, and the collection of a \$3 assessment from shareholders. The \$10 par value shares have slumped from \$8 to less than \$1. Montreal & Boston, of British Columbia, although it acquired by consolidation several adjoining mines, and reorganized on a \$7,500,000 basis, has suffered from peculiar stock-jobbing. From \$3.875, the \$5 par value shares dropped to less than half a dollar in December. British Columbia copper early in the year expected to consolidate with the Snowshoe property, but the scheme fell through. In November and December British Columbia shares stood at the best, \$6.875 to \$7.875. Homestake gold, of South Dakota, paying 3 per cent per annum on par (\$100), fluctuated between \$50 and \$73.

Horn Silver, of Utah, declared 5c. per share quarterly, and having made a contract for the treatment of its zinc concentrate, was steady at \$1.50 to \$1.65. Ontario silver was weak at \$3.75 to \$4.25 for the \$100 par share, partly because no dividend has been paid in two years. Portland, of Cripple Creek, disbursed 24 per cent on par (\$1), which has held the market value of the stock around \$1.75. Elkton rather unexpectedly announced a 1c. dividend in December, after three years' silence; the \$1 shares stood at 62 to 74c. in 1904. The Comstock shares were burdened by assessments, though the Ophir \$2 dividend, after 24 years' inactivity, instilled hope in the unwatering of the lower levels of the Comstock and Brunswick lodes. Ophir advanced to \$5.50, but when

the contribution of \$91,254 to the employees' profit-sharing fund. Other favorable factors were the redemption of the Omaha & Grant and Pueblo bonds, and the acquisition of controlling interests in more properties. The preferred stock advanced from \$88.75 in January, to \$115 in November, and the common from \$46 in February, to \$82.50 in December.

The Federal Mining & Smelting Company, a \$30,000,000 consolidation of certain Cœur d'Alene silver-lead mines, first called on 'change in November, this year, made sales of its 6 per cent \$100 par value common stock at \$45 to \$68, and of its 7 per cent \$100 preferred at \$50 to \$85. The United States Reduction & Refining Company, at first a consolidation of milling plants in Colorado, but recently

### New York Mining Stock Quotations in 1904.

Name of Company.	Par Val.	January.		December.		Year, 1904.		Sales.
		High.	Low.	High.	Low.	High.	Low.	
Amalgamated, Mont.	\$100	\$52.00	\$47.50	\$82.75	\$61.50	\$82.75	\$43.125	\$10,662,073
Anaconda, Mont.	25	19.62½	18.00	29.62½	23.75	30.22	15.25	180,203
Belcher, Nev.	1	.70	.33	.....	.....	.70	.18	8,200
Best & Belcher, Nev.	1	3.50	2.10	1.22	1.10	3.50	.60	4,900
Brunswick Con., Cal.	1	.06½	.05	.16	.10	.20	.03	65,420
Caledonia, Nev.	1	1.50	.80	.49	.42	1.50	.35	10,860
Chollar, Nev.	24	.38	.21	.26	.20	.38	.08	21,722
Confidence, Nev.	1	1.10	1.00	.85	.75	1.15	.65	5,850
Con. Cal. & Va., Nev.	24	3.20	1.15	2.10	1.50	3.20	1.00	35,998
Crown Point, Nev.	1	.40	.23	.21	.15	.40	.11	12,500
Daly, Utah	20	2.00	1.80	2.00	2.00	2.25	1.80	595
Elkton Con., Col.	1	.63	.45	.74	.63	.72	.45	40,563
El Paso, Col.	1	.60	.60	1.15	1.15	.95	.60	18,500
Federal, com., Idaho	100	.....	.....	68.00	60.12½	68.00	43.50	8,345
Federal, pt., Idaho	100	.....	.....	85.00	75.50	85.00	72.00	2,920
Gould & Curry, Nev.	1	.75	.35	.25	.25	.75	.13	13,500
Greene Con., Copper, Mex.	10	14.50	11.50	34.75	18.50	34.75	9.87½	1,404,347
Hale & Norcross, Nev.	1	1.00	.60	1.20	.95	1.20	.55	19,400
Homestake, S. Dak.	100	50.25	50.25	73.00	72.00	73.00	49.50	1,831
Horn Silver, Utah	25	1.25	1.15	1.55	1.50	1.65	1.15	8,610
Iron Silver, Col.	20	.....	.....	1.55	1.55	2.10	1.85	2,013
Isabella, Col.	1	.14	.09½	.30	.25	.37	.09½	70,409
Justice, Nev.	1	.22	.10	.10	.10	.23	.07	23,200
Little Chief, Col.	50	.08	.07	.06	.05	.09	.05	10,950
Mexican, Nev.	1	4.00	1.50	1.35	1.00	4.00	.78	22,850
Mollie Gibson, Col.	1	.06½	.06	.04	.04	.08	.04	29,300
Moon Anchor, Col.	1	.10	.10	.08	.07	.11	.07	32,300
Moulton, Mont.	25	.24	.20	.15	.14	.24	.14	2,800
Ocidental Con., Nev.	1	.55	.50	.82	.81	1.80	.50	3,500
Ontario, Utah	100	4.50	4.50	4.37½	3.50	4.75	3.50	3,260
Ophir, Nev.	1	7.50	3.60	3.70	2.50	7.50	2.20	23,385
Overman, Nev.	2	.39	.34	.....	.....	.39	.12	10,130
Phoenix, Ariz.	1	.15	.09	.15	.10	.30	.04½	420,720
Portland, Col.	1	1.60	1.20	1.75	1.70	2.10	1.20	15,985
Potosi, Nev.	1	.46	.21	.17	.12	.46	.08	29,720
Quicksilver, com., Cal.	100	.....	.....	2.50	2.00	2.50	.75	15,339
Quicksilver, pt., Cal.	100	6.00	5.25	6.00	4.00	7.00	3.62½	4,200
Savage, Nev.	1	.80	.47	.28	.17	.80	.17	237,500
Sierra Nevada, Nev.	1	1.20	.65	.52	.42	1.20	.22	18,700
Silver Hill, Nev.	1	.83	.68	.65	.57	.83	.54	9,406
Small Hopes, Col.	20	.30	.30	.26	.26	.30	.20	3,400
Standard Con., Cal.	10	2.00	2.00	1.90	1.70	2.75	1.70	9,821
Tennessee	25	32.00	28.00	43.75	34.00	43.75	26.50	127,520
Union Con., Nev.	1	1.80	.75	.60	.48	1.80	.32	15,900
United, com., Mont.	100	8.00	5.87½	12.50	5.00	12.50	5.00	27,095
White Knob, Idaho	100	9.00	6.50	.62½	.43½	9.00	.43½	808,990
Work, Col.	1	.08	.04½	.13	.09	.13	.03	79,200
Yellow Jacket, Nev.	1	.53	.44	.23	.15	.53	.15	11,326

Total sales, 14,600,856 shares.

dividend payments were stopped, in July, the stock weakened, and in November sold at \$2.50. Standard Consolidated, of California, failing to resume its quarterly dividends, slid off to \$1.70. Greene Consolidated Gold, of Mexico, a new company, with \$5,000,000 capital, placed 50,000 shares at par (\$10); later this stock relapsed in sympathy with Green Copper.

Industrial stocks showed the effects of a change in the dividend policy of certain large combinations, and the necessity of others to issue bonds to liquidate their indebtedness. American Smelting & Refining shares were strong, reflecting larger earnings, the payment of 7 per cent on the preferred and 5 per cent on common, and

acquiring Utah property, suffered severely from the prolonged labor troubles in Cripple Creek. Only one preferred quarterly dividend of 1.5 per cent on par \$100 was paid during the year, nothing on the common, which has resulted in limited trading on 'change at \$36 to \$41.50 for the aforementioned shares, and \$16 to \$21 for the common.

United States Steel has been the target for speculators by reason of heavy reduction in earnings. The 7 per cent preferred shares fluctuated widely, selling as low as \$51.25 on May 13, and as high as \$55.625 on December 3, while the extreme quotations for the non-paying common stock were \$8.375 on May 13, and \$33.125

on December 5. Republic Iron & Steel could pay only one quarterly dividend of 1.75 per cent on the \$100 preferred stock, and found it necessary to issue \$10,000,000 first mortgage bonds to meet its pecuniary obligations. Consequently, the market price of the common stock fluctuated between \$6 and \$18.25, and the preferred from \$37 to \$73.50. Colorado Fuel & Iron, in the interval between reorganization by issuing \$31,000,000 new bonds and \$6,200,000 new common stock to pay for property improvements, etc., is attracting attention. From \$25.50 in May the common stock sold up to \$58.375 in November, while the preferred brought \$63 in April, and \$95 in December. Monongahela River Consolidated Coal and Coke Company, after paying 7 per cent annual dividends on its preferred for nearly four years, declared only 3.5 per cent in 1904, because of losses by river accidents. Sales of the preferred stock were made at \$19 to \$32. Lehigh Coal & Navigation, incorporated 82 years ago, paying 7 per cent, made a sensational jump in the stock market to \$131.50 on December 2.

Virginia-Carolina Chemical Company, owning, in addition to numerous fertilizer manufacturing plants, extensive deposits of pyrite, and having a long-time agreement with the German syndicate for supplies of potash salts at special prices, has doubled its preferred capitalization to liquidate the loan made in 1903. The preferred shares yield 8 per cent annually, and during the year sales were made at \$96 to \$114.50. Dividend payments on the common stock have not been resumed, hence the market value has fluctuated between \$22.75 and \$4.125.

Rather unexpectedly the Allis-Chalmers Company, known as the mining machinery combination, suspended quarterly dividends on the 7 per cent cumulative preferred stock in February. To date these shares have received 21 per cent, while the common stock has yet to share in the profits. Sales of the preferred stock are reported at \$39.50 to \$71, and of the common at \$6 to \$21.375. Standard Oil cut its dividend from 44 to 36 per cent in 1904, putting its market value from \$674 to \$590 per share.

**ELECTRIC SMELTING.**—The Gin electric furnace produces (says *The Electrical Review*) 350 tons of steel in 24 hours; it uses 60,000 amperes at 120 volts, and thus consumes 7,200 kilowatts. The effective temperature of the upper basins is 1,600°C. On account of the excessive cost of obtaining the energy from the dynamo driven by steam, or even by water power, it does not promise to compete with the blast furnace. But as it can use a more basic slag, it may be utilized in reducing steel direct from certain ores, such as the titaniferous material of Newfoundland where there is water power, but no coal.

**The Boston Mining Stock Market.**

By E. WILKINS.

Thanks to a reviving domestic demand for copper, coincident with the heaviest export movement ever known, copper-mining companies made more money last year than for a number of years past. Of course this was reflected in the scale of prices, although the number of listed mines in this market that have resumed dividends during the period is but one, and that is the Greene Consolidated, which was listed late in the year. The Calumet & Hecla increased its payments, as did the Wolverine, and others are expected to do so, early in the year; while some others should commence payments in 1905. Few people stop to consider what a cent advance in the metal means to the pro-

to the brighter outlook in the trade. It was well into the summer before copper shares began to move, and then only feebly, but with the advent of the bull market in New York stocks, the local traders took courage, and copper scored big advances. At the time Thomas W. Lawson issued his bear manifesto on Amalgamated, which was early in December, a full head of steam was on, and it looked as if 1904 would go out in a blaze of glory so far as copper shares were concerned. His action, however, put a stopper on the market boom; it subsided and is now but a shadow of its former self. There is one thing that Boston can congratulate itself on, however, and that is that there is a larger following in our copper-share market than ever before. Orders have come from all over the country. New York has been particularly active, largely in the-

**Coal and Industrial Stock Quotations in 1904.**

Name of Company.	Par Val.	January.		December.		Year, 1904		Sales.
		High.	Low.	High.	Low.	High.	Low.	
Allis-Chalmers, com.	\$100	\$8.75	\$7.00	\$19.87½	\$16.00	\$21.37½	\$6.00	82,006.
Allis-Chalmers, pf.	100	66.00	55.00	71.00	59.00	71.00	39.50	22,223.
Am. Agric. Chem., com.	100	14.75	14.50	24.62½	21.00	24.62½	13.00	9,846.
Am. Agric. Chem., pf.	100	75.87½	72.75	87.00	80.00	87.00	72.75	1,718.
Am. Sm. & Ref., com.	100	51.50	47.50	82.50	75.75	82.50	46.00	1,723,056.
Am. Sm. & Ref., pf.	100	94.50	88.75	113.50	111.62½	115.00	88.75	235,579.
Col. Fuel & Iron, com.	100	34.50	27.62½	58.00	40.62½	58.37½	25.50	1,451,685.
Col. Fuel & Iron, pf.	100	65.00	50.00	95.00	90.00	95.00	50.00	8,610.
General Chemical, com.	100	58.50	55.00	65.00	60.00	65.00	43.00	2,066.
General Chemical, pf.	100	.....	.....	102.00	100.00	102.00	94.00	2,741.
Meng. River Coal, com.	100	.....	.....	11.00	10.12½	11.00	8.00	5,785.
Meng. River Coal, pf.	100	29.00	25.00	32.00	28.87½	32.00	19.00	21,507.
National Lead, com.	100	16.50	14.50	25.50	22.00	26.25	14.12½	455,700.
National Lead, pf.	100	85.25	79.75	98.00	96.37½	98.00	79.75	23,307.
Pittsburg Coal, com.	100	15.25	10.00	26.12½	22.00	26.12½	10.00	93,780.
Pittsburg Coal, pf.	100	59.00	47.87½	85.00	82.00	85.00	47.87½	135,742.
Republic Iron & Steel, com.	100	8.75	6.50	18.00	14.50	18.25	6.00	393,732.
Republic Iron & Steel, pf.	100	49.50	40.50	72.00	65.37½	73.50	37.00	336,912.
Sloss-Sheffield St. & I., com.	100	39.00	31.25	63.50	58.50	65.37½	31.25	116,292.
Sloss-Sheffield St. & I., pf.	100	79.25	77.00	105.00	102.00	105.00	77.00	10,682.
Standard Oil	100	674.00	649.00	639.00	624.50	674.00	590.00	7,018.
Tenn. Coal & Iron.	100	40.00	35.00	77.12½	63.00	77.50	31.62½	1,294,327.
U. S. Steel, com.	100	12.62½	9.62½	33.12½	25.00	33.12½	8.37½	12,086,262.
U. S. Steel, pf.	100	60.00	54.62½	95.62½	84.75	95.62½	51.25	16,650,013.
Va.-Car Chem., com.	100	34.37½	27.00	44.12½	39.50	44.12½	22.75	326,907.
Va.-Car Chem., pf.	100	106.25	98.00	114.00	110.00	114.50	96.00	109,976.

Total sales, 35,077,472 shares.

ducing companies. For instance, such an advance, if held for a year, would mean added profits of \$7.74 per share to the Calumet's 100,000 shares on an annual production of 77,400,000 pounds. On the same basis, it would mean \$2.60 on the Tamarack's 60,000 shares, although this company has not paid a dividend for a year. On Osceola it would mean \$2.34, Quincy, \$2.13, and Wolverine, \$1.64. A record of the copper-share movements of 26 active stocks in this market shows that the average price at the end of 1904 is \$60.50, against \$40.75 at the end of 1903 and \$51.50 at the end of 1902. The highest average of these 26 stocks for 1904 was \$68.75 and the lowest average was \$39. During 1903 there was a shrinkage of about \$110,000,000 in the market value of these 26 stocks; but during 1904 at least \$125,000,000 was added to the total value, bringing it up to well over \$300,000,000.

The early part of 1904 did not bring much to copper shares, although the metal showed a hardening tendency, and it was remarked that the shares did not respond

stocks of the Bingham, Utah, camp. The importance of this market was recognized by two New York commission houses, who bought seats in the local exchange during the height of the boom. The situation is a healthy one, and it is hoped that 1905 will prove a bonanza one in mining shares.

Several of the Michigan mines that were floated during the boom of 1898 and 1899, have emerged from the prospect stage, while others are beginning to. Copper Range is expected to commence dividend payments next year, and will be followed, probably, by Mohawk, Bingham, and Tamarack. With the advent of new money, which was called during the year in the way of assessments by the Adventure, Allouez, Massachusetts, Michigan, Victoria, Winona, and a few others, it is likely that valuable mining properties may result, especially when it is taken into consideration that many new orebodies have been discovered on some of these properties, the best of which is in the Allouez.

### London Stock Market.

By EDWARD WALKER.

There were no booms during 1904 in the London Mining market, but there were several eventful happenings in mining and financial circles.

From a broad view, the introduction of Chinese on the Rand, has been the event of greatest influence. Since the war there has been much anxiety among employers of labor in South Africa. The impossibility either of obtaining enough native labor, or of mixing black and white, prevented resumption at many fully equipped mines, and, of course, checked expansion of undeveloped properties. It was not until the beginning of 1904 that arrangements were made to admit Chinese labor; and the number imported at first, was not great. At the time of writing, coolies are arriving in a well-regulated stream. In spite of many drawbacks, such as racial feuds, mysterious and objectionable diseases, and the sentimental objection (in some quarters), to the terms on which the labor is obtained, the experiment appears to be a success. So far, the coolies have shown an aptitude for the work, and many are becoming skilled at drilling. Underground work of this character has no bad effect on their bodily power, a point which was by no means clear when the proposition, to use coolie labor for this purpose, was first discussed. In consequence of this solution of the last problem, the mining industry and the general business of South Africa are steadily improving, and before long should be on a satisfactory basis.

Another event, in connection with South Africa, was the discovery of banket and alluvial in parts of Rhodesia. The discovery was really important, in spite of its use for Stock Exchange purposes in running up certain shares. It should also be recorded that a million pounds of new capital have been issued by the British South Africa Company; and that, after a fight, the issue was made direct to the present shareholders, instead of to underwriters, as originally proposed. The expenditure of the company still continues above the income, and appears likely to do so. As long as the present shareholders cheerfully provide new capital, statesmen in Great Britain and South Africa will postpone the day when the administration of Rhodesia by the community at large, will come within the sphere of practical politics.

The West Australian market has provided a good deal of material for discussion. Undoubtedly the most important feature was the consigning to Bewick, Moreing & Co., of the management of so many mines, and the commendable economy obtained thereby. Perhaps it may be rightly said that this economy is not the greatest of the blessings due to the change, and that the place of honor should be given to the resulting elimination of local speculation. The excellent work done by this

firm, in cutting down cost, has also had the effect of stimulating competition with other managements.

An incident in the West Australian market, that caused much disquietude, was the collapse of Great Boulder Perseverance. A year ago, I wrote that this mine was one of the best at Kalgoorlie; since then much has happened. At the beginning of the year, ore value was found to be diminishing; and, in order to prevent a collapse, the secret gold-reserve was used to maintain the monthly returns; meanwhile, those 'in the know' disposed of their holdings. The West Australian was also worried by the unseemly fight for the control of Associated Northern Blocks, from which Mr. Landau emerged victorious, in spite of the evidence brought forward that he had previously directed operations in an unmineral fashion. The exposure of Mr. Darlington Simpson's methods, in the case

Also the shares in Champion Reef have been split from 10s. to 2s. 6d., to facilitate transactions. A welcome event of the year was the renewing of the youth and activity of the Exploration Company. After Hamilton Smith's death, the company fell on evil days; and what would have happened, but for the heroic efforts of Mr. R. T. Bayliss, is unpleasant to contemplate. After repeated internal reorganizations, final improvement took shape in the reconstruction of the company, and the relegation to an asset company of all the doubtful lumber that was hampering operations. The company has done well with the Tomboy in Colorado, and El Oro in Mexico, and is now engaged in investigating other properties in various parts of the world.

Another reconstruction of interest has been that of the Venture Corporation; but it cannot be said that the future of the new corporation has much promise. Though

### Boston Mining Stock Quotations in 1904.

Name of Company.	Par Val.	January.		December.		Year, 1904.		Sales.
		High.	Low.	High.	Low.	High.	Low.	
Adventure.....	\$25	\$3.50	\$2.25	\$6.75	\$5.50	\$7.875	\$1.75	55,094
Allouez.....	25	5.00	4.37½	19.87½	17.00	21.00	3.37½	258,301
American Zinc & Lead.....	25	10.50	10.00	13.12½	11.75	14.00	8.00	22,616
Arcadian.....	25	1.00	.75	2.00	1.12½	3.00	.25	30,208
Atlantic.....	25	8.75	7.75	18.00	15.00	22.25	7.00	126,120
Bingham.....	50	24.00	22.00	37.75	33.00	38.75	19.00	257,516
Boston Con.....	5	.....	.....	7.75	6.12½	7.87½	6.12½	126,859
Calumet & Hecla.....	25	455.00	435.00	680.00	645.00	700.00	435.00	4,395
Centennial.....	25	17.75	15.00	29.25	24.00	33.00	14.62½	202,483
Con. Mercur.....	5	.75	.60	.40	.33	.75	.33	119,023
Copper Range.....	100	47.75	44.50	71.87½	64.00	74.50	38.00	684,467
Daly-West.....	20	36.50	34.00	13.50	12.00	36.50	11.62½	106,904
Franklin.....	25	9.25	8.00	13.00	11.00	15.00	7.87½	37,315
Granby.....	10	4.00	3.25	5.50	4.75	5.87½	3.00	436,287
Guanajuato.....	5	.97½	.75	4.25	3.12½	4.25	.62½	86,496
Isle Royale.....	25	9.50	7.00	26.75	20.00	35.50	7.00	206,101
Mass. Con.....	25	4.87½	4.00	10.00	8.00	10.00	3.00	59,746
Michigan.....	25	6.50	4.75	10.00	8.25	11.00	4.25	48,159
Mohawk.....	25	39.50	35.62½	56.00	49.87½	57.75	34.12½	111,480
Old Colony.....	25	1.25	1.00	1.50	1.25	2.50	.87½	15,723
Old Dominion.....	25	12.00	9.50	27.50	23.50	29.00	9.00	136,134
Osceola.....	25	62.87½	58.50	97.00	89.00	98.00	53.00	77,537
Parrot.....	10	23.50	21.00	32.00	25.50	33.50	21.00	72,217
Quincy.....	25	103.00	94.75	117.00	99.00	125.00	80.00	10,023
Rhode Island.....	25	1.12½	1.00	2.37½	1.50	3.00	1.00	11,594
Shannon.....	10	9.25	7.25	9.75	6.87½	10.50	6.50	555,011
Tamarack.....	25	120.00	100.00	128.00	115.00	140.00	94.00	10,236
Trinity.....	25	5.25	4.87½	14.50	9.00	18.50	4.62½	337,510
United States.....	25	22.00	18.00	28.75	23.50	28.75	19.75	633,140
Utah.....	5	35.50	30.00	46.12½	40.00	47.00	30.00	1,553,158
Winona.....	25	7.50	6.50	12.50	10.00	13.50	5.00	93,029
Wolverine.....	25	73.50	68.00	108.00	104.00	110.00	68.00	20,899

Total sales, 6,305,771 shares.

of Peak Hill, caused amusement to the public and anguish to the shareholders; and, though the company and mine are now in different hands, it is difficult to see how shareholders are ever to recover anything.

Of West Africans, little is heard now, and practically the Ashantee Goldfields Corporation, which is managed by Mr. J. W. Dow, is the only company making a substantial return. This market suffered severely by the deaths of Sir J. B. Maple, Mr. Frederick Gordon, and Mr. Percy Larbutt, who were the financial mainstays of legitimate mining in the district.

Indian mines have been steady, and operations have progressed without let or hindrance. It is interesting to note that Messrs. John Taylor & Sons took up another goldfield in addition to the Kolar, having acquired and developed properties at Dharwar in the Bombay presidency.

the Camp Bird is doing well for shareholders, the memory of their methods in a past case, is too fresh to insure a large following. The corporation has introduced two American mines, the Esperanza in Mexico, and the Dolores in California; but the companies formed to acquire them have not been advertised; and the shares have been disposed of entirely by Stock Exchange underwriters.

Little is heard of British Columbians, Le Roi, Le Roi No. 2, and Columbia-Kootenay have been given up by most shareholders as hopeless. Ymir has received attention, because its mining operation is in honest and capable hands; but the ore is of such quality as to render profits doubtful. The Hall Mining & Smelting Company continues custom smelting and does fairly well in a small way. The best results of all are given by the Tyee Copper Company working on Vancouver Island. This com-

pany is managed capably, and the ore deposits are developing satisfactorily so that profits are being made.

As regards other American ventures controlled on this country, the most interesting items to record are the splitting of the Arizona Copper Company's shares from £1 to 5s., to facilitate business; the reduction of capital of the Montana Min-

cases, stamping will commence almost at once, so that the country will soon be a regular producer. The Etruscan Copper Estates have not fulfilled the promises of the directors, and have continued to be a laughing stock of the City. During the autumn the company was reconstructed and the shareholders put up further capital, in spite of opinions passed by consult-

Dividends and Assessments.

Although the number of companies reporting dividends in the United States during 1904, was only one less than 1903, being 160, yet the total payment of \$123,596,000 shows a falling off of over \$16,000,000. The industrial combinations are largely responsible for this decrease, as

Fluctuations in Mining Shares in London in 1904.

Table with columns for Company, Shares Issued, Par value, Latest Dividend (Amt., Date), and trading activity for January 12, April 15, July 15, October 20, and December 15. Each trading period includes Buyers and Sellers with prices in £ s. d. format.

\* Ex-dividend.

ing Company; the winding up of the Chianpas Mining Company; the sale of the property of the Sierra Buttes Company; and the embarkation, on the manufacture of sulphuric acid and phosphate, by the Mountain Copper Company of California.

Egypt has continued to receive attention during the year, and the operations conducted by John Taylor & Sons, and by Lake & Currie, are progressing. In both

ing engineers and by the engineer in charge of mining operations.

It only remains to be said that, with the exception of the hardening of the South African market, there is nothing to indicate any approaching briskness. No new mining district has been discovered, and the number of new prospectuses issued during the year could be counted on the fingers of one hand.

may be judged by the fact that the United States Steel Corporation paid only \$25,220,832, as against \$53,510,264 in 1903, and the Standard Oil Company, \$34,926,000, against \$42,680,000. In all, 29 industrial concerns declared \$76,904,000 in 1904, of which 8 were iron and steel, paying \$28,826,000; 19 coal and coke, \$5,703,000; 26 oil and gas, \$39,156,000, and 6 miscellaneous companies, \$3,219,000. There were



Dividends.—Continued.

Table with 12 columns: Name of Company, 1903, 1904, Grand Total, Name of Company, 1903, 1904, Grand Total, Name of Company, 1903, 1904, Grand Total. Lists various companies and their dividend amounts for 1903 and 1904.

c.—Copper. g.—Gold. i.—Iron. l.—Lead. q.—Quicksilver s.—Silver. z.—Zinc.

Assessments.

Table with 12 columns: Name of Company, 1903, 1904, Grand Total, Name of Company, 1903, 1904, Grand Total, Name of Company, 1903, 1904, Grand Total. Lists various companies and their assessment amounts for 1903 and 1904.

c.—Copper. g.—Gold. l.—Lead. q.—Quicksilver. s.—Silver.

**Metal Market.**

New York, Jan. 4.

**Gold and Silver Exports and Imports.**

At all United States Ports in November and year.

Metal.	November.		Year.	
	1903.	1904.	1903.	1904.
G <sup>ld</sup> Exp	\$993,150	\$28,813,443	\$42,882,178	\$107,709,000
Imp	11,370,690	4,714,452	48,037,398	81,414,345
Exc Silv	I.\$10,377,540	I.\$16,098,991	I.\$5,155,220	E.\$26,294,655
Exp	6,067,762	3,405,566	34,094,689	46,020,584
Imp	2,556,426	2,452,396	21,895,853	23,692,106
Exc	E.\$3,511,336	E.\$963,171	E.\$12,198,836	E.\$22,328,47

The year opens with business in good condition and fair promise for 1905. The demand for gold abroad is still strong, and some exports are being made—an unusual condition for this period of the year.

Our usual tables are, for the most part, omitted this week, as their substance will be found in the annual reviews given elsewhere in this issue.

The close of the year showed a sharp advance in silver, but the opening of 1905, so far, has not maintained this advance, the market to-day being dull at 28 3-16d. in London.

The United States Assay Office in New York reports receipts of 21,500 oz. silver for the week.

The coinage of the United States Mint for the year 1904 was: Gold, 12,338,084 pieces, value \$233,402,428; silver, 49,921,408 pieces, value \$15,696,609.95; nickel and copper, 82,732,999 pieces, value \$1,683,529.39; total, 135,993,881 pieces, value \$250,781,567.34. In addition to this the Mint coined 15,905,460 silver pieces and 27,803,465 nickel and bronze pieces for the Philippines. Coinage for foreign countries was also executed as follows: Panama, 4,710,138 silver coins; Venezuela, 500,000 silver coins; Costa Rica, 250,000 silver coins; Salvador, 400,000 silver coins. The total work was therefore the execution of 185,561,944 coins.

**Prices of Foreign Coins.**

	Bid.	Asked.
Mexican dollars	\$0.48 1/2	\$0.49 1/2
Peruvian soles and Chilean pesos	.43	.45
Victoria sovereigns	4.85 1/2	4.87
Twenty francs	4.78	3.90
Spanish 25 pesetas	4.78	4.82

**Other Metals.**

**Daily Price of Metals in New York.**

Dec.-Jan.	Copper.		Tin.	Lead.	Spelter.		
	Lake, Cts. per lb.	Electrolytic, Cts. per lb.			New York, Cts. per lb.	St. Louis, Cts. per lb.	
29	@ 14 1/2	@ 14 1/2	67 1/2	29 1/2	4.60	@ 6.05	@ 5.87 1/2
30	@ 15 1/2	@ 14 1/2	68 1/2	29 1/2	4.60	@ 6.07 1/2	@ 5.92 1/2
31	@ 15 1/2	@ 14 1/2	68 1/2	29 1/2	4.60	@ 6.07 1/2	@ 5.92 1/2
2	@ 15 1/2	@ 14 1/2	68 1/2	29 1/2	4.60	@ 6.12 1/2	5.95
3	@ 15 1/2	@ 14 1/2	68 1/2	29 1/2	4.60	@ 6.12 1/2	5.95
4	@ 15 1/2	@ 14 1/2	68 1/2	29 1/2	4.60	@ 6.15	@ 6.00

London quotations are per long ton (2,240 lb.) standard copper, which is now the equivalent of the former g. m. h's. The New York quotations for electrolytic copper are for cakes, ingots or wire-bars. Cathodes are usually 0.25c. below the price of electrolytic.

**SILVER AND STERLING EXCHANGE.**

December.	Sterling Exchange.	Silver.		January.	Sterling Exchange.	Silver.	
		New York, Cents.	London, Pence.			New York, Cents.	London, Pence.
29	4.87	61 1/2	28 1/2	2	4.87	61 1/2	28 1/2
30	4.87	61 1/2	28 1/2	3	4.87	61 1/2	28 1/2
31	4.87	61 1/2	28 1/2	4	4.8710	61 1/2	28 1/2

New York quotations are for fine silver, per ounce Troy. London prices are for sterling silver, 925 fine.

The usual tables of monthly averages of prices of metal, and the tables showing imports and exports of metals in the United States, will be found this week in the reviews of the different metals given upon other pages of this issue.

**Copper.**—During the week under review, the market has developed considerable strength, and the cheap offers from second hands about which we reported last week have entirely disappeared. There has been a good demand from home consumers as well as from the Far East. The closing quotations are given as 15 @ 15 1/4 for Lake Copper; 14 1/8 @ 15c. for electrolytic in ingots, cakes and wire-bars, 14 1/8 @ 14 1/4 in cathodes; 14 1/2 @ 14 1/2 for casting copper.

The market for standard copper in London, which closed last week at £68 7s. 6d., opened on Tuesday at £68 12s. 6d., and the closing quotations on Wednesday are cabled as £68 15s. @ £68 16s. 3d. for spot, £69 @ £69 1s. 3d. for three months.

Statistics for the second half of December show an increase in the visible supplies of 600 tons.

Refined and manufactured sorts we quote: English Tough, £71 5s. @ £71 10s.; Best Selected, £72 @ £72 10s.; Strong Sheets, £81 @ £82; India Sheets, £77 @ £78; Yellow Metal, 6 1/2 @ 6 1/2 d.

**Tin.**—While the market held up pretty well last week, a sharp break occurred on Tuesday, owing to realization by London operators. There has been a fair consumptive demand. The closing quotations are 29 1/8 for spot, 29c. for futures.

The foreign market, which closed last week at £134, opened on Tuesday at £132, and the closing quotations on Wednesday are cabled as £132 @ £132 1s. 3d. for spot, £131 7s. 6d. @ £131 8s. 9d. for three months.

Statistics for the month of December show an increase in the visible supplies of 700 tons.

**Lead** is quiet but steady without any special feature. The closing quotations are unchanged at 4.60 New York, 4.52 1/2 St. Louis.

The foreign market shows quite an improvement, Spanish lead being quoted at £13, English lead at £13 2s. 6d.

**St. Louis Lead Market.**—The John Wahl Commission Co. telegraphs us as follows: Lead is strong but quiet. Ordinary Missouri brands and desilverized bring 4.52 1/2c. Corroding lead is sold at 4.60 to 4.62 1/2 cents.

**Spelter** continues strong and advancing, and there is a good consumptive demand. The closing quotations are 5.95 @ 6c. St. Louis, 6.12 1/2 @ 6.15 New York.

The foreign market is very strong, good ordinaries being quoted at £25 5s., specials at £25 10s. per ton.

**St. Louis Spelter Market.**—The John Wahl Commission Co. telegraphs us as follows: The boom in spelter continues unabated. The latest sales are on a basis of 6.02 1/2c. to 6.05c. East St. Louis, with fair prospects of higher prices during the week.

**Antimony** remains dull and unchanged. We quote Cookson's at 8 1/4 @ 8 1/2; Hallett's 8 @ 8 1/4; U. S., French, Hungarian, Italian, Japanese and Chinese 8 @ 8 1/8c. per pound.

**Personals.**

Mr. W. J. Wolseley, of London, is at Mexico City.

Mr. Herman Lemke is examining mines at San Pedro de Ocampo, Mexico.

Mr. F. G. Saunders, of the Mexico Mine & Smelter Supply Co., is in this country.

Mr. M. O. Childs, Pittsburg, Pa., is making examinations of some Mexican oil fields.

Mr. David Keith, of Salt Lake City, is looking into several mining propositions in Mexico.

Mr. J. C. Brooks has been appointed superintendent of the Avino mines, Durango, Mexico.

Mr. A. Moorehead has resigned as superintendent of the Nevada Chief mine, of Rockland, California.

Mr. J. W. Childers, San Diego, Cal., has returned from an inspection of mines in Chihuahua, Mexico.

Mr. Lee Gilson has finished the erection of a mill for the Idaho Gold Coin Mining Co., in the Seven Devils county, Idaho.

Mr. H. F. A. Riebling is at San Jose, Costa Rica, Central America, engaged in the installation of a large cyanide plant.

Mr. C. R. Troxel of Chihuahua, Mexico, is at Ojinaga, in the eastern part of Chihuahua, investigating niter and oil lands.

Mr. L. Hundeshagen, a mining engineer of Loeboe Sikaping, Padang, Sumatra, is investigating mining conditions in California.

Mr. R. L. Keely has been appointed professor of mechanical engineering in the University of South Dakota, Vermillion, South Dakota.

Mr. A. K. Bohn, of Leadville, Colo., is in Santa Baraba, Chihuahua, Mexico, in the interests of the Lanyon Zinc Co., of St. Louis, Missouri.

Mr. A. H. Ahbe, superintendent of the Colorado Fuel & Iron Co.'s Sunrise, Wyo., iron mines, has resigned and will return to Duluth. His successor has not yet been selected.

Mr. M. D. Stackpole, of the Gold & Silver Extraction Co. of America, has returned to Denver, Colo., from a professional trip to the States of Chihuahua and San Luis Potosi, Mexico.

Mr. R. E. Nelson, formerly of the Lake Superior country, but now with the Colorado Fuel & Iron Co. is at present in southwestern Utah, carrying on land patent work on the company's iron ore properties.

Mr. N. P. Hulst, vice-president of the Oliver Iron Mining Co., left the employ of the company December 31, and has gone to his old home at Milwaukee to reside. He will probably spend the coming summer at Duluth.

Mr. John D. Gilchrist, superintendent of mines for the Colorado Fuel & Iron Co., with headquarters at Pueblo, is at Duluth and on the Mesabi range. Mr. Gilchrist was formerly in charge at the Mountain mine, on the Mesabi.

Mr. C. A. Bohn, formerly at the San Luis Potosi smelter, and later at the Monterey plant of the American Smelting and Refining Co., has accepted the position of assistant superintendent of the Torreon Metallurgical Co., and is now at the smelting plant of that company at Torreon, Coahuila, Mexico.



## THE ENGINEERING AND MINING JOURNAL

MINING AND METALLURGY ESTABLISHED 1866

### The Preparation of Fine Material for Smelting.

By T. J. GREENWAY.\*

In the course of smelting, at the works of the company known as The Broken Hill Proprietary Block 14, material which consisted chiefly of silver-lead concentrate and slime, resulting from the concentration of the Broken Hill complex sulphide ore, I had to contend with all the troubles which attend the treatment of large quantities of finely divided material in blast furnaces. With the view of avoiding these troubles, I experimented with various briquetting processes; and, after a number of more or less unsatisfactory experiences, I adopted a procedure similar to that followed in manufacturing ordinary bricks by what is known as the semi-dry brick-pressing process. This method of briquetting not only converts the finely divided material cheaply and effectively into hard semi-fused lumps, which are especially suitable for the heavy furnace burdens required by modern smelting practice, but also eliminates sulphur, arsenic, etc., to a great extent; therefore, it is capable of wide application in dealing with concentrate, slime, and other finely divided material containing lead, copper and the precious metals.

This briquetting process comprises the following series of operations:

1. Mixing the finely divided material with water and newly slaked lime.
2. Pressing the mixture into blocks of the size and shape of ordinary bricks.
3. Stacking the briquettes in suitably covered kilns.
4. Burning the briquettes, so as to harden, without melting; at the same time eliminating sulphur, arsenic, etc.

1. The material is dumped into a mixing plant, together with such proportions of screened slacked lime (usually from three to five per cent) and water, as shall produce a powdery mixture which will, on being squeezed in the hand, cohere into dry lumps. In preparing the mixture, it is well to mix sandy material with suitable proportions of fine, such as slime, in order that the finer material may act as a binding agent.

The mixer used by me consists of an iron trough, about 8 ft. long, traversed by a pair of revolving shafts, carrying a series of knives arranged screw-fashion; and so placed that the knives on one shaft travel through the spaces between the knives on the other shaft. The various materials are dumped into one end of the mixing trough, from barrows or trucks, and are delivered continuously at the other end of the trough, into an elevator which con-

veys the mixture to the brick-pressing plant.

2. The plant employed was the semi-dry brick-press. This machine receives the mixture from the elevators, and delivers it in the form of briquettes, which can at once be stacked in the kilns. It was found that such material as concentrate and slime has comparatively little mobility in the dies during the pressing operation; this necessitates the use of a device which provides for the accurate filling of the dies. It was also found that the materials treated by smelters vary in compressibility, and this renders necessary the adoption of a brick-pressing plant having plungers which are forced into the dies by means of adjustable springs, brick-presses having plungers actuated by rigid mechanism being extremely liable to jam and break.

3. Briquettes made from such material as concentrate and slime vary in fusibility; they are also combustible, and while being burned they produce large quantities of smoke containing sulphurous acid and other objectionable fumes. It is therefore necessary that such briquettes be burned in kilns provided with arrangements for accurately controlling the burning operations, and for conveniently disposing of the smoke. Suitable kilns, which will contain from 30 to 50 tons of briquettes per setting, are employed for this purpose. Regenerative kilns of the Hoffman type might be used for dealing with some classes of material, but, for general purposes, the kilns as designed here will be found more convenient.

The briquettes are stacked according to the character of the material and the object to be obtained. The various methods of stacking, and the reasons for adopting them, can be readily learned by studying ordinary brick-burning operations in any large brick-yard. After the stacking is complete the kiln-fronts are built up with burnt briquettes produced in conducting previous operations, and all the joints are well luted.

4. In burning briquettes made from pyrite or other self-burning material, it is simply necessary to maintain a fire in the kiln fire-places for a period of from 10 to 20 hours. When it is judged that this firing has been continued long enough, the fire-bars are drawn and the fronts are luted with burnt briquettes in the same manner as the kiln-fronts. Holes about two inches square are then made in these lutings, through which the air required for the further burning of the briquettes is allowed to enter the kilns under proper control. After the fire-places are thus closed the progress of the burning, which continues for periods of from three to six days, is watched through small inspection holes made in the kiln-fronts; and when it is seen that the burning is complete the fronts are partially torn away, in order to accelerate the cooling of the

burnt briquettes, which are broken down and conveyed to the smelters as soon as they can be conveniently handled.

When briquettes made from pyrite concentrate, or of other free-burning material, are thus treated, they are not only sintered but they are also more or less effectively roasted, and it may be taken for granted that any ore which can be effectively roasted in the lump form in kilns or stalls will form briquettes that will both sinter and roast well; indeed, one may say more than this, for briquettes which will sinter and roast well can be made from many classes of ore that cannot be effectively treated by ordinary kiln- and stall-roasting operations; and, moreover, good-burning briquettes may be made from mixtures of free-burning and poor-burning material. Briquettes containing large proportions of pyrite or other free-burning material, will, unless the air-supply is properly controlled, often heat up to such an extent as to fuse into solid masses, much in the same manner as matte of pyritic ore will melt when it is unskillfully handled in roasting. In dealing with material which will not burn freely, such as roasted concentrate, the briquetting is conducted with the intention of sintering the material; and in this case the firing of the kilns is continued for periods of from three to four days, the procedure being similar in every way to that followed in burning ordinary bricks.

When conducting my earlier briquetting operations I made the briquettes by simply pugging the finely divided material, following a practice similar to that adopted in producing 'slop-made' bricks by hand. This method of making the briquettes was attended with a number of obvious disadvantages, and was abandoned as soon as the semi-dry brick-pressing plant became available. The extent to which this process, or modifications of it, may be applied, is shown by the fact that, following upon information given by me, the Broken Hill Proprietary Company adopted a similar method of sintering and roasting slime, consisting of about 20 per cent galena, 20 per cent blende, and 60 per cent silicious gangue. The procedure followed in this case consisted of simply pugging the slime, and running the pug onto a floor to dry; afterward cutting the dried material into lumps by means of suitable cutting tools, and then piling the lumps over firing foundations, following a practice similar to that pursued in conducting ordinary heap-roasting. This company is now treating from 500 to 1,000 tons of slime weekly in this manner. It is, however, certain that better results would attend the treatment of this material by making this slime into briquettes and burning them in kilns.

The cost of briquetting and burning material in the manner first described, with labor at 25 cents per hour, and wood, or coal at \$4 per ton, amounts to from \$1 to \$1.50 per ton of material.

\* Metallurgist to the Chillagoe Railway & Mines, Ltd., Queensland.

## The Mesabi Iron Ore Range.—I.

By DWIGHT E. WOODBRIDGE.

A few figures are required for a proper understanding of the importance of the Lake Superior iron ore region, and these, though they are not new, are valuable. To the close of 1903 there had been shipped out of the lake district a total of 243,865,000 gross tons of ore, all of which was the product of 50 years. So great has been the acceleration of production in the past few years that of the vast total shipments of the region three-fourths is the product of 13 years, and half has been mined in six years. It took all the years from 1850 to 1886 to find a market for as much ore as was consumed in 1903 alone.

The Lake Superior region is pre-eminent as a source of supply for iron ores of high grade and free from impurities; not only this, but it is the only American region with economical transport to distant furnaces that furnishes ore in considerable quantity, of a character requisite for the manufacture of bessemer steel. More than 75 per cent of all the iron ores used in America are mined along the shores of Lake Superior, and far more than 75 per cent of the iron and steel made in this country is from these ores. They are uniformly purer than those mined on a large scale elsewhere, so that a ton of standard lake ore will make nearer a ton of pig iron than a ton of average ore mined elsewhere.

Total shipments of iron ore from the Lake Superior region, for all time since mining commenced there, have been as follows, with the proportionate quantities of the several districts, compiled to the close of 1903:

Range.	When opened.	Total Shipments.	Per cent.
Marquette .....	1850	69,800,898	28.6
Mesabi .....	1893	66,576,771	27.2
Menominee .....	1877	45,918,499	18.8
Gogebic .....	1884	40,646,454	16.6
Vermilion .....	1884	20,738,250	8.5
Michipicoten (Canada) .....	1900	794,645	0.3
Totals .....		244,475,517	100.0

The Marquette range, with its 53 years of production, has mined but 1.4 per cent more than the Mesabi, not yet in its teens. No other lake district has approached the record of the Minnesota range. The present year will put the latter far ahead of any of its adjacent districts, and the passage of years will but increase its lead.

Though there has been a considerable decline in ore mining since 1902, the average of growth for 10-year periods has been in the neighborhood of 300 per cent. For decennial periods since the industry became of importance, the figures are as follows:

Year.	Tons Mined.
1864 .....	247,000
1874 .....	900,000
1884 .....	2,500,000
1894 .....	7,750,000
1903 .....	24,700,000

Three great Commonwealths and a province of Canada contribute to the Lake Superior production of iron ore. The

ranges in which lie these mines are stretched along from near the western side of Lake Michigan to 100 miles west of Lake Superior. Five lie in the United States and one in Canada. All are of practically the same geological age, and most of them have a great similarity in formation, and in the character of ore and of the surrounding pre-Cambrian rocks. Accepted theories of methods of formation of orebodies and of deposition of ores in their great basins are much the same for the entire region.

The first of these ranges to receive attention was the Marquette, which lies wholly in the State of Michigan; second was the Menominee, chiefly in Michigan, but with a minor fold projecting into the adjoining State of Wisconsin; third was the Penokee-Gogebic, also chiefly in Michigan, but extending across the Montreal river into Wisconsin; fourth and fifth were the Vermilion and Mesabi, both entirely within the confines of Minnesota, and, so far as present developments go, almost wholly within the single county of St. Louis. A few years ago developments were extended into the Algoma section of Ontario, and a new range was found, similar in most geological characteristics to the Vermilion; it was called the Michipicoten, and this is its fourth year of small production.

One cannot realize the importance of the iron ore business of the Lake Superior region, and of Minnesota, nor the advances that have been made recently, until he compares the present state of the industry with that of previous years and with that of other iron-producing districts. Within 50 years the United States has risen from a position of absolute dependence upon the Old World for its iron supplies, to that of the largest producer in the world. The first shipment of iron ore from Lake Superior was made in 1850 and consisted of 10 tons. This was hauled around the rapids of Sault Ste. Marie, at the lower end of Lake Superior, on a little strap railway. Unloaded from toy vessels above the rapids, it was re-loaded below them into others almost as tiny. The first use of Lake Superior ore in a blast furnace took place in 1853 in Pennsylvania, when about 70 tons, brought at great expense from Lake Erie by canal, were used in the Sharpville furnace. The first pig iron made in the Lake Superior region was in 1858, in a small furnace near Marquette. It was in 1867 that the bessemer process was developed to such an extent that steel rails were available for commercial uses at prices that were possible. The lake region, containing a large proportion of ores so low in phosphorus and other unfriendly elements that they are available for the bessemer process, immediately became of the utmost moment to the trade.

The existence of iron ore in Minnesota has been known for the past 55 years, but no serious attempt at its examination was made until the 70's. The first official note on the presence of iron in the State was by J. G. Norwood, in 1850, in the report of D. D. Owen, on a Geological Survey of Wisconsin, Iowa and Minnesota; page 417. In this report, Mr. Norwood mentioned the occurrence of ore on the edge of Gunflint lake at the extreme eastern end of the Mesabi range, and then stated it to be in the eastward continuance of the hills that were known further west as the Mesabi, and that extended to Pokegama falls of the Mississippi river. No importance was attached to this mention, and the ore where he found it is considered of very little economic value, even yet. In reports in 1865 and 1866, H. H. Eames, then State geologist, referred to the occurrence of ores on the southern shore of Vermilion lake, where are now the Soudan mines of the Oliver Iron Mining Company, and mentioned the assayed ores from the western end of the Mesabi, from points in T 56 N R 24 W. At the instance of George C. Stone, now dead, Professor A. H. Chester, then at Hamilton College, was sent into northern Minnesota 10 years later, to investigate for Charlemagne Tower, of Philadelphia, the reports of extensive deposits of iron on what is now the eastern Mesabi. George Stuntz, the explorer of the party, had been at Vermilion lake, and endeavored to induce Chester to push on there; but was unable to do so until he had himself brought to his chief, who was unsuccessfully seeking merchantable ore in the magnetic formations of the eastern Mesabi, some excellent specimens of hard hematite from Vermilion. Later investigation by Chester at Vermilion resulted in the formation of the Minnesota Iron Company, the grant of swamp land by the State in aid of a railway to the northern ore-fields, the beginning of active mining operations by Tower, and the actual completion of the railway and shipment of ore in the summer of 1884. Mr. Tower's investment of some \$4,000,000 was sold two years later, to Chicago, Cleveland and Marquette capitalists. They, in turn, sold to the Federal Steel Company, in 1900, and the latter became part of the United States Steel Corporation a year later. Each step in this progression of ownership was attended by a profit of at least 100 per cent.

In the summer of 1884 the Duluth & Iron Range road moved eastward 62,124 tons from the Vermilion range. That was the first ore to go out from Minnesota. It was 20 years ago; recently enough, but how far back as measured by results! Since then the road has increased its business constantly till it is now of enormous proportions. It is an interesting fact, and a still more interesting commentary on the crudity of ideas as to the future

held by those courageous pioneers who opened the northern ore regions, that the production of those mines to serve which this road was originally built, was, in 1903, just 3 per cent of the business of the road. And when the line was built, and the dar-

that all of the companies which received the shipment are now owned by the United States Steel Corporation.

When the Mesabi was first opened, it was generally considered that but a small percentage of its peculiar ores could be

been overcome, and their use has rapidly extended, until to-day more than half the steel made in the great centers of Pennsylvania, New York and Ohio is from ores mined upon the Mesabi range. It was only after strenuous campaigns of education, of costly experiment, through serious financial difficulty, and at the risk of worse, that the steel makers of the iron centers of America were induced to favor the new district, and the struggles of those early days are little appreciated by any not intimately associated with them.

Had it not been for the Mesabi range, no such expansion in American trade as has taken place in the past few years would have been practicable. Indeed, were it possible to conceive this mining district now eliminated from the map, no more material calamity could befall the United States, which would at once retire from her position in the steel trade of the world. Without the Mesabi there could not have been produced the amount of high-grade ore necessary to meet the requirements of America, and though these might have been met without the Mesabi, it could only have been by the use of far leaner ores than have now been utilized. These would have so far increased costs that the people of the United States could never have reached their record-breaking consumption of the past few years.

The Mesabi is not only the largest producer, but it contains the biggest mines to be found. It has several that are lim-



A MESABI MINE BEFORE LOGGING.

ing venture was successfully made, there was no thought that other and far larger deposits lay contiguous, or that any other business might be secured.

In 1889 and 1890 merchantable deposits of iron ore were found on the Mesabi range by men of activity and foresight, who were not far in advance of their time. Innumerable were the hardships of the early explorers, as they are in every new mining region remote from civilization and in the heart of an unconquered section, but development was exceedingly rapid, and in November, 1892, the first ore was hauled out by railway. Two cargoes of this ore, brought down in the fall of 1902, were shipped by the Cleveland firm of Oglebay, Morton & Company, which was agent for these trial shipments. The ore was divided among four concerns: The Carnegie Steel Company, the Thomas Furnace Company, the Isabella Furnace Company, Ltd., and the Oliver Iron & Steel Company. These cargoes went out late in the season, the ore froze in dock pockets, and the whole operation was attended with the utmost difficulty and discouragement; but since then there has been a constant and steady growth, until last year this range shipped 52.8 per cent of all ore sent forward from Lake Superior.

These pioneer cargoes were of the grade later known as 'Mountain Iron.' They were shipped in two boats belonging to the American Steel Barge Company, and the total was 4,104 tons. It may be noted

used in the blast-furnace charge, on account of the fact that these ores, instead of being hard and granular, like those of most of the other regions, were fine, and



LOGGING BEFORE STRIPPING.

in some cases almost like dust. They packed in the furnaces, and there were occasionally dangerous and even fatal explosions. But, under the stimulus of low costs for these ores, the difficulties have

ited in their annual capacity only by the demands of the steel trade and the ability of railways to take away what they mine. Mines on the Mesabi have produced as much as 15,000 tons a day for weeks to-

gether, and might maintain this extraordinary production for entire seasons could railways, ships and receiving docks care for the avalanche of tonnage. In 1903 there were 15 mines on Lake Superior that produced more than 500,000 tons each. Of the 15, ten were in Minnesota and five upon the Mesabi range. Up to 1894, there had never been a mine in the world that had produced as much as 500,000 tons in a single year.

### Spanish Exports.

The imports of fuel into Spain for the 10 months ending October 31 were 1,751,511 tons of coal, and 148,280 tons of coke. Exports of minerals are reported by the *Revista Minera* as follows, in metric tons:

	1903.	1904.	Changes.
Iron ore .....	6,445,108	6,060,954	D. 384,154
Copper ore .....	900,934	888,284	D. 12,650
Zinc ore .....	102,969	115,794	I. 12,825
Lead ore .....	2,136	4,114	I. 1,978
Pyrites .....	471,518	446,130	D. 25,388
Salt .....	254,258	296,842	I. 42,584

Exports of metals included 34,170 tons of pig iron, against 39,943 tons in 1903; 24,891 tons copper, against 24,390 tons; 1,566 tons spelter, against 1,640 tons; 147,388 tons lead, against 136,548 tons last year.

### German Iron Production.

The reports collected by the German Iron & Steel Union show that the output of the German blast furnaces in November was 833,255 tons of pig iron, which is a decrease of 35,268 tons, as compared with the month of October. This is only a little more, however, than would result from the fact that November has one day less than the preceding month. For the eleven months ending November 30, the total production was as follows:

	1904.		Changes.	
	Tons.	Per ct.	Tons.	
Foundry .....	1,694,387	18.4	I. 45,400	
Forge .....	754,295	8.2	D. 31,066	
Steel pig .....	576,103	6.2	D. 76,761	
Bessemer .....	360,573	3.9	D. 41,872	
Thomas .....	5,847,389	63.3	I. 100,160	
Total .....	9,232,747	100.0	D. 4,139	

Steel pig, in the German classification, includes spiegeleisen, ferro-manganese, ferro-silicon, and similar alloys used in the manufacture of steel. It will be seen that there was a slight increase in foundry iron, and a considerable one in Thomas, or basic, pig. The decreases in bessemer, steel pig and forge iron, however, made the production for the two years practically the same. Of the total output 73.4 per cent was intended for conversion into steel, which shows the tendency of the German trade. By districts, the Rhenish-Westphalian region produces about 40 per cent of the total, while Lorraine and Luxemburg furnished 30 per cent. Of the minor districts the more important are the Saar, Siegerland and Silesia.

At Wieliczka, in Austrian Poland, salt occurs in massive beds stated to extend over an area of 20 by 500 miles, with a maximum thickness of 1,200 feet.

### Tin.

Among the important metals which find a wide use in construction, tin occupies a peculiar position. The output of the metal is largely from countries where no accurate statistics of the production can be expected. Consequently, the production for the year must be estimated almost entirely upon the commercial movement. However, this is, as a rule, carefully watched, and is reported with a close approach to accuracy. From the various commercial statements of imports and exports, especially those of Great Britain and Holland, which are the centers of the commercial dealing in tin, and from various circulars of the metal firms, chiefly those of Sargent & Company, of London, and of Ricard & Friewald, of Amsterdam, we obtain important data. Those given below cover the twelve months ending November 30, 1904.

From these sources of information, we estimate the production of tin in 1904 as follows, in long tons of 2,240 lb.:

	Tons.	Per ct.	Changes from 1903.
Straits .....	58,657	63.7	I. 3,292
Banka and Billiton .....	14,638	15.9	D. 4,082
Australia .....	5,082	5.5	I. 705
Bolivia .....	9,200	10.0	D. 590
England .....	4,282	4.7	D. 18
Germany and Austria .....	100	0.1	I. 25
Miscellaneous .....	125	0.1	I. 25
Total .....	92,084	100.0	D. 668

The increase in 1903, was only 0.7 per cent; that is, the production was practically stationary, notwithstanding the considerable increase in the Straits output, and the smaller, though proportionately large, gain in Australia. This was more than offset by the reduction in the Banka and Billiton sales and output, while the Singkep mines produced no tin during the year.

From this table it will be seen that the chief source of production is found, as it has been for a number of years, in the Malay Peninsula, the output of that region being known in the trade as Straits tin. From this source nearly two-thirds of the world's supply is derived. Next in importance come the Dutch East Indies, where the mines of Banka and Billiton are controlled by the Dutch government, the metal being disposed of in periodical sales. The third source in importance is found in the mines of Bolivia. This metal is exported chiefly in the form of concentrate, which is shipped to Germany and England to be refined. The mines of Cornwall in England still produce a considerable quantity of tin, although they have lost their old-time importance. There is a very small production also from ores mined in Germany and Austria, where the tin is obtained chiefly as a by-product. A very small quantity also is reported from Japan, and another small contribution comes from the mines in the neighborhood of Guadalajara in Mexico.

Outside of this tin, which is included in the table above, there is a production in China which we have not given, because

it is entirely impossible to ascertain its actual amount. The estimates of those who were best informed vary from 10,000 to 20,000 tons yearly, but the latter figure is probably too high. Nearly all this tin, whatever its amount may be, is consumed in China itself, though occasionally some parcels of Yunnan tin appear on the London market. Allowing for this production, it appears that the world's supply of the metal is a little over 100,000 tons yearly.

In the United States no actual production of tin can be reported for 1904. Some small parcels of ore were shipped from Gaffney, in South Carolina, and were sent to England for treatment. The discoveries in the York Peninsula, in Alaska, still lack sufficient development work to prove their actual value. An exhaustive article on 'Tin in the United States,' by F. Lynwood Garrison, appeared in the *JOURNAL* for November 24 last.

We may add that the German official returns show a production of about 5,000 tons of tin yearly in that country, but as this is almost entirely from foreign ores, we have credited the metal to the country where the ores were mined. There are also some 350 tons of pig tin produced yearly in Germany from tin scrap, and a small quantity is made in the same way in the United States. This, however, is not new metal.

Estimating in very much the same way, with the additional assistance of the carefully prepared figures of the Metallgesellschaft, of Frankfort, we find that the consumption of tin during 1904 was approximately as follows:

	Tons.	Per ct.
United States .....	38,500	40.6
Great Britain .....	15,898	16.8
Germany .....	14,832	15.7
France, Italy, Spain, Russia .....	17,920	18.9
Eastern Europe and South America .....	4,305	4.5
Eastern Asia .....	3,300	3.5
Total consumption .....	94,755	100.0

We thus find that the consumption of tin, as reported in 1904, exceeded the output by 2,681 tons. Perhaps, it would be more correct to say the deliveries than the actual consumption; but in this case the deliveries must be accepted as the measure of consumption. We may remark that this apparent excess of consumption is equal approximately to the increase in public stocks, which was 2,973 tons. These public stocks include the quantities known to be in store in Great Britain, Holland and the United States, together with the tin known to be afloat, or in transit to those points from producing countries. In the above estimates of production, we have omitted China, for the reasons already given; and in the estimate for consumption, we have included only, under the head of Eastern Asia, the quantities known to be imported into China, through the maritime customs. To these, of course, should be added the tin produced in the country itself; but, as this must necessarily be considered an un-

known quantity, we have not included it in this table.

Imports of tin into the United States for the eleven months ending November 30, 1904, with changes from 1903, were as follows, in long tons:

	Tons.	Per ct.	Changes.
Straits .....	15,082	43.9	D. 2,504
Australia .....	287	0.8	I. 65
Great Britain .....	18,020	52.4	I. 1,929
Holland .....	618	1.8	D. 428
Other Europe .....	356	1.0	D. 18
Other countries .....	24	0.1	D. 21
Total .....	34,387	100.0	D. 977

The larger part of the metal received from Great Britain is Straits tin; so that our chief supply in this country is derived from the mines of the Malay Peninsula. The decrease in direct imports from the East was not made up by the shipments received through London.

The fact remains, as in former years, that by far the greater part of the tin production of the world is won by Chinese labor. In the Straits especially, mining is done almost entirely by Chinese, and a very large part of the output passes through the hands of the Chinese merchants and speculators before reaching its final market. This has been especially noticeable during the past year, when speculation on the part of some of the big Chinese firms played a most important part in the trade. With regard to the market, it must be remembered that, owing to the limited supply and the peculiar condition, tin is a metal specially subject to speculative influences, and last year was no exception to the rule, as is shown in the market report which follows.

THE NEW YORK TIN MARKET.

The average price of tin in New York during 1904 was about as high as that for the preceding year, due to the article continuing in a strong position in the relation of supply and demand. It is true, the American consumption proved somewhat of a disappointment, imports showing a falling off against last year of about 8,000 tons, but the European countries more than made up for this. Production in the Straits was about the same as last year. The Dutch Government announced that the quantity of Banka tin to be put up for auction during 1905 will amount to about 200,000 pikuls, being an increase of about 600 tons over the current year.

Strange to say, no tin has as yet been profitably mined on the North American continent, although there are some prospects of regular shipments of tin ore from Alaska. Fair quantities continue to be imported from Bolivia, but are sold at a discount, owing to inferior quality.

Speculation at times again had full sway on both sides of the Atlantic, but the fluctuations were not quite as wide as during former years.

The year opened with Straits selling at 29½, but towards the end of January the market broke suddenly to 28½. February

proved a very dull month, values ranging between 27¾ and 28¾. In the middle of March a sharp upward movement took place, caused by the scarcity of spot supplies, and 29c. was paid for early deliveries, whilst futures sold at ½c. discount. This squeeze, however, was only of short duration, and values fell back to 28½, at which figure the market ruled steady throughout April.

During May the market had a declining tendency and broke sharply about the middle of June, when 25½ was accepted for spot tin. During July, the usual summer dullness prevailed, but at the end of the month there was one of the periodical displays of fireworks in the London market, the price advancing over £2 in one day. In some quarters the rise was attributed to a fear on the part of importers that, owing to the Russo-Japanese war, shipments from the Far East might be interfered with. Our market responded only a little to the upward movement abroad, 27c. being paid for early deliveries.

In August the prices fluctuated only within narrow limits, but in September an upward movement was again started, and prices rose to 28¾c. by the end of the month. During October and November values continued to advance, but consumers over here only covered their immediate requirements, being frightened off by the continuous manipulations of the London operators. At the end of November the latter succeeded in putting up prices to £16 5s. per long ton, in London, 30c. here. From this figure, values receded

MONTHLY AVERAGE PRICES OF TIN IN N. Y.

Month.	1903.	1904.	Month.	1903.	1904.
Jan. ....	28.33	28.845	July. ....	27.68	26.573
Feb. ....	29.43	28.087	August ..	28.29	27.012
March. . .	30.15	28.317	Sept. ....	26.77	27.780
April. ....	29.81	28.132	Oct. ....	25.92	28.596
May. ....	29.51	27.718	Nov. ....	25.42	29.185
June ....	28.34	26.325	Dec. ....	27.41	29.286
			Av., year	28.09	27.986

again to 28½, when it became apparent that consumption over here had improved to some extent, tin-plate mills especially taking large quantities.

In these circumstances, values during the second half of December rose steadily and the closing quotations for the year were 29½ to 29½ cents per pound.

LEAD IN MAGNETIC ALLOYS.—Lead has recently been added to the list of the effective ingredients of magnetic alloys, principally in connection with manganese and aluminum.

RADIUM.—The atomic weight of radium is placed, provisionally, at 235. It is possible that one of its decomposition products may be helium, which has an atomic weight of four. It is also possible that atoms may not only be decomposed by emanation of particles, but may even be built up by accretion of the radium particles.

Crushing with Rolls.

By R. K. HUMPHREY.

The crushing of crude ore to a given size, to facilitate the extraction of the precious metals, may be considered a most important factor in the treatment of any low-grade ore, particularly in view of the perfecting of processes and machines for the treatment of slime.

It is not my intention, at this time, to take up stamp-mill practice, or to discuss the effects of the use of heavy stamps upon sulphide ores; it suffices to say that there are methods more satisfactory; these may be divided into three classes:

Rolls.—The ore is crushed by being fed between the faces of the rollers, and is then screened; the product that is not fine enough is returned again for further treatment.

Chilean or Huntington Mills.—The ore is fed into a pan, in which the ore is crushed by means of revolving mullers, either vertical, having springs to force them down on the ore, or of sufficient weight to crush the ore by passing over it; or horizontal, the mullers being forced outward against a stationary die, or ring, by centrifugal force. In each case the crushed product is thrown or splashed against a stationary screen; the oversize, or product too coarse to pass through the screen, falls back, and is again subjected to the crushing action of the mullers, where, if it be only oversize, it is reduced to about the proper size, or if already fine enough, but unable to pass through the screen, it will then be reduced to slime.

Tube- or Ball-Mills.—These consist of a rotating cylinder, filled with balls, or pebbles, and having a heavy lining to resist the abrasion of the ore and crushing mechanism. The ore is crushed by passing between the balls or pebbles as the cylinder rotates, and the balls rolling over each other, create a grinding motion, which pulverizes the ore as it passes between them. The ore is then screened through a grating at different intervals around the periphery of the cylinder, or it may be conveyed to one end, and discharged therefrom. The difficulty of a machine of this kind is that, the balls or pebbles being round, and the faces, where they come in contact, being small, the crushing action at this point is more severe than anywhere else, which causes the ore to be ground to a powder; hence this type of a mill is commonly used where the operator does not need a granular product.

It can be safely said that for almost any process, the best results can be obtained when the ore is reduced to as near an even size as possible, and as soon as it is fine enough, is then disposed of, and not allowed to be exposed again to the action of the crushing machinery. It is my opinion that this can be done better with the modern crushing rolls than with any other machine. The faces, the parts com-

ing in contact, should be adjusted so as not to produce an undue pressure at any point, for the reason that the ore passing such places will be reduced to a powder, while that passing the open places will not be ground at all, but will have to be returned again for further treatment, thus cutting down the capacity of the mill, besides spoiling the product. A common way in which an excess of slime and an uneven product may be produced is by trying to reduce an ore in one operation. Ore can be reduced only to a certain degree, without there being an excessive pressure upon some part of the mass; for instance, a piece of ore passing a  $\frac{3}{4}$ -in. ring, cannot be reduced finer than to pass about a  $\frac{1}{4}$ -in. ring, at one operation, without causing a severe strain on the bearings of the machine. The center of the larger pieces being subjected to the greatest pressure will be reduced to a powder, and if it be moist, it will be pressed into a cake like a brick, so that it will not pass through the screen.

It is difficult to find men who are able to secure a granular product, and at the same time get the whole capacity of the machine, that is, wear out 90 per cent of the steel in the tires; usually the shells are taken out a number of times, for the purpose of having the uneven ridges turned, or chipped off, thus wasting a lot of time, and steel. This is mainly because of the fact that the modern crushing roll has been in use only a few years. It is a very different machine from the old, slow-gearied Cornish rolls; it does a different class of work, and requires different treatment. There are two operations in roll crushing, namely, to crush the ore down to a given mesh, and to be able to screen out every particle that has been reduced to the proper size, as fast as it is small enough to pass the screen.

We will now look at the rolls, and see that they are properly built and adjusted. The machine should be designed first for strength, the main frame to be strong enough to permit of crushing the hardest ore, without damage; the hearts just as heavy as possible, so that by their weight, the ore will be crushed without displacing them. The springs should be placed in cages, and compressed to a sufficient degree to insure the crushing of everything that passes between the rolls, except pieces of iron or steel, and yet exert no pressure upon the journals when there is nothing going through. The tires should be made of forged steel as hard as can be used without chipping on the edges, perfectly true on the faces, and so fitted to the hearts that they may be tightened from time to time, because when they are almost, or two-thirds worn out, they will begin to stretch, or get loose; they should be almost straight and smooth on the inside, so that when they are worn down in the thinnest places, they do not weigh more than 50 or 75 lb. The heart con-

struction should be so designed that worn-out tires may be quickly removed, and new ones put on with the least delay. The whole machine should have as few nuts and bolts as possible, because the severe duty demanded creates vibrations, which cause the bolts to break, and the nuts to work loose. There should be no sliding parts, as they are always cut away by the abrasive action of the sharp sand and mineral.

Since the most important factor in getting capacity and efficiency is the adjustment, condition and care of the faces of the roll-tires, I will name some of the things that happen, and cause the most trouble. The journal boxes should be as long as possible, with the plane of contact between the cap and base at right angles to the direction of the displacement or vibration caused by the contact of the rolls with the ore, and be securely clamped together, and should also be self-oiling; experience indicates that it is then impossible to keep the bearing of each roll exactly in line vertically with the other, because the journal boxes do not always wear alike; consequently, after a while,



A ROLL TIRE.

the shafts get lower at one end, and usually at the different corners of the machine; for instance, the right hand end of the stationary roll, and the left hand end of the movable roll will be either higher or lower than the other ends. As soon as this occurs, each roll will begin to travel sideways down hill, and in an opposite direction, causing the faces to lap past each other, so that a ridge or ring will form on one side of each tire, there being nothing for it to wear against. This will cause the faces to pinch at each side, and crowd the ore in the middle, and wear them away there, allowing the uncrushed ore to pass through, necessitating its return until it is crushed; but any ore that does get through at the tight places at the sides will be reduced to a powder.

In attempting to overcome this difficulty, some manufacturers have put on what might be called an end adjustment, which is simply a clutch, fitted to one end of one of the roll-shafts, for the purpose of pulling or pushing it back, after it has forced

itself to one side or the other, because of its being out of level and out of line with the other roll. This does not obviate the trouble, but simply adds another difficulty, namely, the heating of the journal-box on the opposite end, where the large cast-iron collar bears against the outer end of the cast-iron journal-box; despite the excessive end strain caused by the friction between the roll-faces, when they get out of line, and out of level, the heavy spring pressure holds them together, as is necessary in crushing ore to 12-mesh and finer. The end strain is so severe that it often causes the collars to slip on the shaft, and in order to keep them from slipping, some manufacturers have cut threads on the shafts and screwed the collars on like nuts, instead of changing the design, so the ends of the shafts could be raised or lowered. The roll ought to be made to travel back and forth at the pleasure of the operator, so as entirely to remove the end strain from the boxes and shafts, allowing them to run cool, with plenty of lateral motion, thus obviating all unnecessary friction and tendency to heat; by this arrangement, all the objectionable ridges are worn off the crushing faces of the rolls, leaving them straight and smooth, so that the pressure is even all the way across, and a uniform product, to any desired mesh, is produced.

Another difficulty confronts the millman when the rolls are stopped by the belts coming off, or any other cause; it is impossible to start them again without removing all the feed from between the faces or unscrewing the springs, and allowing the feed to pass through. This usually consumes much time. Hence there should be a releasing device, so that the roll-faces may be thrown apart, allowing the feed to fall through, until such time as they can be safely thrown into action again. The accompanying photograph was taken at a mill of which I was manager, showing how a tire may be worn out entirely by using the system of alignment here recommended. Twenty-four hours before this tire was taken off, there were no holes in it. The photograph shows the superintendent holding it about six inches from the ground. It now weighs about 50 lb.; originally it weighed about 600 pounds.

The tire on the roll with fixed bearings (and large pulley) will wear out much quicker, as it is positively driven, while the roll having the smaller pulley and the narrow belt will be more liable to travel or stop with the ore, and become worn less rapidly. Therefore, both shafts should be alike, so that in a plant having two or more sets of rolls, the tire having still some wear in it after the other has been worn thin, can be put into the same frame without the necessity of removing the tires from the hearts; the worn-out tires can be replaced by new ones, and placed in the other frame, thus doing away with the

wasteful practice of taking off and throwing away a tire that is still from one to two inches thick. An ordinary tire should be worn down until it weighs from 50 to 100 lb. before it is taken off, and any roll that does not allow about 80 to 90 per cent of the tire to be worn out in reducing ore is either improperly designed or operated.

Various rates of speed are recommended by manufacturers, from 150 to 2,600 ft. peripheral speed per minute. Without going into detail, a few suggestions may be useful. The first set of rolls taking the rock which has passed a  $\frac{3}{4}$ -in. or 1-in. ring, should be run as slowly as possible, to get about 300 or 450 ft. peripheral speed—slow enough to allow the largest pieces of ore to crumble and spread as they pass through, and not cause the rolls to snap and jump. They should not be set to reduce their product finer than about  $\frac{1}{4}$ -in. ring. This product should be screened, the oversize being returned. The finished product should then pass over about 10-mesh No. 20 wire screen, the oversize going to the second set of rolls, which may be set to a peripheral speed of 800 to 1,000 ft. per min., the product passing to the 10-mesh screen, while the oversize is returned. The product passing the 10-mesh screen goes to the 20- or 30-mesh finishing screen. All the oversize from this screen should go to the finishing rolls, having a peripheral speed of from 1,500 to 2,500 ft. per minute. There is no reason why a plant, having the necessary elevating and screening capacity, and three sets of 36 by 16 in. rolls, designed and built properly, and set at the speed above mentioned, should not be able to treat continuously from 200 to 250 tons of ordinary ore per 24 hours, or 350 tons of oxidized quartz to 16- or 20-mesh, with a return from the screens of not to exceed 10 per cent. It is necessary to run each of the rolls faster than the preceding set, for the reason that there must necessarily be a much thinner distribution of ore between the faces as the crushing becomes finer, and as the distribution cannot be widened to get it thin enough, the machine must be accelerated. By lengthening the distribution every particle of ore can come in contact with the faces of both rolls; if the ore is worn out merely by attrition between other pieces of ore, the sulphides do not stand any chance of remaining granular, but become worn to a powder; the harder particles of ore are returned as an oversize and will accumulate, with the result that the feed must be cut down to provide for a return treatment.

The term halogen (salt-former), includes chlorine, fluorine, bromine and iodine, their commonest compounds being both binary -ides and simplest salts. Similarly the term metallogen (ore-maker), may be used for oxygen, sulphur, selenium and tellurium.

### Kern County Mines.

By OUR SPECIAL CORRESPONDENT.

The Queen Esther mine is 4.5 miles from Mojave. The manager is Mr. S. W. Mudd, formerly of Denver, now at Los Angeles. The vein, which strikes northwest-southeast through a porphyritic country, is well opened by a system of adits and cross-cuts, and ranges in width from 4 to 15 ft. The ore is a hard, white quartz, mixed with oxidized material, carrying about equal values in gold and silver. The gold is recovered in part by amalgamation, but mainly by cyanide. The mill, which handles 100 tons per 24 hours, is equipped with crusher, rolls, impact screens and leaching facilities, fuel oil being used for making steam. Water for mill and steam uses is piped 15 miles from springs and wells near Tehachapi pass. This pumping and water-conveying enterprise is a joint arrangement in which the Queen Esther, Karma and Echo mines are concerned, the three named being nearly contiguous properties. The Queen Esther workings open the vein for about 800 ft. on the strike, and the incline distance between the highest adit and the lowest blind level is 900 ft., there being five different levels. An electric hoist, stationed on the second adit, operates a skip. The stopes between the highest adit and the mill level show a regular vein formation.

The 15 claims of the Echo Mining Company are close to the Queen Esther. The manager is G. H. Hooper, of Los Angeles, with John Keith as superintendent. There are two principal, parallel veins, 400 ft. apart. They range from 1 ft. to 10 ft. wide; the gangue consists of brecciated quartz. One of the veins carries gold only, the other both gold and silver. The workings aggregate 3,000 ft. in all. A 20-stamp mill treats about 55 tons of ore daily, the crushing being done in cyanide solution. The pulp is passed over amalgamating plates, thence to separators that part the sand from slime. The sand is leached in cyanide solution in the usual way, the slime being subjected to agitation and decantation. About one-third the value is recovered on the plates. The company employs 36 men. C. F. Wyett is in charge of the cyanide work.

The Karma Mining Company of San Francisco owns an adjacent mine and mill. H. C. Johnson is superintendent. The output is 30 tons per day. The vein parallels that of the Queen Esther, and carries ore of the same character. It is opened by adits above and upon the mill-level, and by a vertical shaft 160 ft., with a drift 300 ft. long at the bottom. There are basic silicates which have been altered by the introduction of calcite and manganese. The ore carries gold and silver, the latter, occurring as a chloride in a native state and as an alloy with gold. The gold is all alloyed with silver, in the ratio of two to one. The stamps have a capacity of 0.195

tons per stamp-hour. The slime is subjected to agitation in a trapezoidal agitator. The pulp passes through Richards' perforated board classifiers. Sliding shunt boards along the Wilfley tail-discharge effect the first separation between sand and slime; the latter goes to a distributing box from which two pipes lead to separators. A lower feed-pipe leads from the bottom of the box to modified Richards' perforated board classifiers, with central feed, which distribute the pulp from center toward periphery in a horizontal current. This device has given satisfactory results. One classifier, 28 in. diam., handles 20 tons per day; all slime from overflow being finer than 100-mesh. The upper feed-pipe from slime distributor carries the product with less sand, which goes to a tube classifier. All slime is settled in square settling boxes with central feed, with peripheral discharge to a launder surrounding each department, giving a spitzkasten effect and making perfect settling. In the decantation system, lime is used to facilitate settling. In the battery practice, some copper carbonate and sulphide present were found to coat the plates, so as to interfere with amalgamation. This was overcome by the use of 0.25 lb. salt per ton of ore. This, again, prevented the copper from passing to the cyanide department, thereby lessening the consumption of cyanide. On account of clay in the ore, the crushing is relatively coarse, so that in leaching the small quantity of slime that goes to sand tanks, the tendency is to draw down to the filter, forming a relatively impermeable layer. This has been overcome by creating an upward current from beneath the filter during the filling of the Butters distributor, which has the effect of floating out the fine slime from the sand tank.

A new use for aluminum is found in making spools and bobbins, particularly for mill work. The aluminum bobbins weigh less than half as much as wooden ones, are less influenced by changes in heat and moisture, and are said to be more durable.

A great pipe-line, starting from Red Fork, will pursue its course across Kansas to Kansas City, across Missouri, under the Mississippi river, and across Illinois to Whiting, near Chicago; across Indiana to Cygnet, Ohio, where it will receive a fresh impulse from the largest oil-pumping station in the world; across Ohio and the northwestern corner of Pennsylvania to Olean, N. Y., the junction point of the different pipe lines, and then across New York and northern New Jersey to the refineries of the Standard Oil Company, at Bayonne, N. J., and Newtown creek, New York City, reaching the latter by a line laid under the Hudson river, Central park and the East river. The line, taking in its whole course, is undoubtedly the longest pipe-line in the world.

## The Origin of the Witwatersrand Gold.\*

By FREDERICK H. HATCH AND GEO. S. CORSTORPHINE.

Microscopically, the conglomerates occurring in the Witwatersrand series consist chiefly of rolled fragments of quartz; but fragments of quartzite, banded chert, and slate also occasionally occur. The quartz and quartzite fragments, from their well-rounded character, have obviously been water-borne; the banded chert and slate pebbles are usually of a more angular and elongated shape. The pebbles are of all sizes, but in the Main Reef series the average dimensions are those of a small walnut. They lie in a matrix of quartz grains, which, by the deposition of secondary quartz, has been cemented to a hard and compact mass.

There are two other mineralogical characteristics which are well marked in a hand-specimen of Witwatersrand conglomerate. The first is the presence of abundant sericite and talc, in lustrous silvery scales and films, which impart a somewhat greasy character to the rock. This is especially marked in those portions of the beds which have been subjected to slickensiding or shearing. The second characteristic is the presence in the unoxidized rock of a considerable proportion of iron pyrite. This pyrite occurs in grains which even with the unaided eye can be seen to be sometimes round, sometimes partially formed, and sometimes perfect crystals. Occasionally, larger round nodules of pyrite occur, some of which have quite a pebble-like appearance. We have examined many specimens of these so-called 'pyrites-pebbles,' and in a number of them we have observed a radially fibrous structure, while others show distinct series of concentric coats. Distinctly radiate structure was observed in two instances.

Some of the pyritic 'pebbles' from the Buffelsdoorn mine have a concentric structure, but none show any signs of superficial weathering. We have not noticed the weathered coating of iron oxide described by Mr. G. F. Becker,<sup>1</sup> but it might be formed under the influence of ordinary percolation, though the rest of the specimen remained fresh. In any case, its presence appears to us, if taken alone, too slight a reason for regarding the pyrite as rolled. It is a remarkable fact that almost every author who has referred to the rounded pellets of pyrite regards them as owing their shape to attrition. In our opinion, the bulk of the so-called 'rolled' pyrite owes its shape to growth by accretion, and consists of the mineral marcasite. If rolled pebbles of pyrite occur, they are the exception, and not the rule. We have seen none to which we would assign such an origin.

In the so-called 'buckshot' reef, the pellets of pyrite vary from 0.1 to 0.3 in diam. They occur in a narrow band, associated with a thin seam of small pebble conglomerate, which is the foot-wall leader of the Rietfontein mines. When the pellets are partially weathered, a radiate structure can be clearly discerned, and in thin sections of the fresh reef the same structure is visible even to the naked eye. The "carbon leader" is an interesting feature in the same mine; it consists<sup>2</sup> of a thin layer in which small black spots of carbonaceous matter occur, generally associated with visible gold, which forms an incrustation on the carbonaceous matter. It occurs on the hanging-wall side of the hanging-wall leader, from which it is separated by from three to eight feet of quartzite. Carbonaceous matter of a similar nature has been noticed in the Buffelsdoorn mine, and at Randfontein.

All the sections examined show practically the same type of rock, the main differences being the proportion of matrix to pebbles, and the occasional occurrence of some particular mineral in greater quantity than the normal. The quartz pebbles show numerous fluid enclosures, arranged in irregular lines throughout the fragments. Between crossed nicols the quartz sections generally show an undulatory extinction, and in some cases are broken up into separately polarizing fields, a result, no doubt, of the strain to which the rock has been subjected. As already mentioned, these pebbles lie in a matrix of quartz grains, which is mainly of secondary origin. The secondary quartz is in the form of a fine mosaic of differently orientated granules.

The pyrite is in all shapes, but the circular predominates; sections of cubes and pentagonal dodecahedra and octahedra are found; and every variation of these forms, from sharply angular sections to partially or wholly circular, can be seen. In a section of the Reitfontein buckshot reef we noticed that one pyrite concretion had been cracked and re-cemented by secondary quartz, showing that the silicification of the conglomerates had to some extent been posterior to that of the pyrite.

The matrix contains much chlorite, talc, sericite, and occasionally ordinary muscovite; in some sections abundant rutile is present, and zircon is also an accessory constituent. Magnetite is rarely seen. With the talc and chlorite there is associated a colorless mineral of fairly high refraction, generally in prismatic sections, which are occasionally bifurcated, and often broken across by a well-marked

cleavage. Between crossed nicols, it shows an imperfect lamellar twinning, with a high index of refraction and low double refraction. This mineral is chloritoid.

Although rarely visible in the hand specimen, the gold can be easily studied under the microscope, if rich specimens are examined; it occurs in irregular angular particles, often lying on the periphery of individual pyrite crystals, or in the interstices between aggregates of that mineral particles, often lying on the periphery of gold lying inside a homogeneous crystal or piece of pyrite. In many cases perfectly round pieces of pyrite may be observed to be bounded by gold particles. It is difficult to explain such an occurrence on the assumption that the pyrite with its attached gold was brought into the conglomerate by the same processes which produced the quartz pebbles, since it is obvious that the gold particles would have become detached during the attrition which gave the quartz pebbles their rounded form. We deduce that the gold certainly, and probably most, if not all, the pyrite, have been carried in by percolating solutions, and have crystallized in the matrix of the conglomerate.

The fact that the cementing material of the conglomerates is so largely composed of secondary minerals shows that they must have been subject to much percolation by mineralizing solutions before final consolidation. The slow and repeated passage of such solutions, even if carrying only a minute quantity of gold in solution, would gradually enrich the matrix.

Three main theories have been put forward to explain the presence of the gold in the Witwatersrand conglomerates:

(1) The gold was mechanically deposited with the pebbles of the conglomerate as the result of the denudation of some pre-existing auriferous rocks—that is to say, the conglomerates represent ancient alluvial or placer deposits.

(2) The gold was present in solution in the waters by which the conglomerate was laid down, and while the pebbles were accumulating, as a result of mechanical action, the gold itself was being chemically precipitated.

(3) The gold, with the other minerals (quartz, chalcedony, pyrite, etc.), which now form the bulk of the matrix, was introduced by percolating waters into the interstices of the partially solidified conglomerates as a subsequent infiltration.

(1) *The Placer Theory.*—To view the Rand conglomerates merely as ancient placer deposits, in which the gold is as much a product of denudation as the pebbles which accompany it, is, perhaps, because of its simplicity, the first explanation which presents itself. It is a view which was suggested by several of the earlier writers. Some authors have based their preference for this theory on a superficial resemblance to certain Californian

\*Abstract of paper entitled 'The Petrography of the Witwatersrand Conglomerates, with Special Reference to the Origin of the Gold,' Geological Society of South Africa, November 14, 1904.

<sup>1</sup>G. F. Becker. 'The Witwatersrand Conglomerates,' Washington, 1896, p.

<sup>2</sup>Professor Miers, of Oxford, to whom we sent a specimen of this carbonaceous matter, writes: "It appears to me to consist mainly of carbon, burns with production of CO<sub>2</sub>, it is mixed with a sulphur (and arsenic) compound, probably of iron, since ash appears to be mainly an iron residue. I do not think it contains any hydrocarbon."



alluvial deposits, but their chief argument seems to be the occurrence of the rounded grains or pellets of pyrite in the cementing matrix, which are assumed to have acquired their shape by trituration or rolling.

An interesting variation of this view has been presented by Mr. G. F. Becker,<sup>3</sup> who regards the conglomerates as being ancient marine placer deposits, whose original pyrite has been partially, and the gold entirely, dissolved and re-deposited. Like the supporters of the simple placer theory, Mr. Becker lays stress upon the rounded form of the pyrite, which he considers as due to attrition. This he regards as the original form of the pyrite in the rock, and explains the presence of complete or partial crystals as the result of recrystallization. He describes the pyrite as occurring in round pebbles or pellets, which in some cases are superficially converted into a brownish-black mineral, which is probably hematite. The free gold in the matrix is, in Mr. Becker's view, also present in two different conditions. He accepts Koch's description of the metal as occurring in minute crystals, or in irregular, hackly aggregates, and Pelikan's statement that the gold is in irregular particles, grains and scales, corresponding to alluvial occurrences, and concludes on his own part that the angular outlines of some of the gold particles are due to their being moulded by pressure against the accompanying minerals.

With regard to this theory, we consider that there is little in the character of the conglomerates which supports such a simple explanation, for whether we regard the conglomerates as simple or modified placer deposits, the difficulty of the invariably fine state of sub-division of the gold and the regularity of its distribution remains. All who know placer deposits will agree that the gold in these occurs either in nuggets, or is characterized by a coarseness which is quite foreign to the Rand conglomerates. Again, though the average gold content or grade of the conglomerates is not a high one, it is higher than that of the usual placer deposit. Even Mr. Becker's hypothesis that the banket is a placer in which the gold has been partially dissolved and re-deposited does not simplify matters, since it involves the assumption of a free percolation of waters capable of dissolving the pyrite and the gold, and an almost simultaneous precipitation of these minerals.

(2) *The Precipitation Theory.*—The second theory, that the gold and the pyrite are chemical precipitates from the waters beneath which the conglomerate pebbles were laid down, was first presented by W. H. Penning<sup>4</sup> in 1888, and elaborated by De Launay<sup>5</sup> in 1896. Penning put forward this view because he considered that it best explained the occurrence of the gold in hackly aggregates and rude crystal shapes.

This theory is also open to many objections. It pre-supposes waters rich in dissolved gold, and the occurrence of some chemical change at a time when the waters were disturbed by movements capable of causing the formation of fairly coarse conglomerates. One naturally associates the growth of crystals with quietude, and not with violent disturbance of the water in which the crystals were supposed to be formed.

(3) *The Infiltration Theory.*—As we have already indicated, we believe that the infiltration theory satisfactorily accounts for most of the phenomena, without postulating any peculiarly abnormal conditions.

The most striking feature of the gold contents of the Rand conglomerates is the limitation of the gold practically to that zone of conglomerates which we know as the Main Reef series. That only certain conglomerate beds should be the main gold carriers seems to us to speak strongly for the theory of subsequent infiltration, for on the placer theory it is difficult to believe that only one horizon of conglomerate beds should be derived from pre-existing gold-bearers. The assumption necessary on the infiltration theory, that the entire series of conglomerates and quartzites has been permeated by the auriferous waters, presents no serious difficulty. The limitation of the gold deposition to definite zones was probably due to certain chemical conditions, as, for example, the presence of some reducing agent existing in these, and not in the other beds. In this way alone does it seem possible to explain the presence of the gold in beds near the center of a conformable series. At the same time, on the theory of a general percolation of the auriferous waters, wherever the necessary conditions prevailed, precipitation could take place, and thus we can account for the occasional presence of payable gold in the conglomerates above and below the Main Reef horizon, as well as the existence of richer shoots or patches in the main gold-bearing series. What this reducing agent was it is difficult to say. The frequent association of the gold with the pyrite suggests that the latter had something to do with the precipitation. In some rich conglomerate reefs, carbonaceous matter is found to be plentifully present, and we suspect that this substance played a greater rôle in the precipitation of the gold than is usually thought.

Aluminum is so friable at a temperature of 986° F. that it is easily pulverized. The natural ductility of the metal disappears as it is hammered in the cold, but is restored by heating to 750 to 900°, followed by slow cooling. Hammering is best done at a temperature of from 215 to 300°, and shaping by pressure at 930°. The melting point is 1157° F.

<sup>3</sup>G. F. Becker, *loc. cit.*

<sup>4</sup>*Journal of the Society of Arts*, Vol. XXXVI. (1888).

<sup>5</sup>De Launay, *loc. cit.*

### A Testimonial.

Recently a number of members of the American Institute of Mining Engineers, acting on the suggestion of Dr. R. W. Raymond and John Hays Hammond, decided to present Dr. Joseph A. Holmes a testimonial in recognition of his work in the organization and presentation of the mining exhibit at the Louisiana Purchase Exposition. The testimonial took the form of a silver cup, or trophy, and the presentation was made at a dinner given at the St. Louis Club, in St. Louis, on the evening of Dec. 27. Mr. Arthur Thacher, chairman of the local committee of the Institute, presided at the dinner. The cup, which was of solid silver, bore an engraving of the Mines Building on one side, and an appropriate testimonial inscription on the other. It was mounted on a base of teak wood 6 in. long. Doctor Holmes was taken by surprise, but made a very happy response to the presentation, in which he said that the appreciation of his hard work by his colleagues was even more grateful to him than the testimonial, in which their good wishes found expression. Among the local members of the Institute and visitors present were Governor D. R. Francis, the president of the exposition; Professor Watanabe, the mining commissioner from Japan; Messrs. Pierre Chouteau, P. N. Moore, F. E. Drake, William Chauvenet, H. A. Wheeler and Arthur Thacher.

REVERBERATORY FURNACE.—The low, almost flat, arch of the reverberatory furnace used to be, and still is, a nice problem of construction. It may be built successfully, if the buckstays are heavy enough, and well braced, and if the tie-rods are strong enough and kept adjusted to tension. The modern practice of running slag along the side of the furnace to brace the lower end of the buckstay is simple and effective. But the chief trouble with the reverberatory is not so much when it is running, as when it cools off. That relaxes the strain, starts the joints, and gives more slack than can be taken up.

SURFACE TENSION.—Small particles are more soluble than large ones, as the tension of a highly curved surface is greater than that of a slightly curved surface. This is further illustrated by the tendency of precipitates to become coarsely crystalline on standing, the large grains gaining at the expense of the small ones. This matter of surface tension is something that needs study; it is capable of being a help rather than a hindrance; and it can not be ignored, because the play of forces—counted by hundreds of atmospheres—is not a negligible item. This question concerns particularly the treatment of slime; so that it becomes another phase of an already large subject.

## The Chemistry and Metallurgy of Copper.—IV.

By CHARLES S. PALMER.

Some general peculiarities of slags have already been given; attention was called to the fact that we have not as yet any simple and handy test for the acid or alkaline condition of fusions comparable with the use and significance of litmus in water solutions. The fact and the theory, connected with the behavior of acids, bases and salts which are defined by the use of litmus, form collectively one of the greatest achievements, not only of the last two decades, but even of all chemical history. The clearing up which has come, with the theory of the dissociation of inactive molecules into active ions, is to be likened to nothing else that has preceded it, unless it be the great insight shown in the reactions of the carbon compounds. To be sure, ionization (developed from dilute solutions) has doubtless been too largely and too carelessly projected over some fields not as yet covered by requisite experiment (concentrated solutions); but regarding the general reliability of the theory of these part-molecules as a working hypothesis in explaining *mode* of reaction, there can be no doubt. It has done too much actual work to be treated with anything but the greatest respect. The difference between the bound condition of the hydroxyl of common alcohol, or of the chlorine of chloroform, as compared with the free condition of the hydroxyl of sodium hydroxide, or the free chlorine of common salt—a freedom illustrated by chemical activity, by electrical conductivity and by the hidden but enormous osmotic pressure—all this is only the advance guard of a progress which will not cease till we are in possession of a fairly complete history of the field of wet solution and of dry fusion. But at the present we are still enveloped in darkness regarding the structure and condition of the field of dry fusion.

To be sure, most of the common fluxes which are used in fire assaying can be separately examined in water solution. We know that soda and niter behave in solution as though they had the molecular structures implied in the formulæ  $\text{KNO}_3$  and  $\text{Na}_2\text{CO}_3$ , respectively; but we do not know what is the true polymerization in the solid state. To be candid, one should always write such formulæ, when considered in the solid state, with the conservative and apologetic parentheses, thus:  $(\text{Na}_2\text{CO}_3)_x$  and  $(\text{KNO}_3)_y$ , respectively,  $x$  and  $y$  being the unknown factors of polymerization. What these factors may be we do not know; but from the evidence given by the crystallographic molecule, they are probably of considerable magnitude. But, though these substances are mixed in the flux, and though they pass through the unknown condition of fusion, yet we are clear as to the end products, and these end products are practically identical with those obtained by the better

understood methods of solution. When we ask regarding the chemical condition of the field of fusion, we are met by very scanty information. The field of the dry melt, as a rule, does not seem to conduct electricity with the readiness shown by the common water solution, though there is some conductivity. Naturally, the difficulty of performing the appropriate experiments in this field will explain, in part, the neglect with which it has been treated; but it is significant that one of the most recent laboratory notebooks on metallurgy, and edited by one of the most progressive authorities of the world, does not even mention this phase of the study of melted fluxes. Not for criticism, but merely for emphasis, the writer ventures to state what most readers might surmise ('Metallurgical Laboratory Notes,' Henry M. Howe). No proof is needed that this eminent authority who, in his masterly work on 'Iron, Steel and Other Alloys,' has given the very latest results of science in treating the structure of alloys, would also have at least mentioned it had there been any available method of making a direct attack on the condition and structure of the field of fusion.

But, in the poverty of other evidence, one has the Hobson's choice of analogy. In general, one uses the same kind of compounds, and one meets with the same kind of results as those which are well known in the field of solution. The partners in the salt-couples exchange places, with the same practical results which are characteristic of wet solution reaction. The same quantitative relations are observed, both of the weight of the ingredients and of the absorption or evolution of heat. The intermediate stages are under the screen of the hot field of fusion, where there is a high degree of molecular freedom, as shown by the mobility of the melt. We are not left in doubt, therefore, as to the general avenue of molecular exchange. There must be free ions, and they must play all the chief rôles in the atomic and molecular drama. Moreover, there is not only the probability, but almost the certainty, that some unknown compounds are formed in fusion; but it is doubtful if there are any *new kinds* of chemical compounds, or indeed any new kinds of chemical reactions. New varieties of apparatus to register new conditions of properties will have to be devised, and it can hardly be to the credit of our common science that we are still destitute of the method, the apparatus and the result. There is room here for another Percy to labor in his laboratory, and to bring this neglect more nearly up to date. But to return to the evidence furnished by analogy, as far as it goes, it is ample and not to be despised.

I come to the study of slags from the standpoint of the eruptive rocks. The

completeness of this series, from the acid granite and diorite to the basic leucite and basalt, furnishes a basis for comparison that is by no means unworthy of use in the attack on the composition and structure of slags. Broadly speaking, the bulk of slags may be regarded as silicates or alumino-silicates of lime and iron. The use of the word alumino-silicate at this stage of the discussion does not commit one to any special view of the rôle of that quizzical ingredient, alumina, which will be discussed later. For the present I will limit the discussion to the silicates of iron and lime.

*The oxygen ratio and the naming of silicates.*—To illustrate, the common formula of iron olivine, fayalite, one of the ingredients of common iron slag, is  $(\text{FeO})_2\text{SiO}_2$ , or as it may also be written,  $\text{Fe}_2\text{SiO}_4$ , as though from ortho-silicic acid,  $\text{H}_4\text{SiO}_4$ . All salts were written in dualistic style before the influence of the so-called 'Cannizarro's reform,' in 1858. Thus the old method of writing common potassium sulphate— $\text{K}_2\text{SO}_4$ —was  $\text{K}_2\text{O}, \text{SO}_3$ , and similarly with other innumerable examples that might be given. When we ask why the dualistic method of dividing the oxygen between the metal of the basic part of the salt and the non-metal of the acid part was used, we find that it was the natural method of recording the actual results of analysis. In many cases of inorganic analysis, the calculations could be made most directly for the base radical and the acid radical. It was only natural that these results should be grouped together as fact, without regard to theory. When, in the forties and fifties of the last century, the study of the water of crystallization of the phosphates and arseniates, under Graham, began to reveal the real structure of acids, there was good reason for the use of the unitary formula; e.g.,  $\text{K}_2\text{SO}_4$ . When, in the sixties, the application of the then new theory of valence came to recognition, there was more reason for the use of the unitary system. But in all these advances, the inorganic chemist, represented by the mineralogist, clung usually to the old method of writing his formulæ. There are some advantages to be gained from the use of these dualistic formulæ. Thus, in a series of compounds, as in the silicates now being discussed, a glance is all that is needed to show the relative degree of acidity. In the potassium sulphates and pyro-sulphates, the formulæ  $\text{K}_2\text{O}, \text{SO}_3$  and  $\text{K}_2\text{O}, (\text{SO}_3)_2$  would probably be more directly intelligible to the analytical chemist than would the unitary formulæ  $\text{K}_2\text{SO}_4$  and  $\text{K}_2\text{S}_2\text{O}_7$ . But it would take only a slight application to master the fuller relations shown by the unitary formulæ; and it should be noted that even conservative mineralogists are now using both styles. Now, though the dualistic formulæ, which divide the oxygen between the metal of the base and the non-metal of the acid radical, are supposed to show the 'oxygen ratio,'

yet it can be easily proven that this is liable to misinterpretation. Thus in the formula,  $K_2O, SO_3$ , it would formerly have been taken to mean that it is a 'tri-sulphate,' something the real meaning of which may be very uncertain. It is a tri-sulphate in the sense that the sulphur carries three atoms of oxygen, as compared with the double potassium group ' $K_2O$ '; but if one considers the potassium atom K, it becomes a 'hexa-sulphate' or a 'six-sulphate.' Thus the naming of salts from the oxygen ratio leads to complex and uncertain relations. It will not serve as a simple basis, except as a convenient comparison of any one series, and then it counts from some imaginary type as a basis. It is not necessary to go to the other extreme and use unjustified and unjustifiable graphic formulæ. The simple empirical unitary formula is the real basis of work, though it is often convenient for the student to write out the hypothetical graphic formula in testing the actual matching of the acid and basic parts of any salt. To the curious student who is interested in this line of theory there is abundant evidence which can be presented for the hypothetical graphic formula; and there is no special harm in doing this for practice, if the student will always remember that he is dealing with substances the molecular weights of which have not been determined, and the inter-molecular reactions of which have not been traced with the detail allowed in the carbon compounds. The student is recommended to study that remarkably illuminating little work by Remsen, 'Theoretical Chemistry,' and also the larger edition of the 'Inorganic Chemistry,' by the same author. It will be found that there is abundant evidence for the interpretation of the structure of inorganic compounds from the analogy of the organic and volatile compounds. But to hark back to the oxygen ratio; while it is a convenience as a memory aid, it does not go far enough in interpreting the structure of the salt under consideration. Let us illustrate this by proceeding to the special study of some typical silicates of slags.

The per cent of silica in smelting slags may be considered as averaging round about forty, dropping to thirty or less, as in some lead slags and also in converter slags, and mounting to fifty or even higher in some, especially the slags of iron smelting. This just about matches the lower limit of the massive rocks of the earth's surface, limburgite carrying less than forty per cent of silica in some places. Therefore, in looking for minerals which may be found at the basic limit of slags, one would naturally seek the heavier and darker eruptives, both for the basic nature and also for the fusibility which must ever be a characteristic of furnace fusion.

Now the natural minerals, which would be expected to duplicate the probable chemical individuals of slags, are not al-

ways to be found as fully developed as might be expected. One great reason for this is the widespread occurrence of both alumina and magnesia in natural lavas, both of which form isomorphous mixtures with what otherwise would be pure silicates of iron and lime, and in smelting both alumina and magnesia must be avoided, when they are in any considerable quantity, on account of the well-known infusibility of their silicates. As exceptional, note magnesia slags in an iron furnace.<sup>1</sup> The commonest and simplest of the iron silicates, found both in natural lavas and also in smelter slags, is fayalite, or iron olivine,  $Fe_2SiO_4$ , or  $(FeO)_2SiO_2$ . It is called, in the time-honored nomenclature of metallurgy, a mono-silicate, because the oxygen in the basic part is the same in quantity as that in the acid part; but the more rational way is to regard it as a simple ferrous ortho-silicate, from the acid  $H_4SiO_4$ . It is interesting as showing the strongly basic nature of iron in being able to form a numerically neutral salt with ortho-silicic acid. It is also one of the most obligingly fusible reliances of the smelter-man. One would expect to find it as a very common ingredient of natural lavas; but it is surprising to observe that it is listed in the standard mineralogies as though it were rather a rare mineral. The reason for this appears to be the widespread abundance of the contaminating magnesia and alumina. With magnesia the mineral would tend to form common olivine, which is an isomorphous mixture of the ortho-silicates of iron and magnesia; with alumina, fayalite would form some of the more complex aluminosilicates of the pyroxene or amphibole groups. On the other hand, looking for the representatives of the common calcium silicates of slags—calcium meta-silicate,  $CaSiO_3$ , or  $CaO, SiO_2$ , we find as the mineral wollastonite. This has a fairly common occurrence, not only as an alteration and contact mineral both in limestones and granites, but also as an original member of basaltic lavas. The contamination by magnesia would tend to form something like diopside. But the odd thing about these two minerals, fayalite and wollastonite, is that the one is the iron ortho-silicate, the other is the calcium meta-silicate, and the complementary exchanges of these, namely, the pure iron meta-silicate is not known, neither is the pure calcium ortho-silicate. To be sure, the iron meta-silicate molecule appears abundantly in the isomorphous series of enstatite, bronzite, hypersthene, and in increasingly greater quantity in the order given; but the increasing fusibility with the diminution of the magnesia molecule and the preponderance of the iron molecule, illustrates both the effect of the contamination of the infusible magnesia and also the rarity of the occurrence of the pure iron molecule.

Continuing the search, natural calcium

<sup>1</sup>This JOURNAL, p. 501, September 29, 1904. 'Titanium Iron Ores,' A. J. Rossi.

ortho-silicate,  $Ca_2SiO_4$ , does not appear to have been observed as yet in pure form. This is the more surprising because of the strongly basic nature of calcium, and also because of the universal abundance of both lime and silica. The same molecule is, however, found in several minerals in what may be isomorphous mixture, as in grossularite or cinnamon stone, which is the common lime garnet, and in the common iron garnet, andradite, and possibly elsewhere.

Now, if one takes the analyses of actual slags, and calculates the probable composition of the chemical individuals contained therein, he will arrive at results that indicate that the iron forms both the ortho-silicate, and perhaps some of the meta-silicate, though there is also evidence of a little of an acid silicate. The calcium seems to form mainly the meta-silicate, though in the case of the aluminosilicates, to be considered later, there may be some of the ortho-silicate, unknown in the pure form.

It should be noted that while there may be instances of the formation of the so-called 'sesqui-silicate,'  $(RO)_4(SiO_2)_3$ , or  $R_4Si_3O_{10}$ , this is easily seen to be a probable mixture of two molecules of the meta-silicate  $RSiO_3$  (as  $CaSiO_3$ ), plus one molecule of the ortho-silicate  $R_2SiO_4$  (as  $Fe_2SiO_4$ ). Some slags, in particular certain copper slags, clearly show an approximation to this formula.

Regarding the rôle of the other most common ingredients, a word may be in place at this time.

Zinc, though an undesirable flux in quantities above 5 per cent, does not appear to offer any special difficulties on the theoretical side. The mineral, willemite,  $Zn_2SiO_4$ , though not of widespread occurrence, does appear in large quantity at one locality in New Jersey. It has also been recently reported as crystallizing from some zinc slags.<sup>2</sup> The occurrence of the zinc spinel, gahnite,  $Zn(AlO_2)_2$ , or zinc met-aluminate, is well-known in nature, as also are the isomorphous modifications of the spinel molecule, franklinite, dysluite and kreittonite. The writer just quoted also mentions these spinels as occurring in slags. The only difficulty seems to be, not with the chemical condition, but with the infusibility, though it is well to mention that several good authorities regard zinc oxide as being in a state of suspension as such in slag, rather than as in the form of real chemical union with any of the other ingredients. The subject may be said to be still open for further investigation, with the responsibility resting with the 'suspensionists' to show evidence.

Magnesia never seems to have bothered the theorists, as it is calculated with the lime and ferrous iron; but it is well to call attention to the fact that its simple and double silicates are well known. Magnesium meta-silicate is found not only in

<sup>2</sup>W. M. Hutchings, this JOURNAL, p. 959, December 24, 1903.

the enstatite-bronzite-hypersthene series, as meta-silicate, but also in the pyroxene and amphibole groups. As magnesium ortho-silicate, it is found in the olivine molecule, and also in the great garnet group. Regarding spinel proper,  $Mg(AlO_2)_2$ , magnesium met-aluminate, it would be interesting to know with certainty whether it has ever been found in slags. The conditions would usually tend to the avoiding of circumstances where it could form.

The chief arguments for evolution are: (1) That from classification, known to Lamarck; (2) that from paleontology, known to Lamarck; (3) that from the common method of development of all plants and animals from the fertilized egg; (4) that from embryology, whereby the successive stages of the individual illustrate the great successive series of ancestors, in epitome; (5) that from variation and adaptation, resulting in the survival of the fittest, recognized by Darwin and Wallace.

By repeated precipitation and re-dissolving of a solution containing lead, bismuth and tellurium with some radio-active substance, the radio-activity was successively associated with the lead, the bismuth (as polonium) and the tellurium. Thus it appears that radio-lead, polonium and radio-tellurium, so-called, cannot be distinguished and identified by chemical reaction, but recourse must be had to the nature of the respective radiation.

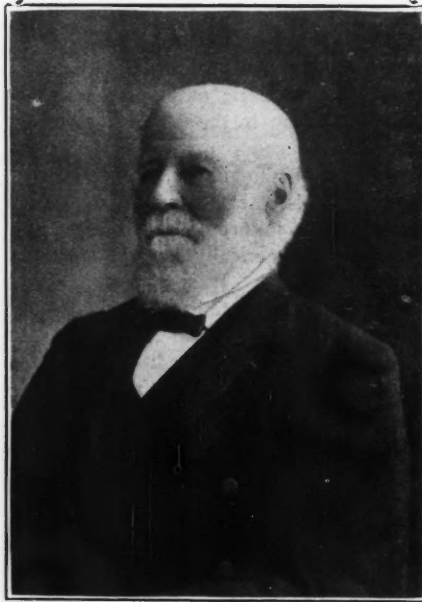
The temperature of the metal in steel casting is very important, hotter metal being more necessary for small intricate molding than for thick, heavy castings. If the metal is a little too hot, however, there is a danger of blow-holes and unsound casts, owing to the greater degree of contraction involved. If the temperature is too low, the molds may not be filled completely, and surfaces are apt to be defective.

Cryptocrystalline magnetite and massive hematite seem to make up the greater part of Iron island. This is one of the Duke group of the Northumberland Islands, on the east coast of Queensland, Australia. The phosphorus is 0.065 per cent. Several other similar deposits are found on the adjacent mainland.

The Salguez method of zinc treatment is effected either in oxidized or sulphide ores, with fluxes of different composition; iron and coal are added, fusion is performed in a closed electric furnace, the zinc is distilled off, and the residual slag is said to be free from the metal. The advantage clearly lies in the easy control of the composition of the slag, by control of the temperature. The cost of zinc works is comparable with that of a calcium-carbide plant.

### Lowthian Bell.

Isaac Lowthian Bell—better known in recent years as Sir Lowthian Bell—whose death, on December 22 last, was briefly noted in this JOURNAL, was born at Newcastle-on-Tyne, England, in 1816. After studying in the local schools he went to Germany and to Denmark, where he spent sufficient time to become acquainted with the languages of those countries. At a later date he entered as a student at Edinburgh University, and afterwards, and finally, at the Sorbonne, in Paris, where he gave special attention to the study of



LOWTHIAN BELL.

chemistry, so as to be able to deal with the practical aspects of iron and steel manufacture. On entering business life he first spent a year in the offices of Losh, Wilson & Bell, at Newcastle, and afterwards became manager of the rolling mills of the firm at Walker-on-Tyne. With an intermission of a few years, 1850 to '52, spent in chemical works near Durham, where he tried to manufacture aluminum, but with little success, his whole life was spent in the manufacture of iron and steel. In his practice as an ironmaster, however, he was inclined to be conservative, and though ready to take up and discuss new improvements, he was rather slow to adopt them.

Sir Lowthian Bell made his highest reputation as a writer on metallurgical matters and a critic of metallurgical work. The greater part of his work of this kind appeared in the proceedings of the Iron and Steel Institute, of which he was an active member from 1868 down to the time of his death, and of which he served as president for a number of years. In addition to the papers thus published, he wrote several important works, the most elaborate being the 'Chemical Phenomena of Iron Smelting,' published in 1872, and 'Principles of the Manufacture of Iron and Steel,' published in 1878. Both works

were for many years standard authorities on iron practice. Another notable work was a report on the 'Iron Trade of the United States,' prepared in 1876. Of his numerous papers before the Iron and Steel Institute, it would be impossible to make a complete record.

Sir Lowthian Bell visited the United States three times, his first visit being in 1874. He returned to this country in 1876, when he served as a juror in the metallurgical section of the Centennial Exposition in Philadelphia, his colleagues being such distinguished men as Professor Ritter von Tunner, Professor Akermann, Professor Jordan and the late Abram S. Hewitt. In 1890 he visited the United States again, presiding at the meetings of the Iron and Steel Institute, held in New York and Pittsburg.

In addition to his work for the Iron and Steel Institute, he served for a number of years as president of the British Iron Trade Association, in the formation of which he took an active part. He was also president and member of a number of societies in Great Britain, including the Institution of Mechanical Engineers, the Chemical Society, the North of England Institution of Mining & Mechanical Engineers, and the Institution of Mining Engineers. He was a member of Parliament for several years, but took no prominent part in the debates of that body.

Sir Lowthian Bell believed fully in the exchange of experiences and comparison of views and results as a means of progress, and he did much to break down the old tradition of exclusiveness and secrecy in the iron trade. He was always ready to open works which he controlled to visitors, and to give any information in his power to those who sought it. He was a severe critic of all new processes and suggestions for improvement, but was nevertheless quick to recognize whatever merit they might possess.

An intimate friend and associate of Sir Lowthian Bell says that his two most striking characteristics, and the two which explain the high regard in which he was held, were his gift for saying the right thing at the right time, and his great capacity for taking pains. Up to the last he never spared himself labor, and this was the case throughout his active career.

Among the immediate advantages to be gained by duty-free alcohol, may be mentioned a cheaper high-grade explosive, as smokeless powder; and also the service of alcohol in motor engines.

Steel castings are manufactured with open-hearth furnaces and with small converters. Where castings of various sizes are made, as in a general steel foundry, a small open-hearth furnace affords excellent results, as it gives control over both the composition of the steel and the melting temperature.

**Power Coal Drill.**

Heretofore drilling in coal mines has been done by the time-honored hand-drill or by the more modern portable electric or compressed-air drill. The first method is an expensive operation both to the miner and the owner of the property. It requires from 20 to 30 minutes to drill a hole of the ordinary depth; and this makes it plain that a device which will do the work in less time will save money.

As a step in the right direction, portable drills, to be operated by electricity or compressed air, were introduced and are used to a greater or less degree in different bituminous districts. This form of drill is operated by a man and a boy, who are paid at a specified price per ton of coal produced, or at a specified rate of wages per

As the only way to provide for the payment of labor to operate the power drill is by deducting an amount from the loader which would properly represent the amount of time consumed by him in drilling by hand, the value of the drill to the mine-owner is limited and its saving power determined entirely by the amount of coal which can be drilled in a given time and the cost of repairs. The driller cannot afford to work at a less price than he can obtain by performing other work about the mine and the mine owner cannot afford to invest his money in machinery unless it would make a reasonable earning for him.

The amount which can be deducted from the loader for having his drilling done by power has been determined and

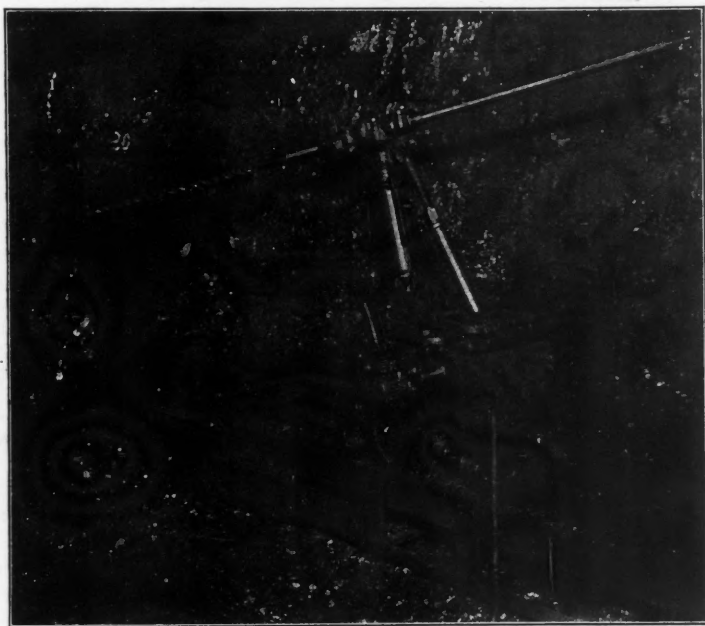
sity, must not be considered, as the drill is a part of the cutting machine and must go wherever the machine goes. The only time to be paid for by the mine-owner is that actually occupied by the machine-runner in adjusting the drill and boring the hole. The flexibility of the drill and the small number of working parts enables the runner to adjust it quickly, and very little time is occupied in the entire operation of setting the drill for placing the hole where required and boring the hole. The necessity for high rates of wages for this part of the work is accordingly overcome, and the mine-owner has an opportunity to share the gain with the regular machine-runner. This does not in any way change the relation of the loader to the mine-owner and the reduction provided for by the scale can be properly made, the same as in the case of the portable drill.

The drill being attached to the machine at all times, readily changed so the holes can be placed wherever desired, and capable of being placed flat on the top of the motor when the cutting machine is being moved from place to place in the mine, permits the drilling to be done properly and the cutting machine to be moved without any appreciable loss of time on the part of the machine-runner. It has also been demonstrated that more coal is produced at every cutting when the machine-runner does his own drilling. This, in itself, is a source of increased revenue to the machine-runner, and has proved to be one of the most important advantages in the adoption of the drill to the mine-owner. It has been found that a rate not to exceed 0.5c. per ton, where the vein is thin, fully compensates the machine-runner for the time occupied in doing the drilling. As to the question of repairs, the first of these drills has been in operation for more than eighteen months and has cost nothing for repairs.

Those who are using the drill recommend it highly. More than 60 have been installed since they were placed on the market. Two of the largest coal companies in the world—the Fairmont Coal Company, at Fairmont, W. Va., and the Pittsburg Coal Company, of Pittsburg, Pa., have adopted these drills.

This drill, we are informed, is fully covered by patents which have been allowed but not yet issued.

**IRON MANUFACTURE IN AUSTRALIA.**—In a recent debate, in the Australian House of Representatives, upon the question of granting a bounty on all iron made in Australia, it was stated that the estimated requirements of the Commonwealth in iron and steel would consume annually about 1,400,000 tons of iron, 300,000 tons flux and 2,000,000 tons of coal, all of which, it was claimed, could be supplied in the country. The making of pig iron would require about 4,500 men, and some 4,000 more would be employed in finishing.



A NEW COAL DRILL.

day. These drills are capable of doing the work rapidly and can generally bore a hole in about 1½ minutes. If the time were the only point to be considered in connection with drilling, this form of drill would be very valuable, and would have been more generally adopted than is the case at the present time. There are, however, two principal disadvantages in connection with their use. The first is that the amount to be paid for labor to run the drill is such that it leaves a very small margin of profit to the mine-owner. The second is that the repairs are so high that the small profit left is wiped out. The first of these disadvantages is necessary, and it seems to be impossible to overcome the second, for the reason that in order to quickly and easily transport the drill from one working place to another, and after reaching the working place to set it up ready for work, it is necessary that it be very light. This does not allow the different parts to be made of sufficient strength to withstand the heavy work which the drill is called upon to perform.

agreed upon in various mining districts. These fixed rates show that for the form of drill which requires the entire time and attention of a man and a boy, when the cost of repairs is taken into consideration, the reduction in the cost of coal is practically nothing.

It is, therefore, plain that the only kind of power drill, which will be of any value both to the man who runs it and to the mine-owner, must be of such construction that it can be operated with a small amount of labor and low cost for repairs. These are the results claimed for a new drill recently placed on the market by the Wagner-Palmros Manufacturing Company, of Fairmont, West Virginia.

This drill is used in connection with the undercutting machine and both are run by the same motor, and the drill operated by the man who runs the machine. The time taken to drill a hole 7 feet deep is about one minute. The time taken from the operation of the cutting machine is very small. The time consumed in moving the drill from place to place, of neces-

### Conditions in the Joplin District.

By JESSE A. ZOOK.

The year 1904 records no radical change in the general plan of operations, but unlike 1903, it inaugurated a course that promises to have a material influence on the incoming year. At many of the mines electric power is to supersede steam, a large dam having been constructed west of Joplin, below the junction of Spring and Shoal rivers, where a central generating plant is being installed. Work was begun in the summer, and it was hoped to usher in the new year with it in operation, but delays will postpone the start for a month or six weeks. A large amount of electric machinery has been ordered by mine operators, and many mills will be supplied with motors, on a guarantee of a positive saving in the expense for motive power. A few pumps to be driven by electricity are to be given a trial, but the larger use will be for hoisting and milling.

A year ago it was noted as follows: "Few prospects were found in 1901, but a number were found in 1902 and 1903. These should have the effect of enlarging the output of 1904." In 1904 there was a total shipment of 268,540 tons of zinc and 34,500 tons of lead; an increase, as compared to 1903, of 33,670 tons zinc and 5,840 tons lead. This is the largest tonnage of zinc shipped in any one year, and the maximum for lead with the exception of 1901, when the total was 35,177 tons.

It was also noted a year ago that lower levels were being prospected with churn drills. It was said: "None of these lower levels have been developed and it is quite probable that very few, if any of them, will be outputting this year." Shaft-sinking and development work is progressing for the extraction of ore at these lower levels, but it will be well into 1905 before actual production begins.

The idea of consolidating a number of interests, which took hold during 1902, advancing during 1903, still further progressed during 1904, until the district is practically under the control of 30 mine-managers, organized into a secret club for the protection of local mining interests. It is an offshoot from the Missouri and Kansas Zinc Miners' Association, with a club room and regular monthly meetings. With this club originated the policy of curtailment begun during the first two weeks of July, during which the reserve stock was cleaned up, since when there has been no further accumulation. The one policy of the club is apparently to prevent such a surplus of zinc ore as would amount to an over-production and glut the market. The curtailment of July was a test of strength, and a signal victory.

The larger part of the year's output has been from old mines, though some important new ones have contributed. Satisfactory ore prices have made it possible to

work mines that were abandoned during the low prices of 1902. Some of these were re-opened in 1903 and 1904.

One flood period affected the output of the year for three or four weeks, otherwise there were no obstacles of general import. An exceedingly dry fall and early winter did, however, cause a few mines to be closed down from lack of water for concentration. New smelters erected during the year contributed to a stronger demand for zinc ore, and the larger demand and higher price, made it possible to work mines at a cost of \$32 to \$35 per ton of concentrate during the last quarter. The year 1905 begins with more auspicious indications than did 1904, and with a firm spelter market it will exceed its predecessor in output.

### Manganese Ore.

Consumption in America in 1904 was much impaired by the depression in the steel and chemical industries. Only about 82,500 long tons (against 146,056 tons in 1903) were imported from Russia, Spain, India, Brazil and the West Indies. These imports satisfied fully half the demand in this country, which in recent years amounted to between 225,000 and 275,000 tons of manganese ore, calculated on the basis of 30 per cent metallic content. The greater part of the domestic production is credited to manganiferous iron, zinc and silver ores, containing from 7 to 30 per cent metal, while imports are mostly of manganese ore carrying from 45 to 52 per cent metal.

Steel works in Pennsylvania pay for ore delivered from 22 to 25c. per unit (\$8.80@ \$12.50 per ton) for the manganese from 40 per cent up, and 5c. per unit for the iron. Ordinarily steel-makers will not accept ore that assays more than 8 per cent silica and 0.1 per cent phosphorus. In the open market prices for 50 per cent ore show the effects of competition, and at New York were 18@20c. per unit (\$9@ \$10 per ton).

In recent years the larger consumers have taken options on the output of foreign mines for the purpose of obtaining a regular supply of ore at advantageous prices.

Production abroad has been generally curtailed as a result of the relaxation in consumption. Something over a million tons of ore are mined annually throughout the world, more than half of which is credited to Russia. In 1903 Russia exported 440,857 long tons, but in 1904 the amount was much less, owing partly to the war with Japan and to business depression. In Spain the government dynamite monopoly, by advancing the price of a case of 25 kg. from 75 pesetas (\$14.48, or 26c. per lb.) to 135 pesetas (\$26.06, or 47c. per lb.), has caused dissension among the miners. In the Cartagena district the consumption of dynamite is about 155,000

cases, equivalent to 8,525,000 pounds per annum, representing an enhanced cost to mining of over \$1,790,000 as a result of the monopoly. Miners have also been handicapped by weak prices for ore, and were it not for the comparatively low ocean freights to foreign consumers, the industry would be demoralized. In the West Indies much development work has been done, and substantial exports made to American steel plants at about \$1.80 freight. This compares with an ocean freight to Baltimore or Philadelphia of \$2.50@ \$3 from Brazil, and about \$4.20 from India and Russia. At the higher ocean freights profits on sales are small, but the good quality of ore seems to keep up the traffic.

### The Indiana Mining Industry for 1904.

By OUR SPECIAL CORRESPONDENT.

There is considerable interest manifest concerning the output for the year just closed as compared with the previous year. The year 1903 was the most remarkable in the history of the mining industry of the State; more mines were opened, more coal produced, and more wages paid to employees. There is a decided discrepancy between the reports of James Epperson, inspector of mines, and William Johnson, State statistician, as to the total production of coal. According to Mr. Epperson's books there were mined 9,992,553 gross tons, a net increase of 1,229,356 tons, or nearly 14 per cent over 1902. According to Mr. Johnson's data, gathered by a competent agent, there were 11,866,023 tons of coal mined in the State in 1903. This discrepancy is due to the fact that there are several hundred mines in the State, working more or less men, who are not required by law to report to the inspector of mines; and these, it is claimed, produced 1,873,470 tons. The large increase was mainly attributed to the 37 new mines opened, the scarcity of western coal and the severity of the winter.

The law requires the owner, operator or agent of every coal mine in Indiana to report to the inspector of mines before the 15th day of each calendar month, the number of tons of coal produced at such mine during the preceding month, the amount of wages paid, and the amount of money expended for improvements. Mr. Epperson says, according to the reports for the eleven months at hand, the output for 1904 will be considerably less, possibly not over 9,000,000 gross tons. There were 30 new mines opened during the year, making a total of 215 mines operating. A greater number of miners were employed; but the average of days' labor per week will not equal the average of last year. Fewer accidents have occurred, and local labor troubles have been less frequent and easily adjusted. The decrease in accidents is attributable to closer inspection and the more skillful and expert use of explosives.

Considerable money has been expended in improvements. A number of mines have been equipped with modern machinery, electricity being employed as a motive power. The sanitary conditions have greatly improved, and the safety of the miners has been enhanced. Several causes contributed to the decrease in the output. The principal one is a disappointing coal market. The demand for bituminous coal was quiet during the year. The spring floods interfered with the operation of a number of mines; a shortage of cars or embargo on transportation also curtailed the output somewhat.

Mr. Epperson is preparing a bill for the consideration of the incoming legislature to amend the law, so as to require an inspection of, and report from, all the mines in the State. There are several hundred small mines operated, employing more or less men, that escape supervision. Men employed in such mines are entitled to the protection of the law, and the amended act will afford them such protection.

In every respect the conditions in coal mining in Indiana have improved. New mines have been opened and there is a steady output; and, while it did not equal that of the previous year, this has brought much wealth into the State.

The Homestake consolidated companies have produced \$90,000,000; have paid \$20,000,000 in dividends; and in over 25 years have not missed paying a monthly dividend. This has been done on ore averaging from \$3.50 to \$5 per ton. The annual production is \$4,500,000; and there is enough ore in sight to supply its present capacity for 20 years. Over 2,600 acres are controlled, and over 1,000 stamps are constantly employed.

Salt beds are not confined to strata of any one geological horizon. Those of Canada, New York State and part of Michigan lie among upper Silurian rocks. They are regarded by Professor Newberry as the deposits of a great salt lake that formerly occupied central and western New York, northern Pennsylvania and Ohio, and southern Ontario, the area being as large as Lake Huron or larger.

Type metal is made of lead, tin and antimony. Some makers claim to alloy copper and also aluminum in small quantities, but as the admixture is very difficult, it is assumed that such claims are made mainly for advertising purposes. As a matter of fact so much junk is worked over into type metal that the metallurgist cannot be sure of any mixture, except as his experience indicates from observing how the metal alloy runs. For linotype metal the alloy contains reduced proportions of tin and antimony, in order to secure a mixture that will cast more easily. Electrotype metal is very similar to type metal.

#### Books Reviewed.

*Jahrbuch für das Berg und Hüttenwesen im Königreiche Sachsen.* 1904. By C. Menzel. Freiberg, Germany: Craz & Gerlach. Pages, 396; illustrated.

This is the annual report on the commercial and educational progress of mining and metallurgy in the kingdom of Saxony. The first division of the contents consists of a series of papers, among which should be noted: 'Gas explosions in clay mines and their prevention,' by H. E. Müller of Zwickau; 'Progress in the wet and dry extraction of zinc in the last 20 years, and the application to Freiberg conditions,' by Rudolf Hoffman of the Muldner smelter at Freiberg; 'Old Japanese mine and smelter practice,' by Emil Trepow, of the Bergakademie at Freiberg. The second division includes numerous short communications of every phase of engineering activity, especially as related to Saxon work and result. Here also is included a detailed description of the mining school which has made the Freiberg training so effective the world over. Naturally the biography of Clemens Winkler occupies a prominent place in the fore part of the volume. The third and last part of the contents is devoted to the laws and official reports of the various departments relating in any way to the general province of mining and metallurgy in Saxony. Altogether this volume is a valuable reference book on matters metallic and mineral.

*Annual Report of the Board of Regents of the Smithsonian Institution for the year ending June, 1903.* S. P. Langley, Secretary. Washington; Government Printing Office, 1904. Pages 876, including index.

Comparatively few of the intelligent citizens of the United States realize the value of this publication. At one time it was the custom of some reliable house to issue an annual of scientific discovery; and the volume used to fill the need, measurably. In recent years this custom has fallen off, except in the too condensed form of the large, but cheap, annual almanacs of the great dailies. But the need still persists; and this government publication is admirably suited to give the busy man of affairs a digest of the progressive thought, experiment and culture of the age. The table of contents is almost bewildering in its variety and richness. Following the additions to the Smithsonian, the administrative detail, and the work of the Astro-Physical Laboratory, come the reports of the National Museum, the Bureau of American Ethnology, the International Exchange Service, the National Zoological Park, the Astro-Physical Observatory, the Librarian and the Editor. But it is the General Appendix (which makes up seven-eighths of the book) that claims our attention. It

is impossible to review in any detail the 53 papers which reflect the intellectual progress of the globe. The titles are as cosmopolitan as the list of authors. A few citations must serve to illustrate these invaluable papers. Geology is in evidence from the pen of Charles Lapworth, who writes on the 'Relations of Geology,' and N. S. Shaler, who discusses the 'General Description of the Moon,' the first paper of his 'Comparison of the Features of the Earth and the Moon,' published elsewhere in full as Vol. XXIV of the Smithsonian Contributions. The reproduced photographs of the satellite are excellent; but one (Clavius, Plate V), unfortunately and without apology, by some trick of reproduction is reversed right and left—a mistake for which there is no excuse. Astro-physics gives not only Langley's own report on solar radiation, but also 'Terrestrial Magnetism' by E. W. Creak. Polar exploration has three papers, by R. E. Peary, Sir Clements R. Markham, Otto Nordenskiöld; and E. Curie, J. J. Thomson, Sir William Ramsay, F. Soddy present papers relating to radium, which are further fortified by papers on matter, the atom, and the inter-atom, by Sir William Crookes, F. W. Clarke, Gustave LeBon and Sir Oliver Lodge.

The 'Electric Furnace,' by J. Wright; 'High-speed Electric Railways,' by George H. Gibson and Alfred Gradenwitz; 'New Aspects of Evolution,' by A. Dastre, M. Anthony, and Gill; 'The Mental Life of Animals,' by N. Vaschide and P. Rosseau; and so on, even to the 'Ancient Hittites' (the vanished civilization of old Asia Minor), and Central American hieroglyphics. One interesting paper by W. H. Holmes deals with aboriginal operations of a Missouri iron mine (the fairly systematic 'gophering' seems to have sought for the ore as a pigment only). Others describe Lhasa, Thibet and Chinese Turkestan.

It is safe to say that no other volume carries more of timely interest, high scholarship and fascinating description, than does this. Indeed the mental progress of the human race is well illustrated in this one book.

*The Elements of the Differential and Integral Calculus.* By Donald Francis Campbell. New York; The Macmillan Company. London; Macmillan & Company, Ltd. Pages, 364. Price, \$1.90.

Professor Campbell has prepared this book expressly to meet the needs of his own classes, but thinks that it will have a utility in any institution in which the study of calculus is begun without a thorough grounding in mathematics. In it he makes no pretense of contributing to the science.

The treatment differs but little from that in Osborne, except that the solutions of type examples in integration are given in more detail, and that, from beginning to end, the practical applications of the

subject are kept in view. The last 100 pages give an introduction to mechanics, in which kinematics, center of gravity, moment of inertia, etc., are treated with a thoroughness somewhat out of proportion in a work with this title.

The book fulfills the modest claim made for it, but has no exceptional value as a work of reference.

#### Books Received.

In sending books for notices, will publishers, for their own sake and that of book buyers, give the retail price? These notices do not supersede review in a subsequent issue of this JOURNAL.

*Tonindustrie Kalendar*, 1905. Berlin, Germany; *Tonindustrie Zeitung*. Three parts, 800 pages.

*The Granger Movement in Illinois*. By A. E. Paine. Urbana, Ill.; the University of Illinois. Pages, 56. Price, 35 cents.

*Das Oberdevon Eropas und Nordamerikas*. By Joseph Culver Hartzel. Munich, Germany; Published for the Author. Pages, 76.

*Tasmania. Report on the Mt. Victoria Gold-field*. W. H. Twelvetrees. Hobart, Tasmania; State Printer. Pages, 32; with maps.

*Annuaire pour le Bureau des Longitudes*. 1905. Paris, France; Gauthier-Villars. Pages, 800; illustrated. Price (in New York) 50 cents.

*Objections to Reciprocity on Constitutional and Practical Grounds*. By William Whitman. Boston; Published for the Author. Pamphlet, 36 pages.

*Geological Survey of Ohio. The Uses of Hydraulic Cement*. By Frank Harvey Eno, Columbus, Ohio; Published by the Survey. Pages, 260; illustrated.

*Thirty-fifth Annual Report of the State Board of Health of Massachusetts*. Samuel W. Abbott, Secretary of the Board. Boston; State Printers. Pages, 644.

*Illinois Railway Legislation and Commission Control Since 1870*. By Joseph H. Gordon. Urbana, Ill.; the University of Illinois. Pages, 84. Price, 25 cents.

*Victorian Year-Book*. 1903. Compiled by the Government Statist. Melbourne, Victoria; Government Printer. Pages, 548.

*Geological Survey of Georgia. A Preliminary Report on the Coal Deposits of Georgia*. By S. W. McCallie. Atlanta, Ga.; State Printer. Pages, 124; illustrated.

*Expériences sur les Lampes de Sureté*. By V. Watteyne and S. Stassart. Report to the Ministry of Industry and Labor. Brussels, Belgium; L. Narcisse. Pages, 332; illustrated.

*Transactions of the American Ceramic Society. Volume VI*. 1904. Edward Orton, Jr., Secretary. Columbus, Ohio;

published by the Society. Pages, 286; illustrated.

*Geologic Atlas of the United States. Heron Folio, South Dakota*. Washington; Engraved and published by the Geological Survey. Three maps and eight pages text.

*Techno-Chemical Analysis*. By Dr. G. Lunge. Translated by Alfred I. Cohn. New York; John Wiley & Sons. London; Chapman & Hall, Ltd. Pages, 144; illustrated. Price, \$1.

*Western Australia. Annual Progress Report of the Geological Survey for 1903*. A. Gibb Maitland, Government Geologist. Perth, W. A.; Government Printer. Pages, 36; illustrated.

*Windmills in Foreign Countries. Special Consular Reports, Volume XXXI*. Compiled in the Department of Commerce and Labor. Washington; Government Printing Office. Pages, 296.

*Tables of Trade and Navigation of the Dominion of Canada for the Year ended June 30, 1904*. Compiled in the Ministry of Customs. Ottawa, Canada; Public Printer. Pages, 548.

*Annales des Mines de Belgique. Volume IX, Part IV*. Prepared under direction of the Ministry of Industry and Labor. Brussels, Belgium; L. Narcisse. Pages, 604; illustrated.

*New Zealand Official Year-Book. Thirteenth Year*. 1904. Compiled by E. J. Von Dadelszen, Registrar-General. Wellington, N. Z.; Government Printer. Pages, 720; with map.

*A Treatise on Rocks, Rock-Weathering and Soils*. By Geo. P. Merrill. New York; the Macmillan Company. London; Macmillan & Company, Ltd. Pages, 412; illustrated. Price, \$4.

*Geological Survey of New Jersey. The Clays and Clay Industry of New Jersey*. By Heinrich Ries, Henry B. Kummel and Geo. N. Knapp. Trenton, N. J.; State Printer. Pages, 548; with maps and illustrations.

*United States Geological Survey. Geological Reconnaissance Across the Bitterroot Range and Clearwater Mountains in Montana and Idaho*. By Waldemar Lindgren. Washington; Government Printing Office. Pages, 124; illustrated.

*United States Geological Survey. Water Supply and Irrigation Papers. No. 106. Water Resources of the Philadelphia District*. By Florence Bascom. Pages, 76; with maps. No. 107. *Water-Powers of Alabama*. By Benjamin M. Hall. Pages, 248; illustrated. Washington; Government Printer.

*Geology of the Bezuidenhout Valley and the District East of Johannesburg*. Pages, 10, with three plates. *Petrography of the Witwaterstrand Conglom-*

*erates, with Special Reference to the Origin of the Gold*. By Frederick H. Hatch and George S. Corstorphine. Johannesburg. Transvaal; Reprinted from the *Transactions of the Geological Society of South Africa*.

*United States Geological Survey. Bulletin 245. Results of Primary Triangulation and Primary Traverse*. 1903-04. By Samuel S. Gannett. Pages, 328. No. 248. *A Gazetteer of Indian Territory*. By Henry Gannett. Pages, 72. No. 254. *Report of Progress of the Resurvey of the Cripple Creek District, Colorado*. By Waldemar Lindgren and F. L. Ransome. Pages, 36. No. 235. *A Geological Reconnaissance Across the Cascade Range*. By G. A. Smith and F. C. Calkins. Pages, 104. Washington; Government Printing Office.

#### Correspondence.

We invite correspondence upon matters of interest to the industries of mining and metallurgy. Communications should invariably be accompanied with the name and address of the writer. Initials only will be published when so requested.

Letters should be addressed to the Editor. We do not hold ourselves responsible for the opinions expressed by correspondents.

#### The Metal Gallium.

Sir—The metal "gallium" was named by its discoverer after his own name, Lecoq de Boisdaubrau. *Lecoq*=the cock-gallus, hence gallium.

The Germans imagining wrongly that it came from Gallia, and not to remain behind in patriotism, forged the name "germanium," which is as clumsy as "gallium" is concise and elegant.

RAFAEL GRANJA.

Kingston, N. Y., Dec. 24, 1904.

#### Cost of Electric Drilling.

Sir—In reading the very interesting article upon 'Electric Drilling, Dredging and Pumping,' by George E. Walsh, which appeared in your issue of December 15, I noted an apparent error in his statement of the tests of electric drills at the mines of the Consolidated Cariboo Company, at Bullion, B. C. The test is evidently the same as that referred to by Mr. Gillette in his book upon rock excavation. Mr. Walsh gives the figures as follows: Lubricants, \$0.35; current, \$2.25; three drillmen at \$4, \$12; three helpers at \$2, \$6; one blacksmith, \$4; one blacksmith helper, \$2; total for 312 ft., \$26.60. Mr. Gillette gives them thus: Lubricants, \$0.35; one cord wood, \$2.25; three drillmen at \$4, \$12; three helpers at \$2, \$6; one blacksmith, \$4; one blacksmith helper, \$2; one electrician, \$4; charcoal, \$0.95; total, \$31.55.

The total cost of drilling 312 ft. is stated by Mr. Walsh in his paper to be \$31.55, which led me to believe that an accidental error had crept in.

LINDSAY DUNCAN.

Denver, Dec. 21, 1904.