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Stebbins Dry Concentrator in Yellow Pine District

By Fred A. Hale, Jr.*

SYNOPSIS—One experimental and one permanent dry concentrating plant have been erected to operate on lead-zinc ores in the Yellow Pine mining district of Nevada. Description of the mills and of the Stebbins dry concentrating reciprocating table, which uses low-pressure air through perforated riffles. Results satisfactory; low costs, high capacity obtained. Process is rough concentration on an unclassified feed.

An interesting development in the Yellow Pine mining district of Nevada last year was the introduction of dry concentration. The district presents an ideal field for this process, inasmuch as the ores, even when taken from considerable depth, carry little moisture, and at most of the properties in operation, the scarcity of water renders concentration by ordinary wet methods out of the question. The only available water in the district is at Goodsprings, where the Yellow Pine Mining Co. is operating an 80-ton concentrator, and at Ripley, both places situated several miles distant from the principal mines.

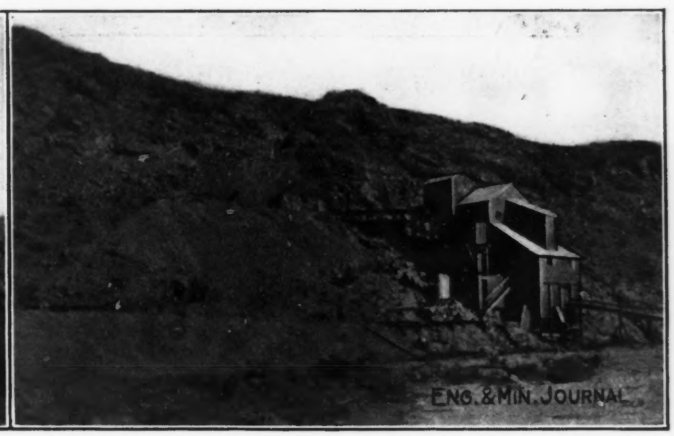
Singer and Hoosier Plants

During the summer of 1913, the Howard Mines Co. was organized to take over the Singer group of claims, situated 10 miles west of Goodsprings. A good tonnage of lead-zinc ore was developed, averaging 15 to 18% lead, 15 to 20% zinc, and 4.5 oz. silver per ton. The zinc occurs in the form of carbonate and silicate, in approximately equal proportions, the lead minerals being cerrusite, with some galena. The orebodies are found in a siliceous limestone gangue close to the surface and are mined largely from opencuts, the ore being dropped at most of the mines through mill holes to a tunnel level below.

Since the property is situated 16 miles from the railroad, it soon became evident that preliminary concentration would be necessary before the mixed lead and zinc ore could be shipped profitably; and after experimenting it was decided to install a dry concentrating plant, utilizing the Stebbins dry concentrator. The work of erection was rushed; within 50 days after beginning work, the mill was running at full capacity. The plant was designed to handle 50 tons per 24 hr., but it is found that, with a mill feed averaging 15% lead, a capacity of 75 tons may be obtained, this capacity increasing somewhat when the lead content is higher. The ore is dry as it comes from the mine, requiring no further treatment to remove moisture, and is extremely friable, so that no large equipment is required for crushing.

From the main tunnel level of the mine, the ore is trammed to the coarse-ore bins of 100 tons capacity, from which it is fed to a grizzly with 1-in. openings and thence to an 8x12-in. crusher of the Blake type. After passing through the crusher, the broken ore, together with the fines, passes to a set of 12x12-in. Davis rolls, set to about

Hoosier Testing Plant



Singer Mine and Mill

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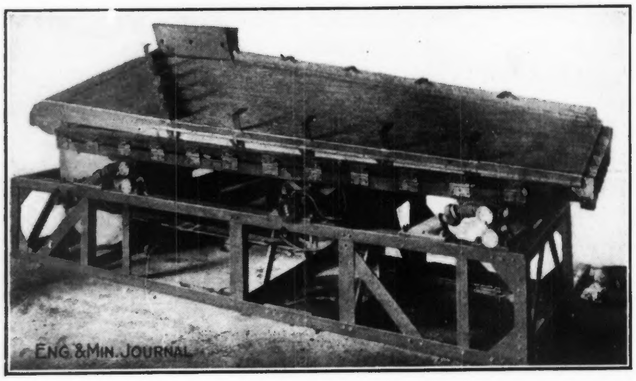
¼-in. opening. This feeds directly into an 8-in. belt elevator, 25 ft. in length, which discharges on a shaking screen fitted with 8-mesh wire screen. The oversize from this screen is sent back to another set of 12x12-in. Davis rolls for regrinding and thence is returned to the same screen by the elevator. The undersize passes directly to the feed hopper of the concentrator.

Stebbins Table

This Stebbins table is worthy of special description, as it is the essential machine in the operation. The photograph gives an idea of its general appearance. It is built of steel throughout, the frame made of 2-in. angle iron with crossbraces for stiffening. The deck is 36 in. wide, 9½ ft. in length, and is built of sheet metal, with ¼-in. rectangular riffles, running lengthwise of the table; the riffles have a lip-perforated surface through which air is forced from an air chamber beneath the surface of the table. This air chamber derives its pressure and volume from a 10-in. pressure blower, revolving at 1200 r.p.m., self-contained with the table, belted directly to the table lineshaft and situated near the center of the frame. The table has a reciprocating motion lengthwise, supplied by an adjustable toggle on the main shaft, which is arranged to vary the stroke from ⅜ in. to ⅝ in. The normal speed of operation is 362 r.p.m.; it requires 10 hp. to operate, of which 6 hp. is consumed by the pressure blower. The table is equipped with five setscrews between the upper end of the deck and the frame, by means of which the slope of the deck may be adjusted. A slide in the air chamber below the deck is arranged so that the air pressure through the perforated riffles may also be adjusted.



Stebbins No. 10 Dry Concentrator with Dust-Hood Removed

The ore is fed through a hopper at the head end of the table. A constant air pressure is maintained through the riffles, which are perforated on the downward side and this forms a continuous air-cushion underneath the bed of ore. The lighter material flows over the tops of the riffles, as in ordinary table concentration, and the concentrates contained within the riffles are discharged from the end of the table. Some of the upper riffles end against buffers arranged along a downward-trending diagonal wall; these have a retarding action on the concentrates and force the discharge nearer the corner of the table. For the removal of dust, the table, with the exception of the discharge end, is completely covered by a sheet-metal hood, to which an exhaust fan is attached. A 14-in. fan, revolving at 650 r.p.m., is used, but this is of sufficient size for two tables. The dust is discharged outside the mill. The concentrates and tailings fall into bins beneath the table, where the former are drawn into wagons and the latter are trammed to the tailings dump. The middlings are returned by the mill elevator to the roll system, and again go over the table.

A testing plant, using the Stebbins machine, was erected at the Hoosier mine early in the summer, but, although more crushing machinery has been added, and the plant has been in operation for several months, the machinery is not housed as yet and the plant is by no means complete. The ore at the Hoosier is similar in character to that at the Singer and the practice will be essentially the same.

Results

It will be noted that this is essentially a "roughing" concentration, but the machine is designed for large capacity, simplicity of operation and close extraction. At the Singer mill, from heads averaging 15 to 20% lead, 20% zinc and 4.5 oz. silver per ton, a concentrate averaging 55 to 65% lead, 4% zinc and 4.5 oz. silver is produced, while the tails average 3.5% lead, 23% zinc and 4.5 oz. silver. It has been estimated that 10% of the mill heads are lost as dust, but assays of this material indicate that little of the lead is contained in this dust. The mill has not been in operation sufficiently long to give accurate data on extraction, but it is evident from the assays given that the lead extraction approaches 80%. The silver is evidently disseminated throughout the entire ore and shows little effect of concentration. By careful sorting at the mill, it has been demonstrated that the zinc content can be raised sufficiently to permit the tailings, after removal of the lead, to be shipped as zinc ore. It is stated by the Howard Mines Co. that the plant at the Singer did not cost more than $10,000, although it is situated 16 miles from the railroad. The extraction obtained, considering the large capacity and the fact that it handles an unclassified feed, is truly remarkable. It has been fully demonstrated that the machine is capable of handling the lead ores economically, the cost of milling being under $1.25 per ton. At both mills mentioned, distillate is used for fuel, each plant being equipped with a 50-hp. gas engine. The products are hauled by wagon to the shipping point, Jean. Several other properties in the district are considering the installation of mills of this type, and the availability of the machine for the treatment of some of the oxidized copper ores of the district is to be tested. The inventor of the concentrator, A. H. Stebbins, of Los Angeles, states that he has obtained even better results than those obtained at the Singer, by classifying the feed before concentration, using a pneumatic classifier of his design and making two products, which are treated on separate tables, that for the fines being somewhat different from the other.

Shannon Copper Co.

Shannon Copper Co. reports treatment of 51,960 tons of Shannon ore, and 13,254 tons from outside company properties during first quarter of 1914. Production was 397 oz. gold, 19,480 oz. silver and 2,922,889 lb. of copper obtained at average cost of 12.687c. per lb. Average price received was 14.277c. Net profits were $46,676. Quick assets on March 31, 1914, were $408,591, exclusive of $308,000 Shannon-Arizona Ry. bonds.

Chloridizing the Sudbury Copper-Nickel Ores

By Arthur Howe Carpenter*

SYNOPSIS—The occurrence of copper, nickel and iron in the same ore occasions a waste of one of them, usually the iron. The requirement is a process for saving the copper alone and nickel and iron together, the last two being advantageously smelted for iron, giving a high-grade nickel-bearing product. Application of the Longmaid-Henderson process has shown the way to a solution of the problem. It has been investigated by the Pennsylvania Salt Manufacturing Co., with favorable results. The experiments and conclusions are here given.

The work described in this article was carried out in 1909 under the direction of the late Dr. Franklin R. Carpenter. Dr. H. O. Hofman of the Massachusetts Institute of Technology was consulted and gave much assistance. In Schnabel's "Handbook" (edition of 1898), Vol. II, pp. 502-503, referring to mixtures of iron, copper and nickel sulphides, is the statement:

> If any mixture of the three sulphides is roasted with common salt, the copper is converted into chloride, and the iron and nickel are oxidized. This chloride can be removed from the mixture of oxides by lixiviation, cupric chloride by water, cuprous chloride by alkaline chlorides or weak hydrochloric acid.

With this as a basis, an investigation was made of the application of the Longmaid-Henderson process to the problem of treating the copper-nickel pyrrhotite of Sudbury, Ontario. Manifestly, it would be too expensive to treat the raw pyrrhotite direct, the amount of salt required being too great.

An Apparent Waste of Iron

Nickel is largely used as an alloy in steel, and practical metallurgy has a challenge in the Sudbury pyrrhotite where it occurs with large amounts of iron. Present methods of treating the ore consist in separating the nickel and later alloying it with iron from other sources. It seems a waste of natural resources that the large piles of slag at the copper-nickel smelteries throughout Ontario are 40% to 50% iron oxide. A method should be devised to separate the copper and sulphur from the ore and leave the iron and nickel as oxides ready for reduction to ferro-nickel.

The Sudbury deposits, in addition to their nickel content are really large copper mines, richer than the average porphyry mines of Utah, Nevada and Arizona and of the same magnitude.

The products of the Longmaid-Henderson process are cement copper (from 80 to 95% metallic copper) and an iron ore, the so called "blue billy" or "purple ore" of commerce. It is the most efficient process known for recovering copper from appropriate ores and especially for the removal of sulphur. The process is described in Schnabel's "Handbook" (1898 edition), Vol. I, p. 220. The following description is condensed partly from this book and partly from Lunge's "Sulphuric Acid and Alkali" and other sources. The process was first proposed by Longmaid but was not introduced into England until after the experiments upon a large scale by Henderson. Ores suitable for it have relatively small amounts of gangue and are mainly iron sulphides containing from 3% to 8% copper. The process consists essentially of two steps; first, an oxidizing roast of the ores, usually performed in pyrites burners or other suitable apparatus for conserving the sulphur for acid manufacture, and second, a chloridizing roast with salt, whereby the copper is converted mainly into cupric chloride and a small portion into cuprous chloride. These chlorides are leached out with water, then weak acid, and the copper precipitated from the resulting solutions with metallic iron. Either scrap or pig iron is used for this purpose. It was first employed upon the cupriferous pyrites of Spain and Portugal, but was later adopted in Germany, Austria, Belgium, Sweden and England.

Chemistry of the Longmaid-Henderson Process

The result of the calcination of the ore is a mixture of cupric chloride, oxides and sulphates, cuprous chloride, sodium sulphate, ferrous chloride, ferric oxide and sulphate and chlorides of the remaining metals. The calcination must be conducted so as to produce the minimum amount of copper compounds insoluble in water, namely, copper oxide and cuprous chloride, because these bodies require acids or chlorine compounds to dissolve them. Soluble ferric sulphate should not remain in the calcined ore, because it passes into solution and entails an increased consumption of iron when the copper is precipitated.

The necessary conditions for success are, not too much copper in the ore, nor too much sulphur, and the maintenance of suitable temperature during calcination. The last is particularly important, since the temperature limit of the chloridizing roast is narrow for best results.

If there is too much copper, the whole of the sulphide is not decomposed in the preliminary roasting, so that part of the copper is not chloridized in the second calcining with salt, and it accordingly escapes solution. In Oker, 8% copper was looked upon as the limit for good work, while in England, it was thought that ore running more than 6% could not be successfully treated.

The sulphur must not exceed 1½ times the copper present, as too much salt would be consumed and the calcination would take too long. If the quantity of sulphur is insufficient, the necessary quantity of raw pyrites is added. The temperature must not exceed low redness, or too much cupric chloride would be volatilized; in spite of all precautions, it is impossible quite to prevent the production of cuprous chloride and cupric oxide or the volatilization of small quantities of cupric chloride.

The gases evolved in the chloridizing roast contain SO_2, HCl and Cl and must, therefore, be rendered innocuous before being allowed to escape into the atmosphere. This is effected by leading them into towers filled with acid-proof stones or with coke if the calcina-

*American Vanadium Co., Bridgeville, Penn.

tion is done in muffles, down which water is allowed to trickle, absorbing both the injurious gases and the volatilized cupric chloride. This weak acid solution is used to dissolve the cuprous chloride not leached out by the water. Usually 75% to 95% of the copper is removed by the first water leaching and only a small amount is left for the acid solution to take up.

Use of the Process by the Pennsylvania Salt Mfg. Co.

The Pennsylvania Salt Manufacturing Co. is the principal user of the process in America and was the first to bring the process under American methods and conditions of large scale operations. Reliable information concerning the work and results of practice was obtained preliminary to visiting the plant. Some interesting details were published in *Mineral Industry,* Vol. VIII, p. 262.

At Philadelphia, in 1909, this company was treating over 400 tons a day of copper-bearing calcines from its sulphuric-acid plant by chloridizing and leaching. So efficient had the process become in its hands that 95% to 97% of the total copper present, as determined by electrolytic assay, was recovered and sold as metallic copper. The residue is nodulized, removing the last objectionable amounts of sulphur, and is sold to the iron furnace operators as a high-grade iron ore. It brings a premium over the usual prices. Cinder is treated profitably which sometimes carry only ½% copper. This was made possible by the great capacity and excellent work of the Wedge chloridizing furnace, which reduced the cost of chloridizing to a fraction of that of former days.

The problem was to apply the process, or some modification of it, to the Sudbury nickel-copper ores, so that the whole of the copper should be rendered soluble while the nickel was to be left insoluble with the iron. Sulphur and other deleterious substances were to be removed and cinder made suitable for the production of ferro-nickel pig by direct smelting in cupolas or electric furnaces or by some direct steel process similar to Lash's method.

Ordinarily the roasting of iron and other ores can be controlled to produce larger or smaller amounts of sulphates of the metals present. As practiced at the Pennsylvania Salt Manufacturing Co.'s plant the preliminary roast is purposely arranged to produce a maximum amount of sulphate of copper which is soluble in water without further chloridizing.

Conditions Necessary in Sudbury Roasting

In the case of the Sudbury ore as little sulphate of the various metals was to be produced as possible in conducting the first oxidizing roast, for nickel sulphate is soluble in water and is easily converted into chloride of nickel, which is volatile. Therefore, the preliminary roast was to be controlled to produce a minimum amount of sulphates, different from the ordinary practice. The information obtainable was meager, beyond the fact that a little nickel was rendered soluble at Oker and the work of Stahl (*Berg- und Hüttenmannische Zeitung,* 1893, p. 1, and 1894, p. 105). There was little definite information concerning the temperatures of decomposition of copper, iron and nickel sulphides and of the corresponding sulphates or chlorides. The accompanying tables from *Metallurgie* by Friedrich, 1909, Vol. 6, p. 181, were new and the latest information to be had.

DECOMPOSITION TEMPERATURES OF SULPHIDES

Substance	Heated in Air Current Gives off SO_2 at Deg. C.		(Deg. F.)	Size of Grain
FeS_2	472°		(881)	Larger than 0.2 mm.
Fe_7S_8	590			
Cu_2S	679	These two seem		
NiS	616	to be reversed.		
Ni - 74%, S - 26%,	880			
FeS_2	405			0.1 - 0.2 mm.
Fe_7S_8	525			
FeS	535			
Ni - 74%, S - 26%	802			
FeS_2	325			Less than 0.1 mm.
Fe_7S_8	430			
Cu_2S	430			
NiS	513			
Ni - 74%. S - 26%	700			

Another table, somewhat fuller and differently arranged, was the following:

	Glow 0.1 to 0.2 mm. C	Judged by Smell 0.1 to 0.2 mm. C	0.1 mm. C	0.2 mm. and greater C
Pyrite	533°	405°	325°	472°
Pyrrhotite	595	533	430	590
Iron sulphide	626	535	....	....
Millerite (impure)	....	595	513	616
Fused NiS	....	802	700	880
Fused CoS	....	684	514	859
Fused CoS	850	751	514	1019

Some other tests were:

Cu_2S at 420° C in 3 hr. gives soluble $CuSO_4$, 38%
Cu_2S at 420° C in 3½ hr. gives soluble $CuSO_4$, 40%.
Cu_2S at 420° C. in 4 hr. gives soluble $CuSO_4$, 42% the maximum.
NiS less than 600° gives trace of $NiSO_4$

As to the decomposition of sulphates the latest data were those of Warlimot (*Metallurgie,* 1909, Vol. 6, p. 132). He says that $CuSO_4$ is completely decomposed at 650° C. and that $NiSO_4$ is decomposed up to 88% at 670° C. The $CuSO_4$ figures agreed with other determinations but the $NiSO_4$ seemed doubtful as Warlimot used impure substances, but it seemed proven that $NiSO_4$ required a higher temperature than $CuSO_4$ for its decomposition. The following table comprises the available information then to be had:

DECOMPOSITION OF METALLIC SULPHATES

	$FeSO_4$	in air;	complete	at 550° C.
A.	$CuSO_4$	in air;	2%	at 620
	$CuSO_4$	in air;	4.8	at 630
	$CuSO_4$	in air;	11.8	at 640
	$CuSO_4$	in air;	complete	at 650
	$NiSO_4$	in air;	2.7%	at 600
	$NiSO_4$	in air;	8.7	at 625
	$NiSO_4$	in air;	33.0	at 650
	$NiSO_4$	in air;	88.0	at 670
	$NiSO_4$	in air;	complete	at 675 (?)

SULPHATIZING ROAST Cu_2S WITH FeS

450° C. at start raised to 530 - 550° C.

	1.	2 Cu_2S, 2 FeS;	83% sol. $CuSO_4$;	3.1 sol. $FeSO_4$
B.	2.	1 Cu_2S, 2 FeS;	92% sol. $CuSO_4$;	4.8 sol. $FeSO_4$
	3.	1 Cu_2S, 2 FeS;	95% sol. $CuSO_4$;	None dissolved.
	4.	1 Cu_2S, 10 FeS	97% sol. $CuSO_4$;	None dissolved.

SULPHATIZING ROAST. NiS AND FeS

	1.	1 NiS, 2 FeS;	3 hr. 450° C.;	3 hr. 450° C.;	12.8% sol. $NiSO_4$
C.	2.	1 NiS, 2 FeS;	9 hr 450° C.;	3 hr 450° C.;	5.9% sol. $NiSO_4$
	3.	1 NiS, 5 FeS;	9 hr. 450° C.;	3 hr. 550° C.;	7.3% sol. $NiSO_4$
	4.	1 NiS, 10 FeS	9 hr. 450° C.;	3 hr. 550° C.;	9.1% sol. $NiSO_4$

A sample of the pyrrhotite, hand picked to run as low in copper as possible, analyzed: Iron, 52.50%; insoluble residue, 7.10%; sulphur, 35.90%; copper, 0.32%; nickel, 3.38%; total, 99.20%.

This is, of course, clean ore. It would not be necessary or advisable to submit such ore to a dressing process for the removal of so small a quantity of gangue. However, some tests were made with the Elmore vacuum oil flotation system in a small laboratory machine with results that are both interesting and suggestive.

This is concentration upside down. However, it is possible to separate the Sudbury nickel-copper ore into two products, one of which will be low in gangue and high in copper and with little change in the nickel and the other consisting mainly of gangue, high in nickel and low in copper. This latter product would be suitable to add to smelting mixtures producing higher-grade nickel matte. It would be relatively small in amount. The fact that this product assayed higher in nickel than the original ore was due, it was thought, to the gangue of the ore carrying nickel. This gangue is mainly norite and nickel is not an essential constituent of it. The nickel sulphide must occur in it separately as microscopic veinlets or crystals in the rock away from the main masses of pyrrhotite. This accounts for the failure of water concentration generally and for the non success of magnetic separation. A case was noted where a lot of ore had been hand sorted to remove the gangue, and though nearly freed from it, the sulphides apparently carried no more nickel than the original ore.

RESULT OF FLOTATION CONCENTRATION

		Analysis					Percentages Found in Product				
Amt.	Product	Cu %	Fe %	S %	SiO_2 %	Ni %	Cu	Fe	S	SiO_2	Ni
500	Ore	0.33	49.9	34.65	7.28	3.26					
448	Concentrates	0.34	52.0	38.45	2.82	3.15	92.3	93.4	99.5	34.8	86.6
48	Tailings	0.20	20.6	10.30	49.5	4.37	6.4	4.0	2.7	65.2	12.8
4	Loss						1.3	2.6			0.6
	40 mesh										
Ratio	1.12 to 1										
500	Ore	0.33	49.9	34.65	7.28	3.26					
398	Concentrates	0.35	52.8	37.40	2.46	2.94	84.5	84.4	86.0	26.9	71.8
96	Tailings	0.22	36.2	22.75	27.7	4.61	12.8	13.9	12.6	73.1	27.1
6	Loss						2.7	1.7	1.4		1.1
	30 mesh										
Ratio	1.25 to 1										
500	Ore			34.65	7.28						
441	Concentrates			37.70	2.64				95.9	32.0	
58	Tailings			13.99	37.56				4.7	59.9	
1	Loss									8.1	
	30 mesh										
Ratio	1.13 to 1										

The average of the Sudbury ore is from 10 to 20% gangue. It is possible that by flotation the ore could be separated into two products, one carrying the bulk of the copper, low in silicates suitable for chloridizing or other roasting, and the other product, mainly gangue, carrying nickel, suitable for addition to smelting charges where it would serve to enrich the matte.

Laboratory Tests on Low Copper Ore

The lot of ore was a disappointment on account of the low copper content. Therefore, only a few laboratory tests were made upon it, some of which are here summarized and may be of interest.

ANALYSIS OF SAMPLE FOR EXPERIMENT

Insoluble	Iron	Sulphur	Nickel	Copper
7.1%	52.5%	35.9%	3.38%	0.14%
Roasted over a gas flame.	Weight of sinter 87%.			
8.2	60.4	1.8	3.88	0.16

This was mixed with 20% common salt and roasted over a gas flame at a low temperature, just barely red, leached with boiling water, then with a solution containing 7% HCl and ½% H_2SO_4.

LEACHING ROASTED ORE

	Iron	Nickel	Copper
Water solution contained of total	0.95%	4.85%	30.0%
Acid solution contained of total	4.50	13.35	30.0
Total in solutions	5.45	18.20	60.0
Residue "blue billy"	94.6	81.8	40.0

Analysis of the residue:

Insoluble	Iron	Sulphur	Nickel	Copper
8.20%	67.24%	......	3.53%	0.10%

To another portion of the ore before roasting, 10% by weight of clean (chalcopyrite) concentrates assaying 15% copper was added. The copper in the pyrrhotite is present mainly as chalcopyrite. It was thought that this would give similar results to that which might be expected in treating higher-grade copper ore from Sudbury. After roasting, the analysis of the cinder showed:

ROASTING AND LEACHING, CHALCOPYRITE

Insoluble	Iron	Sulphur	Nickel	Copper
8.26%	60.6%	3.50%	3.62%	1.92%

Calcined with common salt, 20%.
Leached with water, then with acid as above.

Solutions contained of the totals present:	Iron	Nickel	Copper
Water solution	0.63%	3.48%	28.75%
Acid solution	3.62	11.27	23.15
Total in solutions	4.25	14.75	51.90
Residue "blue billy"	95.75	85.25	29.60
Copper not accounted for (volatilized)			18.50

Analysis of residue:

Insoluble	Iron	Sulphur	Nickel	Copper
9.33%	64.47%	......	3.43%	0.61%

The volatilized copper would be recovered in the tower liquids in actual practice.

TESTING FINELY GROUND ORE

The original sample of ore was sized on 100-mesh screen and only the fines taken for experiment.

ANALYSIS

Insoluble	Iron	Sulphur	Nickel	Copper
5.88%	51.60%	36.1%	3.93%	0.35%
Roasted.	Weight of cinder 82%.	Analysis		
7.2	60.1	1.4	4.79	0.43

Calcined with common salt, 20%
Leached with water, then with acid as above.

Solutions contained of the totals present	Iron	Nickel	Copper
Water solution	tr.	1.63%	5.6%
Acid solution	2.65%	13.78	52.4
Totals of both solutions	2.65	15.41	58.0
Residue "blue billy"	97.35	84.6	37.6
Not accounted for (volatilized)			4.4

ANALYSIS OF RESIDUE

Insoluble	Iron	Sulphur	Nickel	Copper
7.4%	65.0%	....	4.5%	0.18%

FINE ORE WITH COPPER

Same as No. 3 with 5% by weight of 15% copper concentrates added.

Roasted. Analysis of cinder:

Insoluble	Iron	Sulphur	Nickel	Copper
8.8%	59.8%	1.1%	4.67%	1.51%

Calcined with common salt, 20%.
Leached with water, then with acid as above.

Solutions contained of the totals present:	Iron	Nickel	Copper
Water solution	tr.	1.67%	3.31%
Acid solution	1.8%	10.41	39.10
Total in solutions	1.8	12.08	42.04
Residue "blue billy"	98.2	87.92	36.4
Not accounted for (volatilized)			21.2

ANALYSIS OF RESIDUE

Insoluble	Iron	Sulphur	Nickel	Copper
7.0%	65.26%	......	4.78%	0.61%

In another experiment, no nickel was dissolved in water, the acid solution dissolved 21.5% of the total present. The water solution contained 1.55% of the copper and the acid solution 68.81%. The residue contained 78.5% of the nickel and assayed: Insoluble, 8.4%; iron, 69.3%; sulphur, 0.0%; nickel, 3.75%, and copper, 0.49%. Some copper concentrates were added to this. There was no means of determining temperatures, or controlling them other than by eye and time for different results.

The temperature of the chloridizing roast was too high, as is shown by the volatilization loss of copper chloride and by the fact that the larger part of the copper was soluble only in the dilute acid solution, whereas, in proper work, the larger part should be soluble in water. Successful work was indicated, however, and a chance sought for a test upon a larger scale.

The larger testing plant consisted of a small five-hearth muffle furnace of the regular Wedge type and was so arranged that the hot gases from the ore could be sent up from the lower hearths through or over the ore on the upper floors in succession and out into the tower, or, else, it could be arranged to send the gases down from the upper floors over the ore in the lower hearths and out.

The gases passing down over the hot Fe_2O_3 in the lower floors in the case of downward draft will be changed from SO_2 to SO_3, Fe_2O_3 acting as a catalytic agent, thus favoring the formation of sulphates. Hence, in the oxidizing roast for low sulphur, upward draft was wanted and downward draft in the chloridizing roast to utilize the gases as much as possible. The furnace was fired from each side with soft coal but a temperature could not be obtained above 1200° F. This temperature would not prevent the formation of nickel sulphate or break it up if formed. The dissociation point of nickel sulphate when pure is about 1250° F. under technical experimental conditions and probably higher when present in comparatively small quantities as in this case. The rabble arms of the furnace made one revolution in 4 minutes and 20 seconds.

The ore was supposed to be crushed to pass 40-mesh screen, indicated as the best size in the Denver laboratory by previous experiments. A screen analysis showed:

SCREEN ANALYSIS OF ORE

	Through 80 mesh	10.0%
On 80,	Through 70 mesh	6.5
On 70,	Through 60 mesh	4
On 60,	Through 50 mesh	4
On 50,	Through 40 mesh	7.5
On 40,	Through 30 mesh	10
On 30,	Through 20 mesh	22
On 20,	Through 10 mesh	33
On 10,		3

A portion of the ore was ground through an old pebble mill, formerly used for grinding cryolite. A screen analysis of this product gave:

SCREEN ANALYSIS OF REGROUND ORE

	Through 80 mesh	85.6%
On 80,	Through 70 mesh	3.4
On 70,	Through 60 mesh	0.6
On 60,	Through 50 mesh	1.4
On 50,	Through 40 mesh	3.0
On 40,	Through 30 mesh	6.0 being all of it.

The balance of the lot was treated just as it was, amounting to about 11,000 lb.; there was 7800 lb. of the material ground in the cryolite mill. However, the crushing was not satisfactory.

A careful sample was taken from the whole lot before any crushing or roasting was done. It gave upon analysis:

ANALYSES OF RAW, UNCRUSHED ORE

Insol. residue	11.11%
Iron	45.00
Nickel	2.85
Copper	1.85
Sulphur	30.85

An attempt was made to divide the ore into lots and treat them under varying conditions, but the whole of the preliminary roasting had to be done before any chloridizing could be undertaken, so there was no means of controlling the first calcination in advance of the experience gained in chloridizing. A preliminary roast was made, and after the poorly calcined ore had been used, the fine material was fed. When finished, the whole was thoroughly mixed and a sample, carefully taken, gave: Insoluble residue, 13.60%; iron, 51.17%; nickel, 3.11%; and copper 2.05%.

Several analyses gave an average of about 3% sulphur, which was a little high for good chloridizing.

TEST FOR SOLUBILITIES

	Copper	Nickel
Boiling H_2O (sulphates)	0.83	0.61
Five per cent. sulphuric acid	0.29	1.24
Aqua regia	0.93	1.26

There was, in addition to this, a pile consisting mainly of furnace cleanings and weighing about 1257 lb., which carried 4.85% sulphur; 0.94% copper, and 0.87% nickel soluble in water. In the regular pile of roasted material, over 20% of the nickel was soluble in water. It should have been either left as the sulphide or all converted to the oxide. The above notes show the preliminary roast to have been unsatisfactory but proper results could have been obtained with larger amounts and higher temperatures than was to be had with the plant in hand.

For the chloridizing roast, 5000 lb. of the roasted ore were thoroughly mixed with 750 lb. of salt and fed into the furnace at the rate of 250 lb. per hour. After three days' roasting, the analysis of the results of the test was the following: Copper—As volatile copper is recovered in the regular plant, it is counted as copper recovered. 91.57% was recovered; 8.43% remained in the residue. Nickel—28.15% of the total nickel was water soluble before the chloridizing roast. In solution, 40%; remaining in residue, 60%. Discarding the nickel already soluble as sulphate and counting the results as applying to the nickel not soluble before chloridizing we have: In solution, 16.5%; remaining in residue, 83.5%.

Indications of the Conditions for the Best Work

The oxidizing roast must be so conducted as not to form sulphates. Or else the roasting must be concluded at a temperature high enough to decompose all of the nickel sulphate formed.

The chloridizing must be conducted at a very low temperature some place between 700° F. and 800° F. to prevent the formation of $NiCl_2$ and its volatilization.

Enough had been done to warrant the statement that for an oxidizing roast the ore, properly prepared and in a suitable furnace, could be roasted mainly by its own heat of combustion and should be roasted until the sulphur content is reduced to less than 1½ times the copper content. The end of this roast should be concluded at a short high temperature, perhaps partial fusion. This would require some extraneous heat.

So far as the roasting for the removal of the sulphur is concerned, there would be no difficulty at all with proper preparation, apparatus and care. Under the adverse conditions of the work as done, the sulphur was successfully removed. However, to prevent the presence of nickel sulphate this roasting ought to take place at a temperature high enough to decompose it if formed. The prevention or decomposition of nickel sulphate might have been had by other means, but the small amount of ore precluded extensive experimentation. It was shown at a later time that the complete oxidation of the nickel could be attained.

The chloridizing roast was carried out in the same furnace as the oxidizing roast. The ore was mixed with 15% common salt and during the operation samples were taken regularly from each hearth. The first sample taken after the chloridizing had started showed that practically all the copper had been extracted, only traces remaining with the "blue billy." This was the case with all samples taken. The Pennsylvania Salt Manufacturing Co.'s men thought that it was more easily chloridized for the removal of copper than any ore that had come to their plant for experimental purposes.

General Conclusions

The Sudbury ores can with ease be practically freed from copper by means of the Longmaid-Henderson process, leaving an iron-nickel ore or residue. A supposition was that low-grade copper-nickel matte might also be thus treated. Subsequent work at Sault Ste. Marie proved this was correct.

In the first sample taken, 20% of the nickel was found to be soluble in water, about the amount already soluble as the result of the adverse preliminary roast. The volatilization of a portion of the remaining nickel was the result of a sharp, quick chloridizing, done purposely. The volatilization of nickel was not desirable, though it would eventually have been recovered from the tower acids and not lost. Its occurrence pointed to the effects of chloridizing at too high a temperature, apparent from the copper results also. Both the volatilization of nickel chloride and the formation of nickel sulphate, it was thought, could be controlled and were largely overcome in the last test, though it was made upon bad material, furnace sweepings containing comparatively large percentages of sulphates.

Later, in laboratory experiments made in Denver, in the light of the experience gained in Philadelphia, the nickel was rendered wholly insoluble and nonchloridizable while the copper was chloridized. This was done by roasting the ore first to so low a sulphur content that nearly all of the sulphides were broken up. If a mixture of the three sulphides is roasted together, the iron sulphide breaks up first, nickel sulphide next and copper sulphide last of all. Therefore, if the preliminary roast is continued until a portion of the copper is converted to oxide, all of the nickel and iron sulphides will be decomposed as well as the corresponding sulphates. This can be further insured by raising the final temperature above the point of the breaking up of the metallic sulphates present. Then the material should be carefully analyzed for copper and sulphur and just enough sulphur added in the shape of raw pyrrhotite or, better, clean iron pyrite, nickel free, to resulphatize the copper, mixed with salt and chloridized. Under these conditions, only the copper is rendered soluble, all of the iron and nickel remain as oxides, unattached.

Low-grade copper-nickel matte was chloridized successfully at Sault Ste. Marie, but a large quantity of ore was not treated. However, matte is more difficult to treat than ore, owing to the intimate mixture of the fused sulphides, and there could be no question about the feasibility in treating ore successfully on a large scale in this manner. It worked well with 10 to 20 lb. in the laboratory, and left little to be desired.

A complete sample of all the residues from treatment gave:

ANALYSIS OF COMPOUND RESIDUE SAMPLE

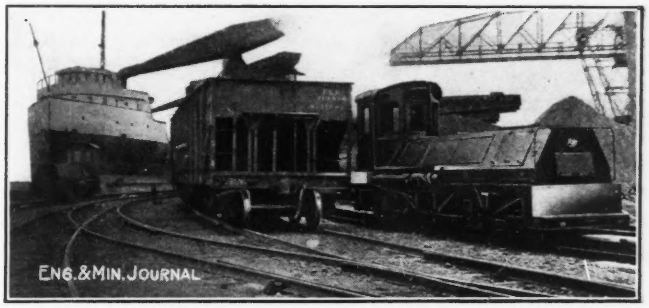
Moisture, at 212° F.	14.83%
Analysis after drying at 212° F.	
Silica	11.24
Iron, 54.38%, equivalent to	77.69 oxide of iron.
Alumina	3.83
Lime	0.66
Magnesia	2.00
Manganese	0.06
Copper	0.35
Nickel	1.87
Cobalt	0.08
Titanium	tr.
Arsenic	tr.
Sulphur	0.44
Phosphoric acid	0.06
Loss on ignition	0.83
Gold, 0.01 oz. per ton of 2000 lb.	
Silver, tr.	

This was, of course, low-grade ore somewhat different from the average of Sudbury. Ernst J. Sjöstedt and others long ago made ferro-nickel pig and even steel direct in the electric furnace, using low-grade copper ores, calcined and nodulized to remove the last traces of sulphur. Their work was very promising.

It seemed that the chloridizing of the Sudbury ores gave a correct solution to the metallurgical problem connected with them. It separated the copper completely in a form easily marketed as cement copper, left the nickel and iron together in a product suitable for direct smelting to ferro-nickel pig or steel in electric or other furnaces and allowed the sulphur to be used for acid manufacture if a market could be found for it.

Side-Pushing Electric Locomotive

For handling cars at their Cleveland ore docks, the Pennsylvania Lines West have recently had built three locomotives of unusual design. The novel feature in these locomotives is the fact that they do not run on the same tracks as the cars they handle but on narrow-gage, parallel tracks. They are not attached to the cars by couplings but each locomotive is equipped with an arm on each side, which can be lowered by means of compressed air controlled from the cab and acts as a pusher, as shown in the illustration. Single cars or trains can be easily handled and cars can be shifted and cut out from trains with the least time and trouble. The locomotives, of Baldwin-Westinghouse make, have bar-steel frames and weigh 25 tons.



ELECTRIC LOCOMOTIVE PUSHING AN ORE CAR ON A PARALLEL TRACK

Mineral Production of Spain for 1912

According to *Revista Minera*, Apr. 24, 1914, the mineral production of Spain for 1912 has been made public by the Department of Mines.

Substance	Metric Tons
Amblygonite	30
Antimony	500
Anthracite	226,663
Asphalt	5,387
Mercury	21,889
Sulphur	42,344
Barite	1,096
Bismuth	73
Zinc	175,311
Copper (pyrite)	1,861
Copper	3,364,294
Tin	5,079
Fluorspar	265
Iron (ore)	9,133,007
Iron (pyrite)	421,070
Iron (argentiferous)	1,588
Bituminous coal	3,625,666
Kaolin	4,920
Lignite	283,980
Magnesia	1,480
Manganese (ore)	17,400
Silver (ore)	668
Lead (ore)	190,162
Lead (argentiferous)	93,850
Salt	23,292
Soda (sulphate)	570
Vanadium	38
Wolfram	169

Solution of a Landslide Fault

By R. W. Smith* and W. G. Zulch*

SYNOPSIS—In the Platoro district of Colorado the surface of the mountain slid down. The movement displaced the veins, so that the outcrop portions are shallow and discontinuous. By means of a topographic survey, maps and a model, the sliding or faulting movement was more easily studied. Analysis of possible theories shows one to be the most probable. If correct, the downward extensions of the veins in their original positions can be easily found when the season opens.

A gold discovery on Gilmore Mountain, about three miles northwest of the town of Platoro, Colo., was the occasion of a rush of prospectors into the Platoro district in the summer of 1913. A landslide on Gilmore Mountain occurred after the formation of the ore-bearing veins, and the consequent fracturing makes it possible to follow the veins only a few feet, before they become brecciated and discontinuous. A number of nearly horizontal parallel ridges and troughs exist on the mountain, the effects of the landslide. It is a peculiar fact that a vein outcrops on nearly every one of the ridges, all in the same relative position, with dips of about 70° toward the mountain, Fig. 4. These veins in places contain good ore which could be mined at a profit if the veins were continuous. We have attempted to ascertain where the veins will be found in place, underneath the disturbed area, thus solving the problem which has so puzzled the miner.

The solution of this problem would be simple in sedimentary rocks, as bedding planes give favorable conditions for sliding, and the displacement could be accurately estimated by measuring the distances between the respective portions of a broken bed. Gilmore Mountain, however, is composed of diorite, and contains no dikes or surface flows which might assist in estimating the distance which the slip covered. The planes of slipping are indicated by ill defined zones of brecciated material, so that even if they could be examined they would yield little information as to the direction and amount of displacement.

The fact that little erosion has taken place since the sliding makes the solution of the problem possible. This absence of erosion is shown by the perfect state of preservation of the glacial striae, and also by the direction of flow of the small streams on the mountain side, which have not worn through the ridges, but flow down the troughs.

Because of this small amount of erosion, the question suggests itself: Could not the displaced part of the mountain be pushed back theoretically to its original position, thus restoring the mountain to its former shape, permitting the displacement of the veins to be measured and the problem to be solved?

In order to accomplish this, a topographical survey was made and mapped on a scale of 200 ft. to the inch. This map was used to construct a model, with vertical and horizontal scales each 200 ft. to the inch. This model was made of layers of pasteboard, $\frac{1}{10}$ in. in thickness, each corresponding to contour intervals of 20 ft. The contours were first traced on the sheets; then each strip was cut and nailed in place. On this model the direction and extent of the main movement can be seen at a glance, whereas the mountain is so heavily timbered that these relations could hardly be detected in the field.

Both up and down the valley from the moved portion of the mountain there are cliffs showing glacial striae and dipping about 60° toward the valley. This indicates that the sides of the mountain were at one time made much steeper by glaciation. After glaciation, some shock occurred, such as an earthquake, and the rock mass slid on the flat jointing of the diorite; this jointing dips about 30° toward the valley. The question might arise: Would the rock mass slide after being jarred loose on this plane? A tabulation in the American Civil Engineer's Handbook of the angles of repose of different materials, indicates that it would.

We now take up two probable theories regarding the manner of this movement. The first assumes that the rock mass split along the jointing into parallel sheets, in a fashion similar to sliding in sedimentary beds as shown in Fig. 3. This supposes one vein to be the original of the parts of veins forming the ridges, the rock breaking away from the vein so as to leave an overhanging cliff. This theory, however, does not conform with the physical conditions on the mountain. First, there is no cliff at the point indicated in Fig. 3. Second, in several places

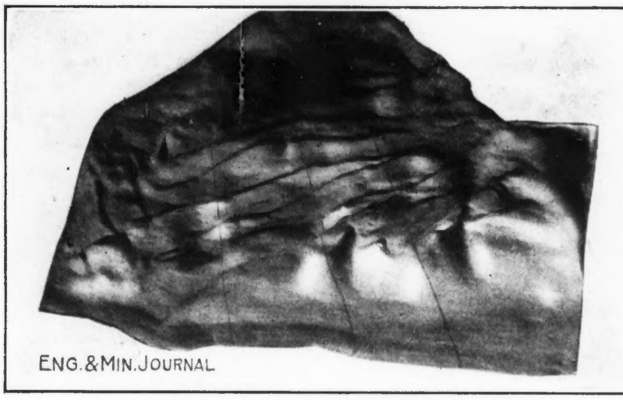


Fig. 1. The Model

there are cliffs in the moved area, over which the slide would necessarily have had to pass, if this sort of sliding had taken place. It is inconceivable that large masses slid over such cliffs and still retained their unbroken form. Third, glacial striae are present on every one of the ridges These ridges must consequently have been at the surface during the time of glaciation, while the theory under discussion assumes these ridges as originally under the surface, where they could not have been striated. In view of these facts, the theory is untenable.

The second theory assumes a deep movement, immediately followed by a thinner surface movement as in Fig. 4. The large mass which slid as a result of the deep movement stopped with a considerable jar, which caused a thin mass on the surface to slide. This thin sheet, however, did not move as one piece, but broke up into blocks

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at the planes of weakness, i.e., the veins. The sliding was retarded on each side by the rock in place, thus turning many of these blocks through an angle. The edges of the blocks cracked off, filling the intervening spaces with irregular broken material. This caused the talus slopes which give the mountain its present appearance. In a detailed discussion of this problem, the behavior of the rock mass was studied as a problem in physics. The mass which was subject to the deep movement was considered as a body held at rest on an inclined plane by friction. It was satisfactorily proved that the mass would tend to slide along a plane tangent to the indented surface of the mountain. The lower sliding plane is shown in this position in Fig. 4. The flat which would be formed by this method of sliding, *B* Fig. 4, exists on the mountain. Thus, not only do the physical features of the mountain conform with this theory, but a mathematical investigation also supports it.

The Gilmore mine, marked *X* in Fig. 4, will be considered, since it is an important point in the moved territory. As the point marked *A* is the highest point of the slipping, it will be taken as our datum, or zero. Fitting the displaced blocks to their original positions, Fig. 2, we estimate the total displacement at this mine at 300 ft., with a "probable error" of not over 60 feet.

There are three directions of jointing in the diorite, which remain the same over a considerable extent of territory in the unmoved rock, Fig. 5. This jointing has been used to determine the angles which the moved portions have turned, both horizontally and vertically, and ultimately to determine the strike and dip of the veins in their original undisturbed positions. Several observations of the jointing of the diorite in place are shown in Fig. 5, and in comparison, that at the Gilmore mine in Fig. 6. In this second case, the rock mass has turned horizontally approximately 15° counter-clockwise, and overturned vertically 5°. The vein at the Gilmore mine, where the readings of the jointing were taken, has a strike of N 10° E, and a dip of 75° E. This makes the strike of the vein in place N 25° E, and the dip 80° E. In this same manner, the distance to the vein can be estimated for any other point on the mountain.

The calculated strike and dip of the undisturbed vein are nearly the same as the strike and dip of the steep plane of jointing in the unmoved rock. As the veins were probably formed in fissures caused by the jointing, it is reasonable to believe that the veins were formed in fissures parallel to the steep jointing. The accuracy of these calculations cannot be tested until summer.

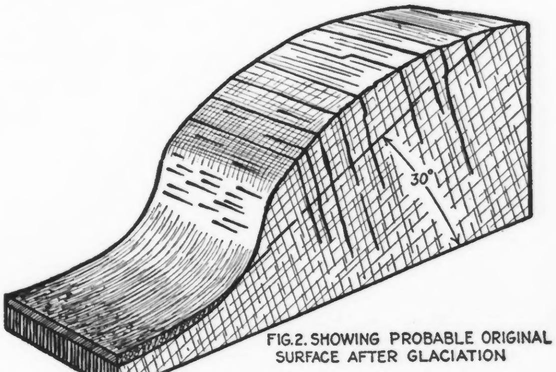

FIG. 2. SHOWING PROBABLE ORIGINAL SURFACE AFTER GLACIATION

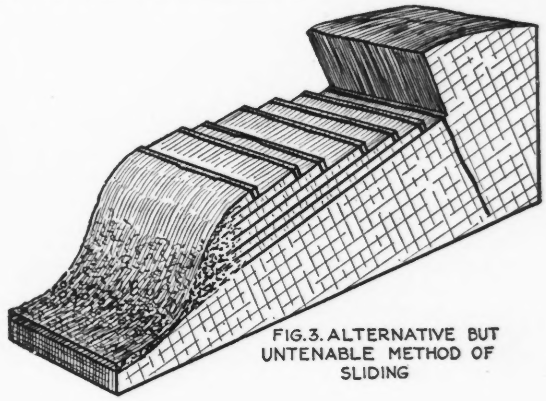

FIG. 3. ALTERNATIVE BUT UNTENABLE METHOD OF SLIDING

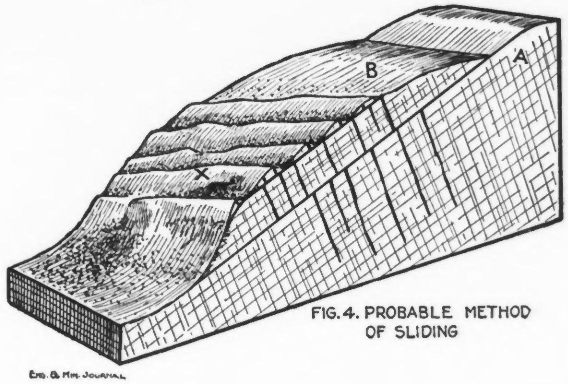

FIG. 4. PROBABLE METHOD OF SLIDING

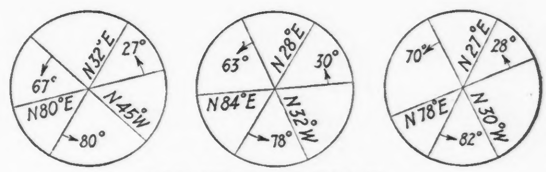

FIG. 5. JOINTING OF ROCK IN UNDISTURBED TERRITORY

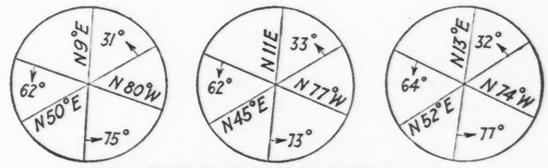

FIG. 6. JOINTING OF ROCK AT GILMORE MINE

JOINTING AND SLIDING OF THE MOUNTAINSIDE

Requisites of Valid Discovery

By A. L. H. Street*

In canceling patents to public lands entered as mining claims on the ground that there had never been a discovery of minerals thereon, and that the claims had not been entered for mining purposes, the United States Circuit Court of Appeals for the Ninth Circuit recently held that there is no such discovery of minerals as will sustain a mining location by the mere finding of traces of gold; minerals must be found in sufficient quantities to justify a man of ordinary prudence, not necessarily a skilled miner, in developing the property (Multnomah Mining, Milling & Development Co. vs. United States, 211 Fed-

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eral Reporter 100). In another case the same court holds that the mere location of a lode claim does not establish the actual existence of a vein or lode. (Thomas vs. South Butte Mining Co., 211 Federal Reporter 105.)

What Becomes of All the Mining Engineers?

By J. I. Blair*

What becomes of the mining engineers, metallurgists, and electro-metallurgists who are graduated year after year from the universities? In the articles which were published some time ago in one of the popular magazines under the caption "Choosing a Vocation," I think the attractive field offered in the line of mining and the treatment of ores was overlooked. In the beginning the field looked to me, I suppose, just as it did to hundreds of others before me. Also to a hundred or two since my graduation, while I later discovered the fact that the field for metallurgists and mining engineers while seemingly open is, in reality, open only to outsiders, to the untrained.

Look into the records of most graduates and you will discover just about 1% of these metallurgists and engineers holding positions in their chosen work. Watch them for three years and you will see that three-fourths have dropped out, have turned to other lines of work, other fields of employment. The question is not why, it is rather who, then, does do the work at the hundreds of mines, smelting plants, mills and other places where metallurgists should be employed. That is the question, and you are to answer it after following me across the Continent.

We will begin this tour of metallurgical plants and mines in New York. There are no big mines in the city, but there are some important refineries in the vicinity, such as those of Perth Amboy. How many technical men are employed there? In the assay office the work is so routine that, excepting the chief chemist's work, high-school boys could do it quite satisfactorily. Next let us inspect the zinc-oxide plant at Palmerton, Penn. Skip Newark and a few other metallurgical plants in New Jersey because they, too, are just like the Perth Amboy plant. At Palmerton, who is the technical man? Who are the furnace tenders? What does the manager say? "We want men to do as we tell them; not full of book ideas; they are never satisfied." On to Chicago, skipping Copper Hill because there the furnace men are not even high-school boys. At the great steel mills, technical men who have been trained to solve difficult problems in the metallurgy of steel are working as chemists. Sometimes they become inspectors doing work requiring common sense but not technical training. But until we reach the zinc-smelting plants of Illinois we are unprepared for the revelation which produces the query, "Who does the work that trained miners and metallurgists should be doing?" In Illinois we are destined to learn.

Without becoming personal, let us say the first zinc plant we come to is managed by a Russian technical student of ability. Now let us pause to inquire into the whyfore of his holding the job for which he was trained. We learn that he holds his position because he has seemingly forgotten all the school knowledge he ever acquired. He has no use for it. The president of that company is not only the president, but the chemist, the consulting engineer, in short he is the "whole thing," and this technical man was smart enough to know that in order to hold his position he had only to obey orders, and cease making inquiries or suggestions.

At another zinc plant, we find that the man in charge has not had even a high-school education, nor does he wish to employ college men. At still another plant, the manager grew up in the company's plant out in Kansas with no education worthy the name. "No college men for mine; they are too unreliable, chasing around." At another plant the manager had been a college man but was willing to confide that he could hold the job without the school work because the work was all mapped out by the main office in St. Louis, and it remained for him only to see that orders were carried out. Each man on the job knew his work, the difficult questions were all solved by the main office, so he, too, was more or less of a figurehead. But this man was above the average, he knew his capacity and his position, while the others were all laboring under the impression that they were really important in the company's affairs. At another plant, the manager never cared to inspect the pages of the mining journals, which were now and then thrown unopened into the waste baskets.

From Illinois, let us continue to Missouri and Kansas. Most of the mills in the Joplin district are managed by ex-farmers, who have learned their work by close application to the running of that particular kind of mill; it was the height of their ambition to be able to run a mill.

Turning to the Kansas zinc-smelting field we find practically the same thing. Zinc works everywhere in charge of men who could not tell you what a calorie is, nor of what importance it is to the technical man in the consideration of problems relative to heat. They will tell you they do not need to know. And the president of the company employing them will tell you: "We work those things out up here," and, "That's the best manager we ever had, because he will do what you tell him, and he knows how to get work out of the men."

Skipping the intervening territory we next visit the mines of the West. Besides the chemist employed by the smelters, we now have a surveyor, but like the work of the chemist, this position can also be filled by any man with no more qualifications than those gained in an average high school.

Having made this trip you are now in a position to ask with reason, "What becomes of our mining engineers and metallurgists?" The brakeman on one of the trains we rode on, was an engineer, graduated from an Eastern university; the chef in the hotel at Denver graduated from another technical school; the machine man at the face was a man with an engineer's degree; his companion was a "Hunky." With these facts in view a student would do well to investigate the demand for miners and metallurgists, before he decides the all-important question.

*Mining engineer, Coffeyville, Kan.

Exports of Caucasian Manganese ore through the ports of Batum and Poti are given by Russian statistics at 1,059,810 metric tons; of which 405,390 tons went to Germany, 242,960 tons to Great Britain, 179,726 tons to Belgium and 135,390 tons to the United States. The South Russia works have ceased taking much manganese ore from the Caucasus, drawing their supplies now mainly from the Nikopol district in the Government of Ekaterinoslav.

Stockpiling on the Iron Ranges--II

By L. O. Kellogg*

SYNOPSIS—Michigan system comprises four methods: Endless-rope haulage, motor haulage, gravity descent and hoist return and the permanent trestle method of the Cleveland-Cliffs company. Costs.

Trestle dump with endless-rope haulage is the most common method employed in Michigan stockpiling. It consists of dumping under a long trestle with a single car hauled by an endless rope. The endless-rope method presents the one great advantage in that one or two men can control all operations without leaving the headframe except at infrequent intervals. It is sometimes believed that the system is applicable only to a single straightaway trestle; as a matter of fact, it seems to work excellently in cases where several curves and switches are used. Fig. 5 of the Caspian mine shows four parallel trestles which branch at right angles from the short trestle leading away from the headframe.

The trestle in this method will range in height about as with methods 1, 2 and 3, but is built lighter, frequently of two posts only. Figs. 5 and 6 show one type of bent. Fig. 7 shows the trestle of the Penn Iron Mining Co., with the bents spaced unusually far apart and the track trussed between them.

The endless rope passes over a sheave at the end of the trestle, or at least at the end of the haul. When, as is usual, the entire length of trestle is built before stocking begins, the sheave is established near the end of the trestle; but frequently it is set at the end of a first section and ore is dumped along this section while the trestle is being extended. In such cases the surplus rope necessary for the complete trestle length is wound around the cars temporarily. The rope is guided by small sheaves at the trestle turn and kept away from friction and wear, so far as possible, by horizontal rollers The return rope after passing around the end sheave is guided and supported by a similar set of sheaves and rollers. The rope is usually kept at a tension as constant as possible by a weight. This is, in most cases, arranged by mounting the end sheave on a carriage which runs on the same track as the car. From the other end of this carriage a short length of rope runs over a sheave fixed in the trestle and carries a weight from its hanging end. This hanging weight is usually an old hoisting bucket full of rock or scrap, as seen in Figs. 9 and 13. At the Norrie group, on the Gogebic, the trestle ends in an incline at 45° to 60°, on which a short length of track is laid, and the carriage shown in Fig. 15 by running on this track acts as the sheave carriage and tension weight both. The endless rope in this case is conducted over the bent at the top of the incline by suitable sheaves. The incline is supported a little less than half way up by a bent inclined in the opposite direction. When the driving engine is on the ground, the haulage rope must pass over at least two turn sheaves with horizontal axes. By mounting such a sheave in vertical guides and attaching a weight, the same tension affect is obtained. It is not uncommon to omit the tension weight entirely and maintain the rope in tension by tightening the end sheave with a screw or by some other means.

The actuating mechanism may be an air or steam engine or an electric motor. The engine or motor may be set either in the headframe at the trestle level or on the ground. The air or steam engine is perhaps most typically a constant-running machine, driving two parallel shafts geared to revolve in opposite direction. The rope makes several turns around two drums, one on each shaft, somewhat as in the Whiting hoist. When the car is pulled out, one drum is clutched into the shaft and the other runs free. When it is pulled back, the second drum is clutched in while the first drum runs free, and the direction of rope travel is reversed. The engine is sometimes intermittent, in which case it has two cylinders; otherwise, only one cylinder is necessary if a flywheel be used. Sometimes a reversing engine is used with drums fast to the shaft; or one drum may be omitted, if a single one can be used with sufficient winding surface to take care of all the rope.

Fig. 9. One Half of the Negaunee Trestle. Note the Few Columns Required for the Great Length of Trestle

Fig. 10. Rolling Mill Stockpile. The Two Inclined Trestles with Single-Rope Haulage Lead to One Stockpile Yard

The electric motor is almost an ideal machine for this work, and its use is becoming increasingly common. The fact that it is easily reversible is a strong point in its favor; perhaps, the neatest installations are those of the Penn Iron Mining Co. Here the motor is set on the ground and is controlled wholly from the trestle immediately above. The man who directs the filling of the cars from the skip, also starts, stops and reverses the motor. Motor and drum, as well as control, are housed in a concrete structure.

The cars are of two types, a gable-bottom dumping on both sides or a shed-bottom dumping on one side only. They are built of both steel and wood. In either case, the dumping is effected by a block or a trip set in the track at the desired point of dumping, the operation being thus automatic. In general, the two-side dump is

*Editorial staff, "Engineering and Mining Journal."

preferable. The car is better balanced and is less liable to derailment. The one-side dump, however, has the advantage of throwing the dirt somewhat farther and thus making possible a bigger dump from any one trestle. The Penn company uses a one-side dump car which is the best stockpile car yet designed. It is shown, front and back in Figs. 11 and 12. It is built of steel and is double-truck, permitting the center of gravity to be kept low. The releasing mechanism, shown at the back is adjustable for height, this makes possible the use of several dumping blocks, increasing in height along the trestle, as many as five if desired. Two of these are shown in Fig. 7. By this means, several grades of ore can be kept separate. The headframe attendant merely sets the trigger to the height corresponding to the block where the grade of ore in the car is to be dumped and the car will pass all intermediate blocks without dumping. When it is desired to dump on the other side of the trestle, the car is lifted with a crane and blocks near the skip dump and is turned completely around and set down on the track again.

Method 5—Trestle Dumping and Motor Haulage

The motor-hauled stockpile car is about as common in Michigan as the rope hauled. It offers the advantage of being more flexible. The electric motor can switch to any one of several trestles and handle the waste as well as the different grades of ore. The trolley wires are strung once for all, or at least are extended only a few times in the season, if the trestle should happen to be built in sections; so that one of the objections to motor haulage is not present. However, the number of men necessary to operate the system is somewhat larger, and the motormen are likely to be exposed to the weather. The car used is usually that of method 4, with an automatic dumping arrangement. At the Rogers-Brown mines on the Cuyuna, however, a two-truck steel car, described in the Journal, Dec. 20 1913, with gable bottom and side doors is employed. The doors are hand actuated, thus making it possible to dump at any point, a considerable advantage in making grades. The additional weight of the motor in this method requires that the trestle be heavier and stiffer.

Method 6—Trestle Dump and Single-Rope Haulage

Many of the advantages and disadvantages accruing to method 2 of the Minnesota system are equally present in method 6 of the Michigan. The loss of height to give suitable grade is perhaps the greatest disadvantage. The method is in successful use, however, at Republic. Here also a most ingenious and economical haulage system is employed. The rope drums are driven by ropes from a hoisting head-sheave. At one shaft, a second sheave is fixed to the hoisting-sheave shaft, and by a three-rope drive actuates the horizontal shaft in a small concrete house near the base of the headframe. The haulage drum is clutched to this shaft, and when the single skip which is used is lowered, the loaded stockpile car is allowed to run down the grade and dump. When the skip is hoisted the haulage drum is clutched in so that it is driven by the sheave and the empty car is pulled back. The system is not flexible, the speed of the car varying with that of the skip, but the advantage of saving another prime mover is considerable, and the power consumption is probably less when thus merely added to the hoist load than if another motor were employed. At a second shaft, a similar system is in use, differing in that the descending skip pulls back the empty car, so that no power is consumed at all. This however, involves holding the skip at the surface until the car has run down and dumped, and if high hoisting capacity were necessary, would not, of course, be feasible.

The topography at this mine is unusually rough, and the position of the shaft collars on hillsides makes it easy to maintain a sufficiently steep grade without seriously cutting into storage capacity. The single rope, of course, is economical, and the operation is carried on by only one man. The cars here are the same as those used by the Penn company at its Menominee mines, with the adjustable triggers as described. There is nothing in the method, however, requiring a different type of car from method 4, and the same statement is true as regards the trestle.

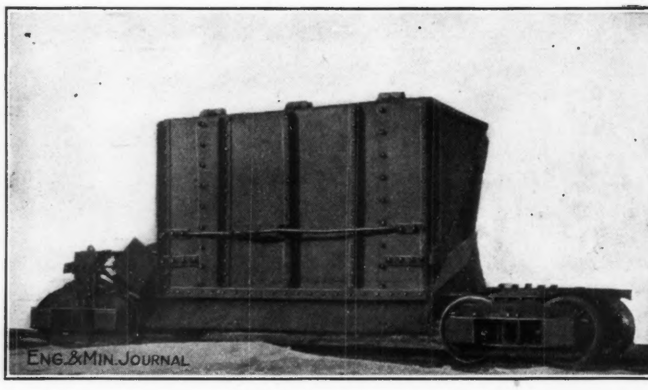


Fig. 11. The Penn Adjustable Dump Endless-Rope Haulage Steel Car. Front View

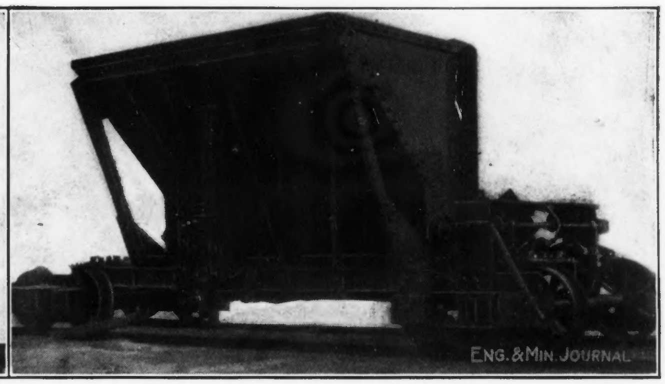


Fig. 12. Back View. Vertical Tripping Device in Center Is Adjustable for Height

Method 7—Permanent Trestle

The one great advance in stockpiling practice was the erection by the Cleveland-Cliffs company of a permanent steel and concrete structure at its Negaunee mine. Various views of this are shown in Figs. 9, 13 and 14. The successful use and construction of this trestle are most creditable achievements and typical of the Cleveland-Cliffs company. The trestle after branching from the headframe extends about 1000 ft. in two directions; 18 great pillars were erected of reinforced concrete jacketed in steel cylinders and strongly anchored. An umbrella-like structure at the top supports two tracks, each track carried by two girders. The track arrangement makes possible a much wider pile from the single trestle. The trestle is built to last as long as the mine. Its first cost is its last cost. There are no bents to be erected and to be torn out when the shovel picks up the ore, with the consequent, inevitable loss by breakage. The shovel dipper can do no injury to the smooth columns and the bracing is above its reach. Of course, a tremendous tonnage of iron must be expected, over which the initial expense of such an installation may be spread, and few mines have such tonnages as the Negaunee. Rope haulage is used on this trestle with electric-motor drive.

Fig. 13. One End of Trestle. This End Was Extended with a Temporary Wood Structure

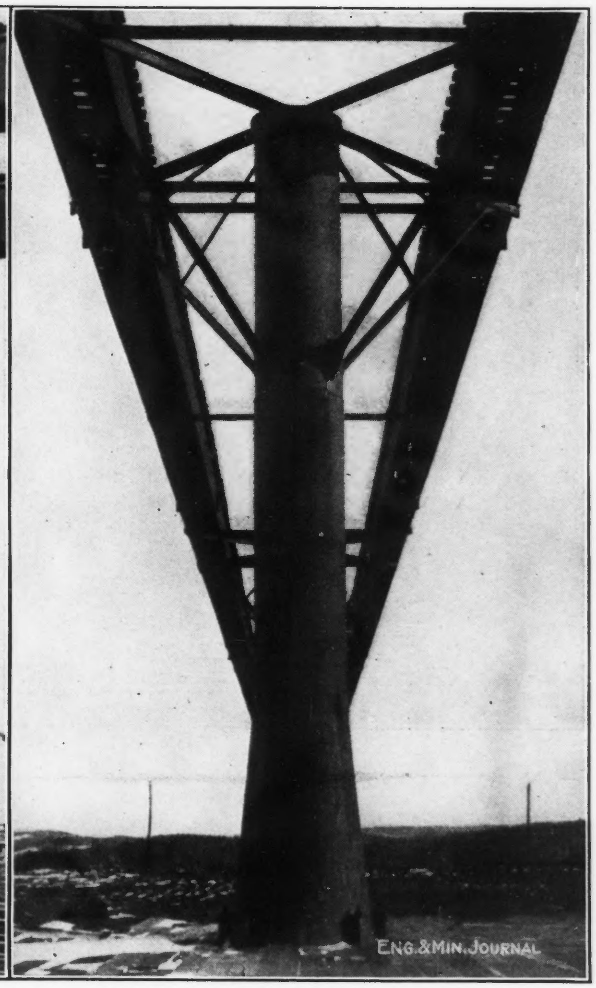


Fig. 14. A Column of the Negaunee Trestle, Looking along the Trestle Length

Costs

Many things enter into the cost of stockpiling, and the final cost is exceedingly variable. The material and erection of the trestle come first. Using the Michigan system, one company estimates a 12½% loss of timber each year. Another puts this at 25%. The timber loss, which is chiefly the breaking of trestle legs by the steam shovel, goes up as the legs are used over and over again and become somewhat rotten. Beside this trestle cost is the first cost of cars and operating mechanism and equipment. Next is the labor consumption of the actual stocking, an extremely large item. Power consumption is relatively small. The cost of loading includes the first cost of the shovel and the additional shop equipment that goes along with it. In underground mines there is little use otherwise for a shovel. The fuel, repairs and labor of loading are large items. It is most important to keep the expensive shovel and its expensive crew working steadily and smoothly. Here the Negaunee trestle shows an indirect economy; there are no wooden trestle bents to be gotten out of the way while loading proceeds.

One of the most important factors affecting costs is the quality of the ore. A wet, sticky ore which is hard to handle and which freezes, is most objectionable. Steady stocking throughout the winter and a complete clean-up in the fall is essential to a low cost. One company operating on several ranges in both states, uses a figure of 2¼ to 2½c. per ton on the entire year's shipments as covering its stockpiling cost. Stocking takes place over from four to five months, work is often somewhat slackened during that time; for this reason a mine which stocks its ore at all would probably handle thus about one-third of its annual tonnage. Therefore, in the cases given, the cost per ton stocked would be about 7c. This is probably a much lower figure than is commonly obtained. Another company also operating on several ranges and using both systems, gives costs obtained at various mines of 2c., 2.7c., 2.9c., 3c. and 5c. per ton on the year's tonnage. The 2.7c. cost was obtained where 1000 tons per day were hoisted on the Mesabi. The 2c. cost was obtained on the Menominee district, also where 1000 tons per day were handled. The 2.7c. cost would have been reduced to 2c., if loading had been possible throughout the shipping season. The 5c. cost was obtained at a relatively small mine. Loading was figured by this company at 1.5c. per ton loaded. A trestle, 42 ft. high, newly erected by one company using the Michigan system was said to cost about $3 per foot.

The question suggests itself as to whether this rehandling of material is worth while. The answer is that

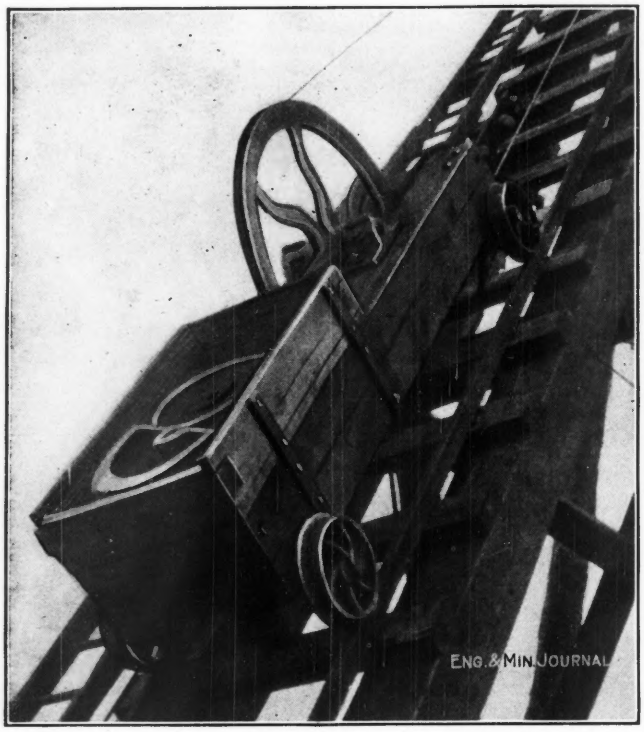


FIG. 15. TENSION CARRIAGE ON INCLINED END OF A NORRIE TRESTLE

it is inevitable. The ore cannot be shipped when the Lakes freeze up; no other storage method is possible, and to close down the mine for five monnths while fixed charges continued, and the organization was lost, would cost much more than the rehandling. It is an interesting speculation as to what would be the result if the Lakes did not freeze. First and last, the direct saving would not be much less than 5c. per ton over the year's output from all the underground mines on the ranges. From the figures of cost given, it is probable that many items of first cost and many incidental expenses are omitted. Even more important would be the effect on freight rates. The railroads and boat equipment, if worked all the year around, could be reduced by 25 or 30%. This would give a corresponding reduction in fixed costs and should result in a similar reduction in freight rates. Data are not available to ascertain what this would amount to, nor is it sure that the companies which own neither roads nor boats would obtain the benefit of the saving. If, however, this saving could be estimated at about 5c. per ton, the total saving on the entire tonnage of 1913, to which this would fairly apply, would be about $2,500,000, and the direct saving on the underground ore given as 5c. a ton would be perhaps $1,125,000; a total annual amount of $3,725,000 would thus be saved by somebody. Unfortunately the Lakes do freeze, and this charge against Lake Superior iron must go on forever.

Temple-Ingersoll Drill Performance

To supply rock for the Kensico dam of the Catskill aqueduct a quarry was opened. The rock is a clean and practically flawless gneiss having a tendency toward granite. In some places, however, it is seamy, presenting more or less difficulty to drilling, but in the main it is hard and solid. The rock surface is fairly level, affording a good footing for the drilling apparatus. Thirty tripod drills and four drill wagons, all of the Temple-Ingersoll electric-air type, were purchased for this work, but the drilling progressed so rapidly that after enough holes were put in to supply rock for a year or two, most of the drills were laid off and the holes are blasted as rock is needed. After the holes are drilled to depth, wooden plugs are inserted to keep out dirt. A great number of holes are shot simultaneously, loosening up a large area of rock at a single blast.

To determine the cost and speed of drilling operations at both the dam and quarry, time studies were undertaken by the Construction Service Co. during the early part of the summer of 1913.

The general design of the Temple-Ingersoll drill is so well known as to demand no further description. In the type 5-F used, the pulsators are driven by motors rated at about 5 hp., operating on 14.6 amp. at 220 volts. The cylinder diameter is 5⅝ in. and the length of stroke 8 in. The length of feed is 30 in., but during observation the bits were usually changed about every 25 in. The strokes per minute were about 400 at full speed. The drills were operated and handled by the drill runner and one helper and moving was accomplished by hand. The method of dismantling is about the same as with the ordinary tripod drill except that the added weight of the mounted motor and pulsator has to be moved.

The diameter of the starting bits was 3½ to 4 in. and decreased ⅛ in. for each succeeding length of steel down to 1¾ in. for the deepest holes. The steels varied from 2 ft. 6 in. to 28 ft. 8 in. The steels were octagonal in section, from 1¼ to 1½ in., with square crossbits. The shorter steels were handled by one man and the longer ones by the driller and helper, sometimes with the aid of a hook. Both bolted chucks and sliding-sleeve wedge chucks were observed. The time required to insert the steel and tighten the chuck was considerably greater with the former type than the latter. Both types appeared equally efficient.

The spacing of holes at the quarry varied from 15 by 12 ft. to 20 by 20 ft. The holes were all vertical and varied in depth from 10 to 26 ft. Generally, the holes were cleaned by pouring water in and bailing out with sand pumps when changing steels.

The sharpening shed at the quarry was situated some distance from many of the drills in operation, hence there were occasional delays in receiving sharpened steels,

Note—An excerpt from a paper by W. L. Saunders, pres., Ingersoll-Rand Co. (Bull. A. I. M. E., February, 1914).

during which time some of the drills were idle. The steels were sharpened by hand at the dam and by a Leyner machine at the quarry. The smith estimated that 75% of his time was devoted to the drill steels and that he burned 500 lb. of coal per day.

The oil consumption of the drills was about 3 quarts each per shift. The power consumption was from 30 to 40 kw.-hr. per drill per shift. Work was carried on in one 8-hr. shift per day.

TABLE I.—TIME STUDY OF DRILLING PERFORMANCE OF ELECTRIC-AIR TRIPOD DRILLS AT THE QUARRY

	No. of Observ.	Minimum M. S.	Average M. S.	Maximum M. S.	Actual Time M. S.	Consumed Time as Per Centage of Total Time
Drill cutting	16	5-40	14-18	23-28	228-54	51.1
Raising drill	15	0-05	1-05	1-59	16-13	3.6
Loosening chuck a	7	0-02	0-11	0-45	1-16	0.3
Loosening chuck b	3	1-06	1-27	1-46	(4-20)c	....
Removing bit	12	0-03	0-32	1-54	6-26	1.4
Bailing hole	11	0-45	1-23	2-00	15-10	3.4
Putting bit in hole	12	0-10	0-22	0-55	4-20	1.0
Inserting bit in chuck	16	0-10	0-23	0-40	6-12	1.4
Tightening chuck a	6	0-05	0-10	0-20	1-00	0.2
Tightening chuck b	10	0-38	0-53	1-20	8-46	2.0
Getting started	17	0-00	1-01	6-23	17-13	3.8
Cycle totals	....	8-44	21-45	41-30	305-30	68.2
Shifting drill	4d	35-32	52-00	60-00	73-18e	16.4
Miscellaneous delays	11	0-30	6-17	25-40	69-05	15.4
Total	.....	.....	.....	.....	447-53	100.0

Observations recorded in minutes and seconds.

Linear feet drilled, 31 ft.; average depth of holes, 22 ft.; total working time 7 hr. 27 min. 53 sec.

a Sleeve chuck. b Bolted chuck.

c This figure is not included in "cycle total," for this operation was performed by one man at the same time that the other man was raising the drill.

d During one observation a nearby derrick assisted in moving the drill, saving several minutes.

e Inasmuch as a shift was made after every 22 ft. of hole the time for shifting properly chargeable is $\frac{31}{22} \times 52$ = 73 min. 18 sec. Several observations were taken simultaneously on different drills to ascertain a fair average time required to shift before deciding upon 52 min. as the average.

From Tables I it appears that the average cutting speed was 0.135 ft. per min. The ratio of cutting time to total time was 0.511 and the ratio of idle time, this including that for shifting drills, to cycle time was 0.467.

Based on this performance at the quarry, costs per linear foot drilled and per cubic yard loosened have been deduced as shown in Table II. One drill cut 31 ft. in 447 min. 53 sec.; equivalent to 200 ft. by 6 drills in one day of 8 hr. The average spacing of the holes being 17.5 by 16 ft., the corresponding cubic yards loosened were

$$\frac{200 \times 17.5 \times 16}{27} = 2070 \; cu.yd.$$

TABLE II. STANDARD BASIS OF COSTS

	Rate	Amount		Cost per Lin.Ft. Cents	Cost per Cu.Yd. Cents
6 drillers	\$2.50	\$15.00			
6 driller helpers	1.75	10.50	\$25.50	12.75	1.23
1½ blacksmith	3.00	4.50			
1½ blacksmith helpers	1.75	2.63			
2 nippers	1.50	3.00			
2 mules	1.50	3.00	\$13.13	6.57	0.64
Total labor (drilling)	......		\$38.63	19.32	1.87
Coal, 500 lb.	3.50	0.87			
Oil, 3 quarts per drill	0.30	1.35			
Power, 35 kw.hr.	0.01	2.10	\$4.32	2.16	0.21
Total drilling cost	......		\$42.95	21.48	2.08
Interest and depreciation, 2 per cent. per month			7.70	3.85	0.37
			\$50.65	25.33	2.45
3 powdermen	2.00	6.00			
1035 lb. dynamite	0.12	124.20			
25 exploders	0.03	0.75	\$130.95	65.47	6.32
Total	......		\$181.60	90.80	8.77

No account is taken of contractor's overhead charges, superintendence, storage, repairs, preparatory costs, insurance, charity, accidents, legal or medical expenses, etc. The low cost per cubic yard is due to the unusually wide spacing of the holes, which were loaded with a heavy charge of dynamite.

Table III gives the results of time studies on excavation work at the dam itself done with similar machines.

TABLE III. TIME STUDY OF DRILLING PERFORMANCE AT THE DAM

	No. of Observ.	Minimum M. S.	Average M. S.	Maximum M. S.	Actual Time M. S.	Consumed Time as Per Centage of Total Time
Drill cutting	12	6-23	11-35	21-24	139-00	58.9
Raising drill	11	0-10	0-51	2-00	9-22	4.0
Loosening chuck	12	0-00a	0-09	0-25	1-45	0.7
Removing bit	12	0-00b	0-29	1-10	5-42	2.4
Bailing hole	10	1-43	1-36	2-42	16-01	6.8
Putting bit in hole	10	0-18	0-45	2-09	7-34	3.2
Inserting bit in chuck	10	0-05	0-25	0-55	4-08	1.7
Tightening chuck	11	0-02	0-14	0-40	2-30	1.1
Getting started	10	0-02	0-13	0-45	2-08	0.9
Cycle totals	......	8-43	16-17	32-10	188-10	79.7c
Shifting drill	2	9-03	12-00	15-00	28-48	12.2d
Miscellaneous delays	8	0-15	2-24	9-40	19-12	8.1
Total	......	......	......	......	236-10	100.0

Linear feet drilled, 26.4 ft.; average depth of holes, 11 ft.; total working time 3 hr. 56 min. 10 sec.; cutting speed, 0.190 ft. per min.; ratio of cutting time to total time, 0.589; ratio of idle time, including shifting of drills, to cycle time, 0.255

a Chuck loosened by one man simultaneously with raising of drill by other.

b Bit removed by one man simultaneously with raising of drill by other.

c The percentage of "cycle total" is higher in this case than at the quarry, due mainly to the fact that the delivery of sharpened steels to the drillers was more prompt.

d For the same reasons as given in the note under "shifting drill" in the quarry time study, the time for shifting properly chargeable in this case is $\frac{26.4}{11} \times 12$ = 28 min. + 48 sec.

Based on the performance of one drill doing 26.4 lin. ft. in 236 min. 10 sec., six drills would accomplish about 320 ft. per day.

During observation, the spacing of holes at the dam was irregular. At the time this observation was made, the drills were at work on the cutoff trench on the up-stream side of the dam. This was only about 15 or 16 ft. in width and averaged about 11 ft. deeper than the main cut. The spacing of holes was extremely close and the blasting charges were correspondingly light. The outer rows of holes had a spacing of only 6 in. which resulted in practically smooth walls.

The total drilling cost at the quarry for six drills per day was \$50.65, including interest and depreciation. On the same basis of costs, the performance at the pit would be at the rate of $\frac{\$50.65}{320}$ =15.8 c. per linear foot, as against 25.33c. at the quarry. Of course, for comparative purposes, the blasting costs should be omitted, inasmuch as the amount of powder per linear foot would be much lower at the dam, due to the closer spacing and lighter loading of the holes. For similar reasons, and because of the irregular spacing at the pit, there would be little value in a comparison of costs per cubic yard excavated. The cost per linear foot drilled is less at the dam than at the quarry for the reasons that the cutting speed and the ratio of cutting time to total time were both greater.

[In Table II, the item of 2% per month for interest and depreciation, equivalent to 18 or 19% per year for depreciation, is probably much too low. Nor is there any charge made for repairs. To cover these three items, 50 to 100% would be about right.—EDITOR.]

Gathering Flint Pebbles on the Coast near Havre, France, for shipment to foreign countries, particularly the United States, for use in the manufacture of porcelain and in grinding operations, has assumed important proportions in recent years. Approximately 20,000 tons are exported each year to the United States from Havre, according to the U. S. Consul at that port. The business was cut down in 1913 by high ocean freights and by the higher wages demanded by the workers.

Gumaos Placer Co.

As important dredging interests are now investigating alluvial deposits in the Philippine Islands, it is of interest to publish some of the data from the last annual report of the Gumaos Placer Co., which in its initial year of operation returned nearly its entire capital expenditure. This company operates a 6-cu.ft. Empire dredge at Gumaos, on the Island of Luzon.

In 1913, the Gumaos company recovered gold valued at $193,176, or an average of 25½c. per cu.yd., at an expense of 7.3c. per cu.yd. for all operating and general expense, except depreciation. Figuring depreciation at 10% would bring the cost up to 9.17c. per cu.yd. During 1913 the dredge was in active operation for 5731 hr., and dug 814,500 cu.yd. of gravel, yielding 10,585 oz. of gold bullion. In the early part of the year, while operating in the narrow gulch at the upper end of the company's property, it was necessary to rehandle about 60,000 cu.yd. of tailings, so that the new ground actually worked was only about 754,500 cu.yd. The average monthly dredging expense was about $5000. Actual operating expenses for the year were $59,680, and receipts from bullion shipped were $209,171. The sum of $125,000 was disbursed in 1913 as dividends. The gold-saving tables were robbed early in the year and it is estimated that about 150 oz. of bullion were stolen.

During the early part of 1913, while the dredge was operating in the gulch referred to, a great deal of sunken timber was encountered which seriously affected the yardage obtained. Quartz reefs also crossed the gulch and difficulty was experienced with uneven bedrock. During July, August and September, the dredge encountered some heavy streaks of a thick, sticky clay, which intruded into the property from the western hills. The dredge path in the gulch for about 1400 ft. has been laid out in three cuts, the plan being first to dredge down the stream on the west side of the area, then up the middle and then down on the east side. With the end of 1913 the first cut was practically completed and the dredge is starting up stream. The 1913 cut was skirting along the hills, which lie to the west of the claims and encountered various difficulties that are expected to be lessened for the coming year. In 1913 the bedrock varied in depth from 25 to 50 ft., but most of the ground hereafter to be dredged will run from 45 to 55 or even to 60 ft. and an addition of 25 ft. to the digging ladder was considered necessary and ordered.

The matter of fuel for the dredge has been under investigation, and it was decided to lay in a supply of coal or petroleum before the next rough season; that is, not later than September, 1914. Wood fuel in the vicinity of the dredge is getting scarce, inferior in quality and is troublesome to get on board of the dredge. In 1913 about 4500 cords were used, the wood costing $2.50 per cord, delivered to the dredge. Crude-oil engines and the installation of a power plant on shore were considered, but abandoned for the present. It is probable that petroleum will be used under the boilers of the dredge, in place of wood.

In July, the superintendent decided to abandon Sunday work, owing to the difficulty of securing native labor on that day. A tentative arrangement has been made with other companies operating in the Paracale district for the employment of a regular physician, for the purpose of improving health conditions. The company reports states that there is not much severe sickness in the district, but that there is a tendency for employees to acquire intestinal parasites.

THE 6-CU.FT. DREDGE OF THE GUMAOS PLACER CO. RETURNED 25C. PER CU.YD. FROM ITS 1913 OPERATION IN THE PARACALE DISTRICT, ISLAND OF LUZON

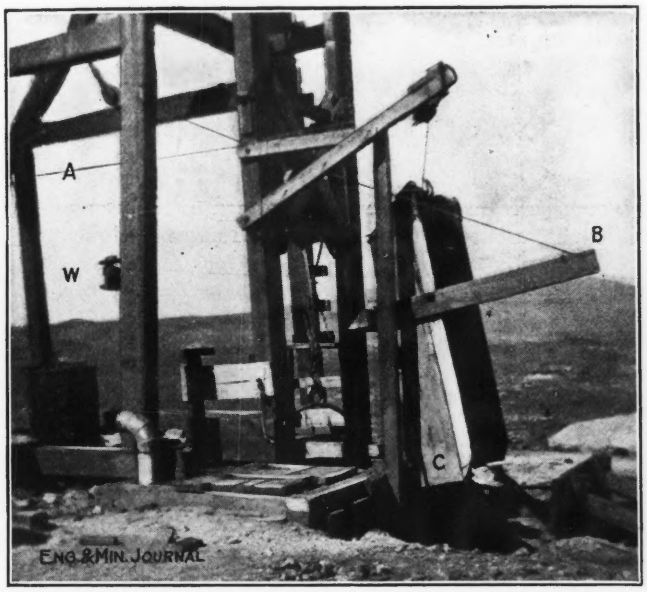
Details of Practical Mining

Bailing Bucket Dumping Device

By Percy E. Barbour*

The accompanying illustration shows a common device which enables one man at the hoist to bail water from a shaft and handle the bucket-dump without leaving his post.

When the bucket is pulled above the collar of the shaft, the engineer releases his end of the cord *A*. This enables the weight *W*, by means of the cord attached to the arm *B*, to drop the wooden spout or trough, which is pivoted at *C*, so that its closed end covers the shaft opening and rests on a supporting block at the collar. The engineer then lowers the bucket, the foot-valve opens when its stem strikes the bottom of the trough and the water runs out. Thus emptied, the bucket is again hoisted above the trough and the latter is lifted clear of the hoist-compartment by a pull on the cord *A*. The bucket can then be lowered again.



Arrangement of Discharge Trough for Bailer

The illustration shows the device as installed at the Krise lease on the Daisy property in Goldfield.

*General manager, Uwarra Mining Co., Candor, N. C.

Sealing Off Gas Strata in Drill Holes

Demonstrations by the Bureau of Mines in the Cushing field of Oklahoma are said to show that the waste of natural gas in drilling and casing oil or gas wells is entirely unnecessary and may be prevented by suitable precautions (*Technical Paper 68*). These precautions may be outlined as follows:

(1) Seal each gas-bearing stratum as it is encountered, by drilling with the hole full of mud-laden fluid.

(2) Set each string of casing with a secure and water-tight seat, using a long shoe or packer to assure tightness.

(3) When casing through a gas-bearing stratum, keep the space between the casing and wall full of muddy fluid.

(4) Place a gate valve on top of the inner string of casing before drilling into any gas-bearing stratum.

(5) The string of casing through which gas is taken should be seated on top of the gas sand and the gas should be prevented from coming in contact with the wall of the hole above the sand.

Ropeway Supports of Concrete

Structural steel, iron or wood supports are generally used for carrying the wire ropes of a rope haulage system, but under certain conditions, supports of concrete or reinforced concrete, such as those shown in the accompanying illustrations, are used. Such conditions might be imposed when the haulage system is installed to dump hot material, such as ashes or slag upon a dump, as there would then be danger that parts of the dump might catch fire; neither wood nor iron supports would then be satisfactory. In one case means were sought to remove the pressure of the dump material from the supports. The supports were built of bricks, or concrete pillars set up as raised foundations, on which only short iron carrying heads were fixed. Fig. 1 shows a support of this class used on a Bleichert ropeway in Bohemia. In a European cement factory reinforced-concrete supports have lately been erected, and these carry the ropes on cross beams. Fig. 2 shows a support of this type.

Fig. 1. Concrete Ropeway Supports with Steel Superstructure

At first sight there appear to be many advantages in favor of reinforced-concrete supports. The simple, graceful form and the absence of danger of corrosion are in their favor. It is clear, however, that these supports can only compete with iron or timber work when all the materials are conveniently to hand, as is the case with cement factories, and where several supports of the same form can be erected on one building site. The line must also be conveniently accessible, so that the supports after completion can be brought to the place they are to be

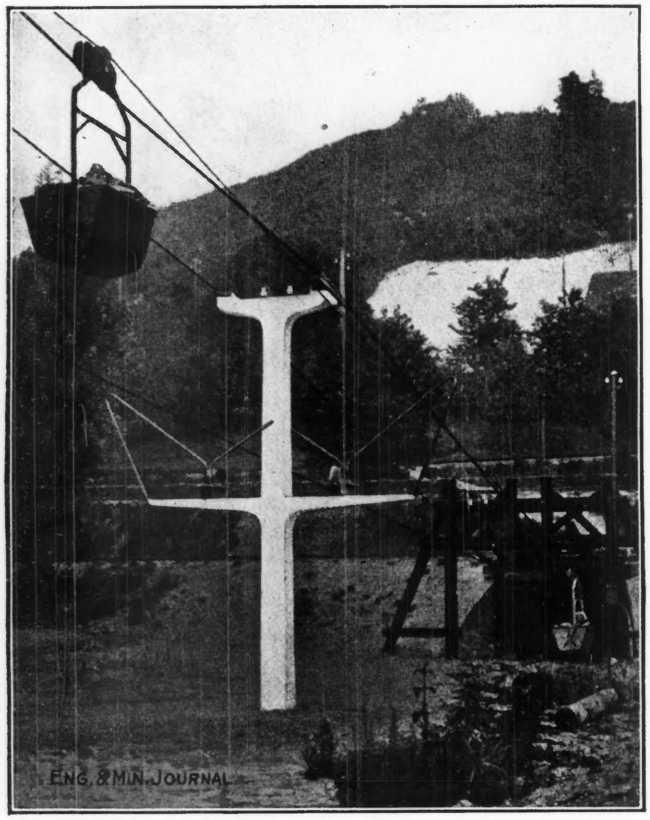


FIG. 2. CONCRETE ROPEWAY SUPPORTS AT EUROPEAN CEMENT PLANT

set up in a finished state. When these conditions cannot be complied with, that is, in the majority of cases, concrete supports are more expensive than iron ones, and therefore, they will only be adopted where the conditions for their manufacture and erection are exceptionally favorable.

Varieties of Carbons

The chief differences of industrial importance between carbons and white diamonds is that the white diamonds show cleavage, so that they are liable to breakage when used for drilling, whereas carbons have a compact structure and are tough; in fact, their structure cannot be judged from the outside and any attempt to cleave them is likely to result disastrously, according to J. K. Smit & Zonen of Amsterdam.

The carbons most to be recommended are those from Japada in Brazil. Those from Morro de Chapeo come next. Since these latter have a shiny coat, they are often preferred by buyers, but erroneously. The shiny coat is hard in itself because it is smooth, but is no indication of the inner hardness of the stone.

Judging the quality of carbons is exceedingly difficult and even experts go wrong. It is a wise precaution to take only split stones and to test the split face with a hard diamond such as a Brazilian "ballas," which is as hard as a carbon. In general, stones that are porous and look like coke are to be avoided; high specific gravity is an indication of hardness, but is not infallible; as for color, grayish stones that have a split side showing like broken steel, greenish stones, and reddish stones that have a fine crystallization are the best.

J. K. Smit & Zonen grade their carbons into six classes. The first or second are recommended for hard work only. The third or fourth at ruling prices are the most economical for all-round drilling. The fifth and sixth are suitable only for soft formations and for such work good borts are preferable.

River-stones, that show the effect of rolling in a stream, are the most easily judged as to hardness, since, if hard, they will have acquired a shiny surface, while if soft, the surface remains rough. Crystallized stones with small crystal faces are as hard as true carbons, although a prejudice against them exists. Coarse crystallization is a bad indication, however.

A-Type Timber Headframe

By G. A. Denny*

The headframe represented in the drawing is one installed by us at a Mexican mine. It was designed for

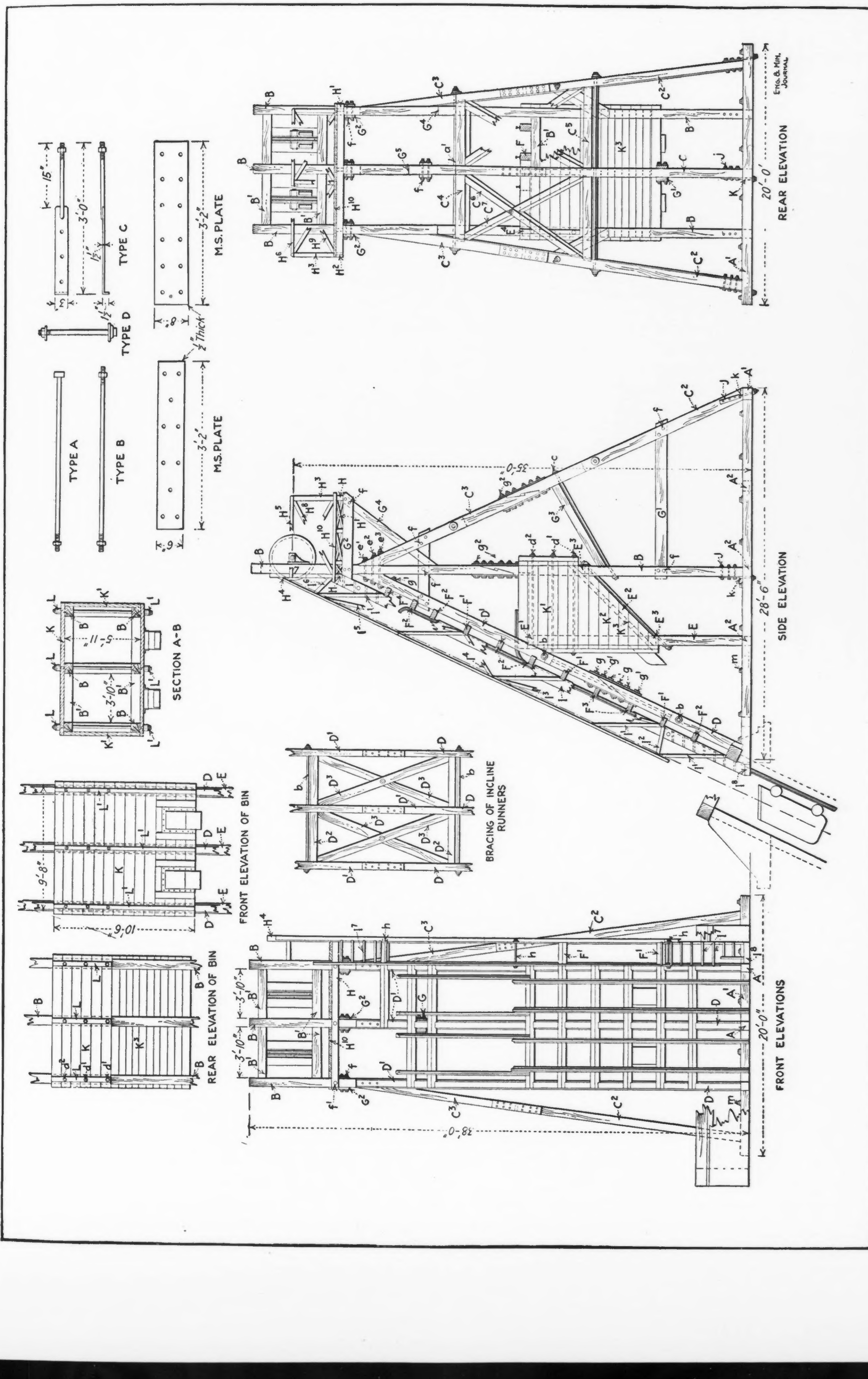
TABLE I. TIMBER LIST

Number	Mark	Size	Length	Number	Mark	Size	Length
3	A	8x8 in.	28 ft. 0 in.	2	G^4	6x8 in.	9 ft. 0 in.
1	A^1	8x8 in.	20 ft. 0 in.	1	G^5	6x8 in.	6 ft. 3 in.
8	A^2	8x8 in.	4 ft. 0 in.	4	H	4x6 in.	11 ft. 8 in.
6	B	8x8 in.	20 ft. 0 in.	12	H^1	2x3 in.	2 ft. 5 in.
8	B^1	8x8 in.	4 ft. 2 in.	2	H^2	2x3 in.	1 ft. 0 in.
1	C	8x8 in.	20 ft. 0 in.	4	H^3	4x4 in.	3 ft. 0 in.
1	C^1	8x8 in.	15 ft. 0 in.	1	H^4	4x4 in.	4 ft. 9 in.
2	C^2	8x8 in.	16 ft. 0 in.	1	H^5	3x3 in.	6 ft. 3 in.
2	C^3	8x8 in.	20 ft. 0 in.	1	H^6	3x3 in.	11 ft. 8 in.
2	C^4	8x8 in.	5 ft. 4 in.	1	H^7	3x3 in.	5 ft. 7 in.
2	C^5	8x8 in.	6 ft. 8 in.	2	H^8	2x3 in.	6 ft. 6 in.
2	C^6	8x8 in.	12 ft. 2 in.	2	H^9	2x3 in.	6 ft. 3 in.
2	C^7	8x8 in.	11 ft. 5 in.	20	H^{10}	2x8 in.	7 ft. 0 in.
3	D	6x10 in.	12 ft. 9 in.	1	H^{11}	3x3 in.	33 ft. 0 in.
3	D^1	6x10 in.	22 ft. 0 in.	2	I	2x10 in.	36 ft. 4 in.
4	D^2	6x10 in.	4 ft. 4 in.	5	I^1	3x4 in.	5 ft. 4 in.
4	D^3	6x10 in.	11 ft. 4 in.	1	I^2	2x3 in.	2 ft. 3 in.
3	E	8x8 in.	16 ft. 0 in.	1	I^3	2x3 in.	12 ft. 6 in.
1	E^1	8x8 in.	9 ft. 8 in.	1	I^4	2x3 in.	4 ft. 0 in.
3	E^2	8x8 in.	7 ft. 6 in.	1	I^5	2x3 in.	11 ft. 2 in.
4	E^3	8x10 in.	4 ft. 2 in.	1	I^6	2x3 in.	2 ft. 0 in.
3	E^4	8x8 in.	6 ft. 3 in.	38	I^7	1½x10 in.	1 ft. 7 in.
4	F	6x10 in.	7 ft. 6 in.	1	I^8	6x10 in.	1 ft. 4 in
3	F^1	5x8 in.	11 ft. 2 in.	4	J	6x4 in.	3 ft. 0 in.
5	F^2	5x8 in.	9 ft. 6 in.	2	J^1	6x4 in.	2 ft. 6 in.
2	F^3	5x7 in.	9 ft. 6 in.	20	K	3x9 in.	10 ft. 2 in.
1	F^4	4x8 in.	6 ft. 8 in.	14	K^1	3x9 in.	5 ft. 11 in.
2	G	3x10 in.	6 ft. 0 in.	14	K^2	3x9 in.	various
2	G^1	3x10 in.	12 ft. 0 in.	13	K^3	3x9 in.	9 ft. 8 in.
6	G^2	3x10 in.	6 ft. 0 in.	3	L	4x4 in.	4 ft. 6 in.
3	G^3	8x8 in.	8 ft. 0 in.	3	L^1	4x4 in.	10 ft. 6 in.

TABLE II. BOLT AND WASHER LIST

Bolts					Washers	
No.	Mark	Type	Size	Length	No.	Angle
1	a	B	1¼ in.	15 ft. 8 in.	2	82°
1	a^1	B	1¼ in.	12 ft. 8 in.	2	82°
2	b	B	1⅛ in.	10 ft. 0 in.	4	flat
2	c	B	1⅛ in.	10 ft. 3 in.	2	flat
					2	65°
1	c^1	B	1⅛ in.	9 ft. 9 in.	1	flat
					1	65°
3	d	B	1 in.	9 ft. 6 in.	6	45°
6	d^1	B	⅞ in.	7 ft. 6 in.	12	flat
3	d^2	A	⅞ in.	6 ft. 9 in.	6	flat
6	e	A	¾ in.	1 ft. 10 in.	12	65°
6	e^1	A	¾ in.	2 ft. 5 in.	12	65°
6	e^2	A	¾ in.	3 ft. 0 in.	12	65°
21	f	A	¾ in.	1 ft. 5 in.	42	flat
3	f^1	A	¾ in.	1 ft. 7 in.	6	flat
21	g	A	¾ in.	1 ft. 1 in.	..	....
11	g^1	A	¾ in.	1 ft. 8 in.	13	flat
72	g^2	A	¾ in.	0 ft. 11 in.	..	....
3	h	B	¾ in.	2 ft. 3 in.	6	flat
18	j	A	¾ in.	0 ft. 11 in.	18	flat
6	k	C	see drawing		3	flat
					3	72°
33	m	D	1 in.		66	flat (see drawing)

*Denny Bros., mining and consulting engineers, Apt. 829, Mexico, D. F., Mexico.



Elevations and Details of Small Timber Headframe for Inclined Shaft

TABLE III. COSTS

	Pesos
Timber (at 50 pesos per M.)	230
Carpenters (at 3 pesos per day)	772
Smiths (at 2.50 pesos per day)	92
Mechanics (at 3 pesos per day	65
Iron plates and bolts	293
Concrete foundations	113
Laborers	70
Freight	35
Administration	375
Total cost	2045

a shaft inclined at 65°, for a load of 4000 lb. and a maximum rope speed of 460 ft. per min. The cost of erection in Mexican currency was as given in Table III. Tables I and II give bills of materials for timber and iron.

Skip-Dump Counterweight

Hoisting at the shafts of the Penn Iron Mining Co. in Michigan is carried on in single skips, which are counterbalanced. The counterbalancing is arranged to give a constant excess pull of the empty skip over the counterweight, amounting to about 800 lb. This allows the skip to lower itself without the application of power.

When the skip is in the headframe dump, however, a large part of the weight is supported by the dump frame instead of by the rope, so that it would be normally unable to run back down the shaft by itself. A method of overcoming this difficulty was tried, which consisted of making the counterweight of two parts, the upper of larger cross-section, so that it was caught by projections in the shaft just as the skip entered the dump, and the skip, on lowering, had only the lower part of the counterweight to lift at first. It was found that the shock of taking up the upper part, however, put an undesirable strain on the ropes even when these were moving slowly. Another method consisted of curving the counterweight road at the bottom, so that the vertical component of its pull was decreased. This required rock excavation, however, was expensive to drive and maintain, and on sinking a new lift of shaft, had to be reconstructed. A similar objection existed to making the equalization on the conical drum used for the counterweight rope.

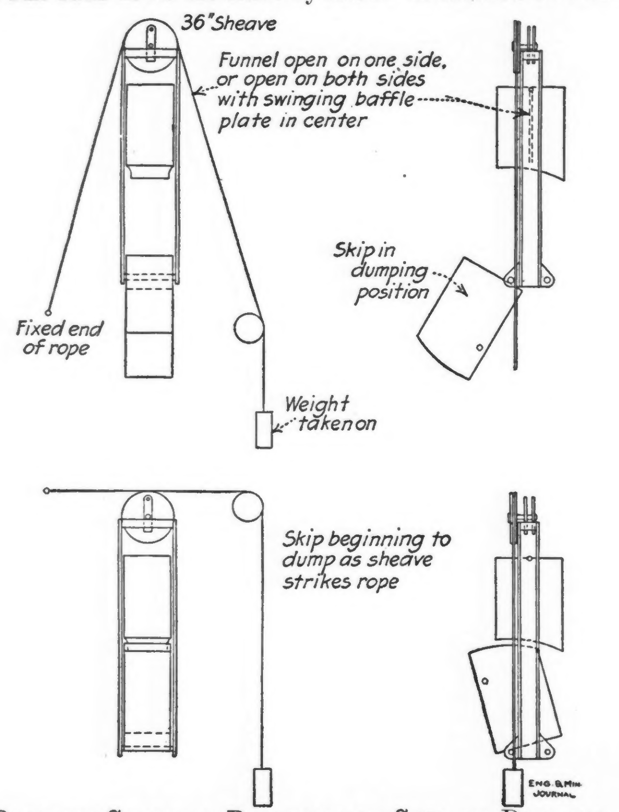
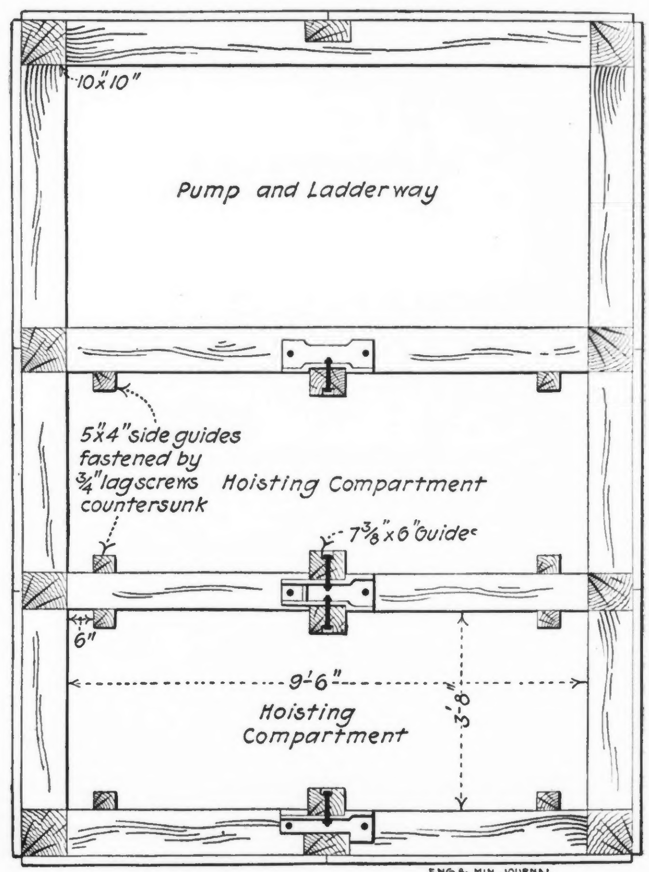


DIAGRAM SHOWING POSITIONS OF SKIP IN DUMPING

The method proving most satisfactory and now in use, is to have the skip pick up extra weight as it goes into the dump, this weight being available to help it start back down the shaft. This is arranged to be done gradually and without jar. A sheave 36 in. in diameter is attached to the top of the skip bail and a rope is stretched across the hoisting compartment at such a point as to be caught by the sheave as the skip starts to dump. One end of the rope is fixed, the other passes over a vertical wheel and carries a weight. This weight is then added approximately to the skip load, and makes up for the loss of weight due to the skip's partial support in the dump.

Corner Guides for Long Cage

The Kintore shaft of the Central mine at Broken Hill, New South Wales, has the plan shown in the accompanying drawing, taken from the *Proceedings* of the Australasian Institute of Mining Engineers, No. 12, 1913. It will be noted that the hoisting compartments are unusually long and unusually narrow. They are designed to accommodate two each of the underground cars. In addition to the central main guides, there are four guides near the four corners of each compartment, on which the slippers or flat shoes fixed to the outside corners of the cage bottoms bear, so as to keep the cage square in the shaft. These small guides are called bumpers, and are fastened by lag screws to the end plates and dividers.



HOISTING COMPARTMENTS WITH SIX GUIDES EACH

Details of Milling and Smelting

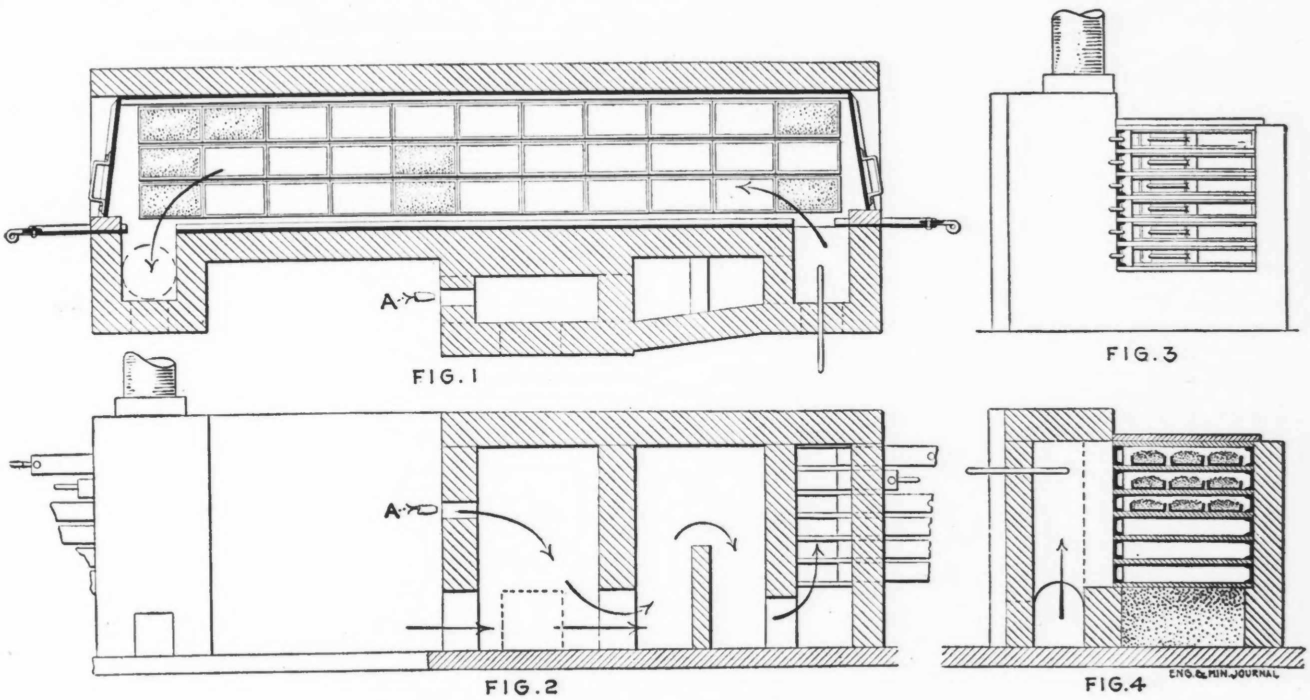
Wales Slimes-Roasting Furnace

The residue from the electrolytic copper process generally contains gold and silver, and is smelted to recover these metals. For the latter operation it is desirable to extract the copper as far as possible from the slimes. Some is in sulphide form, and sulphuric acid is used to leach it out. To promote the efficiency of leaching, it is important to provide a liberal supply of oxygen-bearing material; this is best supplied by roasting the slimes. In order to satisfactorily and conveniently roast the slimes, a furnace has been devised by Rowland T. Wales, of Chrome, N. J., to whom U. S. patent No. 1,085,831 has been granted.

Slimes from the electrolytic plant are washed with water, removing the soluble copper, and then filter-pressed. The cake, containing about 25% moisture, is broken up or granulated so as to permit free and rapid driving out of the contained moisture, and then placed in the roasting furnace in shallow metal trays, where the roasting takes places at low temperature (600° F.) and accompanied by large volumes of air to promote oxidation. This system avoids the necessity of mixing or stirring during the roasting process, and the product is not sintered or fused, so that it is readily leached.

The furnace itself is readily understood by reference to the accompanying drawings. Fig. 1 is a horizontal section on line 1-1 of Fig. 2, while Fig. 2 is a vertical longitudinal section on line 2-2 of Fig. 1. An end elevation is shown in Fig. 3, and vertical transverse section on the line 4-4 of Fig. 2 in Fig. 4.

The furnace is heated by an oil burner *A*, and volumes of air are admitted, subject to regulation, so that an oxidizing atmosphere may be assured. The passage of the heated gases through the combustion chamber, mixing chamber and the roasting chambers to the discharge stack, may be readily followed in the drawing.



Wales Roasting Furnace for Slimes

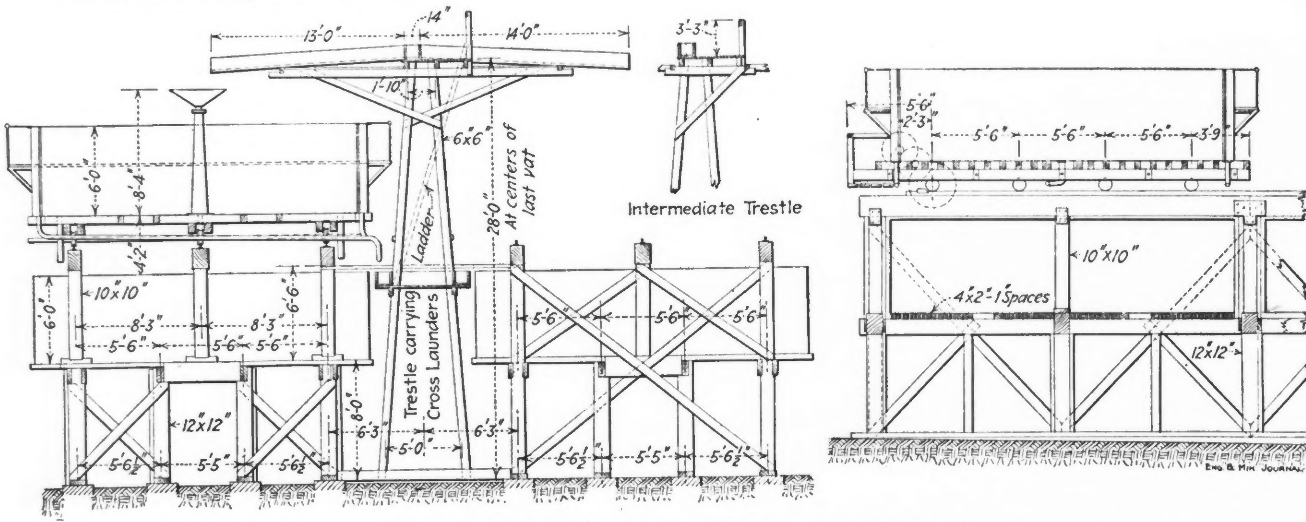
Movable Sand-Collecting Tank

In sand-leaching processes where the leaching takes place in a tank aside from the one in which the charge is collected, the usual way is to have the collecting tank stationary; discharging its contents into the leaching tank by means of a belt conveyor. In many cases mechanical emptying of the tank and also mechanically laying down of the charge in the leaching tank is accomplished. The well known Blaisdell machinery for this purpose is used in many parts of the world. The objection to it, however, is its extremely high cost of installation. This is so pronounced that many mills have preferred to depend upon hand discharging of the collecting tank and charging of the leaching tank.

In an article describing the practice at the Oroya Black Range Gold Mines, by W. B. Chomley, in the *Monthly Journal of the Chamber of Mines of Western Australia*, Jan. 31, 1914, there is described a sand-collecting tank which is movable, running on rails over the leaching tanks. There are two of these tanks which stand on movable platforms operating on a triple line of rails over the top of the treatment tanks. They are moved by means of differential spur gearing, turned by hand. Each collector consists of a steel tank 22 ft. diameter and 6 ft. deep, with a filter bottom similar to that in the treatment tanks. The pulp is delivered by a revolving distributor pinioned on a central pillar. Four slat discharges allow the overflowing slime, and sometimes a little sand which is caught in a sand trap in returning to the sump, to gravitate to the slime settlers to be dealt with by the filter plant. Two circular doors in the bottom allow the sand to be shoveled into the treatment tanks. The eight treatment vats, each 22 ft. diameter by 6 ft. deep, are made of 20-gage corrugated iron. The filter bottom consists of wooden grating made in sections, over which a layer of coir matting covered with hessian is held down, protected by 3x1-in. battens, 3 in. apart, running transversely across the grating. These tanks hold 85 tons of dry sand when filled up to within 6 in. of the top.

When a collecting vat is full, the stream of pulp is diverted to the other collector, and the sand allowed to drain for 10 hr. It is then shoveled through to the two doors in the bottom to the treatment vat. This labor is performed by two men in about 5 hr. The empty collector is then moved by the men over the next treatment vat to be filled. The sampling of the tank and taking care of it during the filling is all done by one man per shift; he also attends to the solution pumping and to the running of the grinding pans, tailings pump, and assists at the battery when required.

The arrangement of this movable collecting tank and the leaching tank is somewhat original, and full details are shown in the accompanying drawing.



DETAILS OF MOVABLE SAND-COLLECTING TANKS AND THEIR ARRANGEMENT

An Acid Proof Tank Lining can be made from 10% litharge, 20% short-fiber asbestos, and 70% sand, mixed to a plaster, with a 40° Bé. solution of silicate of soda, according to the "Chemical Trade Journal." The plaster can be applied as thick as is desired, and an application of acid after drying will "set" the cement and render it acid-proof.

Using Flue Dust in Converter Lining

At the Old Dominion smelting works at Globe, Ariz., the blast-furnace charge contains much fine material, and there is consequently a large production of flue dust. Most of this flue dust is briquetted and returned to the furnaces, and no doubt a considerable proportion is blown out again and repeats the cycle. At one time, prior to the adoption of the basic-lined converter, Supt. L. O. Howard made a series of tests to determine what quantity of flue dust could be used in the acid converter linings without curtailing his copper production.

As shown in the accompanying table, it was finally found that from 18 to 22% of flue dust could be used without materially decreasing the efficiency of the lining. The flue dust used averaged as follows: Cu, 6.2%; SiO_2, 24.6%; Fe, 29.6%; CaO, 2%; Al_2O_3, 8.7%; S, 10.9%. The matte during the period of the experiments ranged from 40 to 45%, and the tons of Fe slagged per ton of available SiO_2, ranged from about 1.41 to 1.53. Before the flue dust was used, the converter lining normally contained about 71% SiO_2, 6% Fe and 3.8% copper.

FLUE DUST IN ACID-CONVERTER LININGS

Time	Proportion of Flue Dust %	Grade of Matte	Av. Blows per Lining	Tons Cu	Tons Fe Slagged per Ton of Available SiO_2	Analysis of Converter Lining					
						Cu	SiO_2	Fe	CaO	Al_2O_3	S
July, 1911	18.0	42.0	3.18	13.56	1.53	4.97	60.0	10.3	0.8	7.8	2.6
Aug., 1911	20.5	44.9	3.14	13.10	1.44	5.75	59.3	11.4	1.0	8.1	3.2
Jan., 1912	25.9	42.0	2.38	9.74	1.41	4.54	57.7	12.6	1.1	8.2	3.9
Feb., 1912	25.3	40.0	2.25	9.40	1.41	4.30	57.0	13.5	1.0	8.4	3.3
*	nil	41.4	2.90	10.80	1.49	3.80	71.0	6.0	0.5	7.7	....

* Normal siliceous lining, without flue dust.

The last line of the table shows the performance of converter lining containing no flue dust. It will be noted that notwithstanding its higher silica content, it did not give as good results as the average lining during January, 1912, when 18% of flue dust was used. The monthly averages with 18 to 20% flue dust were better, especially in the average number of blows per lining and in the tons of copper per lining, but were not always superior in the last analysis, i.e., tons Fe slagged per ton of available SiO_2. However, when it is remembered that these converters were disposing of a portion (nearly 20%) of the most troublesome byproduct of a small smelting plant, it would seem as though other plants might well experiment along these lines.

The Cost of Doing Things

Cost of Pipe Line

The installation of a pipe line by the Moctezuma Copper Co. from a storage dam to the concentrator is described in the *Proceedings* of the A. S. C. E. for April 1914. The line was 2.91 miles long, 1.13 miles being of 8-in. and the rest of 10-in. pipe. The pipe was of riveted steel, No. 14 gage, supplied by the Lacy Mfg. Co., of Los Angeles. For the lower 3600 ft. of the line, wagons were used to distribute the pipe; the rest of it was packed. That for wagon distribution was in 20-ft. sections, the other in 10-ft. For the buried portions, California drive joints were used, for that on the surface flanged joints of pressed-steel flanges riveted to the pipe. Where necessary, bolted joints of the loose-ring type with triangular rubber gaskets were employed.

Break-pressure tanks of concrete with "Davis" float-valve control were introduced at two points to limit static pressure to 179 ft. on the 8-in., and 283 ft. on the 10-in. pipe. At summits, air relief and vacuum prevention was obtained by 2-in. pipe lines carried up the mountain sides. The cost of the installation is shown in the accompanying table.

COST OF PIPE LINE

Huacal pipe line, 8-in. pipe			5,974 ft.
Huacal pipe line, 10-in. pipe			9,415 ft.
Total length			15,389 ft.

		Total Cost	Average Cost per Lin.Ft.
Material:			
Pipe and fittings	$12,456		
Trestles	1,857		
Grading tools and supplies	561		
Transportation of material	790		
		$15,664	$1.02
Labor:			
Grading	$4,546		
Framing and erecting trestles	1,051		
Laying and covering pipe	2,056	7,653	0.49
		$23,317	$1.51
Superintendence		310	0.03
Engineering, field	$950		
Engineering, designing and supervision	816	1,766	0.11
Total		$25,393	$1.65

Mucking Costs

During 60 days development work at the Uwarra mine, Candor, N. C., 2662 cars of rock were handled, shoveled and trammed to the shaft, by 406½ shifts of muckers who received $1.50 per day of 10 hours. This is equivalent to a cost of 23c. per car. After this one of the muckers asked for and was given a contract to take out all the muck at 16c. a car, but he did not hold the contract long.

At present the mucking is being done on company time, but on "task," and the results are very satisfactory. The men receive the same wage, $1.50 per shift, and have a task set for them by the shift boss; when they get out the required number of cars they quit and go home. In this way seven men shovel and tram 70 cars of rock, which is equivalent to a cost of 15c. per car. The cars have a capacity of 14.4 cu.ft., and the average tram is from 250 to 300 ft. The men are more contented and the company is better satisfied with this arrangement than with either of the former ways. It should be noted that this is cheap negro labor and inefficient and unsatisfactory at best.

Tonopah Belmont Milling Costs

According to the report of the Tonopah Belmont Development Co., for the year ended Feb. 28, 1914, the costs at the Tonopah plant were $3.049 per ton milled, and at the Millers plant, $6.905 per ton, including the cost of purchased ore. Distributed costs are given in the following tables.

OPERATING EXPENSE OF BELMONT MILL, TONOPAH, NEV.

	Totals Amount	Totals Per Ton
Crushing and conveying	$15,407.45	0.089
Stamping	62,654.08	0.363
Classifying	5,198.93	0.030
Tube milling	70,450.45	0.409
Thickening	6,293.99	0.037
Concentrating	15,425.34	0.089
Agitating slimes	173,417.08	1.006
Filtering and discharging slimes	34,174.94	0.198
Precipitating	31,175.08	0.181
Assaying	2,610.89	0.015
Refining	11,026.12	0.064
Shift bosses	6,476.16	0.038
Watchman	1,478.00	0.009
Surface and plant	5,565.51	0.032
Total direct cost	$441,354.02	2.560
Administration	$10,200.00	0.059
Office and storehouse	3,209.73	0.019
Taxes and insurance	18,571.77	0.108
Legal and traveling	297.79	0.002
Depreciation	49,999.92	0.290
General expense	1,986.93	0.011
Total indirect cost	$84,266.14	0.489
Total milling cost	$525,620.16	3.049
Dry tons milled	172,398	
Labor, per dry ton		0.463
Miscellaneous and sup., per dry ton		2.092
Power, per dry ton		0.494
Total		3.049
Average stamps	54.8	
Tons per stamp	8.66	

OPERATING COSTS AT OLD BELMONT MILL, MILLERS, NEVADA, YEAR ENDED FEB. 28, 1914

	Tons	Value	Per Ton
Custom ore milled	45,288	$902,489.07	$19.927
Sand tails retreated	2,800	6,678.67	2.385
Total	48,088	$909.167.74	
Cost to bins		538,536.13	18.906
		$370,631.61	11.199
			$7.707
Milling		$176,624.11	$3.673
Metal losses in mill tailings		116,472.70	2.422
Smelting losses in concentrators		8,211.07	0.171
Marketing bullion		11,191.49	0.232
Marketing concentrates slag and matte		6,520.52	0.135
General expenses		13,064.94	0.272
		$332,084.83	$6.905
Net realization		$38,546.78	$0.802
Miscellaneous profit		1,391.49	
Total profit		$39,938.27	

Mining at Tonopah Belmont

The following figures were taken from the report of the Tonopah Belmont Development Co. for the year ended Feb. 28, 1913, and represent mining costs only, with a proportion of overhead charges. Development charges are included in these figures; one foot of development work was performed for every 6.71 tons of ore mined, at an average cost of $8.186 per ft. The mine produced 172,646 dry tons of sorted ore. About 13.5% of the wet tonnage hoisted as ore was sorted out as waste.

	Per Ton
Development Direct:	
Miners	$0.508
Muckers and trammers	0.251
Timbermen and helpers	0.113
Stoping Direct:	
Miners	0.534
Shovelers	0.299
Trammers	0.158
Timbermen and helpers	0.622
Filling	0.046
Repairs and maintenance, piston drills	0.046
Repairs and maintenance, stoping drills	0.033
Steel and sharpening	0.091
Explosives	0.435
Hoisting to surface	0.258
Auxiliary hoisting	0.039
Ore sorting and loading	0.070
Sampling and assaying	0.043
Surveying	0.038
Superintendence and shift bosses	0.088
Mine office	0.090
Surface and plant	0.088
Lighting	0.040
Drayage	0.016
Heating	0.050
Maintenance and repairs, buildings	0.004
Maintenance and repairs, machinery and machine tools	0.011
Maintenance and repairs, pipe lines and tanks	0.025
Maintenance and repairs, railroad spurs	0.000
Pumping	0.118
Ventilation	0.051
Total cost direct mining	$4.205
Administration	0.059
Taxes and insurance	0.101
Legal and traveling expenses	0.020
Bullion tax	0.227
Depreciation	0.087
Total operating cost, mining	$4.699

Mine Costs at Copper Queen

In the 1913 report of Phelps, Dodge & Co., the following data were given on stoping costs and tramming at the Copper Queen mine, Bisbee, Ariz. Four methods of stoping are practiced, the choice depending upon local conditions. The comparative costs are:

Stoping Costs	Tonnage	Labor	Timber	Explosives	Total per Ton
Square setting..	612,299	$1.555	$0.473	$0.085	$2.113
Top slicing......	20,582	1.010	0.210	0.080	1.300
Cut and fill.....	58,239	1.170	0.110	0.120	1.400
Shrinkage	3,822	.....	.....	.....	.....
Total	694,942	$1.506	$0.434	$0.088	$2.028

Electric haulage track aggregates 9.6 miles of main line. The following figures give the average miles trammed per car in 1913; by hand tramming, 214 miles per car; mule tramming, 720 miles per car; by electric locomotive, 2484 miles per car.

The laboratory department at Douglas made 6020 determinations for the mines at Bisbee or about one determination for every 144 tons of copper-bearing material produced at the mines.

Ferromanganese and Spiegel Production Costs

According to Bergassessor Scheffer in *Glückauf,* the cost of producing ferromanganese and spiegeleisen at large works in Germany is as follows, per metric ton of metal turned out:

	Ferro		Spiegel	
	Tons	Value	Tons	Value
Iron ore	0.270	$2.60	1.526	$9.32
Manganese ore	2.430	23.40	0.654	4.00
Coke	2.000	8.88	1.200	5.34
Limestone flux	0.060	0.04	0.520	0.36
Labor, etc.	.....	2.88	.....	2.16
Total	.....	$37.80	.....	$21.18

The standard ferromanganese on which these figures are based contains 80% manganese, and spiegeleisen 20% manganese.

Operating Costs at the Wasp No. 2

By Jesse Simmons*

Operating a dry-crushing cyanide plant, and mining in opencuts an orebody 20 ft. thick, which is first stripped by steam shovels, the Wasp No. 2 property, at Flatiron, S. D., is making an excellent cost record. The full capacity of the plant approximates 15,000 tons monthly. Last year, according to the annual report, the ore going to the mill averaged $2.0306 per ton in gold and $0.6250 in silver. Gold recovery was 77.39% and silver 39.48%. In other words, the ore yielded a total of $1.718 per ton, of which $1.572 was gold and $0.146 was silver. Total costs were $1.311 per ton, and dividends of $55,000 were paid on handling 127,680 tons, which were treated during the 8 months and 20 days that the property was in operation. All the month of March was lost on account of cold weather and snow, and on Oct. 20 a shortage of water forced a suspension which lasted until the end of the year. Detailed costs are given as follows:

TOTAL OPERATING COSTS AT WASP NO. 2

	Total	Per Ton	Total	Per Ton
Mine:				
Labor	$37,856.26	$0.2965		
Stripping	17,931.24	0.1404		
Supplies	5,224.25	0.0409		
Power	2,544.64	0.0199		
Explosives	9,195.82	0.0720		
Stable	2,473.87	0.0194		
Repairs, machinery	510.96	0.0040		
Superintendence	2,500.00	0.0196		
Expense	1,975.30	0.0155		
Coal	1,037.06	0.0081		
Total mining			$81,249.40	$0.6363
Mill:				
Labor	$25,818.19	$0.2022		
Supplies	10,337.57	0.0809		
Power	11,548.72	0.0905		
Repairs, buildings	725.55	0.0057		
Repairs, machinery	10,784.56	0.0845		
Superintendence	2,500.00	0.0196		
Expense	1,130.33	0.0087		
Coal	1,106.75	0.0087		
Cyanide	9,985.82	0.0782		
Zinc	4,238.06	0.0332		
Lime	979.85	0.0077		
Assaying	1,349.61	0.0106		
Total milling			80,505.01	0.6305
General:				
Repairs, buildings	$81.01	$0.0006		
Bullion expense	925.78	0.0074		
Insurance	2,650.48	0.0207		
Taxes	1,790.15	0.0140		
Interest and exchange	40.00	0.0003		
Surveying	150.20	0.0012		
Total general			5,637.62	0.0442
Total expense			$167,392.03	$1.3110

THEORETICAL AND ACTUAL EXTRACTION, WASP NO. 2 MINING CO., YEAR ENDED DEC. 31, 1913

Treated 127,680 tons

	Gold		Silver	
	Fine Oz.	Value	Fine Oz.	Value
Called for by assays of heads.	12,543.154	$259,267.00	79,799.00	$47,280.90*
Called for by assays of tails...	3,124.357	64,580.54	53,178.72	31,507.39*
Apparent extraction (difference)	9,418.797	$194,686.46	26,620.28	$15,773.51*
Apparent extraction (%)......	75.09%		33.36%	
Actual recovery, mill ore.......	9,595.732	$198,401.86	29,633.44	$17,523.73
Actual recovery, slag	113.195	2,263.90	1,877.30	1,145.15
Total recovery.	9,708.927	$200,665.76	31,510.74	$18,668.88
Actual extraction (%)	77.39%		39.48%	

*Calculated at $0.5925 per fine oz.

The property has many years' ore in sight in present workings and is a remarkable example of profits made from intelligent work on large bodies of low-grade ore.

*Deadwood, S. D.

The Research Corporation and the Cottrell Process

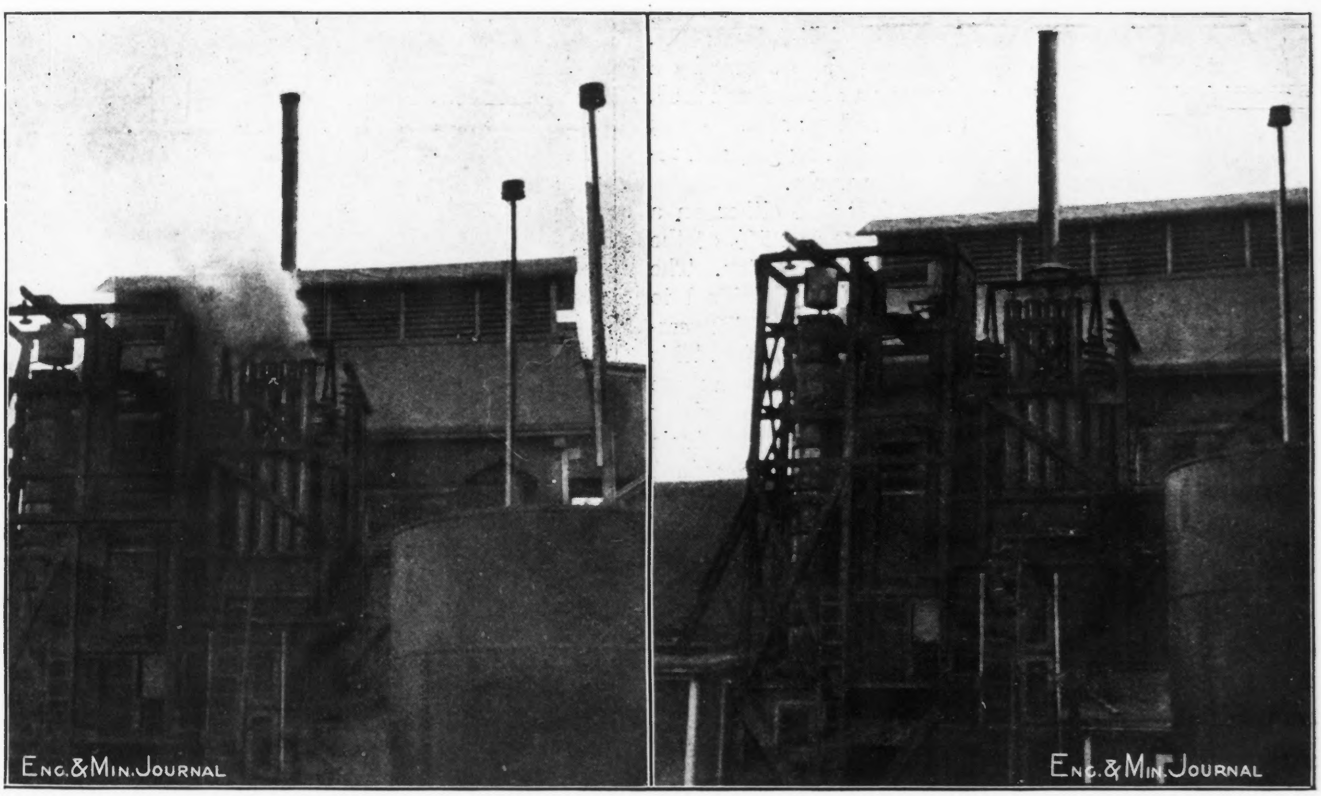
SYNOPSIS—The Cottrell process of electrostatic fume condensation has now been applied to many metallurgical operations, such as condensing sulphuric-acid mist and cupellation fumes at various refineries, converter fumes at Garfield, Utah, arsenic at Anaconda, cement dust at Riverside, Calif., and soot at Pittsburgh; other special applications include condensing powdered eggs and milk, recovering chlorine in bleaching-powder works, etc. Some data of the metallurgical applications are given.

The Research Corporation, through its engineers, has been developing systematically the application of the Cottrell process. It will be recalled that Dr. F. G. Cottrell offered his process to the Government, the proceeds from the use of same to be applied to scientific research. It was found that it would be impracticable for the Government, or the Smithsonian Institution, to administer this gift, and in consequence the Research Corporation was formed for this purpose.

The Research Corporation controls the Cottrell patent for electrostatic fume condensation, except for rights previously granted to the Western Precipitation Co. in six Western states, Washington, Oregon, California, Idaho, Nevada and Arizona, the foreign rights to the process, and its application to the portland-cement industry in the United States. It is expected that the Research Corporation will be the recipient of other similar gifts and the proceeds are to be devoted to scientific research primarily along metallurgical and industrial lines. It is also expected that appropriations from its royalties will be made for investigation of various subjects at different colleges where these may be best taken up, and for the development of processes that give promise of success. Besides the Cottrell process, the Research Corporation at present has under consideration a chlorination process for complex ores, and much other work. It also contemplates the dissemination of the technical information gathered in the course of its researches and experiments. The Corporation has offices at 63 Wall St., New York, in charge of Linn Bradley, chief engineer.

Cottrell Installations

The Cottrell process is now being installed at the Garfield Smelting Co., Garfield, Utah, where the converter fumes and a portion of the blast-furnace gases are to be treated. The present installation should be ready for continuous operation in June or July and is intended primarily for converter fumes, but if only one or two converters happen to be working, the gases are of variable conductivity; under such circumstances, a portion of the blast-furnaces gases are used to stabilize the operation. At the Anaconda Copper Mining Co.'s Washoe Works, an installation is being made at the arsenic plant for the purpose of precipitating the arsenic fumes from the gases. At its Raritan Copper Works, at Perth Amboy,



Two Views of the Cottrell Apparatus at the Experimental Leaching Plant at Anaconda

Current off — Current on

N. J., a Cottrell installation treats the fumes from the cupelling of the silver slimes, and effects a saving of several thousand dollars annually.

The first commercial installation of the Cottrell processes was at the plant of the Selby Lead & Smelting Co., Vallejo Junction, Calif., where the process has been in operation about six years. It is used in precipitating sulphuric-acid mist from the parting kettles. A similar installation has been made by the Omaha & Grant Smelting Co., at Omaha, Neb.

Among installations now being made are those at the plants of the Goldschmidt Detinning Co., East Chicago, Ind.; at the new International Smelting & Refining Co.'s plant at Miami, Ariz.; and at the lead-smelting plants at Trail, B. C., and at Tooele, Utah. Experiments with the process will shortly be undertaken at the Copper Queen works, at Douglas, Ariz., and other metallurgical plants are making preliminary tests.

An installation of general interest is that at the Bureau of Mines' station at Pittsburgh, where the soot in boiler gases is precipitated. One of the earliest installations was at the Riverside Portland Cement Co., Riverside, Calif., where 900,000 cu.ft. of gas per minute are being treated and about 90 tons of dust precipitated per day. The wide application of the process is also shown by a recent installation for the precipitation of powdered food, such as powdered milk or cream, and powdered eggs; also in the removal of tar from illuminating gas, and recovering chlorine in bleaching-powder works.

The Cottrell process is usually installed either on a lump-sum basis, or on a royalty of 10 to 25% of the recoveries, depending on the size of the installation. The process was rather expensive for a single individual to develop and install, on account of the detailed tests necessary to determine the character of each installation. This is one of the reasons why the process did not have a more rapid reception. Each installation must be carefully studied to obtain the proper operating conditions. This is usually done by the installation of a small testing plant and experiments by the Research Corporation's engineers, the expense being borne by the metallurgical company.

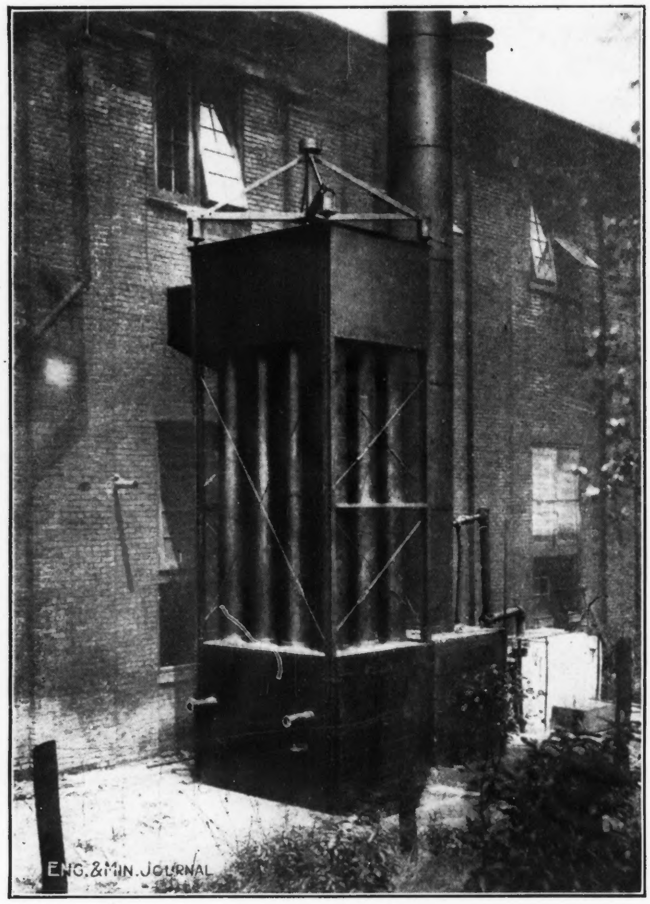
The first application to blast-furnace gases at the Balaklala plant at Coram, Calif., while successful in some respects, was not a complete success. The sulphuric anhydride and dust could be successfully precipitated, but the process had no effect on the SO_2 gas, and this fact, coupled with some other corporate difficulties, resulted in the closing of the Balaklala works.

Some Operating Data

Insufficient data have as yet been collected to make definite generalizations regarding operating costs and conditions, but it may be mentioned that the power consumption at a cement plant handling 900,000 cu.ft. of gas per minute it about 35 kw. This is undoubtedly a low figure as compared with the power required in most metallurgical operations where for an equal volume of gas the power required would range from 35 kw. to perhaps 100 kw. High-tension, intermittent, direct current is used, this being obtained by means of a transformer and rectifier. In actual practice, potentials of from 15,000 to 100,000 volts are being used, and just now a rectifier capable of giving a potential of 250,000 volts is being tested. It is hoped that ultimately a potential of a million volts may be realized for some special problems.

The electrodes used are of two general types, the first known as the "plate and wire," and, second, the "pipe and wire" electrode. The latter are most used and the distance between electrodes ranges from 1½ in. to 8 in. Wrought pipe from 8 to 20 ft. long is used, and in diameters varying from 4 in. to 3 ft.; the wires suspended therein at present range in size from No. 30 to No. 10.

The velocities suitable for precipitation vary with the physical and electrical character of the gases. The process is in operation with gas velocities of from two to 30 ft., but the best range is usually between four and 15 ft. per sec. The conductivity of gases is a subject which has received much study, but sufficient data have not been



Small Cottrell Installations Precipitating Soot at Pittsburgh

accumulated to formulate definite conclusions. In general, it may be said that dust reduces the conductivity of the gases, but this may be counteracted by the admixture of small amounts of moisture and other correctants. The temperatures attained ordinarily in metallurgical flues are no impediment to the process. The principal limitation with regard to temperature in connection with the process is the ability of the iron work to withstand the temperature; the limits in this respect are about 1100° or 1200° F. From the variety of problems now being attacked, the Research Corporation expects soon to be able to present more specific data regarding the operation of the process, its value under specified conditions, costs of installation and operation.

The cost of installation varies from $2000 to $500,000, the former cost being for a small commercial or testing installation capable of handling from 5000 to 8000 cu.ft.

per min., the larger figure being for a large metallurgical installation. It is impossible to give definite figures on the cost of installation until all conditions are determined, but it may be stated that an installation now under way at one of the large smelting works is estimated to cost $350,000, including new stack and other accessories incident to this installation.

A small test plant can be erected for about $500; in fact, one small commercial operation having a capacity of about 3000 cu.ft. per min., was installed for $650. It is generally expected that the process will be cheaper in operation than that of a baghouse, and one company is contemplating the installation of the Cottrell process even though it is able to use cotton bags without corrosion. Reduction in the length and size of flues is one of the savings obtained by a Cottrell installation.

The accompanying illustrations show the difference when the current was on and off at the Cottrell test installation at the Anaconda experimental leaching plant. The other engraving shows the installation at the U. S. Bureau of Mines station at Pittsburgh. This is a typical small Cottrell installation. It takes the smoke from a hand-fired 80-hp. boiler; when the current is turned on, there is nothing visible at the top of the stack, which under other circumstances exhibits the usual black smoke.

Sunset Mill at Rhyolite, Nev.

A stamp mill and cyanide plant of 2000 tons monthly capacity is being built by the Sunset Mining & Development Co., at Rhyolite, Nev., which, it is now expected, will be ready to go into commission in August. The ore will be taken directly from the mine to the mill, the mill being at the portal of the main tunnel. It first passes over a grizzly which removes all ore under 1 in., and which drops to the stamp bins. The grizzly oversize passes through a Blake crusher of sufficient capacity to supply the mill for 24 hr. when run eight hours. From the crusher it drops to the stamp bins. It is then fed through Challenge feeders to ten 1050-lb. stamps and crushed through a 6-mesh screen. From the stamps it flows through a launder to a belt and bucket elevator, which elevates to a 45-in. Akins classifier. Slimes from the classifier flow to the first set of thickeners, consisting of two 20x7-ft. Dorr thickeners. Sands from the classifier flow to a 5x18-ft. Colorado Iron Works tube mill. All material from the tube mill passes over an amalgamating plate, where coarse gold is recovered, and then flows back to the elevator, and is elevated to the classifier, which continues separation of sands and slimes.

From the first set of thickeners the pulp passes to the agitating plant, consisting of four 12x15-ft. Pachuca tanks, where it is agitated from 8 to 16 hr. From the agitators it flows to a second set of thickeners similar to the first set. From the second set of thickeners the pulp flows to a 12x12-ft. Portland continuous revolving filter where both barren solution and water washes are applied. Tailings from the filter dump automatically upon a belt conveyor and run out of the mill.

The cyanide solution is added at the mortars and is drawn off at both sets of thickeners, at the agitators and at the filter, and is replaced by barren solution at the proper points. The gold is precipitated by zinc shavings, the precipitates going to the refinery. The flow through the plant is as nearly as possible by gravity, the only elevators being the bucket elevator and the air lifts in the agitating plant. Tailings are discharged with 26% moisture, making cost for water 5c. per ton. Costs for all chemicals total 15c. per ton, the cyanide consumption being ½ lb. per ton. The total ton cost is estimated at $1.75. The capacity of the plant is 2000 tons per month, extraction according to tests averages 90%. Most of the machinery is being furnished by the Colorado Iron Works.

A German View of Copper Consumption

The following is an extract from a recent interview with Emil Rathenau, the head of the Allgemeine Elektricitat Gesellschaft, of Berlin, published in the *Berliner Tageblatt*, of May 5, 1914:

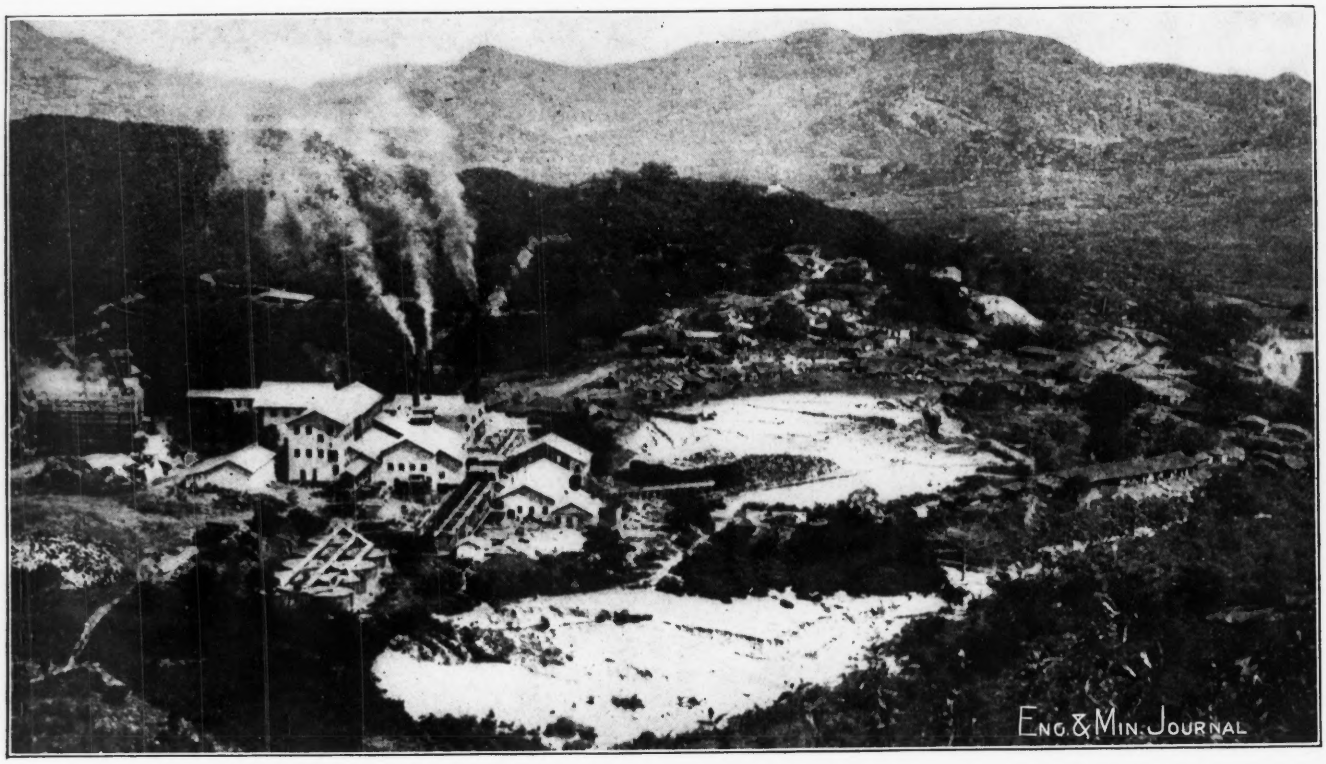
Mr. Rathenau said that the business depression which had been foretold in his annual report had made further progress, but that he thought the low point had been reached or possibly passed. The electrical industry could not escape some effect of this depression, although a material reduction in activities has not taken place. This may be explained in part by the fact that during the period of stagnation a good many industrial enterprises are looking for economies and one of the economies to be introduced is a more efficient production of power, which very often leads to electrical equipment. All the same, it must be admitted that business even in the electrical line is more quiet than it has been, though the open orders on the books of the A. E. G. are about as large as they were a year ago. They are even larger if the special orders for the subsidiary company—A. E. G. Electric Ry. Co.—are considered. The reduction in the number of workingmen which has taken place during the last few months at the A. E. G. is principally due to improved labor-saving machinery. Some extensions of the plant which had been contemplated and for which land had been acquired, have been postponed for better times.

Mr. Rathenau mentioned particularly the development in regard to electric lighting. The A. E. G. has developed an electric lamp with a consumption of only ½ watt per candle. This lamp was at first only applicable for large candlepower, but recently it has succeeded in applying it for 50 and 25 candlepower. Mr. Rathenau expected from this economical lamp a great increase in electric lighting, and doubts whether the gas industry will be able to compete. Of course, he admits that this development has also some disadvantages for the electrical industry because the consumption of electric energy will be reduced materially through this economy, and there will be a large reduction in power plants for lighting purposes, which will have to be offset by larger use for industrial purposes and the latter development is only possible when electric power will be made cheaper.

The interview then drifted to the subject of electric-power generation, Mr. Rathenau having been for many years an advocate for private enterprises, but seems to have veered around somewhat owing to the trend of the public and political views. He admitted that electric power to be generated very cheaply has to be produced in enormous units which probably go beyond the limit of commercial electric units. He stated that Berlin is using approximately 300,000,000 kw.-hours per annum, while the Prussian government railways is using for the small electric railroad from Dessau to Bitterfeld probably twice as much. He considers it, therefore, as quite natural that the Prussian government with the development of electrification of railways, will have to build power plants with enormous capacity exceeding that of any private company and reducing the cost of electric power to such an extent that they can furnish electric energy to private people for very little money. He refers to the fact that recenly one of the government electric plants has asked for tenders for the sale of 30,000,000 kw.-hours.

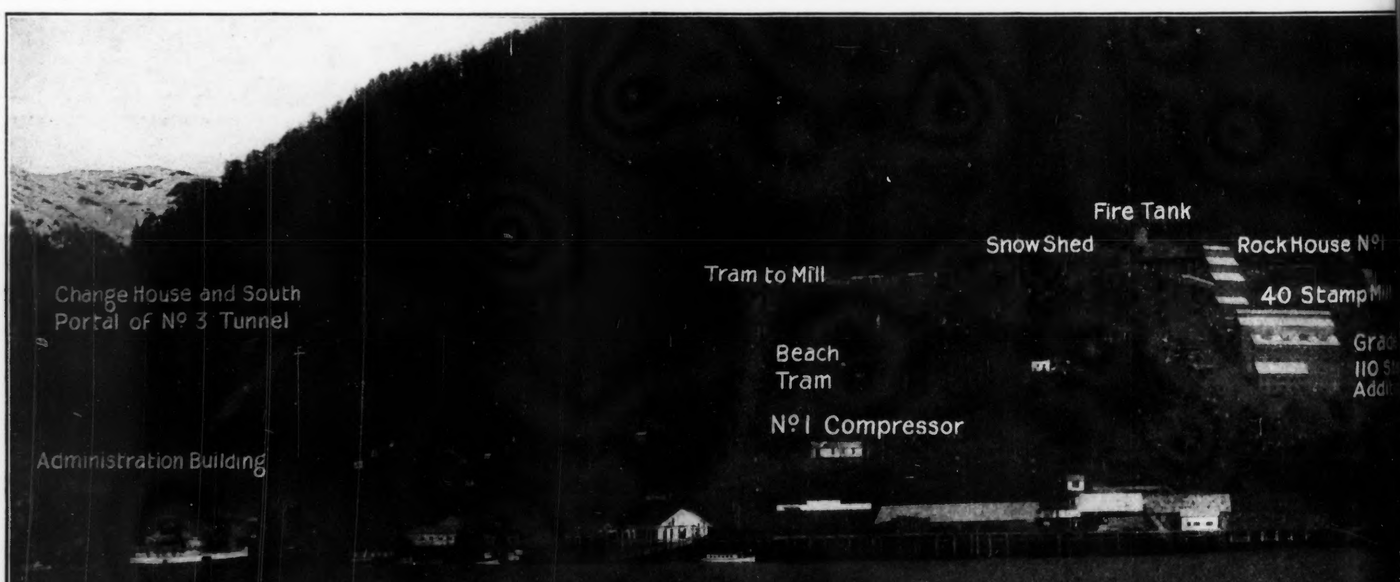
Mr. Rathenau is of the opinion that private distributing enterprises are going to buy electric current from some large government plants which will be cheaper for them than to generate the power themselves. He does not believe that a monopoly of electric power will be possible in Germany, but he thinks it might be possible to establish a monopoly in the kingdom of Prussia under the guidance of some government plant. If this could be done it might be helpful for the purpose of laying conduits giving the government the right of expropriation. Theoretically he says the whole European requirements of electric energy could be generated at one place and distributed.

Photographs from the Field



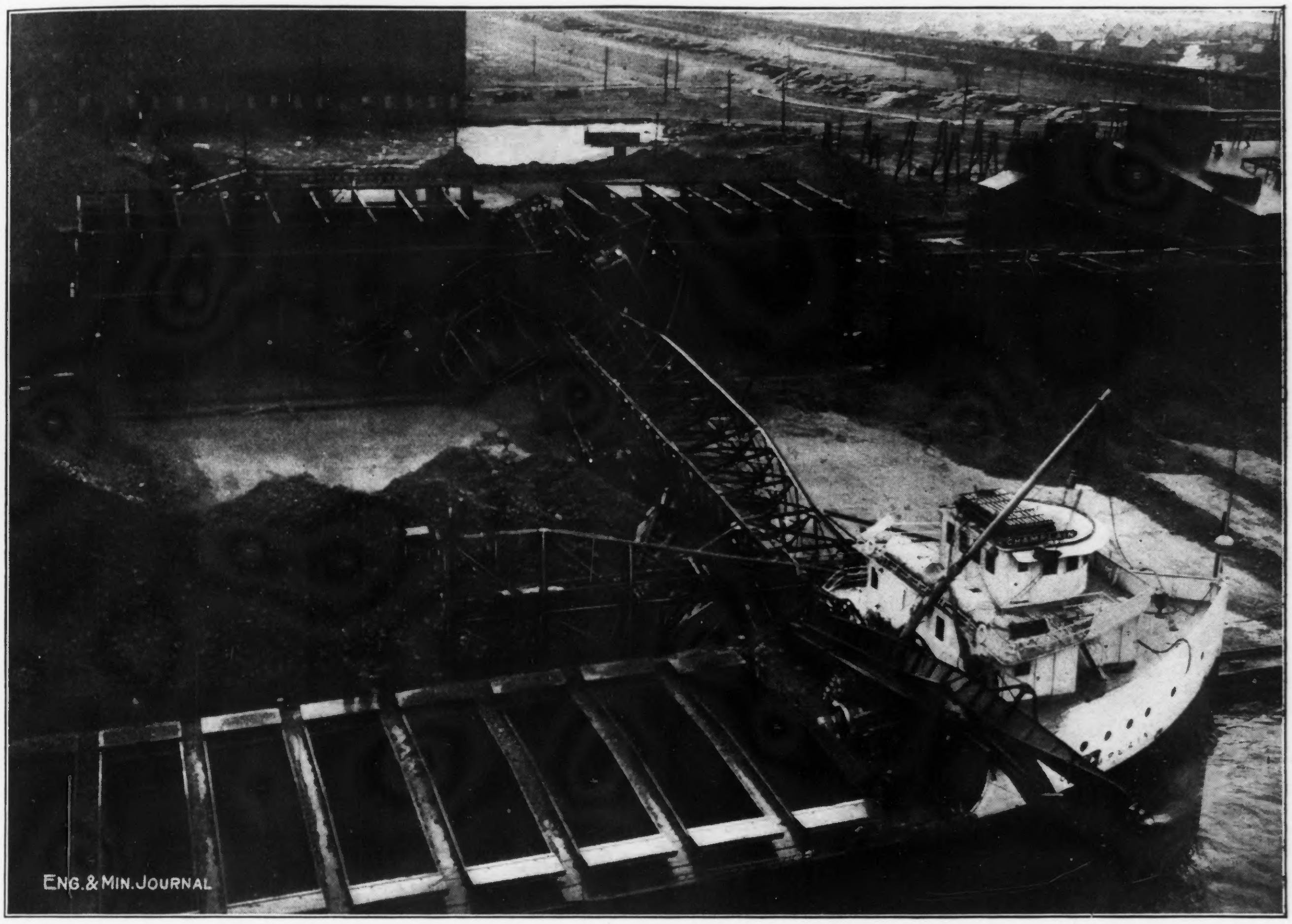
General View of the Butters Divisadero Co.'s Property at Divisadero, Salvador

Mill contains 45 stamps, five 1250-lb. stamps were added this year. California oil will be burned instead of wood.

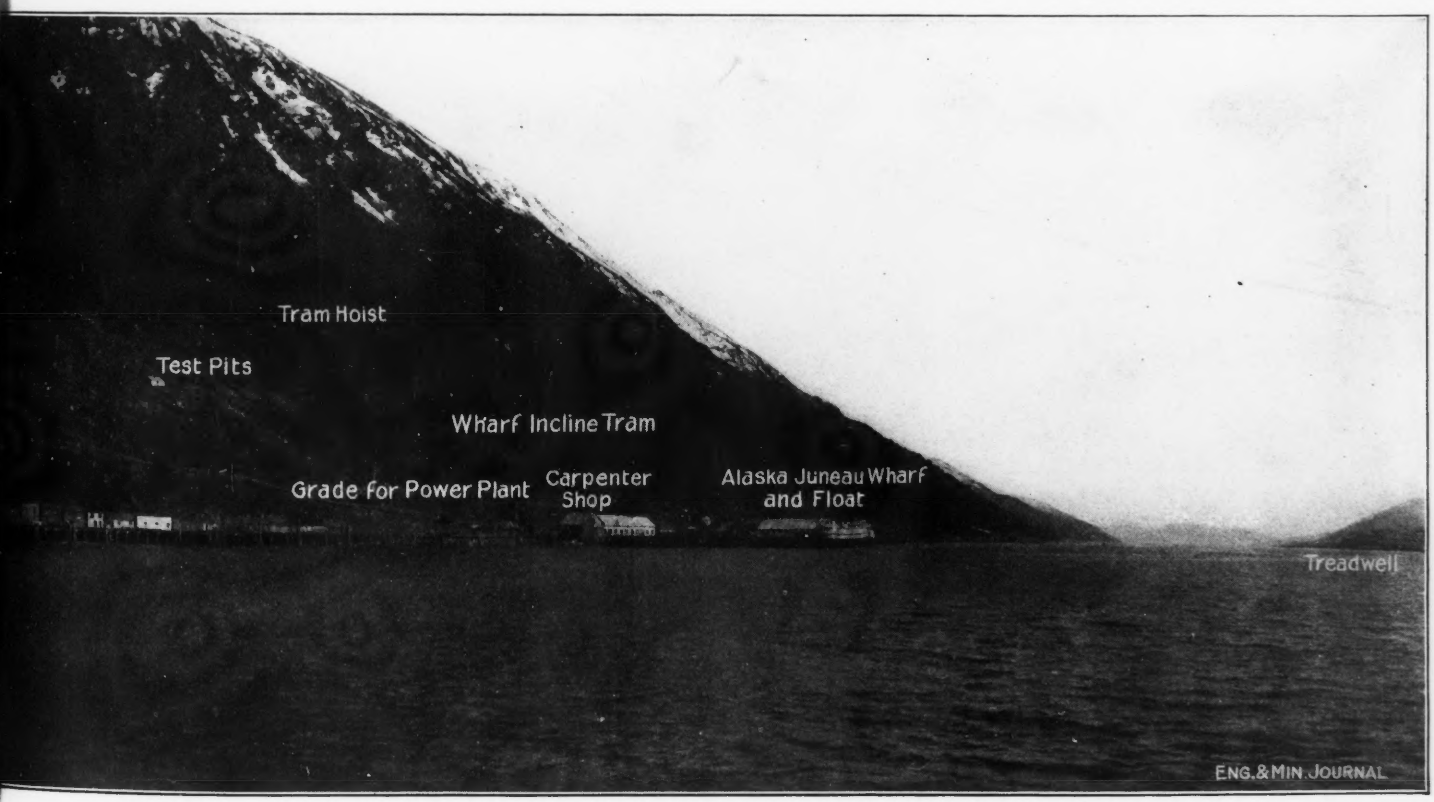


General Panoramic View of the Properties of the Alaska Juneau Gold Mining Co., near Juneau, Alaska; the

One of the several low-grade gold mines now being developed near Juneau. Two milling units of 150 stamps each



Unloading Bridges Wrecked by a 48-Mile Gale, at the Clarkson Coal Co. Dock at Duluth, Minn.



Treadwell Mines, Owned by the Same Interests, and Which Are on Douglas Island, Appear at the Right

will be built, according to present plans; ultimately there will be four units of 12,000 tons nominal daily capacity.

Correspondence and Discussion

Leaching at Chuquicamata

An almost verbatim report of E. A. Cappelen Smith's lecture on Chuquicamata experimental work, published in the JOURNAL of Apr. 25, p. 865, induces me to make some statements about that interesting deposit. As I discussed the Chuquicamata deposits with A. C. Burrage, of Boston, as far back as September, 1910, obtaining for him in the same year, certain options on the properties, I am well acquainted both with the deposits and the nature of the copper occurrences, therefore am greatly interested in Mr. Smith's paper.

A SKELETON FROM THE OLD WORKINGS

Evidently the Indian woman was killed by falling rock while at work. Claude Vautin is holding the skeleton, Louis Ross is at his side.

INTERIOR OF SOME OF THE OLD WORKINGS

The Chuquicamata deposits were worked by great galleries that came within 10 or 12 ft. of the surface in some places. The copper minerals being brittle were separated by screening.

In the following observations I do not for one moment wish to detract from the merit of the metallurgical investigations made by Mr. Smith and his able colleagues, which entirely support the views I previously expressed to Mr. Burrage. As memories, however, are apt to be short, I would like, in justice to myself, to place the following facts on record. Mr. Smith states:

It was formerly assumed that the deposit was atacamite, which could not be profitably treated by established methods because of the siliceous nature of the ore and the absence of sulphides and water, and on account of the volatilization of the cuprous chloride. However, it was eventually shown that the ore was brochantite and salt, and not atacamite (oxychloride). Brochantite is insoluble in water, but readily soluble in dilute sulphuric acid.

Mr. Smith further states:

It was quickly found that the copper was readily soluble in cold dilute sulphuric acid, and that only coarse crushing was required.

That I was fully aware that the principal copper mineral to be taken into consideration when treating the ore was brochantite and not atacamite, and that only coarse crushing was needed, is shown by the following excerpt from a cablegram which I sent to A. C. Burrage from Santiago, Chile, dated Mar. 29, 1911; and with regard to the proposal to adopt coarse crushing, by a clause in a patent application for Chile filed by me in April, 1911. The cablegram to Mr. Burrage read:

Santiago, Mar. 29, 1911.

"Jubilation" Boston:

Prevailing mineral Chuquicamata, brochantite; atacamite only accidental; by simple treatment (leaching) of ore I

SOME OF THE OLD DUMPS AT CHUQUICAMATA

OLD DUMPS AND WORKINGS; THERE ARE 220,000,000 TONS OF 2.2% ORE PROVED

THE AREA OF THE OLD CHUQUICAMATA WORKINGS IS ENORMOUS

There is little doubt that this is the largest body of copper ore known in the world.

have obtained 92% extraction crushing to half-inch only.

The extract from the Chilean patent specification reads:

Crushing: I find in practice that it is not necessary to crush the Chuquicamata llamperas finely as has hitherto been considered necessary; I have obtained good extraction results when treating the llamperas, with the solvent mentioned below, when crushing to the comparatively coarse size passing a half-inch mesh.

Referring now to Mr. Smith's description of the method for removing any copper chloride from the copper-sulphate solution, prior to electrolytic precipitation, and to the recovery of the cuprous chloride, I quote further lines from a provisional specification which I filed in Great Britain, June 21, 1913:

The solution containing the cupric chloride * * * is run into a vessel in which is placed a quantity of metallic copper, preferably in a finely divided condition. The apparatus should be so constructed that the contents can be heated and agitated so that the following reaction takes place: $CuCl_2 + Cu = Cu_2Cl_2$. The cuprous chloride produced being insoluble may be retained by causing the liquor with its suspended contents to be forced or run into a filter-press from which the insoluble cuprous chloride may be collected.

Naturally I did not claim this as a novel method for eliminating cupric chloride from solution as the reaction is well known, and was applied by Ottokar Hofmann at Argentine, Kan., in, I believe, 1906; but in my application it is specified as a step in a combination process for "treating certain copper ores."

The Chuquicamata deposits for many years past have engaged my attention; indeed five years ago I sent representative parcels of the ore to London and endeavored to secure capital there for the purpose of systematically boring the ground, but so small was the interest then taken in such propositions that in one case a well-known metallurgical company never opened the bags containing the samples. In the official report of the recent drilling operations, it is stated that 200,000,000 tons of profitable ore are now considered proved. This is particularly gratifying to me as on Mar. 4, 1911, I cabled from Antofagasta to A. C. Burrage as follows:

Pending the measurements and assays I estimate Duncan Fox properties to contain 7,000,000 tons of ore averaging 2% copper, plus dumps 2%. Probable ore 30,000,000. I estimate average capping, llamperas, to be nil. These figures refer to 40% area 25 meters deep. Probable ore Cecilia group estimated at 40,000,000. Estimate the whole Chuquicamata to contain 200,000,000 tons averaging 2½%. I believe the Chuquicamata ores to be deep. Strongly recommend purchase; all concur.

A further point in Mr. Smith's lecture is as follows:

It was formerly assumed that the deposit was atacamite, which could not be profitably treated by established methods because of the siliceous nature of the ore and the absence of sulphides and water, and on account of the volatilization of the cuprous chloride.

It must not be assumed from this that Mr. Smith had in mind the smelting of the crude ore as this would have been a course contemplated by no one acquainted with the deposit and the nature of its copper contents. Indeed, so far as I know, and I think I have a full record of the many proposals to treat the ore in question, some system of leaching was the only method ever suggested by responsible metallurgists. Nevertheless, referring to Mr. Smith's remark on the loss of copper chloride by volatilization, it may be of interest to JOURNAL readers to know that high-grade atacamite concentrates can be smelted without loss of copper by volatilization, a fact which Mr. Smith practically indorses in the statement describing the method used by him to reduce cuprous chloride.

The truth is that the initial factor in the successful development and economical treatment of the Chuquicamata deposit was the courage of A. C. Burrage in securing the options on the various properties, and this was subsequently materialized by the coöperation of the Guggenheims, who brought to bear their great financial and technical resources, and in having at their service the metallurgical knowledge and skill of Smith, Green, and Thompson. The accompanying photographs were taken in April, 1911, prior to the advent of the Guggenheims.

I trust I may be pardoned for expressing the keen satisfaction I feel in the full confirmation of my repeatedly expressed opinions as to the enormous value of the Chuquicamata deposits, although for a long period, it appeared that I was proclaiming these in the wilderness, and that I forged at least a few of the primary links in the chain of Chuquicamata developments.

CLAUDE VAUTIN.

London, May 11, 1914.

Settling of Converter Slags

Apropos of the discussion on basic-lined converters, I should like to hear more of the various methods of treatment of the slag made by these converters and their justification. Recently an article appeared in the JOURNAL in which it was stated that the fluid slags from the basic-lined converters were poured directly into the blast-furnace settlers. I believe the slags from the basic-lined converters at Anaconda are cast and resmelted, giving as a reason the shortage of iron flux.

Some time ago I saw some interesting experiments performed. Samples of converter slag were taken as the slag was poured. These slags varied in copper contents from 1.5 to 2.5%. They were poured preferably from blue metal instead of from white metal. The nearer the charge was blown to white metal, the higher the slag in copper tenor. At or near blue metal the slags ran close to 1.5% Cu. At that time we were trying to produce a slag directly from the converter which we could throw away, as there was a large labor item attached to the chilling, breaking and resmelting of the converter slag.

The slags were too high in copper to throw away, so we poured them while still fluid directly into a reverberatory furnace. We allowed the slags to settle various intervals of time before tapping them out to be thrown away. At the end of 15 minutes the slags were found to contain from 1.25 to 1.50% copper. By putting in green poles and charcoal, we were able to reduce the slag approximately to 0.75 to 0.85% copper. On throwing in a little iron pyrites, the slag was reduced in a few minutes to 0.35 to 0.45% copper.

There is no doubt that a part of the copper in the converter slag was there as either a copper silicate or oxide, which no amount of settling would reduce. It will be found by analysis of converter slags that there is too little sulphur to combine with all the copper to form Cu_2S.

When the blast furnace does not need the iron flux then the hot fluid siliceous slag should be poured into an externally fired settler, through the roof of which, from time to time, could be dropped small amounts of iron pyrites. In this way a small amount of fuel would be used, the entrained metal would be saved, and the resmelting of the slag would be avoided.

New York, May 8, 1914. JOHN W. JAMES.

Editorials

The Price for Copper in 1913

About all of the big copper-producing companies have now made their reports for 1913, and it is possible to compare the prices that they received for the sale of their product. It is fruitless to consider the reports of the Lake Superior companies, inasmuch as for them the year was so interrupted by the strike. During the last five months of 1913 they produced but relatively little copper, and their sales were chiefly of the metal that they had on hand and were decidedly scattered and irregular in character.

Anyway, it is the electrolytic copper which determines the market, and the producers of electrolytic copper now report so generally that it is possible to obtain a broad view of their returns. Especially is that so since in 1913 many of them began to report their price received, reduced to the basis of New York, net cash. In speaking roughly of the price for copper, persons in the trade talk commonly about the gross price, which includes the delivery charges (freight, etc.) to the consumers' works, and also other allowances. In 1913 the delivery charges as reported by the Chino, Ray and Utah companies came to 0.17c. per pound. Miami reported 0.20c. per pound "for selling expenses, freight and export insurance." Phelps, Dodge & Co. reports the net cash price, New York, and Nevada Consolidated reports the net price, f.o.b. Atlantic seaboard.

The figures reported by 10 large companies in 1912 and 11 in 1913 are given in the accompanying tables. Apparently the United States company realized the highest average in 1913, but we surmise that its figure includes the delivery charges. If that surmise be correct, Phelps, Dodge & Co. realized the highest average, the figure reported by it being the net cash price, New York basis. The Greene-Cananea and North Butte copper is sold by the United Metals Selling Co., and these are the only products sold by that agency that are publicly reported. The Anaconda's reports give no intimation of the price realized for its large output.

The copper reported by these companies in 1913 amounted to 658,533,402 lb., selling for $100,248,273, or an average of 15.222c. per lb. The quotational average for 1913, as reported by the ENGINEERING AND MINING JOURNAL was 15.269c. per lb. In 1912 the copper companies, generally speaking, fell far short of attaining the quotational average; in 1913, they came much nearer to it.

In 1912 the price for copper rose steadily during the first half of the year and remained at a high level during the second half. This was the famous period of pegged prices, during which the largest producers sold the less of their copper. The great break did not come until December. Much depended therefore upon the time when the copper was sold. Certain of the smaller companies sold largely at cut prices, which looked small at the time but looked big later on, and realized high averages for the year. Other companies made their larger sales when the market was low. The result was a range of over 1c. per lb. in the averages actually realized.

In 1913 there were several ups and downs, while the total range of price was confined within relatively narrow limits, the highest monthly average having been about 16½c. and the lowest about 14¼c. In brief, 1913 was quite a normal year. This shows also in the averages reported by the companies, most of which fall between the limits of 15.08c. and 15.37c.

COPPER PROCEEDS IN 1912

Company	Lb.	Value	Average
Chino	27,776,088	$4,344,262	(*b*) 15.640
East Butte	14,709,460	2,455,303	(*b*) 16.692
Greene Cananea	48,157,847	7,714,405	(*b*) 16.019
Miami	32,477,923	5,343,917	(*a*) 16.454
Nevada Cons.	63,063,261	10,076,872	(*c*) 15.979
North Butte	26,480,123	4,334,531	(*b*) 16.369
P. D. & Co.	192,297,374	29,825,323	(*a*) 15.51
Ray	34,674,275	5,467,297	(*b*) 15.762
United States	21,152,620	3,434,551	(*b*) 16.237
Utah	91,366,337	14,471,576	(*b*) 15.839
Total	552,155,308	$87,468,037	**15.841**
Quotational average reported by Eng. & Min. Journal			**16.341**

COPPER PROCEEDS IN 1913

Company	Lb.	Value	Average
Chino	50,511,661	$7,739,398	(*a*) 15.322
East Butte	14,401,108	2,277,591	(*a*) 15.086
Greene Cananea	44,480,514	6,716,558	(*b*) 15.10
Miami	33,134,334	4,983,404	(*a*) 15.04
Nevada Cons.	64,972,829	9,667,307	(*c*) 14.879
North Butte	27,685,400	4,176,619	(*b*) 15.086
P. D. & Co.	201,489,796	30,968,982	(*a*) 15.37
Ray	52,341,029	7,955,836	(*a*) 15.20
United States	20,239,973	3,123,028	(*b*) 15.43
United Verde	35,333,924	5,358,036	(*d*) 15.164
Utah	113,942,834	17,281,710	(*a*) 15.167
Total	658,533,402	$100,248,488	**15.222**
Quotational average reported by Eng. & Min. Journal			**15.269**

(*a*) Net cash, New York; (*b*) Whether gross or net price not stated. (*c*) Price f.o.b. Atlantic seaboard. (*d*) As given by the Boston News Bureau.

The quotational average for 1913 was 1.09c. lower than in 1912, but considering what was actually realized by the producers last year was not relatively so bad a one, their actual proceeds having been only about ⅝c. per lb. less than in 1912.

Paying Dividends Out of Surplus

Several important copper-mining companies have lately been criticized for maintaining their dividend rates although they were not earned last year; in other words, their dividends have lately been paid out of their surplus funds. That has been referred to as more or less reprehensible, anyway as adverse to the position of the companies. The reason why this has happened is that copper in 1913 fetched only about 15¼c. per lb., which was a lower average than for several years previous.

Now, the equalization of its dividend rate is precisely one of the reasons why such companies accumulate a surplus. Their product is one that realizes a wide range of price. The management of a company may establish a dividend rate based upon what it regards as an average price reasonably to be expected. In the fat years, it accumulates a surplus, upon which it draws in the lean years. If the fat years were extraordinarily fat or prolonged, the surplus might become so big as to justify some extra dividends. *Vice versa,* in the case of the lean years, it might be necessary to reduce the dividend.

If the price of 14c. for copper continue indefinitely, a great many copper-producing companies will have to reduce their dividends, none having surplus funds that will stand that price forever. That price is, however, below the average of the last 10 years and everybody is reckoning that the hard times are nearing their end and that a better price and larger profits will soon be realized.

Greasers and Gringos

The hatred of many Mexicans for the gringo is easily explainable, and also is excusable. In the early days of the American industrial invasion, back in the '80s, the Americans who went to Mexico were largely of a class that their own country was not proud of. Not a few of them were fugitives from justice, and the great majority was composed of the roughnecks of the frontier. Fraternizing with the Mexican *peones* and *pelados*, and by entering with them into drunken carousals, brawls, and by treating them roughly always, naturally failing to win their respect, there is no wonder that the better class of Mexicans came to look upon the "gringo" as the representative of a rude, inferior people. When a better class of Americans went to Mexico, and having to do chiefly with the lower class of that country, they naturally came to regard the "greaser" in the same way.

This a common misunderstanding in the association of peoples who do not understand each other. The British gentleman meets an American drummer, finds fault because he does not have the manners and ideas of one of his own dukes, and jumps to the conclusion that he has studied a fair sample of all Americans. Similarly, we look upon our "dagoes" as typical of Italy, and our "wops" as representatives of some foreign people (Slavonians, Croatians, Lithuanians, Ruthenians, etc.), whom we are unable to identify precisely, and lump perhaps as Austrians, and thereby derive some erroneous ideas about Italy and Austria respectively.

The Mexicans are able to learn better of Americans, and appreciate them, when they have a chance. Thus, the American occupation of Vera Cruz does not seem to have been particularly resented by the residents of that place. One correspondent reports: "If once convinced that the American flag is to float over this city until tranquility is restored throughout the Republic, it is virtually certain that the Mexicans of Vera Cruz will give their heartiest support to the American civil government. Today, they admit frankly that they are enjoying greater freedom from apprehension, more personal liberty, and a larger measure of prosperity than they have known in many years. Many even assert that they would cheerfully subscribe to any policy of the United States which would insure them a continuation of the present conditions and the extension of those conditions through the rest of the Republic."

This is like what we hear from Panama since that region has been under American domination. The people there are said to express themselves pleasurably with respect to the orderly peace and the opportunity to conduct their business and seek their happiness that they now enjoy No more are there revolutions and fusillades of musketry. No more are there the machinations of self-seeking would-be dictators, looking for plunder and a subsequent *otium cum dignitate* in Paris. All of that has been done away with, and the common people like the change. What Mexico needs is a similar order.

A Rosy View of Death Valley

Extravagant and ridiculous statements regarding the development of California mines, recently appearing in the daily and weekly newspapers, will add nothing to the fame of the state, but rather tend to discourage investment and retard the progress of the mining industry. Two instances of this extraordinary publicity are samples of astonishing ignorance of practical mining, or of willful misrepresentation; and they come from sources that are supposed by the general public, unacquainted with the actual mining conditions, to be authentic.

A leading San Francisco daily, commenting on the recent find of leaf gold in a mine on the Mother Lode, says: "At a depth of 125 ft. a blast uncovered virgin gold in crystal formation, some of the sheets being nearly the extent of a man's hand, and the ore running more than $25,000 a ton. This is surely a complete answer to those pessimists who have been declaring that the Mother Lode is exhausted." The practical miner and intelligent investor in mines needs no other comment on this ridiculous statement than that if there are any pessimists who have been declaring that the Mother Lode is exhausted, they are as ignorant of mining as the writer of the editorial from which the above is quoted.

The other ridiculous statement is tempered with generalities, and much of its extravagance may be attributed to the rosy view taken by the reporter who interviewed the state official. The following excerpts quoted from the reporter's account of the interview are fair samples of the whole, which reads like a wildcat prospectus instead of the sober statement of a man employed to examine and report on the mineral resources of southern California. "It is like the return of the days of old and days of gold all through the great mining region. . . . Every camp I visited is prospering . . Why, the public would be amazed to know of the richness of some of the recent discoveries . . I began this trip in November and was constantly in the mining districts except in January, when I was in New York City. 'We have millions of dollars for investment in southern California' was the message I brought West, and since then there has been no difficulty in obtaining money for the development of legitimate mining enterprises. The financiers of the East were amazed by what I told them of the vast mineral deposits that extend from Tehacipi pass to the Needles. . . .Death Valley is getting a new lease of life also." It is encouraging to know that since the official visit to New York there has been no difficulty in getting money; but to those who have looked into Death Valley when it was red, the assurance that the valley is getting a new lease of life is like awakening from sleep on the varnished rocks of Wild Rose wash to find a rattlesnake within the blankets.

Death Valley has at times a blood-red hue, and at other times a whitish bloom, viewed from the rim. Anyone who spends a few hours looking down into it thinks it very much dead. Wild Rose wash is a broad stretch of desert to be crossed on the road between Borax flat and Death Valley. It contains a fine example of what is known as "desert varnish," which covers the rock wash. Borax lake has also the red coloring, though of less deathly appearance than Death Valley.

Such writers as we have been criticizing simply make the mining industry look ridiculous.

BY THE WAY

The following excerpt is taken from the Saturday magazine section of a leading Canadian newspaper, and is subheaded:

Experiences, grave and gay, in Northern British Columbia, introducing some exciting hunting incidents. Altogether a most readable narrative, told in a free-and-easy, unconventional style. BY G. H. KIBBEY.

The "narrative" commences thus: "Some years ago I bought the claims of some miners who had 'gone bust' in the northernmost part of British Columbia, but it was not until the spring of last year that I was able to visit the claims and see what my bargain was worth."

A GOLD REEF

It was on June 29 that, after we had spent several days prospecting in ideal country, we struck a great reef. Suffice it to say that when the stuff was tested later on several of the samples we had taken proved to contain no less than 98% of pure gold in the metalliferous deposit. At the Engineer mine itself, in the vicinity of which we were at work, not long ago a thousand ounces of gold-bearing quartz were taken in a week.

The fifth of July we mushed several miles from Golden Gate through very heavy brush and tormented by flies until we reached the dozen odd claims we had staked out. One has to restake each claim every year, and to be pretty "slick" about it, for if it is known that there is any gold in a claim the first second after midnight on the day when the claim should have been staked out afresh, someone will come along and jump it. We had lunch the next day in a hut at Ben-My-Chree mine, that was under 76 ft. of snow in the previous January.

MINE WORKED BY A WOMAN

It was about a week later that we climbed the "mountain" to the Fred Lawson mine, which is about ten miles from Big Horn, and I believe the only mine in the world wide that is worked by a man and a woman. We had the pleasure of meeting both Mr. and Mrs. Lawson. Their life is indeed a strange one. Up on Big Horn creek, ten miles from Tagish point, Fred Lawson, a former university graduate, and Mrs. Lawson live together, working at the operation of the mine which Lawson owns. The problem at first was to find mining machinery small enough to be operated by two people, one of them a woman. This was at length solved by getting a tiny stamp mill, such as is sometimes used by assayers. Water power was handy, so Fred Lawson hitched the stream to a water wheel. The mine shaft is high on the mountain side, and the mill is located on the banks of the stream. The problem of transportation was solved by rigging up a heavy wire as an aërial tramway, and buckets of small size are dropped down this wire from the mine to the shaft. The Lawsons make a pretty good living out of the mine, and in the winter they trap and hunt.

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Charles H. Unverzagt sent the following letter to a reader of the JOURNAL who forwarded it to us:

I am in the mining business as a miner and not as a promoter. I am acquiring a property at a cost of three million. I can handle this if I must, and take stock in the company for the purchase price, thus not encumbering it.

This is said to be the largest property of its kind in North America with a tonnage of over 300 millions which will net about 74c. profit per ton representing therefore a large net revenue. Some 8% has already produced 20 millions.

INQUIRY

What portion of $250,000 operating capital could you take, all things being satisfactory, under these conditions:

(a) That within 12-15 months your entire investment be repaid with 8% interest.

(b) That your stock bonus would then earn you an average net income for a long period of years of 100% of your original investment, or, if you desired to dispose of it on the repayment of your investment it, the Bonus, would return you double said investment.

This is a bona fide and conservative statement which will be apparent on consideration. Please advise on above inquiry and particulars will be sent you. A certain amount carries a directorship.

We do not know of any mining property in North America which possesses a tonnage of over 300,000,000 that will net about 75c. profit per ton, except Utah Copper. This is about the profit expected at the Alaska-Gastineau, but figures for tonnage at this property are well below 300,000,000, up to date. Both of these mines are controlled by Mr. Jackling and his friends, and it would seem unlikely that they have appointed Mr. Unverzagt their agent to obtain capital. Mr. Unverzagt's remark that "some 8% has already produced 20 millions" is cryptic; he neglects to say 20 millions of what.

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Probably the earliest mining operation of importance by white men on the Western Hemisphere was El Cobre mine, near Santiago de Cuba, opened by the Spaniards in the sixteenth century. It is rather striking that the oldest copper mine should be practically the first in North America to adopt the flotation process. It is now using the Minerals Separation process and obtaining a recovery of about 85%, instead of the 67% extraction obtained in its gravity concentration mill built only a few years ago. This modern mill was abandoned when it was found that the flotation process would give a better recovery; the difficulty with respect to the handling of the flotation concentrates has been overcome by the installation of an Oliver filter which reduces the moisture content of the concentrates to about 10%. Several other North American copper companies have installed the Minerals Separation process, but only two or three of these plants are on a commercial basis. El Cobre mine was opened by the Spaniards in the year 1532, and was worked intermittently for several centuries, but repeatedly abandoned on account of the heavy flow of water. A number of attempts have been made to unwater the mine, but these were unsuccessful until the Cuba Copper Co. undertook the operation of the property. After several years of heavy pumping, the old workings have been unwatered and a new shaft sunk to the bottom of the old workings, 1100 ft., at which depth, exploration work will now be undertaken.

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At Eagle, on the Yukon, near the international boundary, a correspondent says he once saw sledge dogs put to a peculiar use. He was waiting for a steamer to take him down river, and while strolling about to kill time, was attracted by loud howlings in several different keys, accompanied by a string of fluent oaths and curses. On investigating the source of the uproar he discovered an indignant prospector-farmer attempting to plow a small field with a team of five big, shaggy "huskies." It was July 5, and the temperature was 85° in the shade. The poor dogs, with swollen tongues hanging from their mouths, were struggling gamely in the hot sun, but were moving the plow only by small, irregular jerks. Every few minutes they would throw themselves exhausted on the ground, and then their excited master would assail them with whip, boots, and verbal pyrotechnics simultaneously. Altogether, it was picturesque, but ineffective, plowing. Unluckily, there was no local S. P. C. A.

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For brevity in a mining report, we commend the following as a result of three weeks' work: "I don't believe anybody will ever be guilty of stealing a ride out of that place on an ore train."

Chuquicamata

The recent history of Chuquicamata, which is perhaps the world's greatest copper mine, is interesting. One of the first remarks made by a person examining the map of this great property, comprising a large number of mining claims, is: "It must have been a big job to buy up all of those claims." In fact, it was no great job. The contribution, by Claude Vautin, elsewhere in this number of the JOURNAL, is pertinent to this subject.

For a great many years British capitalists have been engaged in copper mining in Chile. They were there long before Americans ever thought of going into the country. It was William Braden who led the first great American enterprise in Chile, and the fact that he had started the Braden Copper Co. certainly facilitated the development of the Chuquicamata deposits. Another indirectly contributory factor was C. S. Bradley, who invented the Bradley process of copper extraction. A. C. Burrage and Thomas W. Lawson took up the Bradley process and Mr. Lawson wrote his famous book about it and the mines which became the property of the Chino Copper Co. This was in 1909.

Mr. Burrage was enthusiastic about the Bradley process, and having the idea that many deposits of low-grade copper ore could be exploited with the aid of it, he inaugurated searches for such deposits. Thus inspired, he learned of the Chuquicamata deposits and obtained posession of them. Louis Ross, a mining engineer, of Boston, claims to have brought Chuquicamata to the attention of Mr. Burrage, and an action by him against Mr. Burrage for nonfulfilment of agreement is now pending in Boston. A photograph that accompanies Mr. Vautin's article shows Mr. Ross in Chile in 1911.

The collection of the Chuquicamata claims was a matter of no great difficulty, inasmuch as they were held by two British companies, dealings being thereby rendered a relatively simple matter. The British companies and the natives before them had done some mining, following the richer leads of ore and effecting a concentration by screening out the friable copper minerals, obtaining thus a concentrate rich enough to ship. Worked in that way, however, there was nothing big in the mine, and the British companies either did not realize, or were unprepared to approach the exploitation on the gigantic scale that was necessary and was immediately undertaken by the Guggenheims. Mr. Vautin's communication indicates that there was an appreciation of the magnitude of the deposits, but probably there was an unreadiness to enter upon the huge outlay of capital that was required.

At about this time, Pope Yeatman and his staff were developing the Braden mine. One or more of his assistants had been to Chuquicamata and had brought back samples of its ore, tests of which were made at Braden. This was before Mr. Burrage had formally approached the Guggenheims. Mr. Yeatman appreciated the magnitude of the deposits and the scale upon which they would have to be exploited, and felt that his principals were the logical people to enter upon such an undertaking and that the property would naturally be brought to them. Consequently he prepared himself by making preliminary tests of the ore, in order to be able to discuss things when the time should come. In fact, things happened as forecasted.

Curiously, the Bradley process was never tried either at Chino or Chuquicamata. In fact, a plant was erected at Anaconda, for which Mr. Lawson and Mr. Burrage jointly supplied about $750,000. A little more than a year ago this plant was closed, only a trifling quantity of ore having been put through it. However, in spite of the great loss suffered in that venture, Mr. Burrage apparently owes his interest in Chuquicamata indirectly to his interest in the Bradley process, wherefore his venture in that process was not wholy unlucky.

The Chuquicamata mines are now owned by the Chile Copper Co., which has issued $10,000,000 in bonds, and $95,000,000 in stock, divided into 3,800,000 shares of $25 par value. The Guggenheims as individuals had 75% of the stock, and A. C. Burrage the remaining 25%. The cost of the property is said to have been $2,000,000, while the cost of the plant for extraction of its copper will be upward of $13,000,000. The bonds are quoted at 101@102. The stock is not listed, but there are said to have been some private transactions at under $20 per share. Louis Ross claims 10% of Mr. Burrage's stock. So far the development of ore in the property has been about 220,000,000 tons, averaging 2.2% copper, but the engineers are sure that the actual size of the orebody is in excess of what has been so far developed.

Butte & Superior First Quarter of 1914

The Butte & Superior has begun to make quarterly reports. The figures for the first quarter of 1914 follow:

TECHNICAL RESULTS

Dry tons of ore milled	97,590
Average zinc contents	18.546%
Average silver contents (ounces per ton)	10.3913
Zinc concentrates produced	63,560,288 lb.
Ratio of concentration, tons ore producing one ton concentrates	3.07
Average zinc in concentrates	51.73%
Average silver in zinc concentrates (ounces per ton)	26.41
Mill recovery, total zinc recovered in concentrates	90.84%
Mining cost per ton	$3.244
Milling cost per ton	$2.175
Total cost per ton, mining and milling	$5.45

FINANCIAL RESULTS

Net value of zinc concentrates, after payment of freight and smelter charges	$704,780.74
Net value of lead concentrates and zinc furnace residues, after payment of freight and smelter charges	161,539.67
Miscellaneous income	2,895.70
Total net value of products at the mine	$869,216.11
Operating costs	531,974.18
Net operating profits	$337,241.93

The average tonnage was 1084 per day, but the normal capacity of the mill may be taken at 1200 tons.

The figures for zinc concentrates and zinc contents are subjected to slight changes following complete smelting returns. The zinc concentrates also carry small amounts of gold, copper and lead, on which realizations are made eventually. There was produced in addition, 887 tons of lead concentrates running 45.34 oz. of silver and 49.24% of lead, with small amounts of gold and copper.

Earnings are calculated on the basis of 5.14c. per lb. for spelter. Net returns on all products sold correspond at the mine to a gross profit of $8.91 per ton of crude ore. Deduction from this of the operating costs leaves a net profit of $3.46. Crediting all other metals to zinc, the cost per pound of the gross zinc contents in the concentrates was 4.12 cents.

Development work of 4361 ft. was done and reserves increased, an especially valuable find being made by extending the 1400-ft. level beyond the east end line of the "Black Rock" claim into the "Four Johns."

In the mill, a filter press is being installed to reduce moisture in concentrates and thus freight charges.

The report has the following to say about the flotation-patent decision in San Francisco:

Advices have been received of a decision rendered May 4, 1914, by the United States Circuit Court of Appeals for the ninth circuit, sitting in San Francisco, wherein the patents owned by the Minerals Separation, Ltd., were held to be invalid. These patents are the basis of the suit now pending against your company in the Federal Court for the district of Montana. The decision, which is most comprehensive and sweeping in its terms, must effectually dispose of the pending suit against your company and leaves it unhampered in the employment of the metallurgical methods, which were designed and perfected by the engineers of your company's technical staff. While the outcome of the suit as above stated has been confidently expected, it is, nevertheless, gratifying to see an end of the expense and annoyance of the controversy into which your company's name and officials were unwillingly but unavoidably drawn.

The announcement is made of quarterly dividends to begin with the second quarter of 1914 at the rate of $3 per share per annum.

Mr. Jackling on Utah Copper Co.

On Apr. 24, 1904, the Utah Copper Co. began operations in its Copperton mill, in Bingham Cañon. Thus it is only the brief period of 10 years that comprises the whole history of the exploitation of the low-grade porphyry ores. During that time the Utah, Nevada, Miami, Chino, Ray and Braden companies have added thousands of millions of pounds of copper to the world's supply, and the Utah has become one of the world's greatest mines. To D. C. Jackling, more than anybody else, belongs the credit for this.

Some recent remarks by Mr. Jackling to the *Boston News Bureau* are worth repeating. He said:

"We aim to make our annual reports so complete as to every essential financial and physical detail, that there is very little which I can add to the recently issued report for 1913. I might say that it is not probable that the copper yield per ton of ore will ever again be as low as was shown in our 1913 statement—16 lb. It is necessary at times, as a matter of mining economy, to include, as operations proceed in their early stages, a larger percentage of low-grade and foreign material, than will be the case when our stripping has been entirely completed and we are enabled to confine our operations to general run of ore.

"It is interesting to note that the very large expansion which we have made in mill capacity during the past five years has been accomplished without increasing the surface area of our mills. Five years ago one of our great metallurgical plants had a capacity of 6000 tons per day; the other one had a capacity of 3000 tons. In the month of March we treated 24,000 tons per day, or an increase in capacity of both mills from 9000 tons to 24,000, without any increase in roof area. Incidentally, it takes a pretty good mine to keep pace with that increase in mill capacity.

"Nearly a year ago we began to reach the slowing-up point in the rapidly increasing capacity of our concentrators. During the past year's breathing spell we have brought the mine up to the point that it can keep ahead of the milling plants. I never expect to see the time, barring climatic disturbances which do not last long, when our mine is not in easy and comfortable shape to furnish a larger tonnage than the mills can handle.

"Our underground mining has been discontinued for good, and this should enable us to lop off two or three cents per ton from our mining costs, and when it is realized that we are handling 8,000,000 tons of ore per year, a three-cent-per-ton saving amounts to an aggregate of $250,000 per annum.

"I am convinced that we can make a substantial profit in leaching our 40 odd million tons of low-grade and partially oxidized capping, and before a great while I expect that directors will authorize some definite movement in this direction. The anticipated profit from leaching this low-grade overburden will be sufficient to retire the entire capital of the Utah Copper Co. at par, and it should do more than this. I hope we will consider ourselves in shape to determine upon some definite plan in respect to this leaching proposition this year, as all our experiments are about completed."

American Iron and Steel Institute

The spring meeting of the American Iron & Steel Institute was held at the Waldorf-Astoria, New York, May 22. The principal part of the opening session was taken up by the presidential address of Judge E. H. Gary and the comments by members. The president, while admitting that business was not in very good condition at present, pointed out the many encouraging factors in the situation and anticipated an early revival. He dwelt especially on the excellent crops which now seem assured, and on the probability that consumers' stocks were at a very low point, and must soon be renewed. The tone of his address was distinctly hopeful and he advised mutual assistance and coöperation. The discussion following showed rather varying opinions. Charles M. Schwab struck a pessimistic note, which was taken up by a few of the Eastern members, but it was noticeable that most of the members from the Central West were much more hopeful and a number of them joined in expecting an active revival of business in the late summer or the fall.

The technical part of the meeting included the following papers and discussions: "Modern American Blast Furnace Practice," by Herman A. Brassert; discussion by John N. Reese, Arthur J. Boynton, Edward B. Cook and Richard V. McKay; "Some Developments in By-Product Coke Ovens," by William H. Blauvelt; discussion by Carl A. Meissner; "Selling Policy as Influenced by Modern Cost Accounting," by Thomas J. Bray; discussion by Charles S. Robinson and H. D. Westfall; "The Practical Importance of Heat Treatments in the Steel-Wire Industry," by John F. Tinsley; discussion by J. W. Smith; "Transportation," by J. Fred Townsend; discussion by Delos W. Cooke and Thomas O. Cole; "Recent Progress in the Building of Large Steam Turbines," by Francis Hodginson; discussion by H. G. Stott; "Sanitation in Panama and Alabama," by Dr. Lloyd Noland; discussion by Dr. Sidney McCurdy.

At the dinner in the evening, a considerable part of the time was occupied by Dr. Thomas Darlington, secretary of the Welfare Committee, who presented an account of the work which has been done in improving conditions of labor and living in the iron and steel industries. He said that over $9,000,000 had been expended under the direction of the committee during the past year.

PERSONALS

H. E. Jackman has returned to Toronto, Ont., from a professional trip to the West.

J. H. Shockley, of New York, is in Silver City, N. M., looking after his mining interests.

J. B. Tyrrell, of Toronto, Ont., has gone to British Columbia to inspect mining properties.

Frank Sweeney, of the Federal Mining & Smelting Co., has returned to New York from Idaho.

Thomas H. Leggett has returned to New York from a trip to California on professional business.

Percy A. Robbins, general manager of the Hollinger Mine, Ontario, returned from a trip abroad and resumed his duties.

J. Hunt, of the Broken Hill Mining & Milling Co., Vancouver, B. C., sailed from New York, May 23, on his way to England.

Franklin Guiterman has returned to New York from West Virginia, where he was a witness in the inquest on the Eccles accident.

Manager Dickerman, of the Pato Mines (Colombia), Ltd., is in London, preparing an exhaustive report on the Pato property.

R. L. Crittenden and Emmett Culliter, of Butte, Mont., are on the way to the Beaver Lake goldfields, Saskatchewan, where they will spend the summer in prospecting.

H. V. Croll has been appointed sales manager of the American Concentrator Co., Springfield, Ohio. Mr. Croll was with that company at the Philadelphia office for the past two years.

John M. Boutwell has finished his detailed geological survey of the Old Dominion property at Globe, Ariz., and has returned to his office at Santa Barbara, Calif., to prepare the report.

D. C. Jackling, manager of the Chino Copper Co., was a recent visitor to the company's property, at Santa Rita and Hurley, N. M. He was accompanied by a party of New York friends.

Professor F. von Hille will investigate the new mineral discoveries north of the Grand Trunk Pacific and east of Fort William, Ont., samples from which were found to contain nickel and platinum.

R. E. Palmer has given up his residence at the Rio Tinto mines, and has taken up consulting work, with office at No. 3 Lombard St., London. He is still retained as consulting engineer for the Rio Tinto.

W. H. Mosely, formerly drill superintendent of the Chino Copper Co., at Santa Rita, N. M., started from New York, May 23, for the Belgian Congo, Africa, where he will take charge of a large oil-drilling outfit.

Ambrose Monell, president, and W. W. Mein, consulting engineer, of the Dome Mines, have gone to Porcupine, Ont., to inspect the property, and will also look into the International Nickel Co.'s operations, at Copper Cliff.

Oberbergrath Dr. Kolbeck, professor of mining and director of the Bergakademie, at Freiberg, Saxony, is in New York, representing his school at the celebration of the 50th anniversary of the Columbia School of Mines. He is stopping at the Chemists' Club, New York.

Sydney F. Walker, at the recent annual meeting of the South Wales branch of the Association of Mining Electrical Engineers, was presented with a handsome gold watch, by the members of the branch, "as a token of their esteem and respect," in connection with his presidency for the four first years of the existence of the association.

Clement K. Quinn, for seven years chief engineer for the Inter-State Mining Co., the mining subsidiary of the Jones & Laughlin Steel Co., has resigned to manage the operations of a newly formed syndicate of Eastern capital, which will operate on the Lake Superior iron ranges, with offices in First National Bank Bldg., Duluth, Minnesota.

William L. Staley has opened offices at Albuquerque, N. M., as consulting engineer and surveyor. He has practiced civil and mine engineering for over 14 years, seven years in the coal fields of Indiana and Illinois, and over seven years in ore mining, milling, irrigation, power-plant construction and surveying in California and the Southwest.

Edgar F. Smith, provost of the University of Pennsylvania, has been awarded the Elliott Cresson gold medal of the Franklin Institute of Philadelphia, in recognition of his work in the field of electro-chemistry. The presentation was made at Philadelphia, May 20, and at that time Doctor Smith delivered an address entitled "Scientists from the Keystone State." The Elliott Cresson medal is the highest award in the gift of the Franklin Institute.

Paul E. Morse, of the Yuba Construction Co., has moved from Merced Falls, Calif., to Hammonton, Calif., where he is to build two all-steel 7½-cu.ft. dredges that the Yuba Construction Co. is to construct for the Yuba Consolidated Gold Fields. Mr. Morse informs us that he has just finished a 3¾-cu.ft. wooden dredge for the Yosemite Dredging & Mining Co., of Snelling, Calif., doing the construction in the remarkable time of 54 working days, this including the installation of 10 units of Neill's pulsating riffles. This is the first gold dredge in which that apparatus has been installed.

Dr. R. W. Raymond, secretary emeritus of the American Institute of Mining Engineers, addressed a large luncheon meeting of members of the Colorado Chapter of the A. I. M. E., the Colorado Scientific Society, the American Mining Congress, and the Denver Chamber of Commerce, at the Savoy Hotel on May 22. Although suffering with hoarseness, he gave a masterly historical sketch of the formation of the states of the Union and the sovereign rights granted them and recognized by the Federal constitution. His arguments were strong and were a severe criticism of the bureaucratic form of government that now dominates those states that have unsettled domains. He advocated state ownership of all natural resources. May 23, he delivered the principal address at the commencement exercises at the Colorado School of Mines, Golden.

OBITUARY

Prof. Alexander K. Kirkpatrick, of the School of Mining Queen's University, Kingston, Ont., died May 19 at Cape Tormentine, N. B., following an operation for appendicitis. He was a native of Kingston, and a graduate of the Royal Military College and was for some time engaged in railway work in Egypt. He was appointed professor of civil engineering in the School of Mining about eight years ago. A widow and several children survive him.

John Singleton died suddenly at Randsburg, Calif., May 20, while superintending the installation of some machinery at his mines. He was the last survivor of the three prospectors who discovered and located the Yellow Aster mine at Randsburg in 1895. The success of that mine is well known. Mr. Singleton and his fellow prospector Mr. Burcham retained the chief interest in the mine, now of great value. Since Mr. Burcham's death Mr. Singleton had been general manager of the mine.

Francis J. Peck, of Cleveland, O., died at his home in that city May 16 after a brief illness from pneumonia. Mr. Peck was born at West Farmington, O., in 1866. He graduated from the University of Michigan. After being connected with the Mansfield Iron Mining Co., Crystal Falls, Mich., for one year as a chemist and for one year with the Commercial Mining Engineers & Chemists, Chicago, he went to Cleveland and opened a branch office for that organization. He later engaged in business for himself and for many years had made a specialty of the analyzing of iron ore.

SOCIETIES

American Institute of Mining Engineers—The final meeting for the season of the New York Section was held on May 21, at 7 p.m., at Browne's Chop House, 1424 Broadway, New York. Following the brief annual business meeting a beefsteak supper was served, price $1 per plate. At supper Oberbergredakteur E. F. Roeber presided. A Bergmansmannerchor sang the old mining songs of Saxony. Prominent members of the institute told stories of their experiences at Freiberg and Clausthal.

In accordance with the notice sent out Mar. 25, the members of the Chicago Section met at the Sherman House, Tuesday, Apr. 14. After the banquet (Captain Hunt in the chair), the following were elected officers of the section for the ensuing year: Robert W. Hunt, Chicago, chairman; J. A. Ede, La Salle, Ill., vice-chairman; Henry W. Nichols, Chicago, secretary-treasurer; executive committee: Messrs. Hunt, Ede, Nichols and F. K. Copeland, Chicago, G. M. Davidson, Chicago.

Editorial Correspondence

SAN FRANCISCO—May 20

Fresh Troubles in the Potash War which has been waged over the Searles Lake deposits for the last year, have broken out. Henry E. Lee, a San Francisco attorney, who disputes the claims of the Foreign Mines Development Co., has been served with a warrant charging him with embezzling a deed to part of the potash land. Charges and counter charges have been made by the contending interests and Lee has been shadowed constantly by detectives. A detective has been arrested charged with tapping a telephone wire leading into Lee's office. The deed in question was made by Rudolph Waymire to a Mrs. B. D. Comer, of San Francisco. Lee claims to have secured the deed for a consideration and had it recorded at San Bernardino and Mrs. Comer was named as a trustee. Guy Wilkinson, superintendent for the California Trona Corporation, has filed suit for $75,000 against Los Angeles and San Bernardino defendants, alleging that stories regarding his arrest were caused to be circulated and printed in the newspapers of the state, which stories were untrue.

Rights of Oil Operators and Oil-Land Holders, whose claims are based on railroad patents, must be determined by the decision of the U. S. District Court at San Francisco. The Southern Pacific company and other defendants have moved to dismiss the suit, known as "Bill in Equity 46." This is a suit filed by the Government to have declared mineral in character, certain lands described in the patent from the Government to the Southern Pacific R.R. Co. The suit applied to more than 45,000 acres of petroleum and other mineral lands in the State of California. It is probably the most important suit ever brought in California, and possibly in the United States, regarding land values and the issues that must result. The decision is expected to determine the mineral or nonmineral character of these lands. Upon the decision of Judge Dooling in the district court, the case will go on appeal to the U. S. Supreme Court, and there be finally determined. If Judge Dooling denies the motion for dismissal and the supreme court approves that decision, then the determination will be made that these 45,000 acres of land are mineral in character. The lands in controversy embrace a wide extent of rich oil lands, including Coalinga and the Eastside and Westside fields. The aggregate value is scarcely computable. If the Government wins this contention and the lands revert back to Government ownership, the result will be an enormous supply of fuel oil conserved to the Navy. The defendant companies are the Southern Pacific Co., Southern Pacific R.R., Kern Trading & Oil Co., Associated Oil Co., Southern Pacific Land Co., Central Trust Company of New York, Thomas S. King, St. Paul Consolidated Oil Co., Zier Oil Co., Fresno-San Francisco Oil Co., Penn-Coalinga Petroleum Co., Aztec Oil Co., Maine State Oil Co., Associated Pipe Line Co., Section Seven Oil Co., C. F. Iredale, L. L. Briner, Julius Fried, J. J. Vincent, G. E. Shore, Oren G. Meyers, W. S. Porter, W. W. Machem, M. L. Woy and M. Madsen.

DENVER—MAY 21

Golden Cycle Deal Is Off, according to General Manager McGarry. Negotiations for sale of the property to New York and Paris men are not likely to be resumed.

Promotion of Fake Radium-Mining Companies was so well anticipated by the postal authorities that a dozen Denver men have been cautioned and placed under surveillance. Six of these promoters have quit business completely, while the others are seeking cover.

Copper Mining in Colorado would prove a novelty. To be sure the state has been for years credited with a small production of this metal, but the copper has been recovered merely as a byproduct from operations that were conducted primarily to obtain the precious and the other base metals. There is, however, a probability that a mine will soon be opened for the sole purpose of producing copper. A new company bearing the title, Copper King Mines Products Co., owns a group of claims near the line between Eagle and Routt Counties in the vicinity of McCoy, a few miles from the Denver & Salt Lake R.R. Here outcropping sandstone beds are impregnated with carbonates of copper, the metallic content being said to average 4%. Some 50,000 tons of the mineralized formation are exposed naturally. Acting conservatively, the company proposes to install a modest 50-ton experimental milling plant while demonstrating the proper treatment for the ore and the permanency of the deposit. A 400-ft. shaft exposes ore continuously.

SALT LAKE CITY—May 21

A New High Record of Copper Production was made by the Utah Copper during April, when 13,133,770 lb. copper were produced. During March the output was 12,704,220 lb. The Arthur and Magna mills in April averaged over 24,000 tons per day, handling up to 25,000 tons. Up to 33,000 tons of ore was loaded at the mine in one day, and, including overburden, 65,000 tons of rock and ore are handled daily. The maximum amount handled in one day was 74,000 tons.

Increased Shipments to Valley Smelters are coming in from some of the camps, which have been unable to market ore during the winter. The ore market in general is good. There is little zinc ore being shipped at present from Tintic or elsewhere on account of the low price of spelter. Some uranium and vanadium ore, carnotite from Grand and Emery Counties, is being shipped East. There is little gold ore coming in at present. Beside the silver-lead ore from Park City, Bingham and local camps, some shipments are being received from Nevada and Idaho. Lead ores have been stockpiled at different plants. The production of copper ore from Bingham is increasing, and from other parts of the state is about normal.

HOUGHTON—May 22

Changes in Calumet & Hecla Concentrating Methods have increased efficiency. Change after change has been made in the milling methods and each one has added to the profit of the company without adding to the cost of operation. What is more important than any other detail, however, is the fact that these various improvements have made it commercially possible to mine a lower grade of copper rock. When the new leaching process is in operation successfully and has been tried out slime tailings, when discharged, will contain only 2 lb. of copper.

Little Tamarack Stamp Mill has been remodeled completely and it ought to be able to crush close to 1300 tons of rock daily. Allouez shipments to the mill will begin June 10. The mill will more than care for the output of the Allouez at present, although the mine is in shape to increase this total substantially and will continue to make some shipments to the Point Mills plant. The change over to the Tamarack mill will be an advantage to the Allouez company as there will be a good saving in freight charges, the rock haul being less than half as long as to Point Mills, a saving of 5c. per ton in freight costs.

Plethora of Labor in the Copper Country continues. In fact, labor in this district is augmented each week by fresh arrivals of skilled miners from the iron districts of Minnesota and the upper peninsula of Michigan. The result is that the mines here now are employing the largest working forces in their history and the rock tonnage now going to the stamp mills is as heavy as at any time in the past, with every indication that by July the rock production as well as the copper output will break all previous records with the possible exception of the 1909 totals. The slackening up of the iron-mining industry has resulted in an influx of many good Cornish miners. In addition to these men many have returned from Cornwall. In some of the iron districts the number of idle men is so great as to be a positive menace to the peace of the community. Whereas a few months ago many of the workmen of this district were on strike and refused to go to work, they are now the most ardent in seeking employment of any kind. In fact, there are more workmen than places. Last week 200 of the idle men gathered on the lakeshore at Hancock and passed resolutions demanding that the county board of supervisors give them employment or provide them with funds. Calumet & Hecla is taking advantage of this opportunity in every possible way. Now the rock tonnage is greater than ever before and the force of men at work underground is larger than ever. In addition to making new records in rock tonnage the development openings are being increased. For the first few months immediately following the strike comparatively little work in the way of new openings was done, all of the energy of the underground men being devoted to the task of making the rock tonnage as substantial as possible, compared with the force at work underground. While the general average of the Calumet & Hecla rock is bound to continue to show a decline each year in the copper recovery the fact is that the falling off is not as serious as most people might suppose. Of course, the total tonnage from the rich Calumet conglomerate lode is being cut down each year as the old shafts near their boundaries, and this lode itself shows a declining copper yield at greatest depth. This is offset, in a measure, by some of the rich rock which comes from upper levels where pillars in the grade of rock that used to run from 50 to 90 lb. per ton are being taken out. While the conglomerate tonnage is constantly becoming less the Osceola and Kearsarge lodes are increasing all the time. It must be said that both of these lodes are gradually improving in appearance in the newer openings on the Calumet & Hecla territory proper.

MARQUETTE—May 22

Shipments of Iron Ore This Season, unless there is a decided improvement in trade conditions, will make a sorry showing in comparison with the outgo the two preceding seasons, this notwithstanding a great cut in prices. Whereas 50,000,000 gross tons went out in 1913 and 48,000,000 tons in 1912, it is estimated that as affairs stand now there can be little hope of a movement much in excess of 30,000,000 tons. Conditions are similar to the season of 1911, when the outgo dropped from 43,500,000 tons in 1910 to 32,750,000 tons, and to the season of 1908, when after 42,000,000 tons had gone out in 1907 the shipments fell to 26,000,000 tons. As the mining men see it, the depression is due to two equally important causes: First, the reduction in the tariff, which has stimulated imports of foreign-made furnace and mill products, and, second, the unfortunate position of the railroads, which has closed to iron and steel an important consuming channel and which there is eager hope will be relieved by the forthcoming decision of the Interstate Commerce Commission in the Eastern freight rates issue. In view of the uncertainty as to market conditions, none of the mining companies, big or little, has made any definite plans for the season. It is realized that the recently announced reduction in ore prices will stimulate demand, but it is conceded generally that there will be no extensive buying unless business conditions improve decidedly. It is pointed out that in 1908, notwithstanding a decline in prices of 50c. per ton for all grades compared with the schedule in 1907, the shipments dropped nearly 40%. On the other hand, when in 1912 ore prices were cut from 65c. for nonbessemer and 75c. for bessemer, in comparison with the quotations prevailing in 1911, the outgo from the Lake Superior region doubled in volume. This year, after having ruled in 1913 on a basis of $4.40 for old-range bessemer and $3.60 for old-range nonbessemer, the prices have been cut 65 and 55c., respectively, to the schedule prevailing in 1912. Since 1900, only in 1904 have quotations been lower and only in 1912 and 1905 have they dropped to the existing level. The small furnaceman, the one owning no mines, is benefited. It puts him in position to seek business on a par with the manufacturing interests possessing their own supplies of ore. But in any event, even if there be an extensive business revival the next few months, the shipments from the mines will not approach the outgo recorded in either the last two years. With the season well advanced, the movement to date has been of discouragingly small proportions. It would require great activity to catch up. Of this activity there are as yet no indications. Since the mines this year will receive much lower prices for their product, amounting on a shipment of 35,000,000 tons to $20,000,000 to $25,000,000, and since for some properties profits have almost reached the vanishing point, there is some apprehension lest wages will he reduced. In this respect there is anxiety as to what the Steel Corporation will do. The entry of this company brought to the Lake Superior region a stability never known before. Its policy has, in the main, been followed by the other operators. Should the corporation decide to scale down wages, there is little doubt it would be the signal for a general movement in that direction. Thus there are anxious eyes turned hoth toward New York and Washington. There have been intimations the Steel Corporation was considering the question of a wage decrease. It is, however, believed no action will be taken pending the outcome of the freight-rate controversy. Then, if the contention of the railroads is upheld and there ensues a rush to buy iron and steel, it is considered in mining circles that wage scales will be maintained on the present basis; otherwise, it is the belief a paring down will inevitably follow. In general, the mines are operating on a quiet basis. A few properties that shipped last season have been closed. Others have reduced forces somewhat. There has, however, been no extensive curtailment, the most important retrenchment having taken place recently on the Gogebic range when the Steel Corporation dispensed with the services of hundreds of men. But there is fear that unless ore begins to move briskly working forces will be pruned considerably. At many mines stockpiles are becoming so large there is looming up the likelihood that it will be necessary to restrict outputs. Dissatisfied with prevailing prices, some producers decline to sell. One such is the Volunteer Ore Co., at the head of which is Thomas F. Cole, of Duluth, formerly president of the Steel Corporation's subsidiary, Oliver Iron Mining Co. No work is being done at the Volunteer company's property in the Cascade district of the Marquette range other than diamond drilling. Usually at the opening of the shipping season the mines increase forces. The reverse is true this year.

JOPLIN—May 23

Sale of the Oronogo Circle to Turner & Co., of New York, was concluded May 16. The Oronogo Circle, at Oronogo, is the largest producing property in the Joplin district and with the longest and largest record of production of any mine so far opened up in the field. The consideration, although not made public, is known to have been approximately $500,000. The previous owners were Moose & Platt, of Chicago, Ill. The property consists of 126 acres under lease from the Granby Mining & Smelting Co. The tract is in the heart of the famous old Oronogo camp which has been mined ever since the first discovery of ore in the Joplin district. It was from this tract that the first "grass roots" lead discoveries were made and which resulted in the early rush to the mining fields. The camp was then christened Minersville but later was changed to its present name, Oronogo. The first mining activity was directly after the Civil War. The record of production from this lease alone is in excess of $5,000,000 and much of the record of the early production has been lost. Since the present going concern has had charge of the lease the output has been slightly over $3,000,000. Ruhl & Shanklin, the engineers who examined the property for the purchasers, estimated the ore reserves at a little over 5,000,000 tons. Operations are being conducted at a number of shafts and all the ore milled at a central milling plant. A. J. Burnham who has acted as general manager for the property for the last five years will be retained by the new owners. The consummation of the deal at this time has created the first real optimism the district has experienced for some months.

TORONTO—May 23

First Strike of Oil at Calgary was made May 14, at the Dingman well, near Okotoks, 36 miles south of Calgary. It created great excitement and there was a rush to subscribe for stock in the companies recently organized, many hundreds of thousands of dollars changing hands. The stock of the Calgary Petroleum Products Co., owners of the well, rose suddenly from $12.50 to $200 per share. Scores of new companies were organized and 100 new brokers' offices opened within a few days after the discovery. A statement by O. G. Devenish, president of the Calgary Industrial Bureau, credits the well with a production of from 150 to 200 bbl. per 24 hr. of oil 62° Baumé. In addition to the oil, the natural-gas output is estimated at 2,000,000 cu.ft. J. S. Dennis, assistant to President Shaughnessy of the Canadian Pacific Ry., stated that there was no douht that a genuine strike had been made. The oil, he added, is shown by analysis to be of exceptionally high grade. The Canadian Pacific owns oil rights in many thousand acres in the district. The province of Manitoba has taken steps to prevent investors being defrauded by wildcat companies such as usually flourish during a period of speculative excitement. Judge Robson, Public Utilities Commissioner of the province, refused to give permission to a number of brokers who came from Calgary, to sell their stocks. No oil stock will be allowed to be sold until the corporations who wish to place it on the market satisfy Judge Robson that it is not of a speculative character and represents a bona fide well. They must also submit a financial statement showing that the enterprise is on a sound basis. When these conditions are complied with a certificate will be issued, allowing the stock to be sold. A representative of an English company which has been for some time negotiating for the purchase of extensive oil rights in Northern Alberta, and is stated to be prepared to expend $2,000,000 in a systematic exploration for oil is now on the way to Canada.

The Mining News

ALABAMA

Etowah County

ALABAMA CO.—Attala ore mine of this company has been reopened after a long shut-down, giving employment to 200 men.

Jefferson County

GULF STATES STEEL CORPORATION (Birmingham)—Gadsden plant is to be operated by electricity purchased from Alabama Power Co.; $40,000 worth of electrical machinery is to be installed.

Madison County

NEW YORK-ALABAMA OIL CO. (West Huntsville)—Drilling will be resumed. There has been no work done on well for more than two years, owing to various difficulties, including loss of a string of tools, breakage of machinery, etc. Well is 2600 ft. deep and has been in Trenton limestone for 800 ft. Oil is looked for below this limestone.

ALASKA

ICE HAS GONE OUT OF TANANA RIVER and sluicing season has begun on all creeks. Johnson Bros., on No. 22 Goldsteam, were first operators to start sluicing.

COAL FROM MATANUSKA will be brought out by Pacific-Alaska Navigation Co., as armored cruiser "Maryland" is in Mexican waters and unable to go to Alaska to test steaming qualities of coal from Matanuska mines. Contract has been let for bringing 900 tons of coal to Seattle. When S.S. "Admiral Sampson" returns June 2 she will have all or a large part of consignment now being brought to Knik, water terminal of Matanuska coal fields. Coal will be brought down from Knik in barges prior to "Sampson's" arrival and stored aboard S.S. "Bertha" lying off Fire Island. Coal will later be stored in Government coal docks at Puget Sound navy yard until such time as it can be properly tested. "Maryland" has been officially designated to test Alaska coal, her officers and crew being skilled in this kind of work, and she is in regard to coal consumption most economical vessel of her class.

SHAW & BOYD (Fairbanks)—These operators are lessees on claims lying at head of Little Eldorado Creek and owned by Ready Money Mining Co., of Fairbanks. They have started hauling ore for a test in Newsboy mill.

WICKERSHAM BENCH (Fairbanks)—First cleanup of season in Fairbanks district was made by Patterson, a lessee on this claim on Eva Creek. Ice interfered to some extent with both sluicing and cleaning up, but it is reported that returns were satisfactory. Sluicing in greater part of district was held back by cold weather until first week of May.

FAIRBANKS GOLD MINING CO. (Fairbanks)—Dredge on No. 8, above Fairbanks Creek, will be put in operation as soon as weather permits. A shipment of machinery for some much needed alterations and repairs is on way from "Outside." This includes a tailings elevator to prevent crowding of stern of boat by tailings, as has happened with centrifugal pump used.

CHENA RIVER DEVELOPMENT CO. (Fairbanks)—J. F. Struthers, manager, left Fairbanks in May for property on Palmer Creek, in Chena River district. Ten men and a "Keystone" drill were taken in. Cabins for accommodation of staff and crew were erected during April and a large quantity of supplies for summer's work was transported over snow. It is intention of manager to confine attention to exploratory and development work, with expectation of moving machinery necessary to work ground on a large scale to claims over snow next winter.

ARIZONA

Maricopa County

BUFFALO-ARIZONA (Morristown)—Operations will be resumed.

BLACK BUTTE GOLD & COPPER MINING CO. (Arlington)—Operations have been suspended for summer.

RELIEF (Peoria)—A set of rolls is being installed to crush ore for treatment in cyanide plant. Underground work is to be resumed.

MONARCH (Wickenburg)—It is reported that work will be resumed. It may be necessary to make repairs to pipe line before mill can be operated again.

SUNSET (Aguila)—Mill which is on south side of Harqua Hala mountains has been placed in commission. Custom work will be done by John Devine, one of the owners.

CALIFORNIA

Amador County

PACIFIC (Plymouth)—New electric hoist is being installed as old equipment was inadequate.

DEFENDER (Defender)—Steam equipment for operating mill has been replaced by a gasoline engine. Cyanide plant to treat tailings dump is now in operation.

ARGONAUT (Jackson)—It has been practically decided to erect a 50-stamp modern mill, 500 ft. above present shaft. Tube mills to be used for regrinding. New headframe is to replace old wooden structure.

Calaveras County

ROYAL CONSOLIDATED (Hodson)—This property, which has been in litigation for last six years, has been sold to Eastern men and it is reported that operations will shortly commence.

KEENO (Parrotts Ferry, A. C. Atherley, San Francisco, manager)—This property is reported bonded to Calaveras Gold Mining, Milling & Development Co., which will proceed to open up old workings.

Eldorado County

UNION (El Dorado)—It is reported that San Francisco men have taken a bond on this property. It is equipped with 60-stamp mill, and was formerly a large producer.

ENSLEY (Fair Play)—W. J. Neale, representing Englishmen, has bonded this property together with Michigan placer claim, adjoining Slug Gulch hydraulic properties. Same interests have also taken a bond on Eureka quartz mine at Cummings and will begin operations.

Kern County

SUMNER (Kernville)—Station at 240 level in new three-compartment shaft has been opened up.

Nevada County

DISTRICT ABOUT COLUMBIA HILL, formerly a great hydraulic camp, is being inspected by representatives of dredging interests with view of installing a dredge.

PREMIER (Grass Valley)—It is reported that 5-stamp mill will be erected.

EMPIRE (Grass Valley)—Twenty stamps are being added to present equipment and new hoist will be installed.

OUSTOMAH (Nevada City)—Shaft is being deepened beyond 1050 level and drifting on 300 is under way.

CASSIDY (Grass Valley)—Preparations for reopening this former producer are in progress. Property adjoins the Empire.

San Benito County

PACIFIC QUICKSILVER (Little Panoche)—Furnaces are working full capacity and new unit will be installed to increase capacity to 30 tons daily.

Sierra County

MONARCH (Sierra City)—It is reported that 15-ft. vein has been encountered in shaft. Company contemplates adding 10 stamps to present mill.

KATE HARDY (Forest)—Three-stamp mill resumed operations. Shaft will be deepened from present 50-ft. level.

RAINBOW (Alleghany)—Development work in upper working continues encouraging. New mill will be started soon.

PLUMBAGO (Alleghany)—New Ingersoll-Rand air compressor has been installed; 20-stamp mill now running full capacity.

Sonoma County

SONOMA MAGNESITE CO. (Cazadero)—Sale of this property has been made to Chicago men, who will do development work. Wagon road has been built to property. It is reported work will be begun on installation of calcining plant.

Tuolumne County

HOPE (Sonora) Five-stamp mill to be operated by gasoline engine is being built.

Trinity County

BONANZA KING (Carrville)—A tunnel one mile long will be driven to intersect vein under present workings and obviate use of aërial tramway. Three shifts will be employed.

COLORADO

Denver

DEISTER CONCENTRATING CO.—Through its attorneys, Taylor & Hulse, company has filed suit against Deister Machine Co. in U. S. district court for District of Indiana, for infringement of patent issued to Gustave Overstrom and purchased by Deister Concentrator Co. Complaint cites that Deister Machine Co. is using a certain feature on its concentrating tables called a "plateau," and is also endeavoring to place this feature on tables of other makes. It is claimed that so called "plateau" is an infringement on Overstrom patent.

Boulder County

SOUTHERN ILLINOIS (Gold Hill)—Modifications in machinery in mill have been made and operations will be started soon. Wood flotation scheme will be used.

Clear Creek

EMPIRE TUNNEL (Empire)—Retaliating for libel suits aggregating $300,000, recently filed, defendants Charles E. Hyman, Henry Apple, William H. Bunge and D. S. Baird have filed countersuits for $200,000 against William H. La Plant, J. R. Patty and M. P. Ryan. Troubles arose among these directors over control of stockholders' meeting. Among allegations are conspiracy in sale of stock, mismanagement, and an illegal granting of a 100-years' lease on property.

Dolores County

RICO-ARGENTINE (Rico)—Investigations of new methods of concentrating this complex ore will be made. It is understood that a short lease has been taken on Pro Patria mill for such work.

Eagle County

FULFORD DISTRICT is attracting prospectors despite deep snow that blockades roads. Men travel on snowshoes. Claims are being staked even where snow lies deep. There are no accommodations in camp.

Gilpin County

EAST NOTAWAY (Central City)—Square Deal Gold Mining Co., owners, are defendants in suit started by owners of adjoining property for removal of ore beyond lines.

ROCKY MOUNTAIN CONCENTRATOR (Black Hawk)—Plant is being remodeled to handle custom ores. Equipment will include jaw crushers, stamps, and an original concentrating table for which unusual capacity is claimed.

GILPIN-EUREKA (Central City)—Rens E. Schirmer, manager of Newhouse tunnel company, and associates have acquired this mine from bankrupt owners and have served notice on all lessees to vacate by June 1. It is presumed that new owners will operate and perhaps drive connections from tunnel.

Gunnison County

TIN CUP GOLD DREDGING CO. (Tin Cup)—New dredge was run 354 hr. during April, recovering 28 oz. gold. Ground was badly frozen and early run was made for trial purposes. Ground is expected to yield 30c. per yd. Operations will be resumed now that ground has thawed.

La Plata County

CAVE BASIN DISTRICT will be busy with prospecting soon as snow is gone. For last two weeks there has been rain or snow every day, thus delaying activities.

DOWELL (Cave Basin, via Ignacio)—Work is progressing and tunnel is expected to cut ore exposed in Dowell shaft within one month. Many large boulders of high-grade silver-copper ore have been found in wash through which this tunnel passes.

San Juan County

RAILROAD TO GLADSTONE is now open. Fifty cars of concentrates are ready to be moved from Gold King mill.

HERMES (Animas Forks)—Lower drift has broken into same character of high-grade ore already opened.

San Miguel County

TOMBOY (Telluride)—Company will use a four-ton General Electric mine locomotive in its mines.

BLACK BEAR (Telluride)—George E. Farish and W. A. Dunn have completed examination for Eastern men.

MICHIGAN

Copper

CHAMPION COPPER CO. (Painsdale)—Three four-ton General Electric mine locomotives have been purchased.

CALUMET & HECLA (Calumet)—New electrolytic refinery at Lake Linden, Mich., has been put in operation and smeltery and refinery at Buffalo, N. Y., will soon be dismantled. Grading for a leaching plant has been commenced at Lake Linden. This plant will be for extraction of copper from slime tailings of regrinding mill and a process will be used that has been developed by Mr. Benedict, nature of which has not yet been disclosed.

Iron

TRADERS (Iron Mountain)—A force of 150 men is now employed getting out ore at this pit mine. Antoine Ore Co., operators, will send out 100,000 tons this season.

MONROE (Norway)—Rogers-Brown Ore Co. will open this property at an early date as sale of a small quantity of ore has been made. Force that will be engaged will not be large.

REPUBLIC (Republic)—Shareholders of Cambria Steel Co. will meet June 10 and vote on proposition of selling Republic mine to Cleveland-Cliffs Co. It is believed that deal will go through.

ATHENS (Negaunee)—Good headway is being made in sinking shaft by Cleveland-Cliffs Iron Co., but it will be two years before production will be started, ore lying at a depth of 2200 feet.

HURON MINING CO. (Iron River)—Machinery, buildings and all equipment of this company were sold at auction last week and purchased by Lake Erie Ore Co. for $14,461. Company has 60 days in which to move property, but where it will be taken has not been decided.

RICHMOND (Palmer)—This is only mine from which M. A. Hanna Co. is shipping ore, a contract having been made several years ago. Richmond is an open pit and ore is exceedingly hard and difficult to mine. Ore is siliceous and low-grade, but is mined cheaply compared with the underground mines on Marquette range.

PORTLAND (Michigamme)—Hoose & Person Construction Co. has been given a contract to mine ore that has been sold from this property for this season's delivery. Steam shovels and other equipment will arrive within a few days and work will be started getting out 100,000 tons. A few men are now working in pit getting tracks, etc., in shape. Mine has not been worked since 1912, when 60,000 tons was shipped. Ore is hard limonite and greatly desired at some furnaces.

MINNESOTA

Duluth

A RIOT AT EVELETH was started by several hundred unemployed miners, mostly Italians, May 18. Rioting continued on streets of Eveleth and at Fayal mine nearby. Mob demanded at least 10 days' work per month for single men and 15 days for married men. Red flag was prominent and acts of vandalism took place. Men working on streets were forced to stop, and local mining operations were temporarily demoralized. Special officers of Oliver Iron Mining Co. were hurried to scene from all parts of Mesabi range, and these, in conjunction with local police, quelled disturbance, at least temporarily. A number of the ringleaders were arrested and fined, others are being held for possible deportation. Eveleth, as well as other Mesabi range cities, is making every effort to supply bona fide residents with work, and much street paving, sewer work, etc., are being carried on to take care of unemployed.

APRIL ORE SHIPMENTS—Following is tabulation of 1914 ore sent forward in April, as compared to 1913 figures:

	April, 1913 Tons	April, 1914 Tons
Superior, Wis.	252,875	62,338
Escanaba, Mich.	217,029	110,729
Duluth, Minn.	160,372	......
Two Harbors, Minn.	145,136	55,781
Ashland, Wis.	53,481	40,838
Marquette, Mich.	37,494	......
	866,387	269,686

This shows 1913 shipments exceeding 1914 shipments for same period by 596,701 tons. It will be noted that no ore went forward from Duluth docks during April. Shipments over these docks thus far in May indicate that 1914 May tonnage will nearly equal 1913 tonnage for same month. Soo Line and Northern Pacific docks at Superior handled no ore in April, entire tonnage shown going over Great Northern docks.

HEARING ON ORE RATES was begun before Interstate Commerce Commission at Washington, D. C., May 21. This is upon petition of independent ore people for a reduction in rate from 60c. Previously same rate to lake ports was 80c., but roads understood to be controlled by Steel Corporation reduced it voluntarily to 60c. Independents claim that even this rate of 60c. is excessive. In opposition to this roads claimed that roads from Mesabi range are good only for hauling ore, and as ore is gradually shipped away roads are being "scrapped." The two Steel roads are Duluth & Iron Range and Duluth, Missabe & Northern. They transport two-thirds of ore mined. Testimony dealt with whether roads can be used for anything other than hauling ore. Complainants called to stand several witnesses to show that agricultural possibilities of country are sufficient to make roads profitable after all ore is mined. In testifying in regard to the movement of iron ore from mines to Head of the Lakes Rukard Hurd, secretary of Minnesota tax commission, stated that in his opinion there will be greater development of iron-ore lands in Minnesota. Hurd gave figures showing that shipments of ore from Minnesota mines from 1907 to 1913, inclusive, were 200,000,000 tons, but that visible supply, as shown by tax commission's records, had increased from 1,190,000 tons in 1907 to 1,413,000 tons in 1913. L. B. Arnold, land agent of Duluth & Iron Range Road, testified that his department was being run at a loss. He said that grant of swamp lands to road from state amounted to over 600,000 acres, but that 500,000 acres were undisposed of. This land, he said, was being taxed $4 per acre, and other expenses exceeded annual revenue of $100,000 from timber sales. A. J. McGuire, superintendent of Northeast experiment station at Grand Rapids, testified as to availability of land in St. Louis, Lake and Cook Counties for agricultural purposes. He said that on such lands as were adapted to agriculture, production of crops was about as good as average in other parts of state.

Cuyuna Range

ROWE (Riverton)—About 100 men are at work. Company expects to ship 400,000 tons this year; Soo Line spur completed into pit.

BARROWS (Barrows)—Shipments are 40 carloads per day from stockpile. Accumulated stockpile will be shipped promptly. This ore is first this season to be handled through Northern Pacific dock at Superior.

LONGYEAR EXPLORATION CO.—Company is exploring Crow Wing County poor farm on an option of lease. Second hole drilled recently encountered a small amount of iron ore of only fair grade, 52%. Property is considered promising.

BRAINERD-CUYUNA (Brainerd)—Second shaft has penetrated to quicksand strata; 40-ft. steel piling is being used to get through this zone. First shaft started by company was lost at same horizon on account of quicksand and water.

WILCOX (Brainerd)—New drop shaft is but 32 ft. from ore. Several structures are being erected on newly plotted townsite of Woodrow nearby and preparations are being made for construction of Northern Pacific spur to mine and town.

CUYUNA-MILLE LACS (Crosby)—Company is still stockpiling, but contemplates loading stockpile by steam shovel soon. E. E. Marshall, president of American Manganese Mfg. Co., of which Cuyuna-Mille Lacs is now a subsidiary, states that all plans in connection with merger have thus far worked out satisfactorily.

Mesabi Range

WISCONSIN STEEL CO. (Nashwauk)—Plans have been perfected for erection of a $50,000 steel and concrete machine shop. A new office building will also be erected.

WEED (Aurora)—American Bridge Co. has a force of men at work constructing a steel shaft-house. Shaft, recently completed, will begin shipments before season ends.

PICKANDS, MATHER & CO., (Hibbing)—Company has offered prizes to residents of its Utica and Albany mine locations for best-kept lawns and gardens. Oliver Iron Mining Co. is also preparing to allot portions of its surface to its employees for such purpose.

Vermilion Range

PARTITION SALE OF A MINERAL TRACT has been ordered by district court at Duluth at instance of owners of certain fractional interests.

PIONEER (Ely)—On May 14 working force was reduced by half, 150 men being laid off.

SOUDAN—Main shaft will be sunk 300 ft. further, or a total of 1900 ft. Stuntz shaft will also be deepened 300 ft. more, or a total of 1100 ft. These are deepest shafts on Vermilion range.

MONTANA

Broadwater County

OHIO KEATING MINING CO. (Radersburg)—A campaign is on foot among stockholders to pay a voluntary assessment on nonassessable stock to raise funds for building a mill, rather than bond or mortgage property. That plan, however, will probably be resorted to by majority stockholders should any considerable number of stockholders refuse to pay an assessment.

Madison County

CORBIN COPPER CO. (Butte)—It is rumored that another company is to take over Blowout mine at Rochester which has been under bond and lease to Corbin company. In sinking shaft Corbin company tapped water which pumps were unable to handle and which caused troublesome caves in shaft, making further development expensive. Resources of company had been taxed recently by obligations incurred in purchase and operation of Gambrinus mine at Butte.

Deer Lodge County

HOLDFAST (Georgetown)—On May 11 main shaft of this mine caved, breaking all the way from surface to 200-ft. level. Men working in mine escaped through an old incline shaft. Mine is near Southern Cross, and has been successfully worked by lessees for several years. Regular shipments were made for some time of good-grade ore. Cave-in will necessitate sinking of a new shaft.

DEER LODGE VALLEY FARMS CO.—Anaconda company has organized this company to which it has deeded its 5180 acres of agricultural lands situated between Butte and Anaconda. Lands were transferred for nominal consideration of $112,300. This land is to be sold to employees on easy-payments, and company will finance and assist in developing small farms. Company has also transferred its timber lands in Ravalli, Sanders, Missoula and Powell Counties to a new corporation known as Blackfoot Land Development Co. at a nominal price of $2 per acre. This land is also to be sold to actual settlers on easy terms.

WASHOE WORKS (Anaconda)—Works on new 2000-ton leaching plant at this Anaconda Copper Mining Co.'s plant is progressing so rapidly that Manager Mathewson felt justified in announcing completion of plant by next spring. New slime concentrator is proving successful. Plant turns out 300 tons of concentrates per day. Coal-dust plant for drying and grinding coal into fine powder will be ready for use by July 1. In meantime reverberatory furnaces are being remodeled to be fired with coal dust instead of lump coal, which is expected to result in a great saving of fuel besides introducing many other advantageous features.

Silver Bow County

EAST BUTTE (Butte)—On Apr. 30, company paid $100,000 on its indebtedness, leaving a balance of $500,000.

BUTTE MAIN RANGE (Butte)—Sinking of Sinbad shaft from 750- to 1200-ft. level will be started at once. At same time stoping will be done on 700 level, ore from which is expected to pay for development work. All necessary machinery has been secured. Properties are in eastern part of Butte district.

BUTTE-BALLAKLAVA (Butte)—An important strike was recently made on 1600-ft. level when 170 ft. from shaft a vein 16 ft. wide was cut; ore being rich in copper and silver. Half of vein is first-class ore. Discovery is important in that it disclosed a larger and high-grade orebody much farther west than had been known. Drifting will be started at once.

DAVIS DALY (Butte)—Shaft sinking at Colorado mine was begun May 7, with intention of sinking to 2600-ft. level. It is estimated that this work will be completed by December when crosscutting will be started from intermediate levels to explore new territory toward Belmont. Funds for work will be furnished by assessment which will be paid in two installments on June 1 and Oct. 1.

ANACONDA (Butte)—H. D. Hawks, of United Metal Selling Co., has been appointed to take charge of mining exhibit of company at Panama-Pacific exposition at San Francisco next year. He is making an inspection of Butte mines, Washoe works at Anaconda and smelting plant at Great Falls to collect data of company's operations in its various mines and plants which will permit him to plan exhibit as outlined by C. F. Kelley upon his return from a recent visit to San Francisco.

BUTTE-DULUTH (Butte)—All previous records of production were broken in April. Total number of tons mined and milled was 3464. From this, 78,380 lb. of electrolytic copper and 22,000 lb. of cement copper were recovered with an acid consumption that was 15% less than in any former month. Three of the five new leaching vats are in place and other two will be by end of month. Including a new battery of 10 cells, 40 cells are now in operation in electrolytic plant. New crushing plant is nearly ready for starting, and with all improvements it is expected cost of copper production will be materially reduced. Open-cut mining will be modified by breaking ore down to a tunnel driven below orebody and by hauling it to top of crusher plane by electric locomotives.

BUTTE & BACORN COPPER CO. (Butte)—Frank Whitman controls 49,500 of 5,000,000 shares of Butte & Bacorn, and he has brought suit in intervention in district court to prevent leasing property to F. W. Bacorn for 30 years as agreed upon by directors in a recent meeting. Complaint asserts that Bacorn and other directors made lease to Bacorn with an 8% royalty on ores; that this royalty should have been at least 20% on smelter returns; that 30 years is an unreasonable length of time, allowing lessee to exhaust ore in properties of company. It is also charged that directors who gave lease to Bacorn are to share in profits; that lease does not contain any provisions whereby operations of lessee can be controlled or checked; that in general terms of lease are grossly unfair to company and its stockholders. Suit brought by F. W. Bacorn against company in which Whitman seeks to intervene, is an unusual one, action having been brought to quiet his title to lease in question, against claims of company to have some interest and right in said lease. According to Whitman's complaint company defaulted.

NEVADA

Clark County

GOODSPRINGS PILGRIM MINING CO. (Goodsprings)—Company has been incorporated under laws of Nevada to operate Pilgrim group, one mile north of Yellow Pine. Mixed lead- and zinc-carbonate ore has been developed.

BOSS (Goodsprings)—Material for aërial tramway is on ground, and erection will begin at once. When tramway is completed, copper ore will be shipped to Salt Lake smelters, and it is expected that a test-plant will be erected this summer for treatment of gold ore, low in copper.

MOBILE (Goodsprings)—New aërial tramway, 2600 ft. long, is nearly completed and it is expected that shipments of ore will be going forward before June 1. Ore is zinc carbonate, carrying some lead and silver, and will be shipped crude. Motor trucks will be used from mine to Roach.

POTOSI (Arden)—Property, now operated by Empire Zinc Co., is shipping 25 tons per day of zinc-carbonate ore to Eastern smelters. Three Saurer motor trucks are in operation, hauling ore from mine to Arden, 20 miles; one trip being made per day per truck. A considerable tonnage of ore has been developed on lower levels, and it is expected that a steady production will be maintained.

MILFORD (Goodsprings)—Stebbins dry process 50-ton concentrator is completed, and test runs are being made. Ore and mill products will be hauled from mine to Roach, a station on San Pedro, Los Angeles & Salt Lake R.R., a distance of 12 miles, and motor trucks have been ordered for this purpose. It is expected that both lead and zinc concentrates will be produced, crude ore being mixed lead and zinc carbonate, carrying some silver. A tramway has also been constructed from upper workings to mill, and a gasoline hoist will be installed.

YELLOW PINE (Goodsprings)—New two-compartment inclined shaft has made connection with 500-ft. level, and will be sunk 200 ft. further. Some ore has been encountered in shaft, but main orebody will not be reached until a further depth of 150-ft. Mill continues to operate but two shifts, treating only low-grade ore from dumps and fills, practically no ore being mined, pending completion of shaft. A new Fairbanks-Morse air compressor has been installed. A dividend of 1% per share was paid Apr. 25, but dividend for May was passed, owing to extra expense incidental to sinking.

Elko County

FLAXIE (Jarbidge)—New vein has been opened by 60-ft. crosscut. Good tonnage of milling-grade ore has been developed in original vein. Some high-grade ore has also been shipped.

KERR & PETERSON LEASE (Bullion)—Creditors have signed agreement to put business in hands of L. O. Henderson, who has been appointed trustee, and proposed litigation has been avoided. Mine will be operated under direction of R. T. Pierce, of Ely, and ore will be hauled to either Raines Siding, on Palisade R.R., or Van Dillon siding on Western Pacific.

Esmeralda County

DARMS COAL MINING CO. (Coaldale)—Sinking of inclined shaft, now 326 ft. deep, will be resumed.

C. O. D. CONSOLIDATED (Goldfield)—Operations have been resumed after two-weeks' shutdown on account of compressor troubles.

YELLOW TIGER (Goldfield)—Arrangements are being made for resumption of operations. Work, for present, will be confined to drifting on 700-ft. level of shaft.

SANDSTORM-KENDALL (Goldfield)—First car of ore shipped recently gave returns of $76 per ton from Hazen sampler. Two more cars, assaying $100 at mine, have been shipped.

Humboldt County

RYE PATCH (Rye Patch)—It is reported that this property will be reopened.

ROCHESTER MINES CO. (Rochester)—It is stated that agreement has been reached between Joseph F. Nenzel, John F. Cowan and William Pitt. Reported terms are that Nenzel will sell 270,000 shares of stock to Cowan and Pitt for 45c. per share, and that Nenzel directors will resign and new directors will be elected. Cowan and Pitt will then build a 100-ton mill and do considerable development work in mine.

Lincoln County

GOLD CHIEF (Pioche)—Mill has been put in operation and results are satisfactory.

YUBA LEASE (Pioche)—Mine crew has been laid off until compressor is installed . Machine drills will replace hand work as rock is hard. At Meadow Valley No. 3 shaft, a 40-hp. Fairbanks engine has been installed, and suitable facilities for handling a large tonnage.

Lyon County

NEW TAILING PLANT AT SUTRO is being built by Metals Recovery Co., of Los Angeles, to treat old Douglas tailings. Plant will be in operation in a couple weeks, and has been erected at cost of $50,000. Tailings will be moved and elevated to 200-ton bins by electrically operated scrapers and a conveyor belt, elevating tails 75 ft. Power line of Truckee River General Electric Co. has been extended five miles from Dayton. It is estimated that there are 300,000 tons of tailings in pond which can be treated at a profit by cyanidation.

Mineral County

MILL AND CYANIDE PLANT AT CANDELARIA, of 25 tons daily capacity, is being built by Grube & Threlfall.

McNAMARA & CAVANAUGH (Athens)—A five-stamp mill has just been completed.

Nye County

WHITECAPS (Manhattan)—Vertical shaft will be sunk another 100 ft. and east and west oreshoots developed.

JIM BUTLER vs. WEST END (Tonopah)—Answer of West End company to complaint of Jim Butler will not have to be filed for another 30 days, extending time to June 13.

WHITE CAPS (Manhattan)—Lessees pulled their pumps after only a few hours' notice, which was not sufficient time for company to install its own pumps, and mine is rapidly filling with water. Company pumps have been secured and will be installed at once, also a hoist.

MARIS CHALCEDONY QUARRY (Manhattan)—A new pebble-grinding mill has been installed. It is similar to a tube mill except cross-section is elliptical, longer axis being 12 ft. Lining is pebble material set in cement. Charge of two tons is treated at a time and mill is run at 25 r.p.m. by 30-hp. engine.

VICTOR (Tonopah)—Last round has been fired in shaft, which is now 1562 ft. deep. This shaft has three compartments and was sunk without any drifting or crosscutting from it, making it the deepest continuous shaft in Nevada. Sump of 22 ft. will be left, and crosscut started on 1540-ft. level to cut Murray shoot. Shaft will be so equipped that 1500 tons daily can be hoisted.

MUSHETT & WITTENBERG LEASE (Manhattan)—Subleases on 100-ft. blocks in Union No. 9 ground are being granted. All ores will be hoisted through main shaft, where new plant has been installed. Big Pine mine and mill of Manhattan Milling & Ore Co. are also being operated. Track from Big Pine to mill, a distance of one mile, will be laid, and capacity of mill will be increased by 10 stamps.

Ormsby County

SIXTY-FOOT DREDGE AT EMPIRE has been completed and will be put in operation as soon as present high water of Carson River subsides. This dredge will be used on tailings from old Virginia City mills.

Storey County

CONSOLIDATED VIRGINIA (Virginia City)—Necessary repairs have been made to shaft.

MONTE CRISTO (Virginia City)—Large cave-in has taken place. Caved area on surface, at largest place, is 30 to 40 ft. across, and ground is disturbed as far as engine house and shaft collar. Work will be started at once to save shaft.

OPHIR (Virginia City)—Central tunnel will be reopened and repaired, preliminary to working in old Burning Moscow and original Ophir ground, where, it is believed, a large tonnage of low-grade ore was left, which can now be profitably treated by cyanide.

White Pine County

PONY EXPRESS (Hogum)—Water pipe line is being tested and repairs made preparatory to hydraulic mining. Line conducts water from large springs on mountain to property.

BOSTON ELY (Ely)—Driving drift on 1100-ft. level of Emma shaft has been discontinued. Ground is so hard that progress of only 62 to 63 ft. per month was made by two shifts, using large machine drills. Diamond-drilling may be done instead of drifting, in order to prospect Matilda contact.

NEW MEXICO

Eddy County

CARLSBAD OIL & GAS CO. (Carlsbad)—At 1200 ft. more salt has been struck beneath 75 ft. of limestone. Samples show potash.

Grant County

LORDSBURG ORE SHIPMENTS for April were 124 cars.

85 MINING CO. (Lordsburg)—Negotiations are in progress for transfer of Three Heroes mines from Bonney to 85 company.

JOHNNY BULL COPPER CO. (Steins)—Property is reported to have been sold by company through efforts of Captain Henry, of Boston Roads, N. Y., to a New York syndicate. Mine is developed to depth of 150 ft. by inclined shaft and drifts. Ore carries copper, silver and gold.

TEXAS

Cherokee County

TEXAS IRON ASSOCIATION (Philadelphia)—D. M. Barringer, president, has notified Governor Colquitt that association would forfeit its contract with State of Texas for operation of the iron mines and furnace at Rusk. Association took over state iron industry and expended more than $100,000 in developing ore beds and adding new equipment to furnace. Barringer's reason for abandoning contract is that pig iron cannot be manufactured in Texas at a profit on account of excessive freight rates.

UTAH

Juab County

TINTIC ORE SHIPMENTS for week ended May 8 were 128 cars; those for week ended May 15, 122 cars.

TINTIC CENTRAL (Eureka)—Preparations for beginning work are being made by lessees.

TINTIC DELMAR (Eureka)—Work has been resumed at this property, idle for some time. Drifting is being done from bottom of 100-ft. shaft.

KNIGHT CHRISTENSEN MILL (Silver City)—Some ore is being put through this plant, and it is hoped to bring it up to its 100 tons capacity in near future.

COLORADO (Silver City)—Most of the work at this property is being done by lessees. The treasury is in good condition, and preparations are being made for work on company account.

SCRANTON (Eureka)—There are indications that the ore lost between 400- and 500-ft. levels may be recovered. A winze was sunk on a streak of iron, and a drift driven on the 600 in search of the ore. Iron streaks such as border Scranton orebodies are appearing in roof of drift.

GOLD CHAIN (Mammoth)—A 112-hp. motor and electrical hoisting equipment have been ordered for this property. When new machinery has been installed air for machine drills will be secured from Grand Central compressor, and compressor which is at present supplying Gold Chain will be shut down.

BECK TUNNEL (Silver City)—This company is out of debt, and there is stated to be $20,000 in treasury from royalties by lessees. This money will be used in development. Twelve blocks of ground are under lease, and 30 men are employed. A weekly output of 150 tons is being produced.

OPOHONGO (Mammoth)—Much development is being done on company account. A drift has been started from main-tunnel level toward a hitherto little prospected section, where there is a shaft a few hundred feet deep. Prospecting will be carried to greater depth here. In main tunnel mineralized quartz has been opened. Lessees above 700 are mining ore of good grade.

Salt Lake County

UTAH METAL MINING CO. (Bingham)—Company is to be reorganized in accordance with wishes of bondholders and largest interests. Number of shares will be reduced, and stock made assessable. Term of bonds will be extended.

WASATCH-UTAH (Salt Lake City)—This company, which owns ground between Big and Little Cottonwood cañons has recently opened a 9-in. streak of ore of good grade. The usual ores carry $3 per ton. A suitable process for treating this material is being sought, and experiments are being made

BINGHAM-NEW HAVEN (Bingham)—This company has just paid a dividend of 20c. per share, or $45,740, which brings total of dividends thus far up to $525,985. There are 228,690 shares outstanding. About 100 tons of ore daily are being treated at mill, and from 75 to 100 tons of crude ore shipped. Two dividends of 10c. per share each were paid last year.

Summit County

GLENCOE UNION (Park City)—A Marcy ball mill is being installed, and another table added at this company's mill. Four jigs and five tables are now in use. New compressor will be started soon, and unwatering of shaft will be begun Shaft is down 200 ft., and is reported to have found a good streak of high-grade ore. Raising in milling ore is being done. Mill is working two shifts.

Utah County

PACIFIC (American Fork)—This property is being inspected with possibility of arranging for milling low-grade sulphide ore. There is much material of this character developed. Further development in search of lead-carbonate ore on upper levels is contemplated.

WISCONSIN

Douglas County

DOUGLAS COUNTY POOR FARM—A body of iron ore, at 350 ft., some of it of good grade, is stated to have been encountered by well drillers on poor farm, near Superior, Wis. There are no known deposits in vicinity.

CANADA

British Columbia

BROKEN HILL MINING & MILLING CO. (Vancouver)—Development work completed to date, consisting of drift and crosscuts totals 400 ft., a contract for 300 ft. more having been let recently. Ore lies in a pay streak in a vein 100 ft. wide or more. Contains silver and copper, sometimes gold. While copper and gold contents vary between wide limits silver appears to be fairly constant; assays range from $10 to $40. At present over 150 ft. depth has been attained by developments. Railroad into district is expected to be operating in August. Tests are being made for suitable concentrating process, possibly ore will prove amenable to oil flotation. J. Hunt, manager who discovered property, has sailed for England to arrange for financing building of concentrator and further development work.

Ontario

TIMISKAMING (Cobalt)—A new shoot showing 75 ft. in length of high-grade ore has been developed.

MILLER LAKE O'BRIEN (Gowganda)—This property is now operating with its own hydro-electric power plant.

PORCUPINE CROWN (South Porcupine)—Mill in April treated 3500 tons of ore averaging $18, and made a recovery of 97 per cent.

HOLLINGER (Timmins)—It is understood that Anglo-French Co., which owned 20,000 shares, has been selling some of its holdings.

TECK-LEBEL SYNDICATE—This is a new London company formed to acquire claims in Kirkland Lake; 20,000 £1 shares have been issued.

MEXICO

Chihuahua

TECOLOTE MINING CO. (Santa Barbara)—Fire recently destroyed power house, warehouse and gas-generating plant. Property is owned by American Smelting & Refining Co. Fire broke out in gas-generating plant and is believed to have originated when sparks from a switch engine ignited some timbers. Extent of the damage so far aggregates $50,000, and it is feared loss will approximate more than $300,000.

Sonora

CANANEA CONSOLIDATED—It is said that arrangements have been made to open mines and smelting plant which were closed down when foreigners were warned to leave Sonora. An agreement for protection by Constitutionalists has been reached.

COLOMBIA

NECHI MINES, LTD. (Zaragoza)—A circular from London office of Oroville Dredging Co. states that specifications for Nechi dredge have been submitted to six dredge constructors in England and America.

PATO MINES, LTD. (Zaragoza)—Dredge resumed operations Apr. 5. Cable report showed gross returns May 5 as $5272 from 39,333 cu.yd. Engineer W. A. Prichard reports that further drilling has added 100 acres to proved area.

The Market Report

METAL MARKETS

NEW YORK—May 27

The metal markets have continued rather quiet, with only moderate buying and with an inclination to easier prices.

Copper, Tin, Lead and Zinc

Copper—The market has been so dull that quotations are scarcely more than nominal. Certain of the agencies have maintained their previous price of 14¼c. asked, and may have realized that on some small business in noncompetitive markets, but copper has been freely available from other agencies at 14⅛c., delivered, usual terms. Some export business is reported on that basis. Offers to sell to domestic manufacturers at the same price failed to interest them, but some of them intimated that they would buy at 14c., delivered, usual terms. The average electrolytic quotation for the week is 14.004 cents.

The leading producer of Lake copper is reported to have sold a few hundred thousand pounds of its special brand at 14¾c. However, prime Lake copper has been available from other producers at under 14¼c., cash, New York.

The standard market has been lifeless but firm, and closes somewhat higher at £63 5s. for spot and £63 17s. 6d. for three months.

Base price of copper sheets was again decreased ¼c. on May 22, and is now 19¼c. per lb. for hot rolled and 20¼c. for cold rolled. The usual extras are charged and higher prices for small quantities. Copper wire is 15@15¼c. per lb., carload lots at mill.

Copper exports from New York for the week were 6608 long tons. Our special correspondent reports exports from Baltimore for the week at 1467 tons.

Tin—The market was rather uninteresting during the past week. Buyers, who had liberally supplied their wants on Wednesday last withdrew and trading ceased almost entirely. The London market on the other hand remained fairly steady, quotations showing hardly any change until today, when the market again became flat and declined about £1 from the highest. The close is easy at £148 10s. for spot and £150 5s. for three months, and about 32⅞c. here.

Receipts of Bolivian tin at Liverpool in April were 35 tons of bars and 2797 tons concentrates; the whole equal to 1713 tons fine tin.

Lead—This has been the bright department of the metal markets. Some round tonnages are reported sold at the last prices and there has been a good inquiry.

The London market is quiet, Spanish lead being quoted £19; English lead 7s. 6d. higher.

Spelter—Demand has been very slack and in consequence thereof there has been a softening of price. Some business realized as high as 4.95c., St. Louis, but at that price there were sellers over.

The London market is unchanged; good ordinaries are quoted £21 7s. 6d.; specials £21 15s. per ton.

Base price of zinc sheets is now $7 per 100 lb., f.o.b. Peru, Ill., less 8% discount, with the usual extras.

Since the beginning of 1914 the unsold stock of spelter in the hands of the International Convention in Europe has been increasing again and at the end of April it was estimated that it amounted to over 80,000 metric tons, a larger quantity than was reported at any time in 1913. Effective May 1, the Convention ordered a curtailment of output at the rate of about 18% by members of the Syndicate.

ALGERIAN MINERALS

Minerals exports from Algeria for the quarter ended Mar. 31 are reported as follows, in metric tons:

Ores:	1912	1913	1914
Iron ore	285,151	430,360	346,299
Copper ore	......	598	171
Lead ore	6,018	5,990	3,576
Zinc ore	15,515	17,105	17,095
Antimony ore	1,075	44	......

Exports of phosphates for the quarter were 133,699 tons, against 96,202 in 1913, and 99,634 in 1912. This phosphate goes chiefly to France.

Pig-Iron Production in Germany in March is reported by the German Iron and Steel Union at 1,602,714 tons. For the three months ended Mar. 31 the total make was in metric tons:

	1913	1914	Changes
Foundry iron	895,901	799,958	D. 95,943
Forge iron	134,477	112,219	D. 22,258
Steel pig	639,815	621,876	D. 17,939
Bessemer pig	91,656	62,159	D. 29,497
Thomas (basic) pig	2,972,836	3,018,518	I. 45,682
Total	4,734,685	4,614,730	D. 119,955

The total decrease was 2.5%. Steel pig includes spiegeleisen, ferromanganese and all similar alloys.

DAILY PRICES OF METALS

NEW YORK

May	Sterling Exchange	Silver, Cts. per Oz.	Copper: Electrolytic, Cts. per Lb.	Tin: Cts. per Lb.	Lead: New York, Cts. per Lb.	Lead: St. Louis, Cts. per Lb.	Zinc: New York, Cts. per Lb.	Zinc: St. Louis, Cts. per Lb.
21	4.8850	57⅝	14.00 @14.10	33¼	3.90	3.80 @3.82½	5.07½ @5.10	4.92½ @4.95
22	4.8845	57½	14.00 @14.10	33¼	3.90	3.80 @3.82½	5.07½ @5.10	4.92½ @4.95
23	4.8845	57¼	13.95 @14.05	33⅜	3.90	3.80 @3.82½	5.07½ @5.10	4.92½ @4.95
25	4.8850	56½	13.95 @14.00	33⅛	3.90	3.80 @3.82½	5.07½ @5.10	4.92½ @4.95
26	4.8860	56¾	13.95 @14.00	33¼	3.90	3.80 @3.82½	5.07½ @5.10	4.92½ @4.95
27	4.8850	57⅛	13.95 @14.00	32⅞	3.90	3.80 @3.82½	5.07½ @5.10	4.92½ @4.95

The quotations herein given are our appraisal of the markets for copper, lead spelter and tin based on wholesale contracts; and represent, to the best of our judgment, the prevailing values of the metals specified as indicated by sales by producers and agencies, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.15c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumer. To reduce to New York basis we deduct an average of 0.15c. representing delivery charges. The price of electrolytic cathodes is usually 0.05 to 0.10c. below that of electrolytic; of casting copper 0.15 to 0.25c. below. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Western brands. Silver quotations are in cents per troy ounce of fine silver.

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

LONDON

May	Silver	Copper: Spot, £ per Ton	Copper: Spot, Cts. per Lb.	Copper: 3 Mos.	Copper: Best Sel'td	Tin: Spot	Tin: 3 Mos.	Lead: £ per Ton	Lead: Cts. per Lb.	Zinc: £ per Ton	Zinc: Cts. per Lb.
21	26 7/16	63 3/16	13.73	63 13/16	68	150	151¾	18¾	4.07	21⅜	4.64
22	26 7/16	62 15/16	13.67	63 9/16	67¾	150	151¾	18⅝	4.05	21⅜	4.64
23	26 5/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
25	25 15/16	63⅛	13.70	63¾	67¾	149¾	151⅝	18½	4.02	21⅜	4.64
26	26 1/16	63 3/16	13.73	63 13/16	67¾	150	152	18⅝	4.05	21⅜	4.64
27	26¼	63¼	13.74	63⅞	67¾	148½	150¼	19	4.13	21⅜	4.64

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latte being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17½c.; £15 = 3.2 = £25 = 5.44c.; £70 = 15.22c. Variations, £1 = 0.21¾c.

Other Metals

Aluminum—Business has been more active, but there is some competition for orders and prices are little changed. Current quotations are 17¾@18c. per lb. for No. 1 ingots, New York. London quotations are £81@83 per long ton—equal to 17.6@18c. per lb.—for ingots.

Antimony—Business is quiet and prices are a shade easier. Quotations for ordinary antimony—Chinese, Hungarian, etc.—are 5.70@5.90c. per lb. For special brands 6.90 up to 7.50c. is asked.

Quicksilver—The New York quotation is slightly weaker at $37.50 per flask of 75 lb. for large lots; 53@54c. per lb. for jobbing lots. San Francisco, $37 for domestic orders, and special terms—usually about $2 less—for export. The London price is £7 per flask with £6 17s. 6d. asked from second hands.

Bismuth—New York quotations are $1.80 per lb. for imported metal; $1.72 for metal from domestic ores. London quotation is 7s. 6d. per lb. The price is controlled by the European syndicate.

Cadmium—The most recent German quotation is 750 marks per 100 kg.—equal to about 81c. per lb.—f.o.b. works in Silesia.

Magnesium—Current quotation is $1.50 per lb. for pure metal in lots of 100 lb. or over, New York delivery.

Nickel—Quotations for ordinary forms—shot, blocks, or plaquettes—are 40@45c. per lb., according to size of order and quality. Electrolytic nickel is 5c. per lb. higher.

Selenium—Quotations are $3@3.25 per lb. for lots of 100 lb. or over. For retail lots $5 per lb. is asked.

Exports from Baltimore for the past week included 2332 lb. selenium to Hamburg, Germany.

Gold, Silver and Platinum

Gold—There was less pressure to buy gold on the open market in London and no premiums were paid, the price being 77s. 9d. per oz. for bars. France and Russia were not large takers. In New York, $4,000,000 gold is reported taken for shipment to Paris.

Gold receipts at the Australian Mints, three months to Mar. 31, were: Sydney, 133,479 oz.; Melbourne, 133,661; Perth, 352,717; total, 619,857 oz. The Sydney receipts included 2253 oz. from Papua.

Platinum—The market is practically unchanged, and business is rather quiet. Dealers still ask $43@44 per oz. for refined platinum and $46@49 for hard metal.

Our Russian correspondent writes, under date of May 13, that the market and prices are unchanged. Platinum at present is offered only in small lots by the starateli, and is promptly taken up by speculators. Current quotations are 9.65 rubles per zolotnik, at Ekaterinburg, and 37,100@37,200 rubles per pood at St. Petersburg—equal to $36.26 and $36.41 per oz., respectively—for crude platinum, 83% metal.

Extensive prospecting work is being carried out by the Nikola-Pardinski Co. in the district of the same name in the northern Urals. This company is using an American dredge, built by the Marion works, and electrically driven. The company is owned chiefly in England. It is reported that extensive areas of platinum-bearing gravel have been uncovered.

Iridium—The metal is still in rather short supply and prices are steady at $75@78 per oz. Our Russian correspondent reports that there is a strong and persistent demand for osmiridium from the Ural placers, but none is offered.

Silver—The market is more steady at the decline, which was occasioned by the output of silver from this side being larger than was expected by the London buyers, who figured on smaller shipments owing to the Mexican contraction of supplies.

Shipments of silver from London to the East, Jan. 1 to May 14, as reported by Messrs. Pixley & Abell:

	1913	1914	Changes
India	£2,769,000	£2,772,000	I. £3,000
China	216,000	40,000	D. 176,000
Total	£2,985,000	£2,812,000	D. £173,000

The net imports of gold into India were £1,265,533 for the month of April.

PETROLEUM

English papers report that the British Admiralty has secured control of the company which is prospecting oil lands in Persia and which has already obtained a number of producing wells. The object is to secure a supply of fuel oil for British vessels in the East.

Zinc and Lead Ore Markets

PLATTEVILLE, WIS.—May 23

The market remained the same this week, the base price for 60% zinc being $39@39.50, and for 80% lead, $48 per ton.

SHIPMENTS WEEK ENDED MAY 23

	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Week	2,648,840	65,300	658,100
Year	59,088,180	2,439,000	18,143,630

Shipped during the week to separating plants, 2,909,580 lb. zinc ore.

JOPLIN, MO.—May 23

Blende remains at $43 high price, the assay ranging from $38 to $40.50 per ton of 60% zinc. Metal-base prices ranged from $37 to $39 per ton. Calamine sold strong, the poorest grades selling on a base of $21.50 per ton in small lots, while carlots sold $22 to $23 per ton of 40% zinc. The average price of all grades of zinc ore is $36.76 per ton.

One lot of lead sold at $48 on a base of $46 per ton of 80% metal content. The average of all grades is $46.36 per ton.

SHIPMENTS WEEK ENDED MAY 23

	Blende	Calamine	Lead	Values
Totals this week...	8,610,430	1,014,730	1,953,620	$222,225
Totals 21 weeks...	219,366,950	14,033,840	37,879,780	$5,380,125

Blende value, the week, $168,185; 21 weeks, $4,307,580.
Calamine value, the week, $8760; 21 weeks, $155,185.
Lead value, the week, $45,280; 21 weeks, $917,365.

IRON TRADE REVIEW

NEW YORK—May 27

While no great increase in orders can be noted, there is undoubtedly a better feeling in the trade, with expectations of an early revival.

In finished material there has been little change and the mills are running at about the same rate as for several weeks past. Jobbers report a better trade, however, and there is an increased demand for bars, sheets and lighter construction material generally. Heavy structural material has been quiet.

The pig-iron market is improving and some heavy contracts for basic iron have been placed. Foundry-iron demand is increasing also, and it is generally believed that consumers' stocks are low and that they must be in the market soon. More activity is reported by the merchant furnaces, with unchanged prices.

Steel Production in Germany, three months ended Mar. 31, is reported by the German Iron & Steel Union as below, in metric tons:

	Acid	Basic	Total
Converter	26,505	2,589,411	2,615,916
Openhearth	96,000	1,817,040	1,913,040
Direct castings	27,160	63,125	90,285
Crucible	23,667	......	23,667
Electric	23,078	......	23,078
Total	196,410	4,469,576	4,665,986

The total production in March was 1,597,911 tons. The steel production has not been reported monthly until this year.

PITTSBURGH—May 26

Steel mill operations have decreased slightly, and are probably at not much over 50% of capacity. The mills have hardly any accumulation of specifications, and are making up their rolling schedules largely from week to week or even from day to day.

Steel orders are light. While they may not have diminished much if any in the past 10 days, they have been running this month at considerably below the average of April and if there is no improvement in demand steel production will probably have to be curtailed further.

Prices have been showing a slight weakening tendency, though there are no regular declines. Bars, plates and shapes, which were held quite well at 1.15c. two or three weeks ago, can be done at 1.12½c. with several mills in the case of only moderately good orders, and there are rumors of 1.10c. being done in special cases. Galvanized sheets have frequently sold at under 2.80c., only recently regarded as the bottom.

The average price of the various finished steel products is only about $1 a ton above the low level reached in the winter of 1911-12. That level was regarded at the time as almost profitless, whereas the mills now labor under disadvantages; their production is at a lower rate, increasing the burden of overhead, while they are paying higher wages, through the general wage advance which was made in February, 1913. Many of the smaller mills have quietly made some wage reductions, but the Steel Corporation and the large independents are paying the old schedules, with no definite indication that they will make any reductions.

Pig Iron—The local pig-iron market is quiet and is not bearing out the predictions of a couple weeks ago of better business in prospect. The Valley furnaces are firm in their price views, while buyers will not take hold. The American Steel Foundries business in basic has not been closed, and it is not likely to be closed soon, as a bid of $13, delivered, has been made, when the Valley furnaces are holding out for $13 at furnace, and there is 90c. freight involved. Furnaces quote: Bessemer, $14; basic, $13; malleable, $13@13.25; No. 2 foundry, $13@13.50; forge, $12.50@12.75, at Valley furnaces, 90c. higher delivered Pittsburgh.

Ferromanganese—The market is very quiet, with prompt and forward English and German quoted at $38, Baltimore, with $2.16 freight to Pittsburgh.

Steel—There is no inquiry for prompt billets or sheet bars, and very little interest in third-quarter contracts. The producing mills are biding their time, but probably expect eventually to shade the present asking prices of $20 on billets and $21 on sheet bars. Rods are dull at $26, Pittsburgh.

IRON ORE

Shipments of Lake Superior iron ore so far are light, and charters of ore boats outside of the regular company lines are few.

Of the total shipments of 269,686 tons reported in April, only 50,544 tons went to Lake Erie ports.

Imports of Iron Ore into Great Britain, four months ended Apr. 30, were 2,738,934 tons in 1913, and 2,070,244 in 1914; a decrease of 668,710 tons. Imports of manganese ore were 230,102 tons in 1913, and 170,210 in 1914; decrease, 59,892 tons.

COKE

Coke production in the Connellsville district for the last week is reported by the "Courier" at 294,715 short tons; shipments, 275,880 tons. Production of the Greensburg and Upper Connellsville districts was 38,219 tons.

Connellsville Coke—Some additional inquiry for second half furnace coke has appeared, involving about 15,000 tons a month, and it is not improbable that $2 will be shaded, as it has been already on certain cokes. Prompt furnace coke is extremely dull, and sellers would accept $1.80. Consumption is decreasing and while production has been curtailed there seems still to be some accumulation.

Coal and Coke Carried on Pennsylvania R.R. lines east of Pittsburgh and Erie, four months ended Apr. 30, in short tons:

	1913	1914	Changes
Anthracite	3,674,096	3,776,953	I. 102,857
Bituminous	15,914,179	16,114,420	I. 200,241
Coke	4,987,304	3,616,606	D.1,370,698
Total	24,575,579	23,507,979	D.1,067,600

The total decrease this year was 4.3%. The loss was entirely in the tonnage of coke carried.

Fuel Exports of Great Britain, four months ended Apr. 30, in long tons:

	1913	1914	Changes
Coal	23,589,878	22,644,387	D. 945,491
Coke	352,390	369,364	I. 16,974
Briquettes	691,347	666,276	D. 25,071
Bunker coal	6,747,177	6,659,730	D. 87,447
Total	31,380,792	30,339,757	D. 1,041,035

Bunker coal is that sent abroad for use of steamships in foreign trade. Imports were only 12,479 tons in 1913, and 11,128 tons this year.

CHEMICALS

NEW YORK—May 27

The general market has shown some signs of improvement, but is still rather quiet.

Arsenic—Business is moderate only. The speculative features have been entirely eliminated and the price is steady at $3 per 100 lb. for both spot and future.

Copper Sulphate—Business remains on a fair scale. Prices are unchanged, $4.65 per 100 lb. being quoted for carload lots, and $4.90 per 100 lb. for smaller parcels.

Nitrate of Soda—The market is quiet, there is some anticipation of lower prices when vessels begin to come through the Canal. Current quotations are 2.17½c. per lb. for spot and June; 2.15c. for futures.

Pyrites—Arrivals at Baltimore for the week include 5963 tons pyrites from Huelva, Spain.

OTHER ORES

Recent quotations for manganese ore in Great Britain are: Indian or Brazilian, 50% manganese, 18½@19c. per unit; 48%, 18@18½c.; 45%, 17½@18c.; Caucasian, 50% manganese is 17@17½c.; 48%, 16½@17c. per unit. All prices are c.i.f. United Kingdom port.

COPPER SMELTER'S REPORTS

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

	January	February	March	April	May
Alaska shipments	2,701,258	1,803,579	2,069,960	1.279.537	....
Anaconda	24,400,000	21,300,000	23,800,000	22,900,000	....
Arizona, Ltd	3,474,000	3,062,000	3,286,000	3,570,000	....
Copper Queen	8,796,358	6.987,366	7,637,042	7,562,723	....
Calumet & Ariz	5.975,000	5.596,850	5,875,000	5 450,000	....
Chino	6,488,220	[illegible],642,426	5,399,814	....	....
Detroit	1,590,681	1,814,214	1,973,725	1,790,926	....
East Butte	1,256,000	1,193,960	1,546,180	1,178,000	....
Giroux	148,411	90,017	287,980	45,948	....
Mason Valley	944,000	1,254,000	1,250,000	....	....
Mammoth	1,625,000	1,400,000	1,800,000	1,850,000	....
Nevada Con	5,791,122	4,588,243	5,218,257	....	....
Ohio	700,728	582,000	597,520	610,518	....
Old Dominion	2,797,000	3,066,000	2,997,000	2,779,000	....
Ray	5,[illegible]05,000	5,432.000	6,036,908	....	....
Shannon	937,432	903.761	1,082,000	1,012,000	....
South Utah	275,569	333.874	406,381	....	....
Tennessee	1,474,890	1,232,812	1,262,184	1,370,800	....
United Verde*	3,000,000	2,700,000	3,100,000	....	....
Utah Copper Co	10,329,564	9.207,111	12,323,493	12,739,757	....
Lake Superior*	7,400,000	8.500,000	11,000,000	13,000,000	....
Non-rep. mines*	6,200,000	5.600,000	6,200,000	6,000.000	....
Total prod	102,100,233	92,290,213	102,536,667	....	....
Imp., bars, etc	24,504,249	19.918,448	22,676,605	....	....
Total blister	126,604,482	12,208.661	125.213,272	....	....
Imp. ore & matte	10,893,969	9,713,164	7,029,646	....	....
Total Amer	137,498,451	121,921,825	132,242,918	....	....
Miami†	3,258,950	3.316,482	3,361,100	3,130,772	....
Shattuck-Arizona	1,276,636	1,134,480	1,136,458	1,386,594	....
Brit. Col. Cos.:					
British Col. Cop	607,930	....	....	....	....
Granby	1,793,840	1,661,212	1,775,852	....	....
Mexican Cos.:					
Boleo†	2,369,920	1,984,080	2,535,680	2,204,720	....
Cananea	3,460,000	2,688,000	4,260,000	2,632,000	....
Moctezuma	3,024,556	2,642,543	2,882,884	2,654,926	....
Other Foreign:					
Braden, Chile	2,430,000	2,362,000	1,810,000	2,720,000	....
Cape Cop., S. Af.	519,680	459,200	660,800	468,160	....
Kyshtim, Russia.	1,559,040	1,534,400	....	....	....
Spassky, Russia	902,720	902,720	896,000	....	....
Exports from					
Chile	5,488,000	6,720,000	6,944,000	9,072.000	....
Australia	5,712,000	7,952,000	8.176,000	7,168,000	....
Arrivals–Europe‡	8,599,360	18,354,560	17,572,800	17,299,520	....

† Boleo copper does not come to American refiners. Miami copper goes to Cananea for treatment, and reappears in imports of blister.

‡ Does not include the arrivals from the United States, Australia or Chile.

	United States			Visible Stocks.		
Month	U.S.Refin'y Production	Deliveries, Domestic	Deliveries, for Export	United States	Europe	Total
Year, 1912	1,581,920,287	819,665,948	746,396,452	....	....	....
VI, '13.	121,860,853	68,362,571	68,067,901	67,474,225	77,235,200	144,709,425
VII	138,074,602	58,904,192	78,480,071	52,814,606	77,904,000	124,808,606
VIII	131,632,362	73,649,801	73,263,469	53,594,945	66,420,480	120,015,385
IX	131,401,229	66,836,897	73,085,275	38,314,037	63,716,800	102,030,837
X	139,070,481	68,173,720	68,123,473	29,793,094	53,625,600	83,418,692
XI	134,087,708	48,656,858	70,067,803	32,566,382	48,787,200	81,353,582
XII	138,990,421	21,938,570	73,542,413	47,929,429	46,592,000	94,521,429
Yr., '13	1,622,450,829	767,261,760	869,062,784	....	....	....
I, 1914.	131,770,274	47,956,955	87.955,501	91,438,867	53,916,800	145,355,667
II	122,561,007	47,586,657	83,899,183	87,296,685	50,108,800	137,405,485
III	145,651,982	69,852,349	89,562.166	78,371,852	47,376,000	125,747,852
IV	151,500.531	63.427,633	82,345,216	64,609,319	46,435,200	111.044,519
V	....	....	....	70,337,001	52,371,200	122.708,201
VI	....	....	....	....	....	....

Note—Visible supplies in Europe do not include copper afloat.

Assessments

Company	Delinq.	Sale	Amt.
Bellerophon, Utah	May 30	June 20	$0.002
Booth, Nev	May 11	June 15	0.02
Bullion, Nev	May 28	June 18	0.02
Challenge, Nev	May 12	June 2	0.05
Cherokee-Nevada, Nev	....	....	0.01
Davis-Daly, Mont	....	June 1	0.25
Eagle's Nest, Nev	May 18	June 18	0.005
Ely Gibraltar, Nev	May 18	June 15	0.0025
Emerald, Utah	May 15	June 6	0.13
Grutli, Utah	May 16	June 3	0.002
Hale & Norcross, Nev	May 19	June 9	0.03
Idaho-Nevada, Ida	May 7	June 1	0.001
Mineral Flat Ext., Utah	June 2	June 20	0.002
Nabob, Ida	May 13	June 8	0.005
O.K. Silver, Utah	May 30	June 16	0.005
Revelator, Utah	May 18	June 18	0.0075
Rico Argentine, Ida	May 20	June 5	0.01
Sierra Nevada, Nev	May 25	June 15	0.10
Silver Mountain, Ida	May 22	June 22	0.003
Snowstorm Ext., Ida	May 22	June 22	0.003
Snowy Peak, Ida	Apr. 29	June 6	0.01
Springfield, Ida	May 18	June 15	0.002
Spring Lake, Utah	May 25	June 15	0.0075
Sunset, Ida	May 12	June 6	0.002
Syndicate, Utah	May 22	June 13	0.0005
Tar Baby, Utah	May 1	June 1	0.005
Tintic Standard, Utah	May 11	June 1	0.005
Wallace, Ida	May 15	June 5	0.0025
Wisconsin, Ida. post'd	....	June 5	0.003
Yellow Jacket, Nev	May 25	June 16	0.10

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1912	1913	1914	1912	1913	1914
January	56.260	62.938	57.572	25.887	28.983	26.553
February	59.043	61.642	57.506	27.190	28.357	26.573
March	58.375	57.870	58.067	26.875	26.669	26.788
April	59.207	59.490	58.519	28.284	27.416	26.958
May	60.880	60.361	......	28.038	27.825	......
June	61.290	58.990	......	28.215	27.199	......
July	60.654	58.721	......	27.919	27.074	......
August	61.606	59.293	......	28.375	27.335	......
September	63.078	60.640	......	29.088	27.986	......
October	63.471	60.793	......	29.299	28.083	......
November	62.792	58.995	......	29.012	27.263	......
December	63.365	57.760	......	29.320	26.720	......
Year	60.835	59.791	......	28.042	27.576	......

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

COPPER

Month	New York				London Standard	
	Electrolytic		Lake			
	1913	1914	1913	1914	1913	1914
January	16.488	14.223	16.767	14.772	71.741	64.304
February	14.971	14.491	15.253	14.929	65.519	65.259
March	14.713	14.131	14.930	14.625	65.329	64.276
April	15.291	14.211	15.565	14.563	68.111	64.747
May	15.436	......	15.738	......	68.807	......
June	14.672	......	14.871	......	67.140	......
July	14.190	......	14.563	......	64.166	......
August	15.400	......	15.904	......	69.200	......
September	16.328	......	16.799	......	73.125	......
October	16.337	......	16.913	......	73.383	......
November	15.182	......	16.022	......	68.275	......
December	14.224	......	14.904	......	65.223	......
Year	15.269	......	15.686	......	68.335	......

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

TIN

Month	New York		London	
	1913	1914	1913	1913
January	50.298	37.779	238.273	171.905
February	48.766	39.830	220.140	181.556
March	46.832	38.038	213.615	173.619
April	49.115	36.154	224.159	163.963
May	49.038	....	224.143	....
June	44.820	....	207.208	....
July	40.260	....	183.511	....
August	41.582	....	188.731	....
September	42.410	....	193.074	....
October	40.462	....	184.837	....
November	39.810	....	180.869	....
December	37.635	....	171.786	....
Av. year	44.252	....	206.279	....

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

LEAD

Month	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	4.321	4.111	4.171	4.011	17.114	19.665
February	4.325	4.048	4.175	3.937	16.550	19.606
March	4.327	3.970	4.177	3.850	15.977	19.651
April	4.381	3.810	4.242	3.688	17.597	18.225
May	4.342	......	4.226	......	18.923	......
June	4.325	......	4.190	......	20.226	......
July	4.353	......	4.223	......	20.038	......
August	4.624	......	4.550	......	20.406	......
September	4.698	......	4.579	......	20.648	......
October	4.402	......	4.253	......	20.302	......
November	4.293	......	4.146	......	19.334	......
December	4.047	......	3.929	......	17.798	......
Year	4.370	......	4.238	......	18.743	......

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

SPELTER

Month	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	6.931	5.262	6.854	5.112	26.114	21.533
February	6.239	5.377	6.089	5.228	25.338	21.413
March	6.078	5.250	5.926	5.100	24.605	21.460
April	5.641	5.113	5.491	4.963	25.313	21.569
May	5.406	......	5.256	......	24.583	......
June	5.124	......	4.974	......	22.143	......
July	5.278	......	5.128	......	20.592	......
August	5.658	......	5.508	......	20.706	......
September	5.694	......	5.444	......	21.148	......
October	5.340	......	5.188	......	20.614	......
November	5.229	......	5.083	......	20.581	......
December	5.156	......	5.004	......	21.214	......
Year	5.648	......	5.504	......	22.746	......

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

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1913	1914	1913	1914	1913	1914
January	$18.15	$14.94	$17.35	$13.22	$18.59	$13.90
February	18.15	15.06	17.22	14.12	18.13	14.09
March	18.15	15.07	16.96	13.94	17.53	14.18
April	17.90	14.90	16.71	13.90	16.40	14.10
May	17.68	......	15.80	......	15.40	......
June	17.14	......	15.40	......	15.10	......
July	16.31	......	15.13	......	14.74	......
August	16.63	......	15.00	......	14.88	......
September	16.65	......	15.04	......	14.93	......
October	16.60	......	14.61	......	14.80	......
November	16.03	......	13.91	......	14.40	......
December	15.71	......	13.71	......	14.28	......
Year	$17.09	......	$15.57	......	$15.77	......

STOCK QUOTATIONS

COLO. SPRINGS May 25

Name of Comp.	Bid.
Acacia	‡.02½
Cripple Cr'k Con.	‡.006
C. K. & N.	‡.05½
Doctor Jack Pot	.05¾
Elkton Con.	.40¼
El Paso	1.25
Findlay	.01
Gold Dollar	.03
Gold Sovereign	‡.02
Golden Cycle	‡1.50
Isabella	.10½
Jack Pot	.06
Jennie Sample	‡.04
Jerry Johnson	‡.03
Lexington	‡.004
Old Gold	.01
Mary McKinney	.44¾
Pharmacist	‡.009
Portland	1.12
Vindicator	.94

SALT LAKE May 25

Name of Comp.	Bid.
Beck Tunnel	.04½
Black Jack	.03
Cedar Talisman	.00¾
Colorado Mining	.12
Crown Point	.01½
Daly-Judge	5.00
Gold Chain	.12½
Grand Central	.55
Iron Blossom	1.32½
Little Bell	.10
Lower Mammoth	.01
Mason Valley	2.25
May Day	.06
Nevada Hills	.25
Prince Con	.19
Silver King Coal'n	2.90
Silver King Cons	1.90
Sioux Con	.03
Uncle Sam	.02
Yankee	.04½

TORONTO May 25

Name of Comp.	Bid.
Bailey	.01
Coniagas	7.25
Peterson Lake	.38
Right of Way	.05
T. & Hudson Bay	75.00
Timiskaming	.15
Wettlaufer-Lor	.05
Big Dome	10.00
Crown Chartered	‡.00¾
Dome Exten	.08
Foley O'Brien	.30
Hollinger	16.25
Imperial	‡.01½
Jupiter	.12
Pearl Lake	.04
Porcu. Gold	.01
Preston E. D.	.03
Rea	.10
Swastika	‡.01¾
West Dome	.05

SAN FRANCISCO May 25

Name of Comp.	Bid.
Comstock Stocks	
Alta	.11
Belcher	.30
Best & Belcher	.03
Caledonia	.47
Challenge Con.	.09
Chollar	.05
Confidence	.20
Con. Virginia	.05
Crown Point (Nev.)	.23
Gould & Curry	.02
Hale & Norcross	.03
Mexican	1.07½
Occidental	.70
Ophir	.08
Overman	.24
Potosi	.01
Savage	.07
Sierra Nevada	.11
Union Con	.06
Yellow Jacket	.29
Misc. Nev. & Cal.	
Belmont	7.00
Jim Butler	1.02½
MacNamara	.03
Midway	.28
Mont.-Tonopah	.78
North Star	.35
West End Con.	.85
Atlanta	.16
Booth	.05
C.O.D. Con	.03
Comb. Frac	.06
Jumbo Extension	.23
Pitts.-Silver Peak	.34
Round Mountain	.30
Sandstorm Kendall	.18
Silver Pick	.04
Argonaut	2.85
Bunker Hill	‡1.90
Central Eureka	.13
So. Eureka	‡1.25

N. Y. EXCH. May 25

Name of Comp.	Clg.
Amalgamated	72½
Am.Sm.&Ref.com	64¼
Am. Sm. & Ref., pf.	100¾
Am. Sm. Sec., pf. B.	81½
Anaconda	32⅛
Batopilas Min.	.75
Bethlehem Steel, pf.	85
Chino	41⅜
Colo. Fuel & Iron.	28
Federal M. & S., pf.	30
Great Nor., ore., ctf.	32¾
Guggen. Exp	54½
Homestake	116
Inspiration Con	16¾
Mex. Petroleum	62½
Miami Copper	22⅛
Nat'l Lead, com	45
National Lead, pf	106½
Nev. Consol	14¾
Ontario Min	2¼
Phelps Dodge	179
Quicksilver, pf	2¾
Ray Con	21⅜
Republic I&S, com	23¾
Republic I&S, pf	87⅜
SlossSheffi'd, com	28
Sloss Sheffield, pf	84
Tennessee Copper	34¾
Utah Copper	57½
U. S. Steel, com	62⅜
U. S. Steel, pf	110

BOSTON EXCH May 25

Name of Comp.	Clg.
Adventure	1¼
Ahmeek	270
Alaska Gold M	28
Algomah	.95
Allouez	41
Am. Zinc	16½
Ariz. Com., ctfs	4⅜
Bonanza	.51
Butte & Balak	2⅞
Calumet & Ariz	66¼
Calumet & Hecla	418
Centennial	16½
Cliff	1 3/16
Copper Range	37
Daly West	1¾
East Butte	10½
Franklin	4½
Granby	81½
Hancock	16
Hedley Gold	‡15
Helvetia	.25
Indiana	4¼
Island Cr'k, com	48
Island Cr'k, pfd	85½
Isle Royale	20½
Keweenaw	2¾
Lake	6½
La Salle	4½
Mass	5¼
Michigan	.60
Mohawk	43¾
New Arcadian	5¾
New Idria Quick	‡3½
North Butte	26¾
North Lake	1½
Ojibway	.99
Old Dominion	48
Osceola	75
Quincy	57
Shannon	5½
Shattuck-Ariz	24½
Superior	29¼
Superior & Bost	2
Tamarack	36
Trinity	3¼
Tuolumne	.50
U. S. Smelting	34
U. S. Smelt'g, pf	45¾
Utah Apex	1¾
Utah Con	10¼
Victoria	2⅜
Winona	3½
Wolverine	42¾
Wyandot	.40

N. Y. CURB May 25

Name of Comp.	Clg.
Beaver Con	.29
Big Four	.06
Boston Montana	9¼
Braden Copper	7⅜
B. C. Copper	1⅜
Buffalo Mines	1¼
Can. Cop. Corpn	1 9/16
Can. G. & S	.07½
Caribou	.69
Chambers Ferland	.20
Con. Ariz. Sm	⅜
Coppermines Cons	1⅜
Davis-Daly	9/16
Diam'field-Daisy	.07
Ely Con	.02½
Florence	.53
Gold Hill Con	.50
Goldfield Con	1 7/16
Greene Cananea	33
Greenwater	.06½
Internat. S. & R.	‡1.05
Kerr Lake	4½
La Rose	1 7/16
McKinley-Dar-Sa	.70
Mines of Am	3⅛
New Utah Bingham	‡.68
Nipissing Mines	6¼
Ohio Copper	5/16
Oro	.12
Puebla S. & R.	2⅜
Stand'd Oil of N.J.	409
Stand'd Silver Lead	1¾
Stewart	1 3/16
Stewart Min.T't C.	1 3/16
Tonopah	6½
Tonopah Ex	2.72
Tonopah Merger	.56
Tularosa	.25
West End Ex	.04½
Yukon Gold	2⅜

BOSTON CURB May 25

Name of Comp.	Bid.
Bingham Mines	.05
Boston & Corbin	.28
Boston Ely	.25
Butte & Lon'n Dev.	.40
Cactus	‡.01
Calaveras	1½
Chief Cons	.90
Contact Copper	‡.05
Corbin	.80
Cortez	.20
Crown Reserve	1¼
Eagle & Blue Bell	1
First Nat. Cop	2 1/16
Houghton Copper	2¾
Majestic	.20
Mexican Metals	.12
Moneta Porc	‡.02
Nevada-Douglas	1 5/16
New Baltic	1¾
Oneco	.75
Raven Copper	.12
Smokey Dev	.25
So. Lake	3¼
S. W. Miami	1
Tonopah Victor	.30
Trethewey	.17
United Verde Ext	.46

LONDON May 15

Name of Comp.	Clg.
Camp Bird	£0 10s 6d
El Oro	0 12 0
Esperanza	0 12 6
Mexico Mines	4 5 0
Oroville	0 12 0
Santa Gert'dis	0 12 6
Stratton's	0 0 6
Tomboy	1 0 6½

‡Last Quotation.