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El Paso Smelting Works--I

By Richard H. Vail

SYNOPSIS—The El Paso Smelting Works of the Consolidated Kansas City Smelting & Refining Co. has been for 30 years the most important custom smelting works in the Southwest. Recently the supply of lead ores has dwindled and copper smelting now predominates at this plant. A new copper works was added when the company contracted to smelt the Chino concentrates. The first installment of the article treats of the lead-smelting department.

The El Paso plant of the Consolidated Kansas City Smelting & Refining Co. is situated about three miles from the center of the city of El Paso, Tex. It is just outside the northern city limits and close to the Rio Grande, from which most of its water supply is obtained, though the plant has also a connection with the El Paso water-works. The plant has a normal annual capacity in the lead-smelting department of about 350,000 tons of charge, and a capacity of 500,000 tons of charge in the copper department, which is now the most important branch, owing to the contraction of the lead-ore supply and the development of copper properties in this region.

Smelting operations were begun at El Paso in 1886, at which time the plant consisted of four lead blast furnaces and four hand roasters. For many years it was the only important silver-lead smelting works in the Southwest. The plant burned in 1900 and was rebuilt, but largely with the idea of utilizing hand labor, cheap Mexican labor being then available, though this has since become more expensive. At the time these notes were written, two lead furnaces out of eight were in blast and two copper blast furnaces were smelting custom copper ore. The company about three years ago took the contract for smelting Chino concentrates and built what is practically a new copper-smelting works; this includes a roasting plant containing eight Wedge furnaces, three 19x100-ft. reverberatories, and a converting plant that now comprises two Peirce-Smith converters and one 12-ft. Great Falls type converter with eccentric mouth.

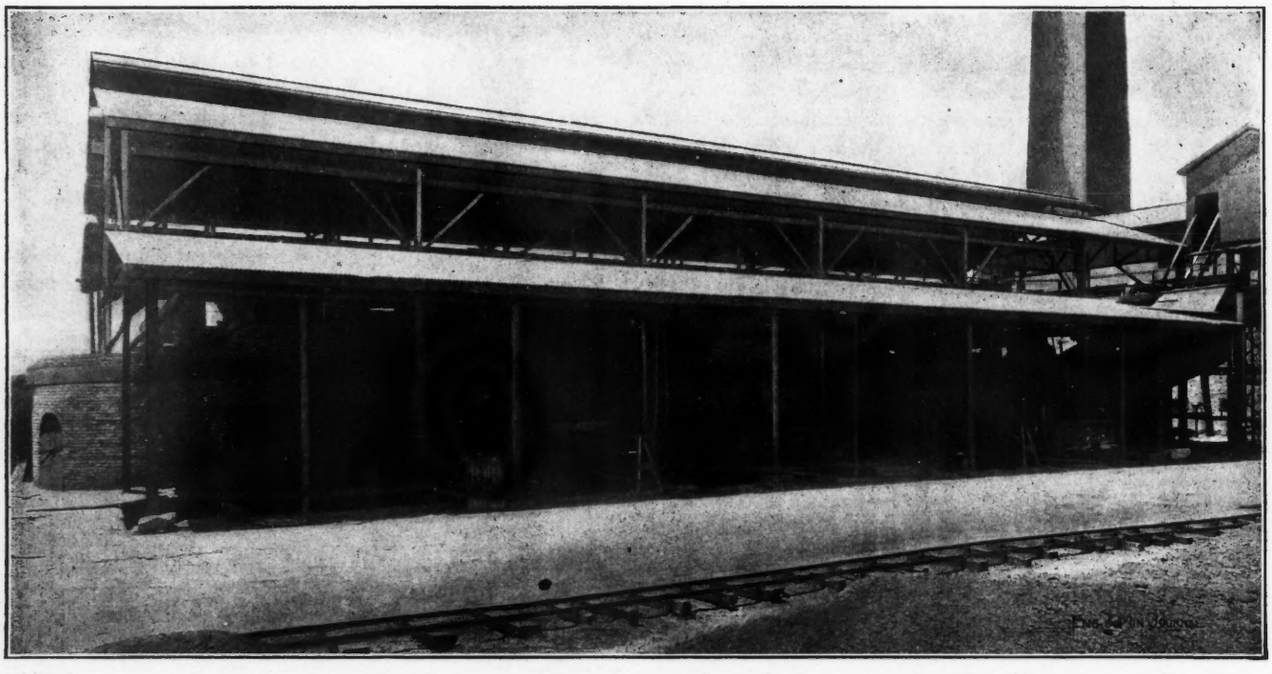
General View of El Paso Smelting Works, El Paso, Texas

Ores Unloaded by Contract

At the El Paso Smelting Works, as this plant is usually known, ores are received principally in box cars and gondolas, and are unloaded by contract. After the plant was closed for a few weeks by a labor strike in April, 1913, it became necessary to break in new men. The work of unloading proceeded slowly until a contract system, based on the foot-tons moved, was established and now there is a constant waiting list of men to get on the

unloading gangs—a good example of the intelligent application of efficiency engineering. These men work in groups of four and earn from 1½ to two times the average day wage for unskilled labor. The pay, as above stated, is based on the foot-ton moved, but consideration is given to the character of the material unloaded and the distance it is wheeled. When ore is spread on the beds, an extra allowance is made to the unloading gang for this work.

Recently a Browning locomotive crane with 40-cu.ft. Brownhoist grab bucket has been added to the plant equipment for the purpose of handling stockpiled ore, of which there is a considerable accumulation, owing to the exigencies of operation during the last year. The stockpiles of Chino concentrates that were received in excess of the reverberatory smelting capacity, have been covered with a lime grouting to prevent them from being blown away by the strong winds prevailing in this region.



THREE GODFREY FURNACES FOR PRE-ROASTING LEAD ORE AT THE EL PASO WORKS

MECHANICAL SAMPLING PRECEDED BY HAND SAMPLING

This works receives a great number of small lots of ore. In consequence, though it has four mechanical sampling mills, the first sampling is done by hand when unloading. Every fifth or tenth shovel is taken, depending on the character of the ore; on concentrates every fifth shovel is retained and this sample is cut in half in the car. The shovel samples are then taken to the sample mill, the concentrate samples going directly to the quartering floor where they are first coned; then distributed in a ring and coned again, after which every third shovelful is taken for sample; this operation is repeated until the sample is reduced to approximately 400 lb., when it is taken to the finishing plates and then to the grinding and bucking room.

The shovel sample from the ore lots may be reduced in any one of four sets of automatic sampling-and-crushing equipments. Two of these are for ores not exceeding three inches in size and two mills handle the coarser ore.

THE SAMPLING MILLS

The equipment in each of the fine crushing mills is as follows: One 9x12-in. Blake crusher; one 8-in. bucket elevator; one Vezin sampler, cutting 1/5; one set of 12x36-in. Allis-Chalmers rolls, crushing to ½ in.; one 8-in. bucket elevator; two Vezin samplers, making a ¼ cut at similar points in the stream and giving a final duplicate sample, crushed to ½ in.

The coarse-crushing sample mills differ slightly and take their names from the size of the gyratory crusher, through which the ore first passes. The so called No. 4 mill comprises: One No. 4 Gates gyratory crusher; one 12-in. bucket elevator; one Vezin sampler, cutting 1/5; one 14x36-in. roll crushing to 1 in.; one 10-in. bucket elevator; two Vezin samplers, making a ¼ cut at the similar points in the stream and giving duplicate samples.

The No. 6 coarse-crushing sampling equipment includes: One No. 6 Gates gyratory crusher; one 14-in. bucket elevator; one Vezin sampler, cutting 1/5; one 14x36-in. roll, crushing to 1½ in.; one 10-in. bucket elevator; two Vezin samplers making a ¼ cut at the same points in the stream and giving duplicate samples.

The No. 4 coarse-crushing mill is being remodeled so that it may be used either as an automatic sampling mill or as a sulphide-ore crushing mill. The company, however, already has a sulphide mill, containing the following equipment: One 12x18-in. Blake crusher; one 16x30-in. roll, crushing to ½ in.; one 8-in. bucket elevator; one 3½x8-ft. trommel with screen having ¼ in. perforations; one 6x42-in. Colorado Iron Works roll, crushing oversize from the above trommel to pass ¼-in. opening.

The samples from the coarse-crushing mills go to the

fine-crushing sample mills and the duplicate samples from the latter go to two sets of finishing rolls, each 14x24 in. There is also a set of 14x36-in. finishing rolls for separate work. The samples from the finishing rolls are dried in two steam-drying rooms and thence go to two bucking rooms; the duplicate samples are handled in different rooms. The equipment in the rooms is in duplicate and comprises four Engelbach grinders and four Eaton pulp mixers. The latter are small revolving cylinders having several interior shelves to assist in mixing the material. From the larger Eaton mixers, the sample is riffled down on a Jones divider, and then goes to the bucking board. From the bucking board the pulp is returned to a small Eaton mixer and after being revolved for a few minutes, the material is poured out and the sample is placed in the pulp envelopes, taking the material from different portions of the flattened cone. In the case of bonded ores, as many as nine pulps are made, two for the shipper, three for the smelter, two for the Mexican Government and two for the United States Government.

Lead Ores Sintered in H. & H. Pots

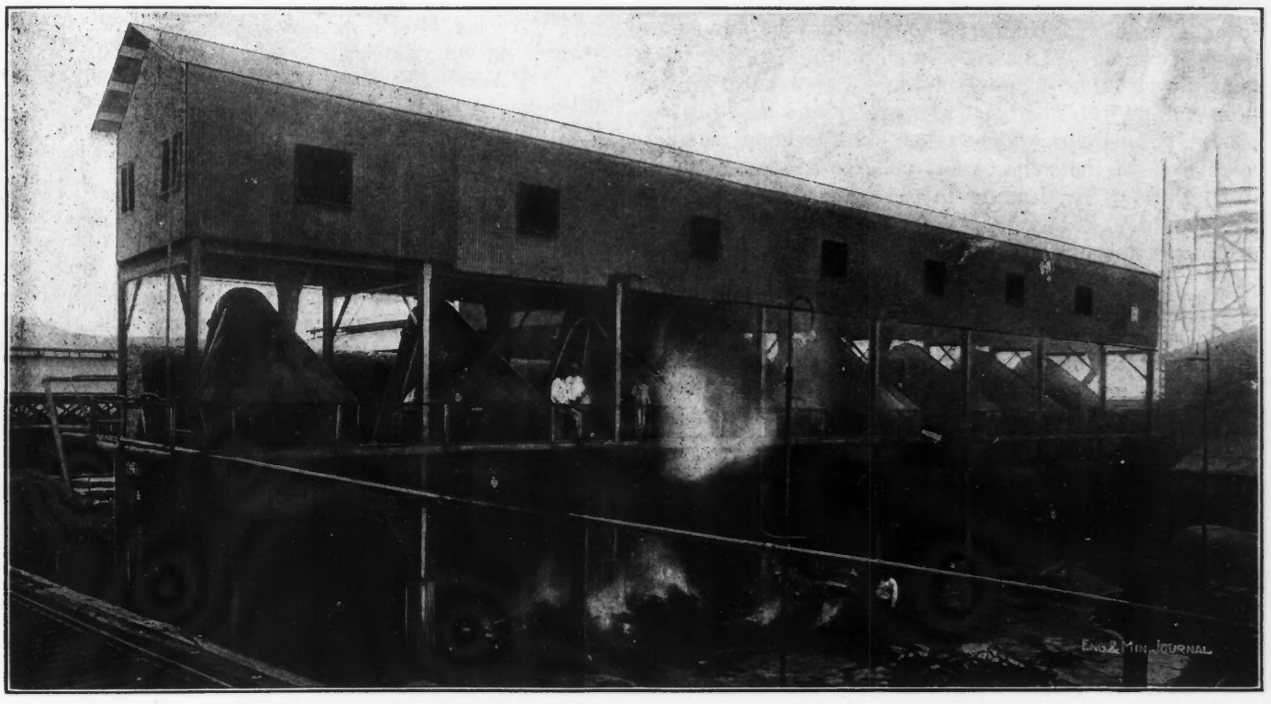
Roasting for the lead department is done in Godfrey roasters and Huntington-Heberlein pots, for which a most satisfactory product is obtained. The preliminary roast is made in three 26-ft. Godfrey roasters, two of which are oil-fired and one coal-fired, the latter furnishing the coals for the ignition of the H. & H. pot charges. The oil-fired Godfreys consume about 0.2 bbl. per ton roasted, and about 0.09 ton of coal per ton of charge is used in the coal-fired furnace. The Godfrey furnace has a movable hearth with stationary rabbles and firebox. The product from the Godfrey furnaces is removed in tram cars, which are raised by a lift to the charge floor of the H. & H. building.

There are eight Huntington-Heberlein pots, in which two 6-ton charges are made per 24 hr., approximately 100 tons per day being obtained from this plant. Blast is supplied at 8-oz. pressure by a No. 7½ Baker rotary blower. The sintered charge is dumped from the pots on a bumping block made from an old roll shell. It is further broken by hand, and the product usually contains less than 10% of fines—probably not over 5% that would pass ½-in. ring. The Godfrey roasters reduce the sulphur content to about 11% and with this elimination treat from 27 to 30 tons per day. The sulphur remaining in the H. & H. sinter during a recent month was 5.66%, when the average output per day was 11.4 tons per pot.

Blast-Furnace Ores Bedded

The usual practice of bedding most of the ore is followed in both the lead and copper blast-furnace departments. Some ores of uniform character and of which a large quantity is received, are often placed in separate bins and added directly to the charge. The lead charges are collected in wheelbarrows and the different constituents, after weighing, are dumped into large gable-bottom larry cars of the type now customary in most large lead-smelting plants. These cars have a capacity of 180 cu.ft. and are raised to the feed floor of the blast-furnace building by two hydraulic lifts operating at 190-lb. pressure and designed to raise the larry car and a 5-ton load. The larry cars operate by the third-rail system.

The charges for the two copper blast furnaces are collected and taken to the feed floor in a similar manner. The gases from the copper furnaces are drawn into the flue, at a point below the charging floor, in the same way as the lead-furnace gases are removed. Only one man is required on the charge floor for the lead department, but owing to the fact that a lower column is carried in the copper furnaces, one man for each furnace is em-



Huntington-Heberlein Sintering Plant at El Paso Smelting Works

ployed on an intermediate floor to feed the charge as needed. When the larry car discharges the copper charges, they fall into hoppers that feed into the stack, through several gates along the furnace sides, at a suitable height on the intermediate feed floor. This arrangement is an ingenious adaptation to suit prevailing conditions and works well, enabling the feeders to dispose of the charges in the places where needed.

Lead Blast Furnaces

There are eight lead blast furnaces, 46x162 in., with a 23-ft. brick shaft above the water jackets. Double-tier steel-plate jackets are used, the lower jackets having a height of 46 in. and the upper jackets 24 in. The lower jackets have a bosh of 18 in. in a vertical height of 2 ft. 6 in. There are 16 tuyeres, 3½ in. in diameter, placed 13 in. from the bottom of the jackets. The hearth area at the tuyeres is 47.25 sq.ft. Four-ton charges are usually used and from 150 to 200 tons of charge are smelted per day. In a recent month, the coke on charge amounted to 14.6%; the sulphur on charge 3.2%; and the lead, 14%. The blast pressure on the lead furnaces carried at 45 oz. The flue dust seldom averages over ½% of the weight of the charge and passes into a flue, 10x17½ ft., leading to the main stack about 700 ft. distant.

Briquetting of flue dust is done in a Chisholm, Boyd & White press, making briquettes of circular section, containing about 10% of lime. In this operation the dry, slacked lime is mixed with the flue dust. The latter is brought to the briquetting plant in wheelbarrows, on which the proper amount of lime is added, the wheelbarrow load then being dumped on a floor in front of a bucket elevator. After a preliminary mixing by shoveling, it is fed into the elevator boot delivering to a trommel, which permits material of suitable size to go to the briquetting press where a sufficient amount of water is added. The briquettes so made seem to be fairly hard and stand handling well.

The slag and matte from the lead furnaces are tapped directly into small slag pots and wheeled to one of two Rhodes separators, which give the matte and slag a better chance to separate than is offered in the ordinary furnace settler. These separator furnaces were developed by R. D. Rhodes, at Leadville, Colo.; they are of the reverberatory type, 14x25 ft., with water-cooled bottom and sides, though above the bottom plate there is an inverted arch of silica brick. Only one of the separators is regularly used, the other being maintained as a spare. The separator furnace is oil-fired, consuming from 15 to 20 bbl. of oil per day. The slag is tapped at intervals into a train of pot cars and hauled to the dump by 15- and 20-ton coal-burning locomotives. Matte is tapped from the separator and granulated by a double stream of water under a pressure of 60 to 100 lb. It falls into granulating boxes having a sloping side, up which it is raked out, loaded and delivered to the Godfrey roasters by contract. The slag from the separator for a recent month averaged: SiO_2, 31.2%; FeO, 30.1; MnO, 4; CaO, 22.9; Al_2O_3, 5.4; ZnO, 2.8; Cu, 0.23; Ag, 0.6 oz.; Pb, wet, 0.83%; Pb, fire, 0.51. Slags direct from the lead furnaces usually run about Ag, 0.7 oz.; Pb, wet, 1.10% Pb, fire, 0.85%. The first matte averages Ag, 125.8 oz.; Pb, 12.9%; Cu, 19.6; Fe, 31.5. Fumes from the tapping of the lead furnaces are carried off by 30-in. ventilating pipes in connection with movable hoods, under natural draft; the arrangement is highly satisfactory and keeps the tapping floor free from fumes.

The slag and matte from the furnace concentrating lead matte is tapped intermittently into a rectangular cast-iron settler, 4x8x3 ft. deep. The matte is separated in the settler by a brick-faced cast-iron water jacket, below which is an 8-in. opening for the matte to flow to the matte compartment. When the furnace is being tapped, the matte overflows continuously and as the concentrating charge runs faster than the regular lead charge, an extra man is employed to remove the matte pots as they are filled. Thus four men are employed in pot pulling instead of three, as on the regular lead furnaces. Besides the pot pullers, there are a furnaceman, a tapper and sometimes a helper.

This plant obtains good results from its matte concentration runs, the copper-to-lead ratio rarely failing to exceed 4:1. The matte on a recent monthly run assayed: Cu, 47.9%; Pb, 9.9; Fe, 20.4; Ag, 129.6 oz. The slag from this run had the following composition: SiO_2, 31.3%; FeO, 29.4; MnO, 2.6; CaO, 22.5; Al_2O_3, 6.7; ZnO, 2.4; Pb, wet, 0.75; Pb, fire, 0.39%; Ag, 0.42 oz. The concentrated copper-lead matte is resmelted in the copper blast furnaces, the lead being wasted, this being more economical than to attempt its saving.

The bullion in the lead-furnace crucibles is tapped from the customary lead wells into small pots from which, after skimming, it is ladled into molds holding 105 lb. The skimmings and any drossy bars are taken to the sweater furnace where the lead is melted out and recast into bars, the dross being returned to the ore charge.

With the building of lead-smelting works in northern Mexico and the generally disturbed condition of the country, much of the former ore supply for the El Paso works has been eliminated and the lead-smelting department is now operated on a much curtailed basis. Lead smelting at El Paso, however, was for many years an important operation and the plant has been noteworthy for several features of its practice, such as the use of Rhodes separators for cleaning blast-furnace slags, and the success attained in the concentration of copper-lead matte. Also, at this plant, a record so far as I know was made in the banking of a silver-lead blast furnace. After the labor strike in 1913, a furnace that had been banked 36 days was started and in a short time was in normal running condition. Another furnace that remained banked 10 days longer, was started and slag obtained, but the furnace did not recover so well and it was considered inadvisable to run the furnace in bad condition for the mere sake of a record. The best previous record at this plant of a banked furnace successfully restarted, was 28 days.

(*To be Continued*)

Lead and Radio-Lead

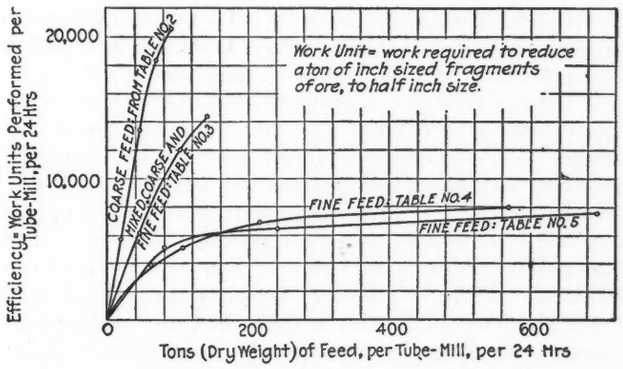
When radium, of atomic weight of 226, undergoes its successive breakdowns, it gives for the fifth disintegration product a radio-lead of atomic weight 206 (226 — 5 atoms of helium @ 4 = 206). When the thorium family undergoes disintegration a radio-lead results of atomic weight 206 (*Metaux et Alliages,* June 20, 1914). It then appears that lead, of atomic weight 207, is a mixture of two distinct radio-leads of unequal atomic weights, but identical chemical and electrochemical properties.

Relation of Feed to Tube Mill Efficiency

By R. T. Mishler*

SYNOPSIS—Tests with short (14-ft.) tube-mills indicate that grinding efficiency increases with the tonnage; but that above 200 tons (dry weight) of sands per day the gain in efficiency is small, not offsetting the greatly increased cost of elevation and classification. By raising the feed per mill from 35 tons to 200 tons daily, the cost of tube-milling has been reduced more than one-half.

Much has been written regarding the effect of dilution on the grinding efficiency of tube-mills, it being well established by varied and ample tests that 40% moisture is usually the best dilution at which to feed the pulp. The effect of varying the tonnage of feed has not received as much attention, and a few additional notes on this phase of the subject may not be unwelcome to those interested in tube-milling. This article deals with an effort to ascertain the tonnage of feed giving maximum efficiency in short tube-mills at the Lucky Tiger cyanide plant in Sonora, Mexico.



Relation of Tube-Mill Feed to Efficiency

The fine-grinding equipment of the Lucky Tiger plant consists of five 5x14-ft. tube-mills. They are lined with manganese-steel liners, of a modified El Oro type, which reduce the effective dimensions to 4½x13½ ft. The feed ends of the tube-mills are equipped with spiral sand feeders, and the discharge ends with worm pebble feeders. Each mill is driven, through gearing, by a separate 60-hp., slip-ring, induction motor. There are ammeter and watt-hour meter connections to each motor, making it possible to ascertain the power used by any mill. The speed of the mills is constant at 27 r.p.m.

Danish flint pebbles of the best grade are used, the pebble load being kept fairly constant at seven tons. This is accomplished by regulating the feed of pebbles by the readings of the ammeter, an amperage of 58 being maintained. With a voltage of 450, and a power factor of 0.75, this indicates a horsepower of 45.5 per mill.

The tube-mills receive from the concentrating plant and from old dumps, an average of 150 dry tons per day of clean, coarse sands. After passing through the tube-mills, these sands are raised in bucket elevators, passed over Wilfley tables, and then distributed to four 16-ft. drag classifiers. The sands discharge from these machines is returned to the tube-mills, and the slimed overflow is sent to agitation tanks, thus being removed from the tube-mill circuit. An average of 80% of the overflow passes a 200-mesh screen, the remaining 15% being finer than 150 mesh.

The experiments for determining the proper tonnage of feed to the tube-mills were made on single mills running under actual working conditions. Special efforts were made to keep the character and dilution of feed constant throughout each series of experiments. Before beginning any test, the mills were run for 90 min. on the same tonnage of feed to be used in the test. Sampling of feed and discharge was then commenced, the sampling continuing 90 min. At the end of this period the volume of feed was changed and the mill again allowed to run 90 min. before sampling was commenced on the following test. Four times during each sampling period, the feed was diverted into a suitable vessel and the flow of wet pulp measured. Knowing the dilution and the specific gravity of the pulp, it was then possible to calculate the tonnage per hour of dry feed. The samples of feed and discharge were retained for moisture and screen analysis, and, together with the tonnage, form the basis for the comparison of efficiency.

TABLE I. EXAMPLE OF CALCULATION OF WORK DONE BY TUBE MILLS.

Tonnage, 45 tons (dry wt.) per 24 hours.

Mesh	Average size of particle Inches	R = Reciprocal of size	Feed % of various sizes	Feed $R \frac{\%}{100}$ = Work Units	Discharge % of Various Units	Discharge $R \frac{\%}{100}$ = Work Units
+20	0.0550	18	0.8	0.1	....	...
+40	0.0245	41	3.6	1.5	....	....
+60	0.01185	84	18.8	15.8	0.4	0.3
+80	0.00775	129	14.2	18.3	2.0	2.6
+100	0.00615	163	15.0	24.4	6.0	9.8
+150	0.00458	218	14.8	32.3	10.0	21.8
+200	0.00330	303	11.2	34.0	11.6	35.1
—200	0.00250	400	21.6	86.4	70.0	280.0

Work units per ton, in feed..... 212.8
Work units per ton in discharge..... 349.6
Diff. = work done per ton of feed..... 136.8
Tons × diff. = work done per day..... 6156

Note:—Work-unit = work required to grind a ton of inch-size fragments of ore, to half-inch size.

Four series of tests were run. Table 2 gives the results from the first series, consisting of four tests made on coarse concentrator tailing, with no admixture of return feed. Table 3 shows the results of four tests run on

TABLE II. EFFECT OF VARYING TONNAGE IN TUBE MILLS.

(Coarse Feed)

Test No.	1		2		3		4	
Tons dry sands per day	22		47		70		85	
Moisture, L:S ratio	1.1:1		0.94:1		0.84:1		0.90:1	
	Feed	Disch.	Feed	Disch.	Feed	Disch.	Feed	Disch.
Per cent on 20 mesh.....	11.2	0.3	21.6	0.2	18.4	....	22.4	....
Per cent on 40 mesh.....	28.0	0.6	39.6	0.6	45.2	0.4	39.4	0.6
Per cent on 60 mesh.....	25.6	1.4	23.0	0.8	19.6	4.0	20.6	5.2
Per cent on 80 mesh.....	13.4	0.4	3.8	2.2	5.0	4.2	4.2	6.2
Per cent on 100 mesh.....	6.0	1.2	2.4	2.9	2.8	5.4	2.6	6.8
Per cent on 150 mesh.....	4.6	2.4	2.2	5.4	1.8	8.4	1.2	9.6
Per cent on 200 mesh.....	3.6	2.6	1.0	4.9	1.2	6.2	0.8	4.8
Per cent through 200 mesh	7.6	91.1	6.4	83.0	6.0	71.4	8.8	66.8
Work units in feed.....		113		82		81		87
Work units in discharge..		381		367		341		326
Diff. = work done per ton		268		285		260		239
Tons × diff = work done per day.....		5896		13,395		18,200		20,315

Power constant at 47 h.p.

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dump sands, mixed with a small amount of return feed. Tables 4 and 5 give the results on tests run on a mixture of return feed with a relatively small amount of dump sand.

TABLE III. EFFECT OF VARYING TONNAGE IN TUBE MILLS

(Mixed Coarse and Fine Feed)

Test No.	1		2		3	
Tons dry sands per day	45		103		145	
L:S	0.44:1		0.46:1		0.57:1	
	Feed	Disch.	Feed	Disch.	Feed	Disch.
Per cent on 20 mesh	0.8	.....	1.0	.....	1.0	.....
Per cent on 40 mesh	3.6	.....	8.4	.....	5.4	.....
Per cent on 60 mesh	18.8	0.4	18.4	2.2	17.4	4.4
Per cent on 80 mesh	14.2	2.0	13.6	5.2	18.0	8.2
Per cent on 100 mesh	15.0	6.0	13.8	9.8	17.0	12.2
Per cent on 150 mesh	14.8	10.0	14.2	13.0	16.0	16.4
Per cent on 200 mesh	11.2	11.6	10.2	12.0	10.2	13.0
Per cent through 200 mesh	21.6	70.0	20.4	57.8	15.0	45.8
Work units in feed	213		203		194	
Work units in discharge	350		320		293	
Diff. = work done per ton	137		117		99	
Tons × diff. = work done per day	6,165		12,051		14,355	

Power constant at 47 h.p.

TABLE IV. EFFECT OF VARYING TONNAGE IN TUBE MILLS

(Fine Feed)

Test No.	1		2		3	
Tons dry feed per day	109		217		570	
L:S	0.47:1		0.49:1		0.53:1	
	Feed	Disch.	Feed	Disch.	Feed	Disch.
Per cent on 20 mesh	0.52	.....	0.76	....	0.42	.....
Per cent on 30 mesh	0.08	0.08	2.72	0.28	1.76	0.60
Per cent on 40 mesh	4.52	0.44	3.40	1.04	3.60	2.56
Per cent on 60 mesh	6.48	2.96	7.24	4.64	10.92	10.56
Per cent on 80 mesh	9.44	5.44	7.76	6.68	13.08	11.08
Per cent on 120 mesh	27.36	19.20	25.40	22.60	29.60	30.52
Per cent on 150 mesh	30.60	32.96	31.20	34.28	24.86	25.20
Per cent on 200 mesh	12.44	18.88	13.28	13.92	9.28	9.20
Per cent through 200 mesh	8.56	20.04	8.24	16.56	6.48	10.28
Work units in feed	218		216		198	
Work units in discharge	264		248		212	
Diff. = work done per ton	46		32		14	
Tons × diff. = work done per day	5014		6944		7980	

Power constant at 45.5 h.p.

TABLE V. EFFECT OF VARYING TONNAGE IN TUBE MILLS.

(Fine Feed)

Test No.	1		2		3		4	
Tons dry feed per day	67		80		239		693	
Moisture, L:S ratio	0.45:1		0.44:1		0.46:1		0.55:1	
	Feed	Disch.	Feed	Disch.	Feed	Disch.	Feed	Disch.
Per cent on 20 mesh	0.20	.....	0.32	.....	0.51	.....	0.99	0.19
Per cent on 30 mesh	0.76	.....	0.96	.....	1.08	0.40	2.23	1.14
Per cent on 40 mesh	1.72	.....	2.12	0.40	2.21	1.00	4.52	3.42
Per cent on 60 mesh	4.40	1.10	7.20	1.80	6.43	4.65	11.48	10.81
Per cent on 80 mesh	8.56	2.85	12.46	4.25	12.78	9.05	12.78	12.96
Per cent on 120 mesh	25.76	14.75	28.40	19.00	30.71	27.50	27.98	28.50
Per cent on 150 mesh	30.20	25.78	27.18	29.30	24.98	27.05	24.92	24.63
Per cent on 200 mesh	17.90	85.49	12.82	15.10	12.62	14.35	9.59	10.26
Per cent through 200 mesh	10.50	30.03	8.54	30.15	8.68	16.00	5.51	8.09
Work units in feed	234		216		214		194	
Work units in discharge	293		281		241		205	
Diff. = work done per ton	59		65		27		11	
Tons × diff. = work done per day	3952		5200		6543		7623	

Power constant at 44.8 h.p.

In order to reduce the screen analyses and tonnages to terms of grinding work, a modification of the method suggested by Algernon Del Mar[1] has been employed. Table 1 furnishes an example of this system. The work units in Tables 2, 3, 4 and 5 were all calculated in the same manner as in Table 1, though the calculations have been omitted on account of space; only the final results being given. The work units in feed and discharge are obtained by multiplying the reciprocal of the average size (in inches) of the sand grains corresponding to each mesh, by the proportion (not the percentage) of the sample remaining on each mesh. The sum of all these products is the work units in one ton of the pulp sampled. The difference between the work units in the discharge and the work units in the feed gives the work units performed upon one ton of the pulp in passing through the mill; while this difference multiplied by the tonnage per day gives the total work units performed by the mill in one day. The advantage of this system is that it furnishes a perfectly definite unit of grinding work; i.e., the work required to reduce a ton of inch-sized fragments of ore to half-inch size. In Table 1, the work units per ton in the feed are shown to be 212.8. This means that in order to reduce the feed to the size shown by the screen analysis, it has required 212.8 times the amount of work which would be required to reduce a ton of inch-sized fragments of the same ore to half-inch size. This system has the same disadvantage as all other systems for determining the amount of grinding work done from screen analyses; it disregards the fact that different sands vary in hardness, and it is therefore accurate for comparing grinding efficiencies only when the material ground is of the same hardness in all cases compared.

That there are pronounced variations in the hardness of sands, even in the same plant, is shown by comparing Table 2 with Tables 4 and 5. At a given tonnage of feed to the mill, five times as much work is indicated in Table 2 as in Tables 4 and 5. Still the horsepower required is practically the same in each case. The explanation of this apparent anomaly is that in the first case the feed consists of comparatively soft fragments of the original ore, while in the last two cases the feed is composed of the harder fragments of the original ore and of particles from the flint pebbles, which were too hard to be pulverized in the first passage through the mill.

The principal lessons, however, to be gleaned from the tables and diagram are, first, that the power consumption is independent of the tonnage of sands fed to the mills, and second, that the proportion of pulverized sands in the discharge is highest for lower tonnages, and decreases as the tonnage is increased. At low tonnages (20 tons per day), coarse sands are slimed in a single passage through the mill—the discharge containing more than 90% of minus 200-mesh product. On the other hand, when tonnages in excess of 200 tons per day are fed to the mill, the discharge is only slightly finer than the feed. The third point is that when we consider tonnage, multiplying the tons passed through the mills by the grinding work done per ton, we see that without a single exception the total grinding work, or "efficiency," increases as the tonnage of feed is increased.

A large feed has the same advantage over a small feed that a short tube-mill has over a long one; i.e., the pulp passes oftener through the classifiers, the pulverized sands being promptly removed from the circuit, and the work of the tube-mill being expended more upon grinding coarse sands than upon grinding sands already sufficiently fine.

Extremely large tonnages, however, have two important drawbacks; first, the gain in efficiency is small; second, the proportion of coarse sands in the discharge is greatly increased. The small gain in efficiency for large tonnages is best shown by reference to the diagram: above a feed of 200 tons of dry sands per day, the curves flatten, indicating practically no gain in efficiency. The increase of coarse sands in the discharge is shown in Tables 2, 3, 4 and 5, and is also indicated in Table 6. This last table shows the increase of return feed when the number of tube-mills in operation are reduced. As the tonnage is crowded into fewer mills, the amount of return feed increases out of all proportion to the tonnage fed to each mill. This excess of return feed must be elevated, concentrated, classified and returned to the tube-mills. The extra cost of performing this work, when the tonnage

[1] "Eng. and Min. Journal," Dec. 14, 1912.

of feed per mill exceeds 200 tons per day, is easily in excess of the slight reduction in cost due to increased grinding efficiency. Hence an average daily feed of 200 tons of dry sands per mill has been selected as the tonnage giving best results. This 200-ton feed includes 50 tons per day of concentrator tailings ("initial feed") and 150 tons of sands returned from the classifiers after having passed one or more times through the tube-mills.

When operations were started at the Lucky Tiger plant, all five mills were run as much of the time as possible. It was soon noticed, however, that the mills grinding the return sands were receiving very little feed, and one of these mills was stopped. Later, three mills were forced to do all the grinding when the feed was light, and a fourth mill run during heavy feeds. Recently (after completing the above tests), a greatly increased initial feed was crowded into three mills, the fourth mill being run only during exceptionally heavy feeds. By this means the total daily feed (initial and return feed) has been increased to 200 tons per mill,

TABLE VI. RELATION OF FEED PER MILL TO TONNAGE OF RETURN FEED

Tube mills Operating	Tons dry sands per day: Feed per mill	Total feed to all mills	Total return feed
5	40	200	50
4	80	320	170
3	200	600	450
2	600	1200	1050

Note: In each case the total initial feed of concentrator tailings, passing to the tube-mills, was 150 dry tons per 24 hours.

TABLE VII. EFFECT UPON PEBBLE CONSUMPTION AND COST PER TON, OF INCREASING FEED TO TUBE MILLS

(From records at Lucky Tiger Mill.)

	Average Tonnage of Initial Sands Feed, per Tube Mill, per 24 Hr.	Approximate Tonnage of Combined Initial and Return Feed, per Tube Mill, per 24 Hr.	Lb. of Quarry Rock per Ton of Initial Feed	Lb. of Imported Pebbles per Ton of Initial Feed	Cost, U. S. Currency per Ton of Initial Sands Feed, of Tube Milling, Elevating and Classifying
First 3 months of operation (data not complete).					
Next 6 months of operation.....	26.1	35	10.0	17.9	$1.88
Next 9 months of operation.....	40.3	80	none	15.8	1.01
Next 12 months of operation.....	42.0	85	none	15.3	0.94
Last 3 months of operation.....	50.0	200	none	8.2	0.68

which is the tonnage shown by the tests to give maximum efficiency. This crowding of the feed through the tube-mills has resulted in practically doubling the capacity per mill. When five mills were being run, the average daily tonnage of initial sand from the concentrating plant was barely 26 tons per tube-mill. Now, with three mills in operation, the average tonnage of initial sands per mill is 50 tons per day. This increase in capacity has occasioned no decrease in the grinding work done, the screen analyses of the final overflow from the classifiers still averaging 80% through 200 mesh, as it did during the time five mills were used.

The power required to grind a ton of sands has decreased in inverse ratio as the capacity of the mills has increased. It now requires 22 hp.-hr. to grind a ton of concentrator tailings to such a fineness that 80% passes a 200-mesh screen. This is half what was required when the mills were run on a light feed.

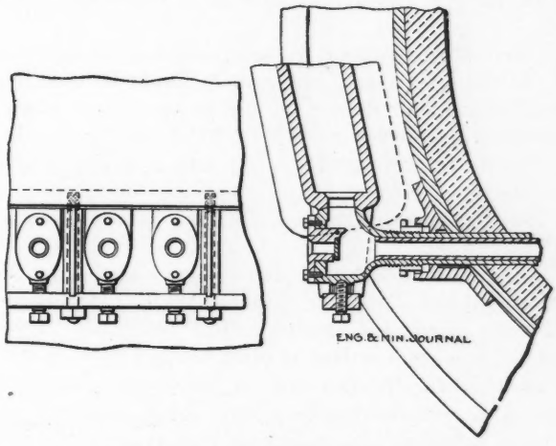
The decrease in pebble consumption has been even more noticeable. With a feed of 26 tons of initial sands per day, it was necessary to charge 2860 lb. of quarry rock and 467 lb. of imported pebbles per day into each mill. This is at the rate of 110 lb. of quarry rock and 17.9 lb. of imported pebbles per ton of sands ground. When the feed per mill was incerased to 41 tons of initial sands per day (80 tons per day of combined initial and return feed), the imported pebbles charged to each mill amounted to 640 lb. per day, or 15.5 lb. per ton of initial coarse sands. No quarry rock was used. When the tonnage was further increased to 50 tons of initial sands, or 200 tons of combined initial and return sands per day, the daily consumption of imported pebbles dropped to 410 lb. for each mill, or 8.2 lb. per ton of initial sands fed.

The cost of tube-milling has been reduced in proportion to the reduction in power and pebbles consumption. With a light feed, the cost of grinding, elevating and classifying, per ton of initial sands fed, was $1.88 U. S. currency. With a medium feed, the cost per ton was reduced to 97c. Now, with a heavy feed, the cost has dropped to 68c. per ton.

*

Bernhard Converter Tuyere

Richard Bernhard has been granted a patent (U. S. Pat. 1,097,907, assigned to the Power & Mining Machinery Co.) for a converter construction having a wind box suitably apertured to receive the inlet end of tuyeres that may be quickly disconnected. A ball-and-socket engagement is provided between the wind box and the tuyeres, the latter being pressed against the wind box so as to insure a tight joint by means of setscrews that engage the lower side of the tuyere. Exterior leaks



BERNHARD CONVERTER TUYERE

around the tuyere pipes are prevented by packing, which may be pressed as tightly as desired by a brass gland threaded to fit the tuyere pipe.

The construction will be readily understood from the accompanying drawing. By simply loosening the setscrew which holds the tuyere in engagement with the wind box, the individual tuyeres can be quickly disengaged. The rounded end of the tuyere finds its seat automatically, as the setscrew is turned up, and by reason of the ball-and-socket connection between the wind box and the tuyeres, the accurate alignment of the latter with respect to the wind box is unnecessary, and a material saving is attained in the machining and assembling of these parts. It will be noticed that the engagement of the tuyere is accomplished with a single setscrew instead of two bolts, as in the case of older forms of bolted-flange connections.

The Leyner Machine for Drift Rounds

By Charles A. Hirschberg*

SYNOPSIS—Advantages of the Leyner type of hammer machine drill. Can drill upper holes and can get closer to the rock sides than can the piston drill. The typical "Leyner cut" and other rounds for which that machine is particularly adapted. Examples from South Africa, Cripple Creek, Michigan copper and iron regions, Roosevelt, Lucania and Laramie-Poudre tunnels.

Economical mining and tunneling calls for the breaking of the most ground with the least footage of holes, inasmuch as this means a saving of powder, time, labor, materials and power. To accomplish this, a thorough knowledge is necessary of the character of the ground to be drilled and broken, its hardness and stratification, whether damp or dry and whether likely to cave or not. Drill steel properly gaged and bitted must be provided, and drilling machines that are economical of power, easily maintained, quickly handled and capable of rapid drilling. Some types of machine drills, while having a large capacity for work when no limitations are imposed as to location, size and depth of holes, cannot always be utilized for drilling the most effective round of holes, due to various features of design to be enlarged upon later.

These features cannot be categorized with faulty design, in the true sense, but rather should be considered as limitations that render an otherwise efficient machine unsuitable for certain rounds of holes calling for drilling close to the top or side walls and at a slight pitch; such machines require ample head and wall room for operation; consequently they are slow in operation and hard to handle.

These drills are of the piston or reciprocating type, as distinguished from the hammer drill. Although all hard-rock drills are reciprocating machines, strictly speaking, the term is best applied to that type in which the steel is rigidly fastened to the front end of the piston and reciprocates back and forth with it, while the term "hammer" is applied to that type in which the steel is inserted loosely in the front end of the machine and is struck by the piston.

The hammer drill divides itself into several styles as distinguished by the method of application to the rock. First, the mounted type, of which the Leyner is an example; second, the self-supporting and automatic air-feed type, commonly called a stoper; and third, the held-in-the-hand plugger or sinker type.

It is the purpose of this paper to deal more particularly with the mounted-hammer type in describing drilling rounds for different characters of ground, and it will be brought out that reciprocating drills are restricted in their application to certain drilling rounds, and hammer drills, on the contrary, are readily applicable to the drilling of all kinds of rounds. It is between these two types alone that a true comparison can be made, inasmuch as both are applied to similar work, such as drifting or tunneling, whereas the stoper and the plugger only rarely come into competition with the mounted machines.

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The Leyner Cut

Fig. 1 shows a round of holes, to which the term "Leyner cut" has been applied, used in a drift or tunnel where the rock is extremely hard. It has been used with variations in the mines of Arizona, Colorado and Michigan. It involves a pyramid or center cut including a great many upper or dry holes.

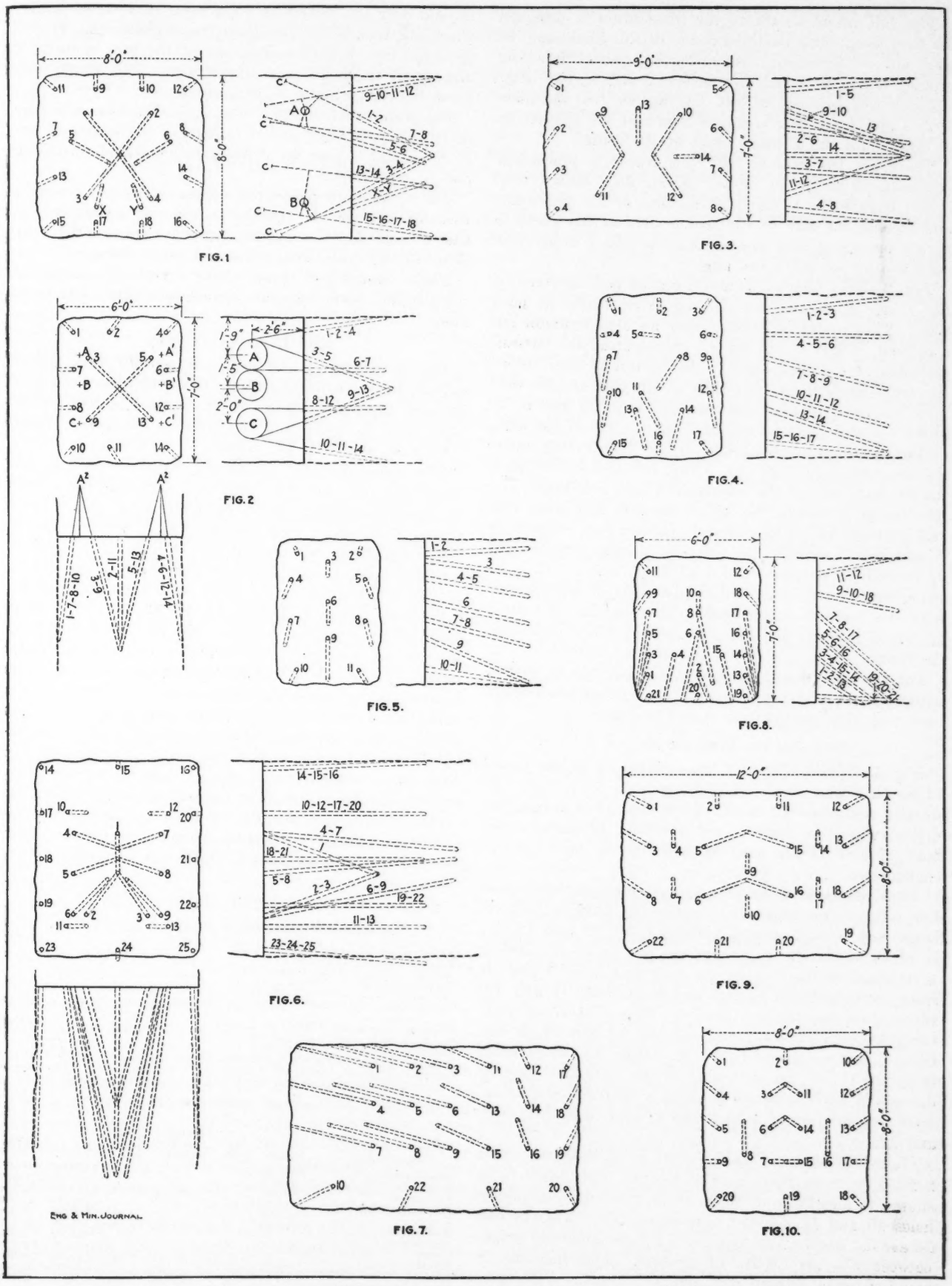
The advantages of the Leyner cut are: (1) The holes are drilled with as few changes of machines and set-ups as possible; (2) a pyramid-shaped wedge of rock is first pulled from the center, after which the rest of the round breaks readily. While there is no hard-and-fast method of putting in such a round of holes, the principle is the same in all cases and involves the many upper and dry holes shown in the illustration.

It is particularly suitable for solid formations containing no slips or seams to break to. It has been used with marked success in the hard rock and ore of northern Michigan, and in at least one case has resulted in drifting at nearly four times the speed formerly made with piston machines. The object of the cut and the system of putting in the holes have been found capable of easy explanation to the foreign miners, so that in a short time they were taught to use this round successfully and almost automatically.

Referring to the illustration, *C* designates the position of the crank of the drill in each case. *A* is a crossbar in the first position. From the top of the bar the four back holes, Nos. 9, 10, 11 and 12, are drilled. The machine is then "dumped" or tipped forward until the crank can just turn and clear the back or top of the drift, is moved out a little on the bar and the top center-cut holes 1 and 2 are drilled. If the bar is set up correctly in a drift of the size shown, the machine can be dumped enough to reach the center of the drift heading with the bottom of the hole. The machine is then turned under the bar and the side holes 7 and 8 and the cut holes 5 and 6 are drilled.

The crossbar is next dropped to position *B*, the machine is set up on top and the side holes 13 and 14 drilled. Finally, the machines are turned under the bar, tipped up in front so that the crank just clears the bottom of the drift and holes 3 and 4 are drilled so as about to meet Nos. 1 and 2 in the center of the heading. The four lifters, 15, 16, 17 and 18 are drilled last, except that, if there is time enough, relievers something like *X* and *Y* may be put in to make sure. When sufficiently strong explosive is used, however, the round will break without these last.

Some of the holes could be placed to better advantage, perhaps, if there were time for another "set-up," or if a column could be used, but this particular sketch applies to a place where it was necessary to drill 100 ft. with two machines in extremely hard steel-ore and jasper and there was no time to waste.



FIGS. 1-10. VARIOUS LAYOUTS FOR THE LEYNER MACHINE

The full round shown in the illustration is designed for hard rock, but a modified round of this kind could be used almost anywhere. In softer and better breaking ground, cut holes 5 and 6, relievers *X* and *Y*, one lifter and one back hole can be left out, but the four cut-holes 1, 2, 3 and 4 are nearly always used and are pitched up or down, and in, to meet about at the center.

There are two reasons why this round is practically impossible with piston drills. First, they cannot drill it fast enough, particularly on account of the dry holes; and second, the size of the piston drill is too great to permit operating it in the positions necessary to give the holes the proper pitch and angle.

Fig. 2 shows another pyramid cut as used in some of the mines of Mexico for driving small drifts in hard rock. This round is drilled from an arm mounted on a column, *A* and *C*, A^1 and C^1 representing the vertical positions of the arm, and A^2 the horizontal position of the arm and drill on both sides of the column; the column is placed midway between the walls of the drift. Holes 4 and 5 are first drilled from the top of the arm, on the right-hand set-up. The drill is then swung under the arm and hole 6 put in. Next the arm is swung to the left-hand side of the column and hole 7 drilled. The machine is turned to the top of the arm and holes 1, 2 and 3 are drilled. The arm and drill are then dropped to *C* and hole 8 drilled; the machine is swung under and 9, 10 and 11 put in. Holes 13 and 14 are drilled by swinging the arm and drill to the right of the column with the machine underneath. The machine is turned on top of the arm and hole 12 drilled, which completes the round.

For extremely hard ground extra holes may be drilled with the arm and machine at *B*, but in all moderately hard rock this has not been found necessary.

A South African Round

Fig. 3 shows a round of holes employed in the mines of South Africa in a drift 9 ft. wide by 7 ft. high. It usually comprises 12 holes. Hole No. 13 is sometimes drilled when the rock is not breaking properly, while both 13 and 14 are used when extremely hard rock is encountered.

The distance between holes 1, 2, 3 and 4 in the vertical line is approximately 2 ft., likewise the distance between holes Nos. 5, 6, 7 and 8. Holes 9, 10, 11 and 12, or, in other words, the cut holes, are put in approximately 4 ft. apart at the face of the rock, but holes 9 and 10 slant downward and inward and meet holes 11 and 12, which slant upward and inward. The distance between the junction of holes 9 and 11, and 10 and 12, at the bottom, is approximately 18 in. Hole 13, when used, is put in 1½ ft. below the top of the drift and slanting downward until it comes to about a central point 18 in. from the junction of holes 9 and 11 and from that of 10 and 12.

Hole No. 14, when used, is put in at the face, about 2 ft. 6 in. from the center of the cut, and slants in as shown, to a distance of about 18 in. from the junction of holes 10 and 12. Usually, however, holes Nos. 13 and 14 are not used. The round of 12 holes generally breaks between 5½ and 6 ft. of ground. The machine is mounted on a column and arm.

Cripple Creek Rounds

Fig. 4 shows a hammer-drill round used in the Cripple Creek district of Colorado. It consists of 17 holes and is used only in drifts 8 ft. high by 6 ft. wide or larger, where the rock is an exceedingly hard phonolite. It will be noted that with the exception of the back holes 1, 2 and 3, all the holes point downward. This round will break between 5 and 6 ft. of ground.

Fig. 5 shows the round of Fig. 4, modified for a smaller drift, one 7 ft. high and 5 ft. wide. It consists of but 11 holes and is used for drilling in brecciated formation and in vein matter.

The ordinary double-screw column with one set-up is used for both rounds. Of course, the arm is shifted from side to side and lowered as occasion requires, the holes being drilled from both above and below the arm.

These rounds are varied slightly with the nature of the ground; fewer holes are sometimes drilled, but never more.

The Lucania Tunnel

Fig. 6 illustrates a round used several years ago in driving the Lucania tunnel at Idaho Springs, Colo., put in with Leyner machines. This tunnel is 9 ft. 6 in. high by 8 ft. wide, and the advance averaged between 7 ft. 6 in. and 8 ft. per round.

The set-up involved the use of two columns, one carrying two arms and the other one arm, making a total of three machines. Short cut-holes 1, 2 and 3 were drilled 6 ft. deep; long cut-holes 4, 5, 6, 7, 8 and 9, 9 ft. 6 in. deep; relievers 10, 11, 12 and 13, 8 ft. deep; back holes 14, 15 and 16, 8 ft. deep; side holes 17, 18, 19, 20, 21 and 22, 8 ft. deep; lifters 23, 24 and 25, 8 ft. deep. Holes 6, 2, 3, 9, 11, 13, 23, 24 and 25 were drilled by the bottom machine; the rest were drilled by the two top machines. The round was shot in the order numbered, the two cuts being loaded and fired first. The balance of the round was then loaded and fired.

During 1911, when the tunnel was being driven on contract by Claypole & Hauser, the work was remarkable for rapid progress and low costs. During June of that year a careful record was kept of all expenditures, and it was found that the tunnel was being driven its entire cross-section for $15.93 per ft. This figure included everything but depreciation on the power plant, *i.e.*, compressor and blower, which was furnished by the Lucania Co.

The figures for the month of June follow:

JUNE PERFORMANCE AT THE LUCANIA TUNNEL

Nature of ground—hard pegmatite.
Total progress—232.5 ft.
Number of shifts—30 eight-hour shifts.
Advance per shift—7.75 ft.
Drill labor—3 runners and 2 helpers.
Outside labor—1 trammer, 1 trackman, 1 blacksmith and 1 day and 1 night engineer.
Mucking—contracted at $2.65 per linear ft.
Machines used—three water Leyner drills.
Depth of holes—6 ft., 8 ft. and 9½ ft.
Powder—1¼x8-in. du Pont 50% Repauno, German ZL fuse and 6X du Pont caps
Outside equipment—Leyner 480-ft. belted air compressor, Leyner drill sharpener and Connersville blower.

COST DISTRIBUTION

Classification	Labor	Live Stock	Material and Supplies	Freight and Handling	Total	Per Ft.
Superintending	$150.00	.....	.....	.....	$150.00	$0.6451
Engineers	240.00	.....	.....	.....	240.00	1.0322
Excavation[1]	480.00	.....	$1056.61	$43.21	1579.82	6.7949
Day tramming[2]	105.00	$12.75	.....	.....	117.75	0.5064
Track	105.00	.....	11.87	0.49	117.36	0.5048
Blacksmith	150.00	.....	16.80	0.70	167.50	0.7204
Mucking	.....	.....	.....	.....	616.12	2.6499
Power	.....	.....	.....	.....	515.86	2.2187
Lighting	.....	.....	14.85	0.60	15.45	0.0664
Drill repairs	.....	.....	.....	.....	21.30	0.0916
Miscellaneous supplies	.....	.....	159.40	5.08	164.48	0.7074
Totals	$1230.00	$12.75	$1259.53	$50.08	$3705.64	$15.93+

[1] Includes all steel received to that date.
[2] For handling supplies, etc., owing to the mucking being done on subcontract.

COST RECAPITULATION

Classification	Total	Per Ft.
Labor	$1230.00	$5.2903
Live stock	12.75	0.0548
Material and supplies	1259.53	5.4137
Drill repairs	21.30	0.0916
Freight and handling	50.08	0.2137
Mucking	616.12	2.6499
Power	515.86	2.2187
Total	$3705.64	$15.93+

Michigan Copper Rounds

Fig. 7 exhibits a round employed in the Michigan copper country for what is known as drift stope, the width of which varies according to the width of the lode; the object is to take out all of the rock between the foot and hanging walls, the holes being pointed in some cases toward the foot and in others toward the hanging. The round as illustrated would do for an 8x14-ft. drift. The set-up consists of a double-screw column with arm.

Fig. 8 shows the method in use at the Quincy mine for small drifts; it works satisfactorily in this particular case owing to the fact that the driving is done entirely through trap, there being no copper to contend with. This round is not good, however, in ground that is heavily charged with copper, since great difficulty would be encountered in getting the cuttings out of the holes. In such cases the direction of the holes should be reversed so as to point upwards. The round is shown for a 6x7-ft. drift and is drilled from a column with arm.

The holes are drilled to the following depths: 1, 2 and 3, 2 ft. 6 in. deep; 3, 4, 14 and 15, 3 ft. 6 in. deep; 19, 20 and 21, 4 ft. deep; 5, 6 and 16, 4 ft. 6 in. deep; 9, 10, 11, 12 and 18, 5 ft. 8 in. deep; 7, 8 and 17, 6 ft. deep.

Michigan Iron Rounds

In Fig. 9 is shown a round of holes for an 8x12-ft. drift as used in the Dober mine near Iron River. The ground was a gray slate. The holes were drilled from a column and arm and required two set-ups, owing to the wideness of the drift. All holes were drilled to a depth of 5 ft. with the exception of those numbered 5, 6, 15 and 16, which were drilled 5 ft. 6 in. deep.

Fig. 10 shows a round of holes employed in medium-hard iron ore at the Cary mine, Hurley, Wis. The size of the drift is 8x8 ft.

All holes with the exception of 18, 19 and 20 look up a little above the horizontal. Holes 1, 2, 4, 5, 9, 10, 12, 13 and 17 are drilled 5 ft. deep; 18, 19 and 20, 5 ft. 6 in. deep; 3, 6, 7, 11, 14 and 15, 5 ft. 8 in. deep; 8 and 16, 6 ft. 6 in. deep. This cut breaks well and lengthens the drift 4½ ft. with each round. The round is drilled with column and arm set-up.

The Roosevelt Tunnel

The Roosevelt drainage tunnel at Cripple Creek, Colo., is believed to have been about the hardest tunnel driving ever encountered. Three sets of contractors successively undertook the job and failed. The rock is that designated by the government geologists as Pike's Peak granite. In some parts the rock has a gneissic or schistose structure, but in the main it is characterized and made notorious by the lack of seams or joints. Thus, while the rock itself is hard, the lack of lines of fracture and planes of seaming is doubtless responsible for the poor rate of progress made by the first contractors. The tunnel was started 10 ft. high and 7 ft. wide, but in the final contract this was changed to 10 ft. wide by 6 ft. high over the rails, and a 3x6-ft. drainage ditch was added.

After the trial of several systems of placing the drill holes, that shown in Fig. 11 finally proved to be best adapted to the tough nature of the jointless rock. Water-Leyner drills were employed. In attacking the ordinary rock, all holes were drilled 8 ft. except the cuts and relief cuts, Nos. 1 to 8, inclusive, which were drilled to a 10-ft. depth. In tougher ground, these depths were each cut down 2 ft., and in addition to the 22 holes used on the ordinary rock and numbered in Fig. 11, the six extra holes *X* were put in.

At first, even with the use of from 300 to 350 lb. of 60% dynamite, great difficulty was experienced in properly blasting the eight cut-holes, sometimes several loadings being necessary to blow out the cut. Finally, however, after putting in the two extra cuts shown, even the toughest ground yielded. The system of placing the holes was evolved with a view not only to blasting the rock to the best advantage, but also to allow the greatest

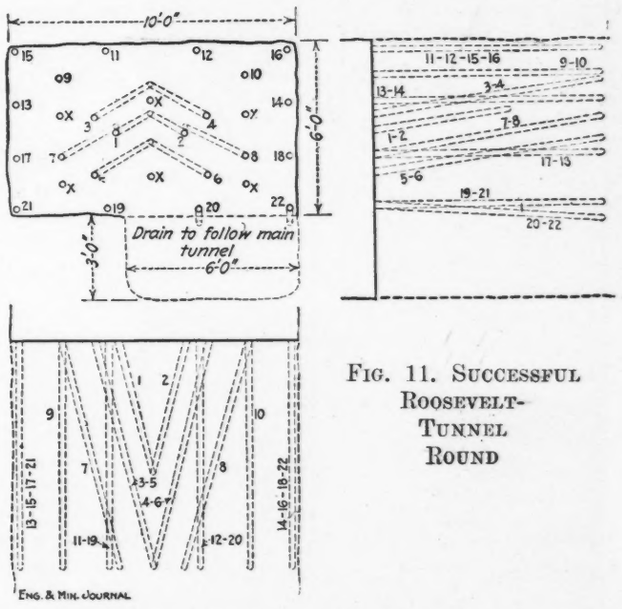


FIG. 11. SUCCESSFUL ROOSEVELT-TUNNEL ROUND

economy of time in drilling. These ends proved to be best effected by mounting the two Leyner drills on a single, horizontal crossbar, instead of on the more usual two independent vertical columns. In this way even the maximum number of 28 holes required but two set-ups of the bar. It will be readily understood that this way of placing the bar eliminated the necessity of mucking out to the bottom before starting drilling, as when vertical columns are used.

The grade line was carried about 18 in. below the top of the bore and about 8 to 12 in. below this was placed the bar. From this, the center and corner back-holes were drilled, and then by revolving the drill around and beneath the supporting bar, all of the remaining holes except the center lifters and bottom corners were put in.

It will be understood that the difference in the level of the drill bit between its position on top of the bar, and below the bar, amounted to about 2 ft. By using proper judgment in placing the horizontal bar, therefore, the feat of putting in 18 holes from one set-up was easily accomplished. The bar was then shifted to its

second position, usually about 18 to 24 in. above the floor, and the last four holes put in. In tough ground an extra center-cut hole *X* was also put in from this set-up.

The bits used at the start of a hole were 3 ft. in length, with a diameter of 2¾ in. Each succeeding steel was 2 ft. longer than the one before, the 11-ft. cut holes requiring six steels to a hole, while the others required five steels each. The diameter of the hole bottom averaged about 1½ in. The number of steels was carefully determined so that as fast as one became dulled it was replaced by a sharp one. While this may seem a minor point, experience proved it to be a potent factor in influencing the speed of drilling and increasing the rate of progress made in driving the tunnel.

The ditch was kept back of the breast about 150 ft. and taken out at convenient intervals by placing vertical 3-ft. holes spaced on 2-ft. centers along the intended center line of the ditch, an ordinary tripod being employed for this work.

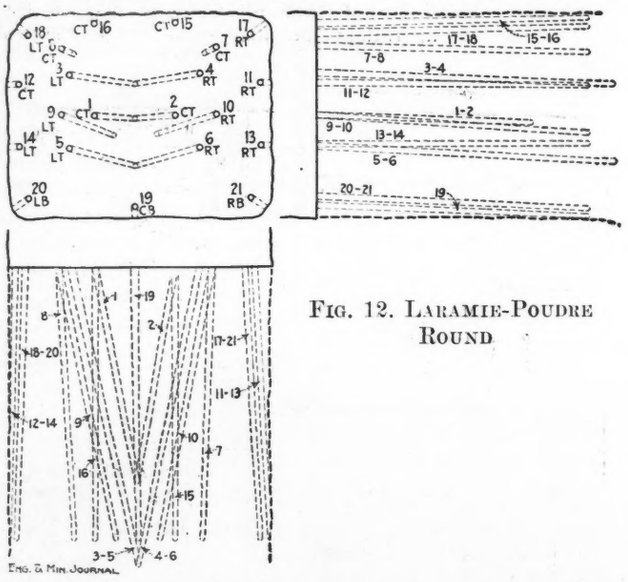


FIG. 12. LARAMIE-POUDRE ROUND

THE LARAMIE-POUDRE TUNNEL

The Laramie-Poudre tunnel at the beginning of the year 1911 held the best two American tunnel-driving records: 609 ft. in January, 1911, and 653 ft. in March. Fig. 12 shows the layout of the holes in regular work. The holes were drilled and shot in the succession numbered in the cut, requiring two set-ups of the tunnel bar, no column being used. The upper set-up was drilled on top of the muck pile, and in the meantime the muck was cleared away, when the bar was lowered and the lifters put in. Holes were started 2⅛ in. in diameter and bottomed at 1⅜ in.

Two water Leyner machines were used, drilling 10-ft. and 12-ft. holes. In case of extremely hard rock a third machine was mounted, each machine drilling holes as follows: Those lettered *LT* were drilled by the left-hand machine on the top set-up, those marked *CT* by the center machine on the top set-up, and those marked *RT* by the right-hand machine on the top set-up. The bar was then lowered and each machine put in a lifter, lettered *LB, CB* and *RB*. The blasting charge for a round generally consisted of about 100 sticks of 100% gelatin, 150 sticks of 60% and 250 sticks of 50%.

Chapman & Tucker Flotation Patents

George A. Chapman and Stanley Tucker have patented (U. S. Pat. 1,102,873, assigned to Minerals Separation, Ltd., of London) a modified flotation process which consists in first agitating a quantity of water with an emulsifying agent, out of contact with the ores so as to form an air emulsion, and thereafter adding the ore and the frothing agent, and separating in the usual manner. They report having found that the efficiency of the flotation process may be greatly improved by agitation of the water with one or more modifying agents before the ore is added to the water. They cite a test on a 2.33% chalcopyrite ore crushed to 80-mesh. A preliminary agitation of the water with 0.022% of cresol and subsequent agitation of ore, together with 0.13% Texas fuel oil and 0.01% of wood-tar oil. This gave a recovery of 86.5% of the copper. A similar test in which the water received no preliminary treatment, but in which the same agents were added, showed a recovery of only 73% of the copper.

With ores containing gangues of a slimy nature, such as clay and chlorite, when the ordinary process is used, there is a tendency for the gangue to become included in the concentrates, but it is found that if the water be submitted to a preliminary treatment with a modifying agent, this tendency is diminished or obviated. Where the ore contains acid consumers, such as carbonates, the ordinary process may not be applicable, but by using this invention, in many cases sulphuric acid, or its usual equivalent, may be dispensed with and good concentration obtained. The process is also claimed to be applicable to ores containing gangues which are readily oiled, or where there are nonfloatable metalliferous constituents, such as oxidized minerals.

The substances suitable for use as the preliminary modifying agents are essential oils, such as eucalyptus, phenol, cresol, amyl alcohol, amyl acetate, wood-tar oil, wood alcohol, etc. These are used in minute quantities, such as from 0.001% to 0.1% of the weight of ore. The modifying agent is said to alter the internal, molecular, physical or capillary properties of the water, and it is generally found that the modifying agents are such as on violent agitation with water bring about an emulsification of air in the water, rendering the water milky for an appreciable time.

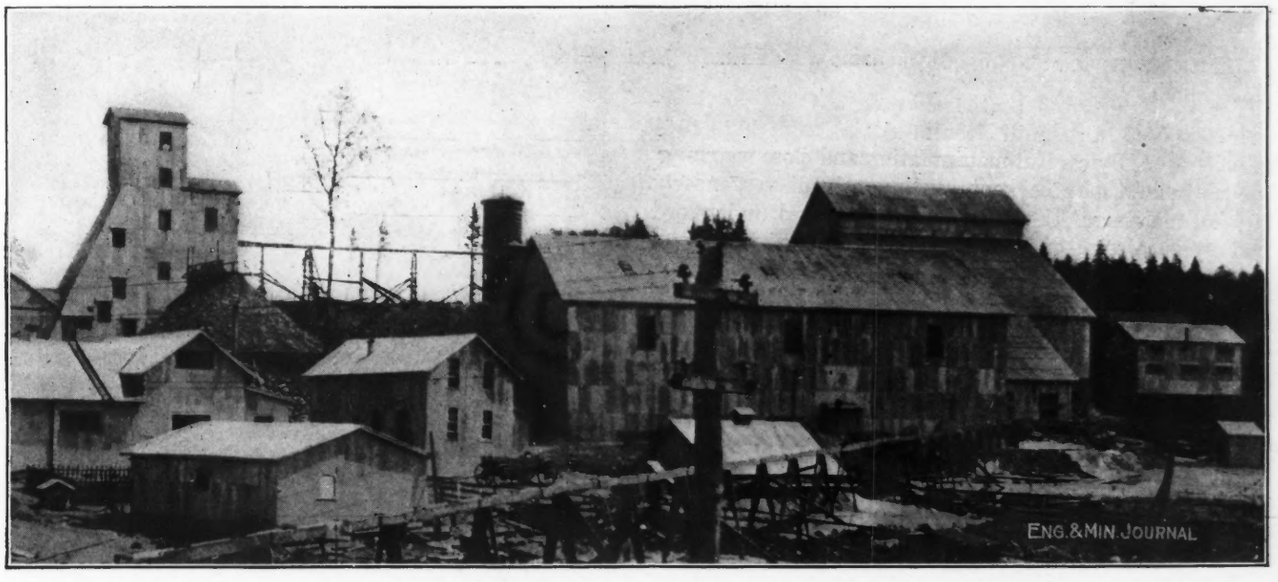
The frothing agents may be any of the mineral frothing agents hitherto employed in flotation processes, generally about 0.002% to 0.4% of the weight of the ore. When a mixture is employed as a frothing agent, the lighter part thereof is preferably amyl acetate, eucalyptus oil, wood-tar oil, amyl alcohol, American turpentine or similar substances; as the heavier part, Texas fuel oil, oleic acid and Russian crude petroleum have been found to be suitable. In certain cases it was found that the same oil may be used as a modifying agent and as the lighter part of the mixture for the frothing agent. Allowing the water to stand after treatment with the modifying agent appears to be beneficial rather than otherwise, so that no difficulty is anticipated in cyclic operations, so long as the circuit water contained sufficient of the modifying agent. It was found that the preliminary agitation of the water with the modifying agent reduced the quantity of frothing agent required.

Cyanide Development at Porcupine, Ont.--II

By Herbert A. Megraw

SYNOPSIS—The Porcupine Crown mill, a new one, has been constructed so as to make maximum use of the counter-current decantation system. Pulp receives short agitation and is passed through the continuous thickening series which accomplishes the remainder of the extraction, and delivers a pulp washed free from dissolved value without the use of a filter. At the McIntyre mill a simple and effective system is followed with good results.

The most recently erected mill in the Porcupine district is that of the Porcupine Crown Mines, Ltd., formerly known as McEnany. The mill has been built particularly to take advantage of the principles of counter-current decantation, and successfully accomplishes the desired results. The ore from the mine is passed over a grizzly which bypasses the fines around a 3-D Gates gyratory crusher, the oversize of the grizzly going to the crusher.



The Porcupine Crown Mill, Near Timmins

A bucket elevator elevates this ore and delivers it to a belt conveyor, which places it in a 270-ton ore bin at the mill head.

Twenty 1050-lb. stamps are installed to crush the ore, and these deliver the pulp to two Dorr classifiers, one a simplex machine and the other a duplex. The product of the two tube mills goes directly to the amalgamating plates and the tailings from the plates are sent back to the classifiers again, so that any sand which is oversize is taken out by the classifiers and returned to the tube mills for further grinding. In this way it may be said that the classifiers, tube mills and amalgamating plates are in a closed circuit, from which nothing can find outlet unless it is fine enough to be considered as slime and treated as such. The combined slimes from the two classifiers are taken through the first Dorr thickener, which is 30 ft. in diameter and 12 ft. deep.

The overflow from this thickener is taken to a clarifier, which is built on the leaf-filter principle, the clear solution going to a 14x12-ft. tank, whence it is extracted by a triplex pump having a zinc feeder in the suction, which delivers to two Merrill precipitating presses. The precipitate is taken to an acid-treating tank, is steam dried, briquetted and melted in two Rockwell furnaces into bullion. The barren solution from precipitation presses is received in an 18x12-ft. barren-solution tank.

Counter-Current Decantation

The underflow from the first thickener is elevated by a diaphragm pump to a Dorr agitator, 16x16 ft., where the pulp receives agitation and proceeds continuously through another identical agitator. These two machines give the pulp all the agitation it needs and recover an economically satisfactory proportion of the gold in solution. It is true that in the further progress of the pulp through the thickeners, which wash and clean the pulp, a slight further extraction is secured, but its extent can be forecasted with great accuracy and is without doubt the cheapest way of securing it. In the series of thickeners, about 92 to 96% of the total gold content is obtained. While in the agitators cyanide is added to bring the strength up to the required mill standard. From the second agitator, the pulp goes to another Dorr thickener, known as No. 2. This is also a 30x12-ft. machine, identical in size with No. 1. Its overflow is led to a 12x14-ft. solution storage tank, from whence it is pumped either back to the first agitator or to the solution storage tank,

*This is the fourteenth of a second series of articles by Mr. Megraw. It deals with the comparative details of cyanide practice, discussing points of possible improvements. Preceding articles of this series appeared in the issues of Sept. 6, Oct. 4, Nov. 1, Nov. 15, Dec. 20, Jan. 31, Mar. 7, Mar. 21, Apr. 25, May 23, June 20, July 25 and Aug. 29. The next article will deal with "Development of the Counter-Current Decantation Process," and will appear in the issue of Oct. 17, 1914.

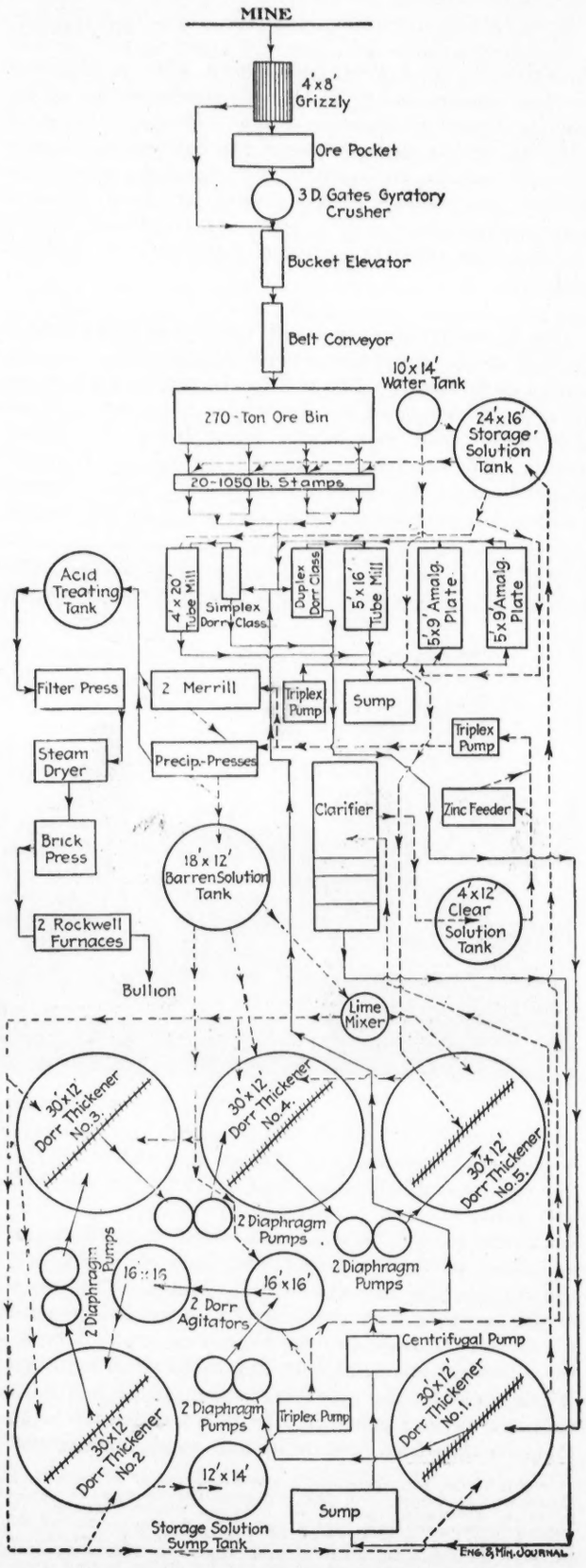
which is a 24x16-ft. tank, situated in the upper part of the mill, and feeds by gravity to the stamp battery. A small lime-mixing barrel is charged with lime and fed with barren solution from the barren-solution tank and led to all of the thickeners, so that alkalinity can be applied at any point, or all points, whenever required.

The underflow from the Dorr thickener No. 2 is received in diaphragm pumps and elevated to thickener No. 3. The overflow from thickener No. 3 goes back to dilute the inflow into thickener No. 2. The underflow from thickener No. 3 goes to thickener No. 4, whose overflow goes back to dilute the inflow into thickener No. 3. Thickener No. 4 underflows to thickener No. 5, its overflow going back into No. 4. The thick pulp inflow to thickener No. 5 is barren solution from the tank which receives the precipitated solution from the Merrill filters. In this way, it will be seen that, beginning with the final one which receives barren solution, the overflow of each thickener in succession proceeds to dilute the thick pulp inflow of the preceding one .Thus, the procedure is from the last thickener of the series back to the first, dilution always being with weaker solution than that with which the pulp enters, and naturally solution containing much less precious metal is dissolved. The final outflow from the final thickener is discarded without any filtering.

Thickness of Underflow from Thickeners

The thick pulp underflow from each of the Dorr thickeners installed in the mill circuit contains from 30 to 40% of moisture. By careful manipulation and close watching the underflow may be kept continuously at very nearly 30% of moisture. It will be readily seen and understood that by successive dilution and thickening of this kind, practically all of the gold-bearing solution may be displaced by weak, low-gold solution, a small portion of which may be discarded with impunity. This obviates the large installation expense attendant upon filter installations, and also the operating cost of such machines. Another advantage, which is of no small importance, particularly in the smaller mills, such as the Porcupine Crown, is the fact that attendance is largely reduced. As a matter of fact, the cyanide circuit in this mill requires only one man to look after it at any time. Three men look after the entire mill without difficulty.

The Porcupine Crown mill treats about 150 tons per day and is an example of about as near automatic working as one could possibly imagine in a metallurgical plant. Its entire dependence upon counter-current decantation, with a very short agitation period, is an extremely interesting experiment which has tended to increase confidence in the counter-current decantation idea. It is the first mill in Canada to depend entirely upon that principle, but in this it will probably not by any means be the last. The ore is said to be particularly adapted for such treatment, in that it slimes readily and the slimes settle without a great deal of difficulty. It is, of course, true that not in every case could a 30% underflow from Dorr thickeners be obtained, but thickness is a matter which depends largely upon careful watching in addition to the ore character itself, so that in any case, even where ores do not settle with ease, it is only necessary to multiply the number of settlers to such an extent that the same results may be obtained as with the few in use at the Porcupine Crown mill. The ore is clean and contains no elements which would unduly complicate treatment. The accompanying flow sheet shows in detail the system of mill operation.



Flow Sheet of Porcupine Crown Mill

Crushing Without Stamps at the McIntyre Mill

At Schumacher, just below Porcupine, the extremely interesting mill of the McIntyre Porcupine Mines, Ltd., has continued to expand and has attained remarkably good results under adverse conditions. The McIntyre company has taken over the Pearl Lake mine on a lease and is now adding ores extracted through that shaft to their mill run of ores extracted from their own shaft. The ore is received in the mill in a 200-ton bin. Ore reaching the bin has already been broken so as to pass a 2-in. ring.

The crushing department of this mill is worthy of particular notice. There are no stamps in use, but the ore is crushed through a series of rolls and ball mills. While it is stated that the ores from the McIntyre are particularly suited for such reduction, it has nevertheless not been demonstrated that the other ores of the camp are too hard to successfully work in the same way through the same system of crushing machines, or perhaps some modification of it. The other mills in the camp are using stamps, and although results are altogether satisfactory, as far as the department of mechanics and metallurgy is concerned, there seems to be no valid reason why the system as applied at the McIntyre, about to be described, would not prove a money saver for perhaps some others.

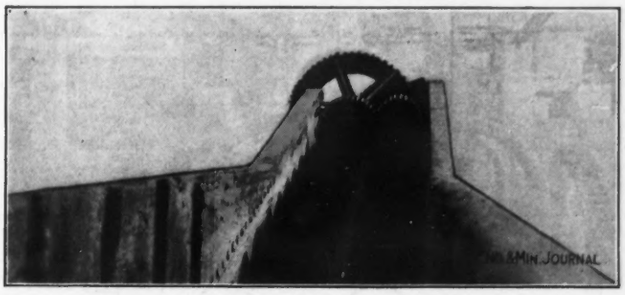
McIntyre Mine and Mill, Schumacher

From the ore bins, the material is passed through a set of rolls, then elevated to a hopper which feeds the second set. In the second set of rolls the crushing is through a ½-in. ring. From this second set of rolls an elevator lifts the ore into the storage bins, having 500 tons' capacity. From this ore bin, which corresponds to the battery bin in the ordinary mill, the ore is taken to Hardinge ball mills. There are two mills installed, but as a rule only one of them is used. They are 6-ft. mills, and it is rather remarkable that, under ordinary circumstances, 150 tons are crushed from ½-in. size down to the consistency of the average stamp-mill product, with one of them. When the ore character is such that one mill cannot handle the entire daily run of 150 tons, the second mill is put to work.

The crushing in these mills is done in cyanide solution, and the product from them is taken to a Colbath classifier. This classifier is a double spiral-screw machine, somewhat similar to the Akins classifier, since the fine slime overflows from the deep portions, while the sand is elevated by the spiral screws and raised out of solution and discharged from the high end of the incline. This classifier takes out all sands which are over 100 mesh, and delivers them to the feed end of a 5x20-ft. tube mill. From the tube mill a Frenier pump elevates the pulp into a hydraulic classifier, where the +100-mesh material is discharged at the apex and sent back to the classifier, thence to the tube mill for regrinding. The overflow from the classifier, an entirely —100-mesh product, goes to the cyanide department for treatment. Cyanide is added to the tube mill in order to bring solutions all up to the standard of 1¼ lb. KCN per ton of solution. The solutions are carried at 1 lb. lime per ton. The breaking, crushing and grinding circuits here described have proved eminently satisfactory on these ores and consume much less than were a stamp installation at work, treating the same quantity of ore. The run-of-pulp for treatment, that flowing from the hydraulic classifier, is sent to two primary Dorr thickeners. In these thickeners the pulp is reduced to a high proportion of solids, a product containing between 35 and 40% moisture being obtained from the underflow. The overflow from these thickeners is taken to an overflow-receiving tank, whence it is pumped to the clarifying system and from there to storage tanks and to the precipitation department. The thickened underflow is elevated to two agitators. In these machines the pulp receives a short treatment by agitation, sufficient to dissolve the greater part of the gold contained, and it is then sent to a secondary thickener. The solution from this secondary thickener goes to a sump and is then pumped back to the head of the mill, where it is used to pulp the ore in the ball mills or is added to the flow in the tube-mill feed entrance.

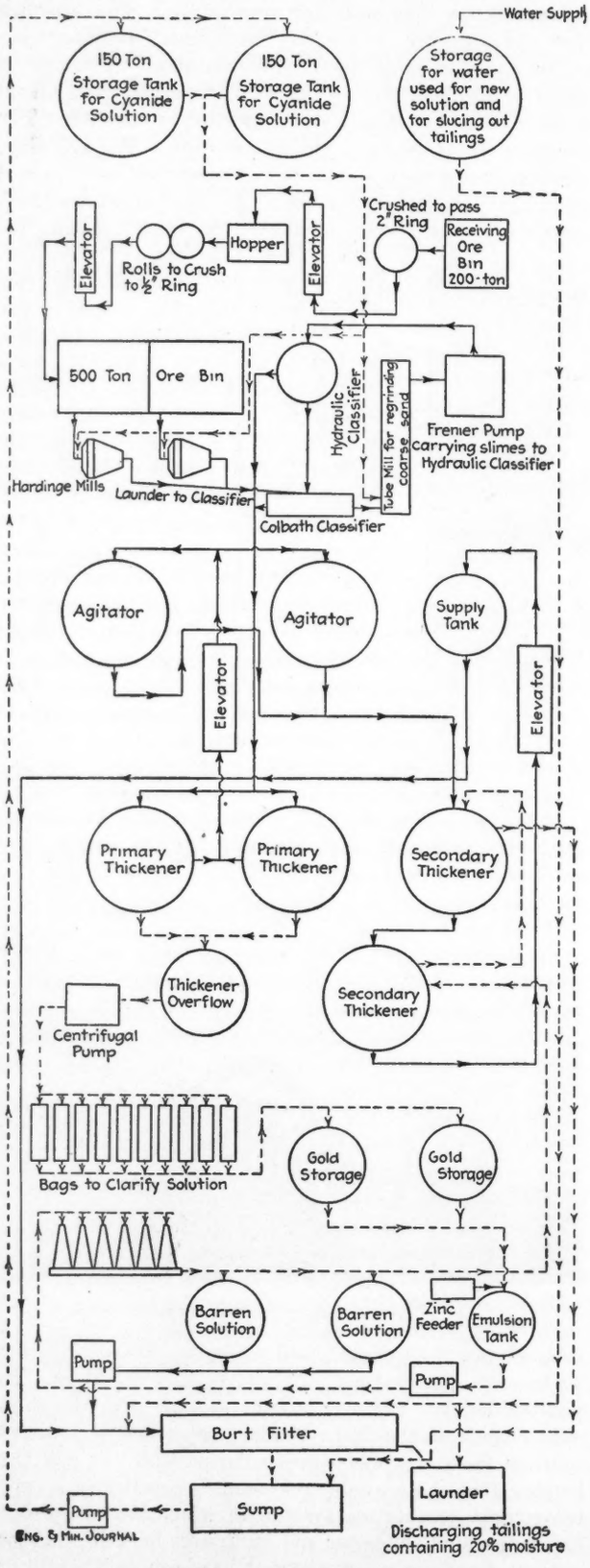
Counter-Current Treatment of Slimes

From this secondary thickener the pulp goes to another identical machine whose overflow goes back to the first secondary thickener, and whose thickened underflow is elevated into a supply tank which feeds the filter. The final secondary thickener is fed, together with the thickened pulp from the first secondary thickener, with barren solution from the precipitation department. It will thus be seen that the cyanide treatment is practically a counter-current decantation system, in which barren solution enters the final thickener and progresses back to the other until it reaches a point where it has been sufficiently en-



The Colbath Classifier

riched to be precipitated. The pulp from the final thickener has, therefore, already been washed fairly efficiently so that no great effort is required in the filters to recover gold and cyanide-bearing solutions. As a matter of fact, the filter is more efficient in recovering cyanide than in recovering gold, the latter having already been rather fully saved in the thickener system.



FLOW SHEET OF MCINTYRE MILL

The filter used is a Burt revolving-tube machine, such as has already been described in a recent issue of the JOURNAL.[3] The pulp is fed into the machine and a cake about 2½ in. thick made, which is lightly washed. The cake is then pulped up with water for discharge, no effort being made to discharge the dry cakes because there is plenty of water available, and it is cheaper to discharge the cake in a pulped condition, besides being easier to retire a pulp from the immediate proximity of the mill than when it is in a more solid condition.

UNUSUAL PRECIPITATION SYSTEM

Zinc dust is used as a precipitant at this plant, and the method of its use is worthy of particular notice, since the system used is that already described in the JOURNAL,[4] as used at the Lluvia de Oro mill, in Mexico. Solutions for precipitation are also clarified by the same system. Solutions are pumped up to the clarifying system and through a series of long bags attached to pipe nipples, as described. The solution is satisfactorily clarified and goes to the gold-storage tanks, whence it goes to an emulsifying tank, where zinc dust is mixed with it, and it is then pumped by centrifugal pumps through a series of filter bags attached to pipe nipples, according to the Lluvia de Oro method. This method has been extremely satisfactory at the McIntyre mill, since it entailed a very low cost of installation and is cheaply operated. The bags are double, the inner one being taken out with the precipitate at the time of melting, while the outside canvas bag is retained until it is destroyed by the pressure from within.

The McIntyre mill works well and succeeds in extracting about 95 per cent. of the total gold content of the ore. A great deal of credit is due to R. J. Ennis, the manager, who had succeeded in making a technical success out of a proposition that is said to have been poorly financed.

The Vipond mill is in course of reconstruction. This mill was operated for some time as a purely amalgamating mill, but it was found that too great a proportion of the values was going out with the tailings, and the process was not profitable. A cyaniding addition is being built, so that the amalgamation tailings can be treated.

Originally the mill was equipped with rolls and Hardinge mills, and this machinery will be retained and used, the cyaniding equipment being added to it.

Safety of Miner's Place of Work

BY A. L. H. STREET*

The legal principle that an employer is bound to use a reasonable degree of care to see that the places where his employees are required to work are kept reasonably safe does not apply to cases where the employees are engaged in making the place of work, as where miners and trammers are engaged in taking ore from a stope; and, hence, in such a case the mining company is not liable for injury to a miner on the theory of failure to provide a safe place of work. (Michigan Supreme Court, Kochin vs. Superior Copper Co., 148 *Northwestern Reporter* 252.)

[3] "Eng. and Min. Journal," June 13, 1914.
[4] "Eng. and Min. Journal," May 17, 1913.
*Attorney, St. Paul, Minn.

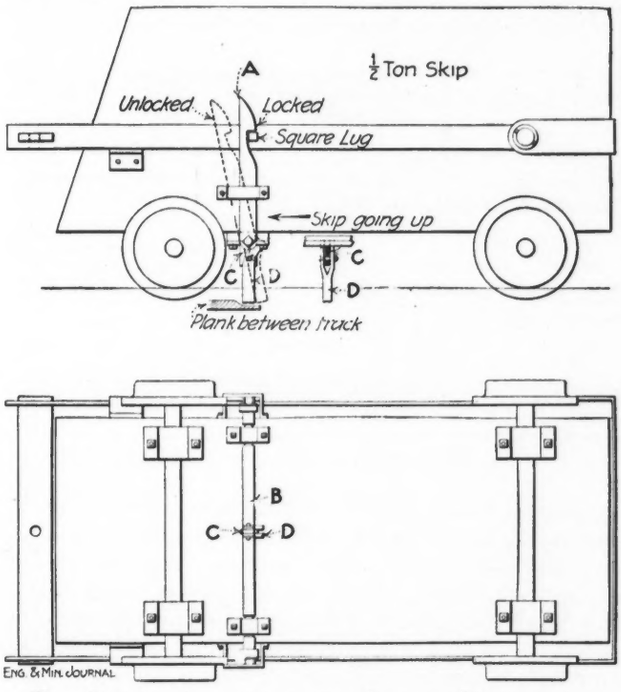
Details of Practical Mining

Skip-Bail Lock and Release

By S. S. Jones*

The safety device illustrated here is one designed to prevent overturning of the skip in the shaft. It was developed by W. H. Flannigan, foreman of the Tom Reed mine.

Two notched bars or latches, *A*, are normally caught over a square lug on each side of the bail and are rigidly connected to a square shaft *B* under the skip, turned for two bearings. A lug *C* projects from the middle of this shaft and a trigger *D* forked at the top is pinned

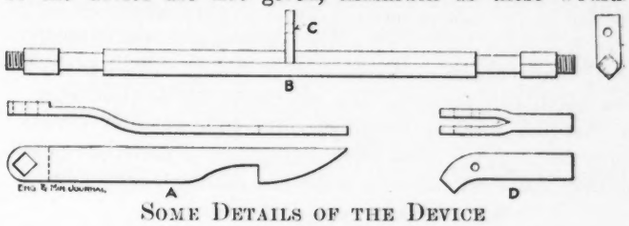


The Device Applied to the Skip in Locked and Unlocked Positions

to this. This trigger is of the shape shown. When the skip arrives at a point near the dump, the trigger is caught by a 2-in. plank covered with sheet iron and spiked between the rails. This forces the trigger to revolve until the upper part presses on the shaft, when it becomes in effect rigidly connected with it and the shaft is revolved sufficiently to release the latches *A* from the bail lugs. The trigger remains in contact with the plank after the skip starts on its dump. On the return, it again comes in contact with the plank, but is free to revolve in the opposite direction. The latches are thus allowed to fall by gravity on the lugs. They are tapered at the top so that the bail can slip into place. This return of the latches might be made more positive by the use of a spring, but, as a matter of fact, this has not been found necessary.

*Superintendent, Tom Reed Gold Mines Co., Oatman, Ariz.

The mine shaft in which this is installed has a dip of 73°. The dimensions of the ½-ton skip and the parts of the device are not given, inasmuch as these would



Some Details of the Device

vary with every installation. The revolving shaft is made of 1¼-in. square shafting; the latches and the trigger of ⅜x2-in. bar iron.

Low-Pressure Air Locomotive

The first compressed-air locomotive constructed in Marquette and also the first low-pressure air locomotive ever built for use in the mines of the Lake Superior region has been delivered to the Victoria Copper Mining Co., of Victoria, Mich., by the Lake Shore Engine Works. The machine was designed especially to meet the needs of the Victoria company and its peculiar hydraulic air-compressing system. The air tank of the locomotive must be refilled every 6000 ft. traveled. This is done by means of a hose. One important feature of the locomotive is the introduction of differential gears, similar to those used in automobiles. This makes it possible to have the chain propelling power on both axles and at the same time makes the engine especially adapted to the short and frequent curves in the tracks in the mine.

The air tank, placed on the locomotive frame, is 4 ft. in diameter by 10 ft. long and has a capacity of 125 cu.ft. of air at a pressure of 116 lb. per sq.in. One charge is sufficient to enable the locomotive to haul three loaded 4-ton cars a distance of 3000 ft. and return with the empty cars to the charging place. The average speed is five to seven miles per hour.

The frame of the locomotive is built of heavy 10-in. channels, well braced with cross channels and corner gusset plates. On each side of the frame at the rear end are the air cylinders, 6½ in. in diameter by 9-in. stroke. The crankshaft is beneath the frame and approximately in the middle of it. The power is transmitted from the crankshaft to the driving wheels by means of heavy chains. The driving wheels are 20 in. in diameter.

The valve gear is of the Baker-Pilliod locomotive type, specially designed to give a large range of cutoff in the cylinders. At the beginning of the run, when the air pressure in the tank has its maximum pressure of 116 lb. per sq.in., the air admitted is only approximately one-tenth of the stroke, but as the air pressure gradually decreases the cutoff in the cylinders is lengthened until, when at the end of the run the pressure in the tank has been lowered to 15 or 20 lb. per sq.in., the cutoff in the cylinders has been lengthened to almost full stroke.

The approximate weight of the locomotive is five tons. The overall length is 12 ft. The total height from the top of the tank to the rail is 5 ft. 10 in. and the maximum width is 5 ft. The locomotive was designed from specifications submitted by Superintendent George Hooper, of the Victoria company.

Rope Idlers for Incline Shaft*

The shaft of the Raven mine, Butte, Mont., is an incline 1700 ft. long and with various dips. At the top the dip is 70° and gradually flattens until at the 300-ft. level it is only 47°. This dip continues to the 1100-ft. level, below which it curves with a 125-ft. radius to 78°. The shaft, furthermore, does not lie in one vertical plane, so that the hoisting rope not only rubs at intervals on both the hanging and foot walls, but presses strongly against the west dividers near the collar, while 300 ft. below, it runs close to the east end plates.

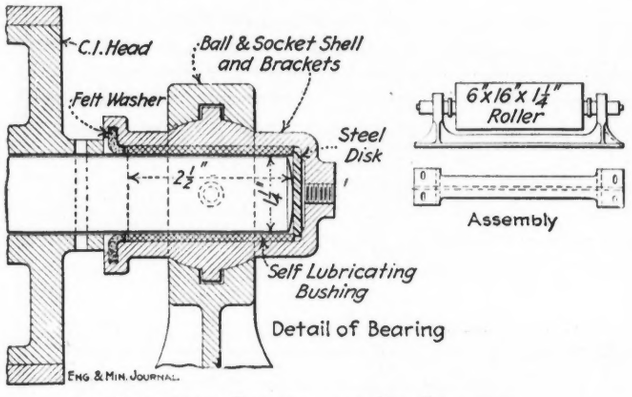
The early operators used no idlers, and wall plates cut 6 in. deep by the rope resulted. Later operators first attempted to overcome the excessive friction, and the wear of rope and wall plates, by introducing solid cast-iron idlers, 3 in. in diameter. To allow for the travel of the rope from side to side, some of these had to be 3 ft. long and were extremely heavy. Judging from the appearance of the old idlers of this type found at the mine, they often failed to turn in the bearings, which is not surprising when it is considered that they would have to make 1000 r.p.m. under ordinary hoisting conditions.

The next rolls were of wood, 6 in. in diameter, with an iron band about each end, and a pintle of 1-in. round steel driven in at the ends to serve as a shaft. These wore rapidly, and were soon replaced by rolls made from water pipe, 5 or 6 in. in diameter, cut to the desired length and fitted with a wooden cylinder into which the pintle was driven. Where the idlers were used on the hanging wall of the shaft the original bearing was simply a piece of ½x1½-in. strap iron, 10 in. long, turned up at the end in a circle of 1⅛ in. in diameter. A small hole served for oiling, and common black oil or filtered oil from engine bearings and compressor bearings was used. When the rolls were to be placed on the foot wall, the bearings were made from two pieces of 1x3-in. steel, 6 in. long. A half cylinder was cut from a side of each piece and the two spaces together formed a bearing. Oil holes were provided, and in some cases holes were bored through the two pieces, so that they could be screwed or spiked to the wall plates. The later practice was to forge the bearings from 1x3-in. steel, and to drill two holes at each end for ¾-in. lagscrews, by which the bearings were fastened to the timbers. These bearings were finally used on both foot and hanging wall. Similar idlers were so placed as to protect the dividers and end plates.

The difficulty of proper oiling presented the greatest obstacle to satisfactory results from this type of idler. As the clearance between the skip and the hanging-wall plates was sometimes less than an inch, there was not room for large oil or grease cups. In addition, the bearings were liable to get full of grit, especially when wet ore was being hoisted. Grease cups were generally unsatisfactory, although several kinds of grease were tried, and especial attention was paid to having that which was suited to the temperature of the shaft. In any event, it was necessary that the rolls be examined and the oil cups filled every two days, which meant the cessation of hoisting for two hours. The bearings wore rapidly and the rollers tended to get out of line. The full skip weighed over three tons, and where the shaft flattened near the surface, the pressure against the idlers was heavy. It was only by distributing this weight over idlers placed but 5 ft. apart that anything approaching satisfactory service could be obtained at this point.

To obviate the necessity for so much attention, an idler was devised by the Robins Conveying Belt Co., following my suggestions. This idler is shown in the drawing. The roller is extra-heavy 6-in. pipe, ⅜ in. thick, 20 in. long, in each end of which is pressed a cast-iron head, and through which passes a 1¼-in. steel shaft. This turns in a self-lubricating bearing carried by a bracket in a ball-and-socket shell, which prevents cramping.

As a preliminary to adopting these bearings, two types of graphite and bronze self-lubricating bushings were tried side by side in the incline for three months. The



Improved Roller and Its Bearing

one proving most satisfactory had cylindrical bodies of graphite ¼ in. in diameter set in the bronze, or "metalline," bushing at about ¾-in. centers. One end of the bearing is entirely closed, the end thrust being taken by a steel disk, which also serves for forcing out the bushing when it is worn. The other end of the bearing is protected from grit by a felt washer. This, however, also retains the fine particles of metal and graphite, and in time this gummy matter causes the bearings to bind. Occasional cleaning of the bushings with kerosene obviates this trouble. The cap is hinged at one side and fastened at the other with a hinged bolt so the roller and bushing can be easily removed. The bearings can be turned through 90°, and the roll turned end for end, permitting the advantage of full wear. The whole is carried in a casting which is fastened to the wall plates with ¾-in. lagscrews. These idlers have been in use nearly a year and are satisfactory. While with rapid and continuous hoisting the bearings become quite hot, they do not bind if they are cleaned occasionally.

For the lower part of the shaft, where the rope runs true and the inclination is 78°, the idlers are merely common sheave wheels, cast solid and keyed on a shaft of 1-in. cold-rolled steel. This has a total length of 13 in. These sheaves are 9 in. in diameter, with a 3-in. face, having a groove 1½ in. deep, 1 in. wide at the bottom. The bearings are maple blocks, 4x4x6 in., bored

*From a paper by George A. Packard in the A. I. M. E. "Bull.," August, 1914.

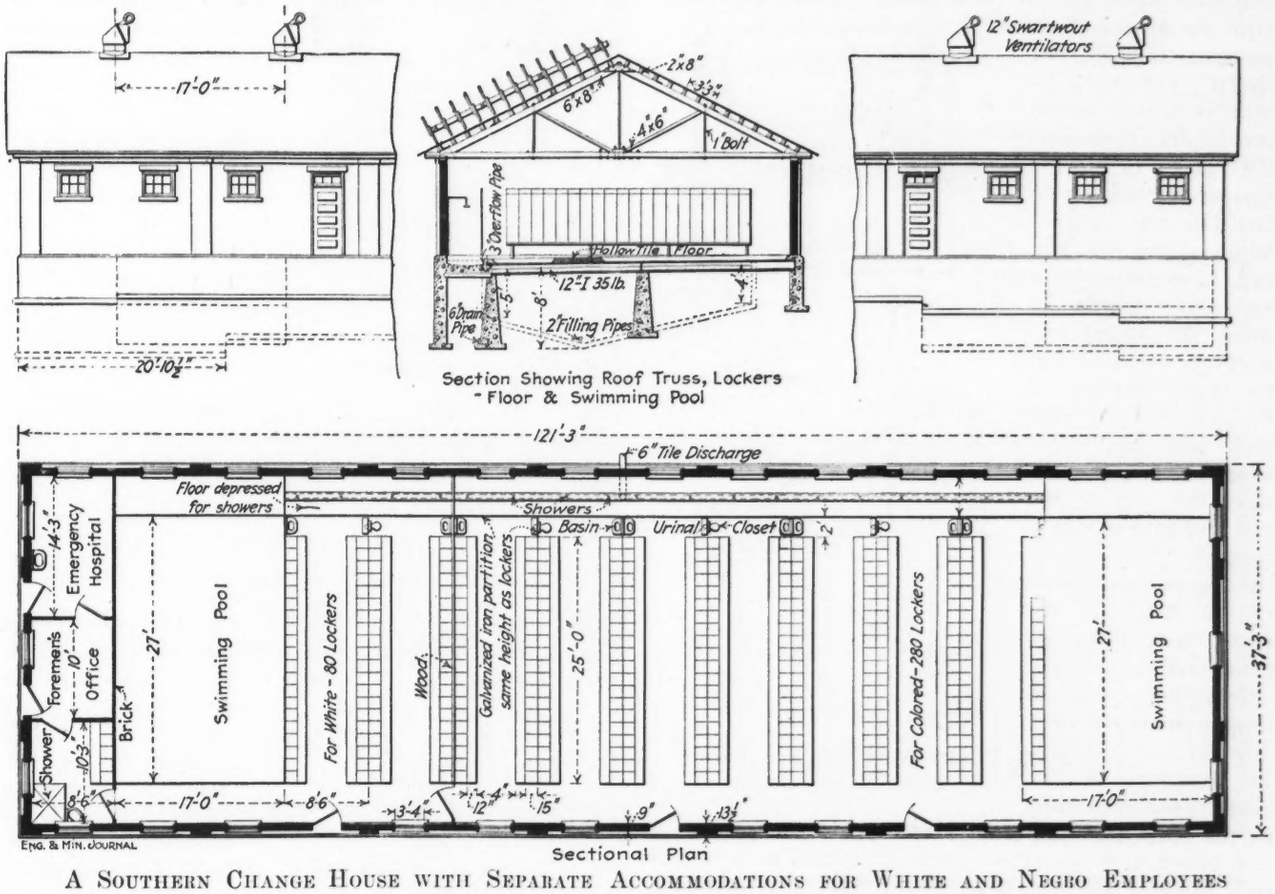
to receive the shaft, and provided with an oil hole. These are fastened to the wall plates with six spikes.

The wood-filled pipe idlers with forged bearings cost at Butte about $8 each, including bearings. The idler with the self-lubricating bearings costs $15, but the difference is quickly saved in decreased cost of attention. The solid cast sheaves weigh 26 lb. They cost, when fitted with a shaft, but excluding the maple bearings, $2.75 each.

Change House with Swimming Pools

By A. H. Sawyer*

A new change house has recently been completed at the Raimund Mines of the Republic Iron & Steel Co., near Bessemer, Ala. It has some novel features which should make its description interesting.



A Southern Change House with Separate Accommodations for White and Negro Employees

The building is constructed of concrete and brick, 121 ft. 9 in. long by 37 ft. 3 in. wide and contains 365 lockers, 280 of which are for colored employees and 85 for white employees, including 5 in the foremen's office. The dimensions of the building give 11.5 sq.ft. per man. If the portion occupied by the offices and swimming pools be excepted, the space per man is 7.3 sq.ft. which is less than in most change houses.

The swimming pools, one for white and one for colored employees, are 27 ft. long and 17 ft. wide with a maximum depth of 8 ft., and hold 21,292 gal. up to the overflow. The water is heated by live steam admitted through pipes into the bottoms of the pools. At one end of the pool and at the water line there is imbedded in the concrete a 3-in. pipe with a slot running its entire length. This serves as an overflow pipe and also as a means to cleanse the surface of the water. No one will be allowed to use the swimming pools unless he has the permission of the mine physician and has previously taken a shower bath.

The lockers are 15x15x60 in., with perforated bottoms, arranged in rows of 20 each; they rest on wrought-iron supports which also carry seats 12 in. wide. Under each double row of lockers, extending its full length, is a radiator made of eight 1¼-in. pipes, giving a total of 1300 sq.ft. of radiating surface for heating the building. Live steam under 3-lb. pressure is used.

Each pair of rows of lockers has wash basins, closet and urinal at the rear, separated from the shower-bath compartment by galvanized-iron partitions. Two sanitary drinking fountains are provided, one in the white and one in the colored section.

There are 19 showers; the water enters a mixing chamber through hot- and cold-water pipes, fitted with lock valves, below which are stop and waste cocks, so that the quantity of water for each shower can be regulated by the attendent, preventing the use of an excessive quantity of water. Above the mixing chamber is a valve for turning the water on and off. In the main part of the change house, there is one shower for every 20 men. It is estimated that eight gallons of hot water will be sufficient for each bath. This water is heated by live steam, in a closed heater situated in the basement of

*Mining engineer, 412 American Trust Bldg, Birmingham, Ala.

the building. Room has been allowed here for the installation of an independent boiler if it should at any time seem desirable.

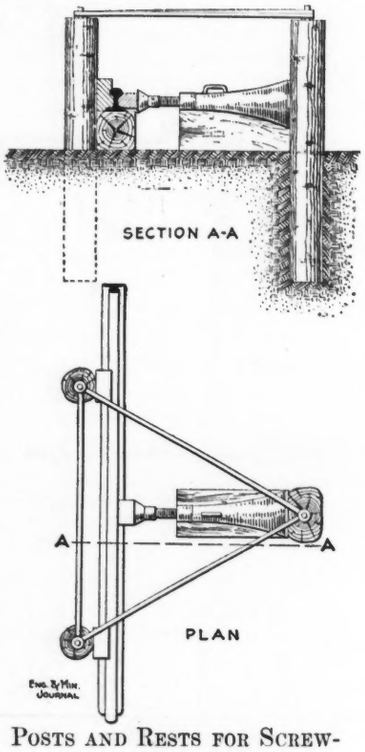
The building is lighted by incandescent lamps, 12 in the large room and a drop light in each of the small rooms.

An emergency hospital 14 ft. 3 in. x 8 ft. is situated just off the foremen's office and is fitted with a wash basin, a first-aid outfit and an ambulance which can be handled easily by one man.

Bending Rails with Screw-Jack

By A. Livingstone Oke*

There is illustrated herewith a method for bending rails, consisting of the use of a screw-jack in conjunction with three upright posts planted in the ground to form the apexes of an isosceles triangle, as shown. The rail to be bent is placed across two of the posts and the jack is footed against the third. To facilitate the manipulation of the jack and rail, it is desirable to use three blocks of wood, the longer one slightly inclined on its upper surface to form a rest for the jack and the other two, notched to receive the side of the rail and give a steady support. To prevent the movement outward of the tops of the posts, three links are made, with eyes at the extremities which drop over round iron dowels driven firmly in the tops of the posts. The lower ends of the posts are sunk from 1 to 2 ft. in the ground.



Posts and Rests for Screw-Jack Rail Bender

I have found this device useful in mines, as it is possible to place posts arranged in this manner at entrances and at suitable points underground, where frequent rail-bending is necessary, and thus avoid the transportation of the usually heavy jim-crow, the lighter screw-jack being all that it is required to carry about.

Underground Copper Precipitation Launder

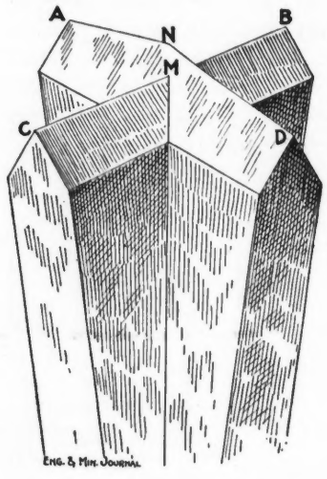
In the Lowell division of the Copper Queen properties, an old fire extends from the 1000 to the 1300 levels, according to the A. I. M. E. *Bulletin* for August, 1914. Water is being run into this fire area and after it penetrates the hot zones, it becomes charged with copper salts. On the 1300 level, there is a concrete precipitating plant, 500 ft. long and 4 ft. wide. In this the acid waters percolate among tin cans and scrap iron, and thus deposit their copper content.

*3 Marine Terrace, Penzance, Cornwall, England.

A New Design in Bits

By Frederick W. Foote*

The bit here illustrated was designed by H. Emens and has been used exclusively for the last two years at the Portland mine, Victor, Colo. During the year after its use, there were 34,000 fewer bits sharpened than during the preceding year, while 7% more drilling was done. These bits are made of the same steel as the old ones, the only difference being in the fact that one set of wings is raised in the center. The raised part acts as a guide for the rest of the bit and causes the cuttings to come out coarser. The wear on the bits comes at the edges, the centers not being worn appreciably.



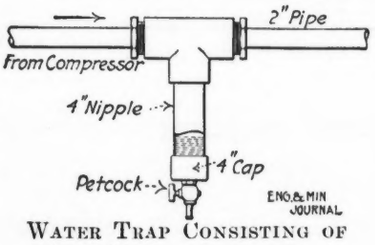
Bit with One Edge High Center and One Edge Straight

The points *A, B, C, D,* are in the same plane. On 1½-in. bit *N* is $\frac{3}{16}$ in. above *M*.

Home-Made Water Trap for Air Line

By A. L. Lamb†

The illustration represents a device for freeing an air line of water which is easily applied and which I have found satisfactory. It consists of a tee larger than the line to which it is applied and a nipple screwed to the bottom. A petcock or other valve is attached to the bottom of the nipple to permit discharge of the accumulated water. For a 2-in. air line, a 3-in. or 4-in. tee should be used.



Water Trap Consisting of Tee, Nipple, Cap and Petcock

All or most of the water in such an air line is dragged along the bottom of the pipe and is caught by the trap.

The Evils of Speiss Formation in lead smelting are summarized by Irving A. Palmer in his paper before the Salt Lake Meeting of the American Institute of Mining Engineers, as follows: "The formation of arsenical speiss consumes iron, reduces the furnace speed, increases the volatilization of lead, causes trouble in the crucible and settling boxes, and constitutes a troublesome byproduct which has to be rehandled. It is the accompaniment of low-silica slag, low sulphur in the charge, and powerful reducing action.

*Britannia Beach, B. C.

†343 Mountain Ave., Ashland, Ore.

Details of Milling and Smelting

The Buffalo High-Grade Mill, Cobalt

Treatment of high-grade silver ore in a plant designed for such work is practiced at the Buffalo property, at Cobalt, Ont. This plant was built after the success of the somewhat similar one operated by the Nipissing Mining Co., also of Cobalt. The essential difference between the two is that the Buffalo mill undertakes the treatment of the concentrates made at the main plant, while at the Nipissing the material treated is solely the high-grade ore from the various mines.

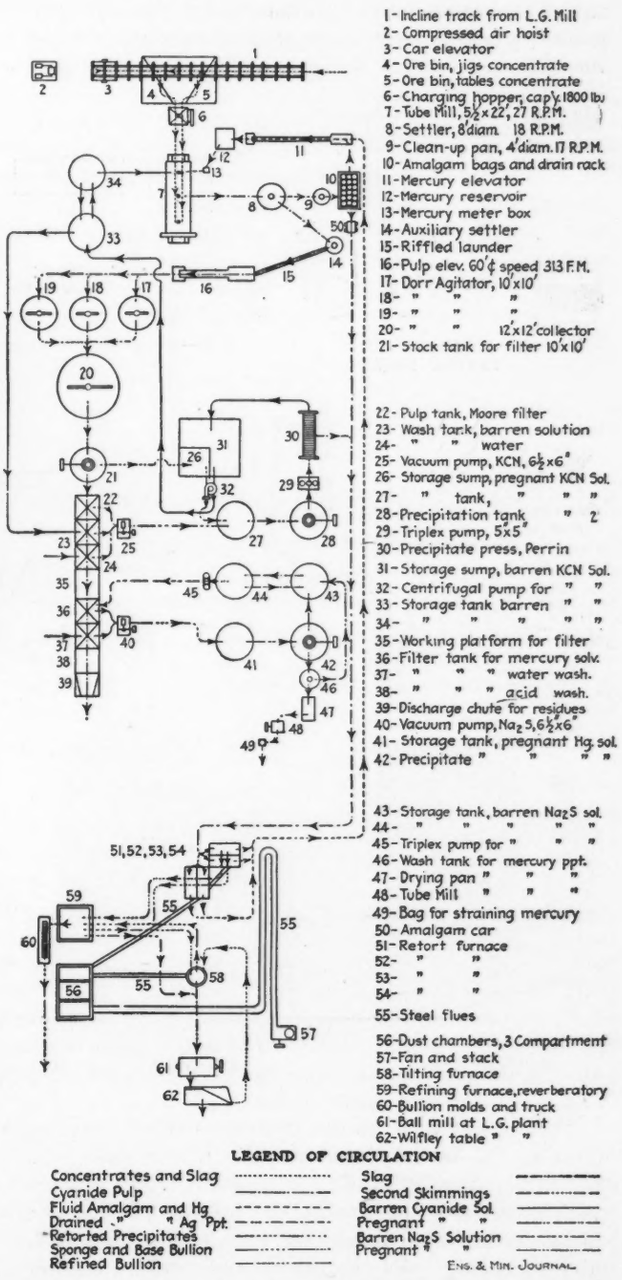
BUFFALO HIGH-GRADE MILL, COBALT, SHOWING INCLINE FROM LOW-GRADE PLANT

At the Buffalo plant, the material to be treated, table and jig concentrates, is brought from the mill in cars, raised by an air hoist, and dumped into separate bins. It is then treated with mercury and cyanide solution in a 5½x22-ft. tube mill, making 27 r.p.m., essentially as is done at the Nipissing plant.[1]

After recovery the amalgam, the tailings from this process are taken to one of three Dorr agitators, operated on the charge system, where the recovery of the remaining silver is effected with strong cyanide solution. The treatment is not widely different from that followed at the Nipissing high-grade mill, although the apparatus is of different make and arranged differently, as is shown clearly in the accompanying flow sheet.

A departure at the Buffalo mill is the additional treatment given to the cyanide residues to recover the mercury from them. The residues are filtered through a Moore filter in the usual way, washed, and then, without dropping the cake, the basket of leaves is passed to an additional tank, and a solution drawn through it which takes the mercury into solution. This is later precipitated and the mercury recovered.

Precipitation is effected with aluminum dust, and the precipitate is retorted to recover what mercury it carries. Both amalgam and silver from the precipitates are finally melted in the reverberatory furnace and cast into bars



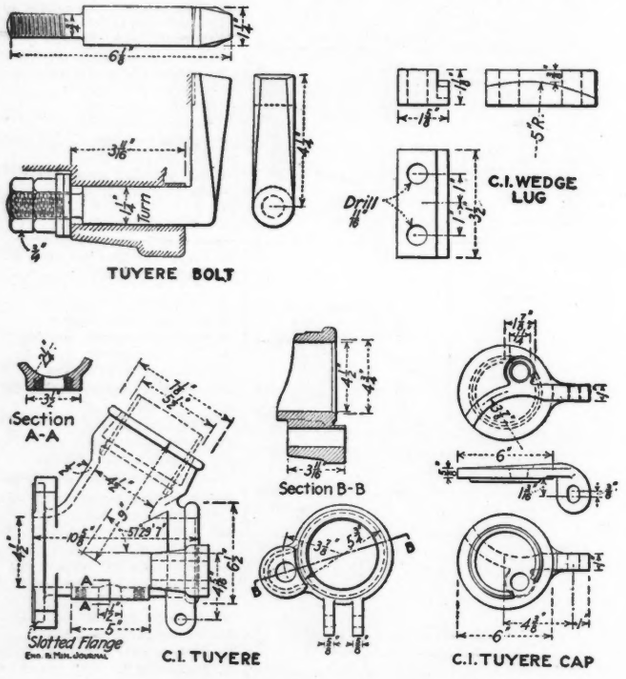
FLOW SHEET OF BUFFALO HIGH-GRADE MILL, COBALT

[1]Eng. and Min. Journ., Nov. 7, 1912.

for shipment. The plant is running steadily and giving results satisfactory to the operators.

The Detroit Tuyere

The tuyere used by the Detroit Copper Mining Co. at Morenci, Ariz., is shown in detail in the accompanying drawing. Tuyeres embodying the finger principle for holding the tuyere cap in place are used by several smelting plants in the Southwest, having originated at the Shannon works. In the Shannon tuyere, however, the cap revolves on the bolt of the finger; when a tuyere is slagged the cap must slide over a face of solidified slag, which is sometimes difficult. In the Detroit design the cap is free to drop out of the way as soon as the finger is lifted. The tuyere cap is attached at the bottom by a loose fitting hinge. The faces of the cap and tuyere box are machined; when in use they are held together by a revolving finger which intercepts a wedge on the outer surface of the cap and makes a tight joint.



THE DETROIT TUYERE

There is a raised ring left on the inner surface of the cap so as to center it on the tuyere in case the hinge becomes very loose from wear; this insures a tight joint at all times and while slightly more expensive at the start, it has the advantage of not wasting compressed air. A wooden plug is used in the cap to close the peep hole, and for the slag escape a wooden wedge is provided on the bottom of the tuyere. The wedge burns out more quickly than a plug in the event of the tuyere slagging, and is cheaper and easier to make.

The tuyeres used by the Detroit Company have an air opening 4½ in. in diameter. The tuyere pipes are simply thrust into the stuffing box of the tuyere and packed with asbestos. The tuyeres are attached to the furnace jacket with slotted flanges, so that by loosening the nuts of the holding bolts the tuyere and tuyere pipe may be quickly removed when it is desired to change a furnace jacket.

Clean Lead Slags and Metal Losses

With the introduction of baghouses, better methods of smelting, and the general use of the wet assay for lead, a much closer check can now be made upon the efficiency of lead-smelting plants. These refinements have shown that, in most cases, the metal losses are greater than formerly supposed. They have also led the metallurgist to modify his views as to what constitutes a good economical slag, said Irving A. Palmer, in a paper before the Salt Lake meeting of the American Institute of Mining Engineers. Twenty years ago it was usually the aim of the lead metallurgist to produce slags and matte containing the lowest possible percentages of the valuable metals. Comparatively little attention was given to any other feature.

The evils of over-reduction was recognized by some, but not clearly. The character of the work done was judged mainly by the slag and matte assays. About 10 years ago a lead-smelting plant in Colorado was noted for the extremely clean slag which is was producing. The average lead content of the waste slag for one year was 0.67%. The mattes also were low in lead. The metallurgist congratulated himself upon the figures. There was no baghouse at this plant, but careful determinations of the lead smelted for the period showed that the lead losses really were high. This was confirmed later by analyses of the flue gases.

At another plant operating on the same class of ores, the speed of the furnaces was greatly increased by screening most of the oxide ores and briquetting the fines. The slags and mattes were unusually clean. A low-silica slag was made and a considerable production of speiss showed a condition of strong reduction all the time. Yet the lead losses were extremely high, as shown by the balance sheets at the end of each month. The work not improving, experiments were begun for the purpose of determining the flue dust and volatilization losses. The dust at the foot of the blast-furnace stack was found to contain 60% lead, and analyses of the gases passing out of the stacks gave similar indications of where the lead was going. These illustrations show the fallacy of depending entirely on slag and matte assays as criteria of the metallurgical work that is being done.

Treatment of Tin-Wolfram-Bismuth Ores

The treatment of this type of complex ores by magnetic separation is strongly recommended by Loftus Hills (*Mining & Engineering Review,* July 6, 1914). On the treatment of concentrate containing: Sn, 40%; WO_3, 22; and Bi, 6%; it was possible to remove first a magnetite concentrate; second, a pyrite concentrate, both together containing less than 1% of the three valuable metals; third, a product assaying WO_3, 70%; Sn, 0.7%; and a residue: Sn, 56.3%; Bi, 8%, and WO_3, 0.7%. While some other ores and concentrates did not yield as good results, the experiments seem to point out a valuable method.

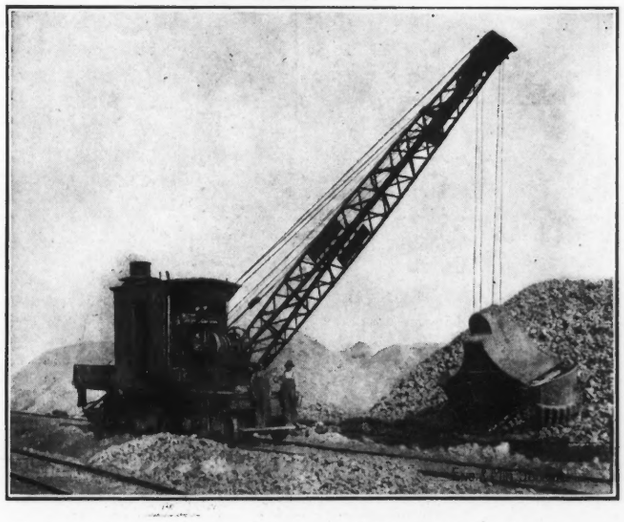
The Abandonment of Buddles at a tin-dressing plant in Cornwall is interesting. At the Hobbs Hill mine, managed by David Draper, near St. Neots, there are no buddles or frames, such as are seen on other tin-dressing floors, says the "London Financial Times," of Aug. 13, 1914. The plant at this mine, where the production of tin commenced recently, comprises four Nissen stamps, Kirk-Lavelle classifiers, James sand tables, cone thickeners and James slime tables.

Mining & Metallurgical Machinery

Brownhoist Special Grab Bucket

The Mond Nickel Co., Coniston, Ontario, is using two standard Brownhoist locomotive cranes, at its operations at Coniston, which were furnished by the Brown Hoisting Machine Co., Cleveland, Ohio. These are 15-ton cranes. With one there is being used a standard 40-cu.ft. clam-shell grab bucket, to which the Mond company has had small teeth fitted, and with the other crane the Brown Hoisting Machinery Co.'s special toothed, 40-cu.ft. grab bucket is being used. This type of bucket has only recently been placed on the market.

In the roasting system used by the Mond company, the ore is first dumped from side-bottom dump railway cars, into a ditch between two tracks, 20 ft. center to center, one side of the car being dumped from each track. The locomotive cranes handle it from the ditch to the roast beds. After roasting, it is loaded by locomotive cranes from the beds into standard open-top railway cars. Each crane has an engineer, a fireman and two bucket-



BROWNHOIST CRANE HANDLING LUMP ORE, CONISTON, ONTARIO

men, who swing and place the bucket, and one watchman looks after the two cranes at night. The ore averages about 16 cu.ft. per ton. Of the tonnage handled 50% is ¾- to 4-in. lump, 40% is roasted ore of all sizes from 12 in. down, and 10% is fines through ¾-in. The small bucket averages about one ton per grab, and the larger one about 1½ to 2 tons. The speed with the smaller one is about one grab per minute, and somewhat less with the larger one. The two cranes, working 10 hours each, handle about 500 tons to the beds and 500 tons from them.

SPECIAL BUCKET

The special bucket is unusual, in that it is equipped with round, cast-steel spades; each spade is fitted with a row of manganese-steel teeth, each tooth being attached separately to the bucket, so that it may be replaced when worn. The opening and closing of the bucket is effected by a crosshead that slides up and down on the guide rails on the inside of the shell, the spades being attached to the crosshead. The crosshead is operated by a closing rope, which is attached to the hoisting drum on the crane. The crosshead on this special bucket is also equipped with five rope sheaves, giving the bucket great digging power. The bucket itself has three sheaves at its top, one of which is for the holding rope. The bucket is closed by drawing in on the closing rope, and is opened by holding the holding rope and paying out the closing rope. The accompanying illustrations show the crane and buckets in operation at Coniston, Ontario.

During the last year these two cranes moved about 260,000 tons of material at the property of the Mond Nickel Co. This amount is the sum of the tonnage handled to the roastbeds, tonnage loaded from the roastbeds, and the various tonnages handled to and from stockpiles. The cost per ton of moving this tonnage was approximately as follows:

Labor	2.95 cents
Coal at $4.50 per ton	1.20 cents
Supplies, renewals and repairs	0.65 cents
	4.80 cents

Two Morris Centrifugal Pumps

The Morris Machine Works, Baldwinsville, N. Y., has furnished at various times a number of pumps for use in the Southern phosphate fields, the general type being shown in Fig. 1.

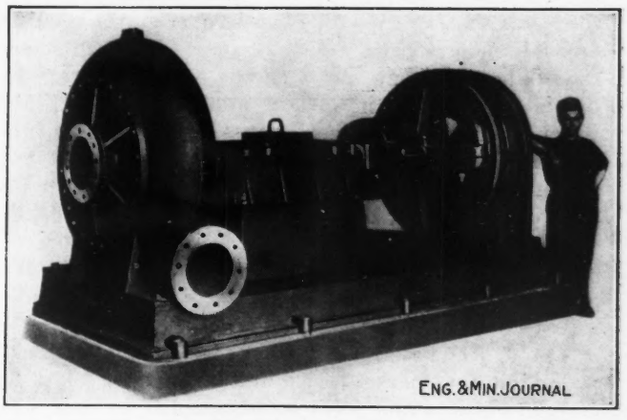


FIG. 1. HEAVY-DUTY, 10-IN. DREDGE PUMP

In the Florida fields, the pebble-phosphate stratum, which is from 12 to 15 ft. thick, is covered by an overburden of about the same thickness; the latter is stripped by means of steam shovels or dredges. After the overburden is removed, the common method of mining is

about as follows: A pit is first made with a hydraulic jack, which washes the material down in a manner similar to that used recently on the Cuyuna iron range in Minnesota and described in the JOURNAL, Jan. 17, 1914. A pump, similar to that shown in Fig. 1, then pumps the material to the washers. This pump is a 10-in., heavy-duty, dredging pump, generally direct-connected to a 125-hp. electric motor, and is double inclosed, with a long thrust bearing running in oil.

If the pit is unusually deep and the pipe line long, booster pumps are used, one pump elevating the material to the top of the pit, where it enters a second pump and is passed through the pipe line and up to the washers.

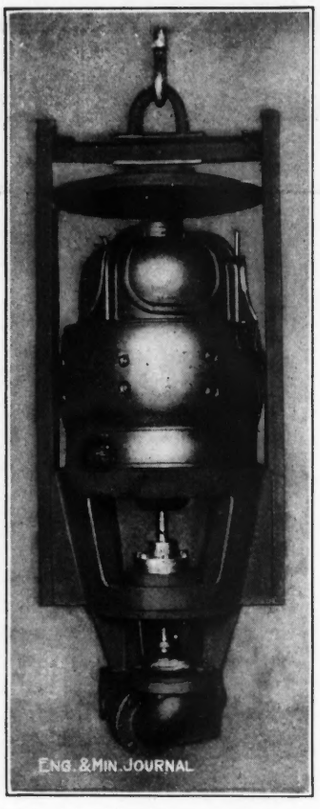


FIG. 2. A MORRIS SINKER, 5-IN. SINGLE STAGE

Fig. 2 shows a Morris 5-in., single-stage, sinking pump for dewatering mines, assembled in a compact structural framework which can be operated by a cable. The pump has a capacity of 700 gal. per min. when operating under 130-ft. head; for higher heads, the pump is built in stages and can be obtained for various capacities.

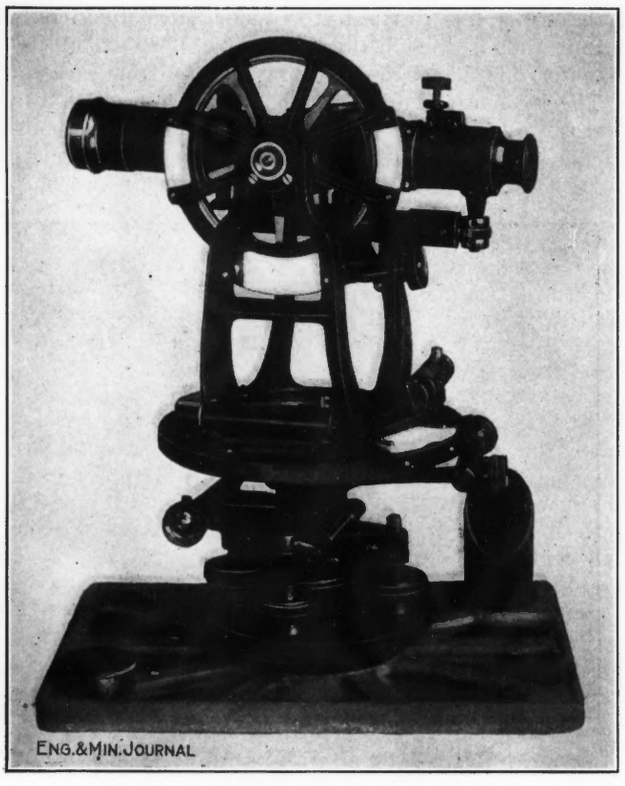
New Gasoline Locomotive

The possibility of gasoline locomotives for use in and around mines has received the attention of a number of manufacturers within the last few years, with the result that a variety of types have been produced, and probably more will be. Some of these have been successful, while others have not. In any event, however, their use is questionable in certain mines where ventilation is not all that it might be, because of the gasoline fumes of the exhaust. Another possible objection to their use in some mines would be the presence of an additional explosive in the form of the gasoline. There would, however, seem to be no real objection to the use of such locomotives around the surface of mines, mills and smelting plants provided the machine is a satisfactory one otherwise.

The J. D. Fate Co., Plymouth, Ohio, has recently placed on the market a gasoline locomotive of a new design, which would seem to be adapted to such work. The engine is a two-cylinder, air-cooled Monarch motor, without gears, differential nor clutches. The friction-drive transmission permits of a great number of forward and reverse speeds, and the tractive effort is the same in either direction. The final drive is transmitted to all four wheels by chains and sprockets. The wheelbase is 38 in. and the machine is built in gages from 24 to 36 in. The weight of the locomotive is from 2½ to 3 tons. For a 2½-ton machine, the drawbar pull is 800 lb. at 6 miles per hour, and the hauling capacity, allowing 40 lb. to the ton, drawbar pull, is said to be 18 tons on the level, or 4¼ tons on a 4% grade in addition to the locomotive. In point of fuel consumption, it is said that this locomotive has handled 2510 tons of clay and coal in seven days, during which it used 41 gal. of gasoline and seven gallons of lubricating oil. In this connection, the makers say in their catalog, that one gallon of gasoline per hour should be ample to operate the locomotive continuously, although actual tests have shown that only ½ gal. per hour is required, as 14 hp. is the maximum power required to operate it.

Stadia Reading Reduction on Transit

The Keuffel & Esser Co. offers a new device for facilitating the operations involved in the stadia method of surveying. It consists of two segment markers applied to the vertical circle, by one of which is read the percentage of the rod interval representing the horizontal component, at the angle at which the telescope is inclined, and by the other, the percentage representing the vertical component. The arrangement of these is shown. The transit itself thus automatically performs one of the operations in reducing the stadia readings.



TRANSIT EQUIPPED WITH REDUCTION SCALES ON SIDES OF VERTICAL CIRCLE

Suppose the observed stadia distance to be 480 ft. and the telescope when sighted to be inclined at such an angle that the reading at the horizontal percentage scale is 0.97 and at the vertical is 0.17. Thus the correct horizontal distance is $480 \times 0.97 = 465.6$ ft. and the difference in elevation is $480 \times 0.17 = 81.6$ ft.

Draining Kerr Lake*

SYNOPSIS—Workings of Kerr Lake and Crown Reserve mines largely underlay Kerr Lake at Cobalt, Ontario; safety and economy required draining the lake. Pipe line laid to neighboring lake, and water and mud pumped by four centrifugal pumps on a scow. Some mud still left in bottom of lake. Detailed description of construction of pumping plant and pipe line.

Kerr Lake, in the Cobalt district, Ontario, Canada, originally covered 45 acres owned by the Kerr Lake Mining Co., the Drummond mine and the Crown Reserve. The property of the latter was entirely under water until, in 1908, a trench was blasted out which deepened the outlet and lowered the lake 8 ft.

Conditions Existing

As many of the rich veins of the Crown Reserve and Kerr Lake companies were under water, mining was pursued at a disadvantage. There was always danger of encountering open seams, through which too large a flow of water for comfortable working might come, and although careful soundings were made over the veins, by means of steel-shod pipe, through mud and water to bedrock, it was sometimes uncertain whether actual bedrock had been reached. Furthermore, large quantities of ore were tied up, unavailable for mining.

The Crown Reserve and Kerr Lake companies gave serious thought to the subject of draining the lake, and came to the conclusion that if the dewatering were to be done, it could be accomplished more cheaply and easily by pumping rather than by tunneling. Preliminary surveys were made over the route the water was to follow, i.e., through the Kerr Lake outlet to Glen and Giroux Lakes, and thence by the outlet stream of the latter to the Montreal River, a total distance of eight miles.

After an act of Parliament had made permissible the draining of such bodies of water, and the seven acres owned by the Drummond interests were purchased, permission was granted by the mining commissioner in May, 1913, and work was begun at once.

Kerr Lake at this time covered an area of 30.35 acres, with no inlets of importance and one outlet which carried off water at the rate of 300 gal. per min. in the freshet season and was dry in the dry season. It was not thought that the lake was spring fed to any extent, but that it maintained its level simply from rain and melting snow. Soundings had established its greatest depth at 100 ft., nearly 20 ft. of which was soft mud. It was estimated that it contained 400,000,000 gal. of water and liquid mud in all. The mud had to be removed, as with a large deposit left behind, matters would be in as bad shape as ever for mining purposes.

Plans for Work

It had been planned in the first surveys to pump the water through the old outlet and allow it to run through natural channels to the Montreal River, but the problem involved by the disposal of the mud prevented the adoption of this scheme. Hence the final surveys were run for a pipe line in a direct line from Kerr Lake to Giroux, crossing the Kerr Lake property, the township highway, the tracks of the Temiskaming & Northern Ontario Ry. and several rights-of-way of power and compressed-air lines. The greatest elevation of the line above Kerr Lake was 53 ft., and the linear distance from lake to lake was 2400 ft. The difference in elevation between the two lakes was 20 ft. Giroux Lake covers about 230 acres, is deep and has an ample outlet, so that the possibility of blocking channels and flooding other properties was done away with.

It was necessary that the pumping plant handle both water and an indeterminate amount of solids against a static head varying from 53 ft. at the start to 153 ft. at the end of operations, through a pipe line large enough to keep the friction factor low, yet small enough to give sufficient velocity to mud-laden water. With an ample friction factor, it was estimated that the total static and dynamic head would approximate 185 ft. The pump had to be movable and the shore and bottom of the lake were steep and irregular: a plant mounted on a movable base

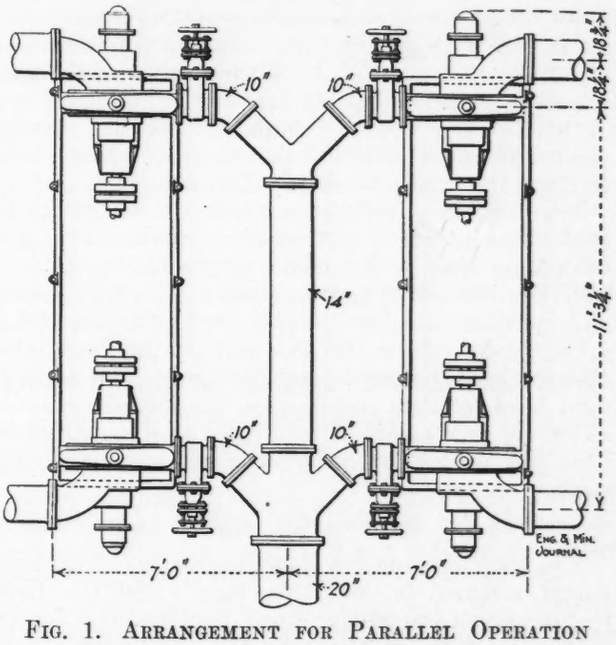


Fig. 1. Arrangement for Parallel Operation

ashore presented obvious disadvantages, so it was decided to place the pumps upon a scow. This scow was to be kept near the shore, so that many pontoons would not be necessary to support the pipe; furthermore, it would have been difficult to anchor both scow and pontoons so as to be flexible enough and yet not too susceptible to wind and movement of the waters, and constant changing of mooring cables at many points would have been necessary as the level of the lake changed.

Since the neighboring mines all took their water from Kerr Lake, it became necessary to erect an auxiliary water-supply pumping plant at Giroux Lake.

The Scow

The scow was designed by the Kerr Lake's engineer and built by the Crown Reserve at its shops on the lake shore. Compactness, commodiousness, stability, rigid

*An abstract from an article by Robert Livermore, presented at the Salt Lake meeting of the A. I. M. E.

construction, light draft and carrying capacity up to 70 tons displacement were all essential, and were taken into account in the plans.

The hull was of Western fir, 40x20 ft. over all, with sides 4 ft. deep and a bottom 31 ft. 6 in. long, allowing an overhang at bow and stern. For the bottom, 3-in. planks laid lengthwise were used; across these, other 3-in. planks were laid at 2 ft. 3 in. centers, as sills for the uprights supporting the deck timbers. The boat was divided longitudinally into four sections; the sides and the intermediate divisions were of 6x6-in. timbers. The uprights were 6x6-in. posts set on the bed planks at 2 ft. 3 in. centers and bolted to the longitudinal timbers. The 6x6-in. deck beams rested on the latter and were bolted to them and to the supporting posts. Deck and sides were of 3-in. plank laid lengthwise, and spiked and bolted to the frame. A 2-in. flush was given to the deck, and hatches provided fore and aft for entrance to the hold. The whole boat was thoroughly calked with tar and oakum. Two anchoring spuds were placed at each side of the stern. These were 16x10-in. fir timbers, 30 ft. long, iron shod and held in place by 14x10-in. guides, which were tied to each other by iron rods above and below the water. The spuds were raised and lowered by rack and pinion with spoke attachment. Besides the spuds, ⅝-in. wire hawsers were provided, to connect with the shore at each corner of the scow. In practice it was found that on account of the shifting nature of the mud and the difficulty of finding firm bottom for the spuds, the hawsers were more useful, and with the aid of small yacht capstans set up on the boat and on the shore, were ample to hold the scow in any desired position.

After launching, the boat was ballasted with about 10 tons of bagged gravel. A temporary crane was rigged on deck for handling the pumps, motors and heavier pipe and valve fittings. The pumps and motors were assembled on their base, the bed plates of each unit bolted through 8-in. sills to the deck and the pipe and valve connections were made between the pumps. A weather-tight house of light construction was erected, to cover all of the deck except a small space at the end, where room was needed for operation of the spuds and capstans.

Pumping Equipment

The plant consisted of four single-stage centrifugal pumps, arranged in two units (Figs. 1 and 2). Each unit comprised two pumps, direct connected by a flexible coupling to a motor placed between them. These had 12-in. side suctions leading outboard and 10-in. discharges facing inboard, shells 1½ in. thick with removable side disks, and heavy inclosed runneds capable of delivering solids up to 4 in. in diameter.

Each unit was designed to deliver not less than 3000 gal. per min. at the greatest elevation encountered during operation, with a minimum mechanical efficiency of 60%. At the start, the four pumps were to work in parallel, as shown in Fig. 1. All pipe connections on the scow were specially cast for the work. Gate valves were set in between each discharge and the main line, so that by disconnecting the motor and closing the valve any one pump could be closed off without affecting the others.

A change from parallel to series operation could be made at whatever point in the undertaking the increase of head and density of material made it advisable. The arrangement for this is shown in Fig. 2. By this arrangement two units, each consisting of a two-stage tandem pump, were obtained at some sacrifice of volume, but at a decided gain in efficiency.

For priming and keeping pressure on the impeller bearings, a 5¼x3½x5-in. air-driven plunger pump was installed on the scow, which took its power from the mine compressed-air supply and its water from Kerr Lake at the start, and after that water became too muddy, from the auxiliary supply from Giroux Lake. The main suction pipes were connected to the pump shell by 90° elbows, and extended to the water's edge, where 8 ft. lengths of smooth-bore suction hose continued the intake. The suctions were fitted with flat foot-valves and strainers having 3-in. apertures, and were arranged on loose threads to act as a swivel joint, which, with the aid of a tackle, allowed them to operate at any desired depth up to 8 ft.

The motors to drive the pumps were 250-hp., squirrel-cage, synchronous, induction machines, operating at 1200

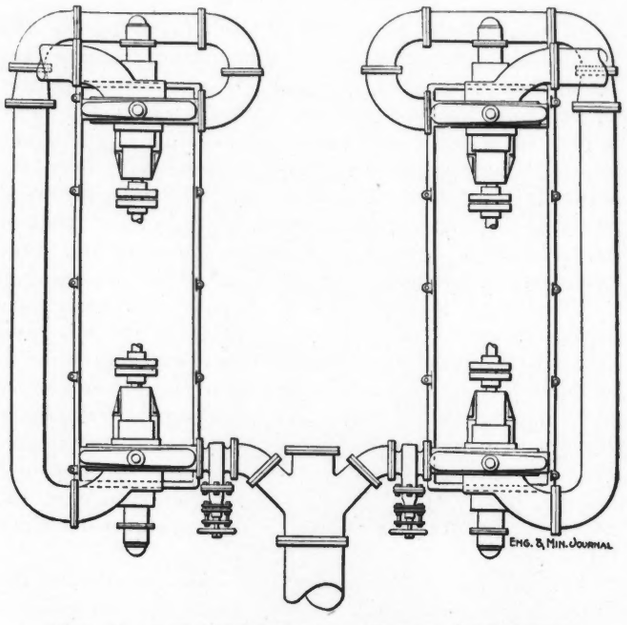


Fig. 2. Arrangement for Series Operation

r.p.m. on a 2200-volt, three-phase, 60-cycle current. Power was obtained from the line of the Northern Ontario Light & Power Co., which passes through the property. A 2200-volt line was carried without transforming, to a switch house built for the purpose on shore near the scow, where oil and knife switches, meters, etc., were installed; hence heavily insulated copper cables were led to the scow and connections on the scow were made through oil-switch, panel-mounted knife switches, and starting compensators for each motor. Lightning arresters were placed outside the deckhouse. Cables inside the house were carried in pipe, and below deck, where possible, to the various connections.

The Pipe Line

A 20-in., 14-gage, spiral-riveted pipe was used for the main discharge line. Bolted steel joints were used, except for a few flanged lengths on angles and between the scow and shore. This joint has great flexibility and capacity for taking up expansion and contraction, qualities desirable here, where extreme changes of temperature occur, and where portions of the line, both at the feed

and discharge ends, had to be shifted from time to time. This pipe was supplied in 32-ft. lengths, weighing 1500 lb. to the length. It was laid either on the ground or on simple bents, two to a length, keeping it in as straight a line and as free from hollows as possible. What few angles there were, were calculated in the survey, and were met by specially cast flanged elbows, to which lengths of pipe flanged at one end were bolted. A little ditch work and rock drilling and blasting were necessary, especially where the line crossed under the main highway by culvert, but in the main, inequalities of the ground were made up by the bents. The chief difficulty was carrying the pipe over the Temiskaming & Northern tracks at the minimum height allowed above rail, namely, 22 ft. 6 in.; this was necessary to avoid the low point in the line, which would result if it were carried under the tracks. Two wooden towers were erected, and the pipe suspended from two cables stretched over them and anchored to the ground.

The Kerr Lake end of the pipe, which reached shore at an angle of 15°, was anchored by straps and bolts set in a cement pier at water line. The end of the pipe facing the water was flanged, and to this was bolted a 20-in. flexible ball joint having a maximum swing of 27°. To this joint in turn two expansion joints giving a lateral play of 16 in. were bolted. At the start, one 32-ft. length of flanged pipe was connected to these, and to a similar ball joint coupled inboard on the scow at the main discharge. A 12-in. bypass, with a gate valve, was inserted on the flanged length, for draining the line.

Operations

The pumps were started on Aug. 28, 1913. It was found that too sudden stopping of the pumps caused vacuums to form, which made one or two lengths of pipe show a tendency to collapse; this was remedied by the insertion of check valves at threatened points. A tendency of the pipe to sag after receiving the full weight of water was observed on the span over the railway, and the structure was strengthened by the addition of two more suspension cables and by the construction of arm props on each tower, which shortened the unsupported span of pipe by 24 ft.

The water was lowered steadily until the depth under the scow became too shallow for convenience, when a new flanged length of pipe was inserted, and the scow moved out a corresponding distance. The extra length was supported by trestle bents having an adjustable block-and-tackle sling to allow for the falling level of the pipe. The operation was repeated as often as it became necessary to make a move until the suspended line became too cumbersome, when the shore ball joint was moved out to a new pier and the connecting pipe shortened accordingly.

It had been intended to stir up the mud as much as possible by agitation while there was plenty of water in the lake, so that the mixture flowing through the line might be as liquid as possible. Various methods were tried, such as directing a stream, pumped from the lake by an auxiliary plunger pump of 300-gal. capacity, through a 4-in. hose with monitor attachment, into the mud, both from shore and from a small scow, but it was found impracticable, since the mud was of such consistency that although the bulk of that exposed by the lowering of the water flowed into the deeper part almost without sluicing, that under water had a glue-like tendency to stay in banked masses near the shores as long as any water remained in the lake to hold it back. The mud left above the water soon dried and became compact to a short depth, so that it offered little difficulty to mining or prospecting, but that in the center of the lake constantly increased in depth with the influx from the sides, and as rapidly diminished the clear-water area. Tests made on this mud showed that its water content was high, nearly 80%, so that it was decided to pump out the remaining water entirely, and with the suctions resting in the mud, trust to the pumps handling it with the aid of the small streams of water flowing into the basin from the mines and mills. The change of the pumps from parallel to tandem operation, provided for as above described, was made in order to obtain better efficiency with the heavier material, and after some experimenting with the proper mixture of mud and water, and with the size of the strainer openings, a fairly steady stream of liquid mud varying from 6 to 20% solids was maintained through the line.

To avoid muddying the water in Giroux Lake near the pumps for the local mine supply, it was found necessary to carry the pipe line to a wooden flume, built along the shore, to a remote cove of the lake.

The pumps were run through September and October and at intervals during November, until increasing cold made operation difficult because of the freezing of valves and of the surface of the mud, and work was stopped for the season. The water had been removed from the greater part of the important reserves of the mines, thus leaving them free for stoping and development. About 325,000,000 gal. of mud and water were pumped, at an average of 6000 gal. per min. for 38 actual working days. It was demonstrated that the liquid mud lying in the deeper parts of the lake could be pumped and the ground underlying these deeper parts could be prospected and mined.

Cleaning Dredge Buckets with a Monitor

By W. H. Wright*

Many mechanical devices for freeing dredge buckets from clay and material that will not fall out of the bucket as it passes over the upper tumbler have been tried. Success has been claimed for a few, but the majority are but makeshift devices at best. The problem of dumping sticky material has been successfully solved on Natoma No. 9 dredge of the Natomas Consolidated of California, in the Natoma field of the American River district.

Encountering a large area of clay that gave great trouble by refusing to dump and plugging the bucket line, all devices of which the management had ever heard, or that the engineering staff could invent, were tried without success. Finally, the idea of turning the powerful stream of the monitor into the buckets occurred to someone, and the problem was solved. A nozzle was placed in the hopper and directed into the dumping bucket. A powerful 1½-in. stream of water playing through this nozzle into the clay never fails to dislodge it. There has been no further trouble from this source, and the other dredges will be similarly equipped when necessary.

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Jacob Langeloth

The many friends of Jacob Langeloth were shocked and saddened by the announcement of his death at his home, in Riverside, Conn., on Aug. 14. He had been apparently in excellent health and succumbed to a sudden attack of heart failure, which came on after he had retired for the night.

Mr. Langeloth's death removes from the mining and metal industries one of its best known and most highly respected figures. Born in Mannheim, Germany, in 1852, he was educated in German schools and universities, and served in the German army, being honorably discharged after his term of service with the rank of lieutenant. In 1886, while traveling in England for the Metallgesellschaft, of Frankfurt am Main, the great German metal house, his attention was directed to the wonderful development then being made in Montana and Arizona, from which states numerous shipments of copper matte and blister copper were being made to Liverpool. In the spring of the following year, he came to the United States as the representative of the Metallgesellschaft, and soon after organized the American Metal Co., Ltd., of which he first became treasurer and soon afterward president.

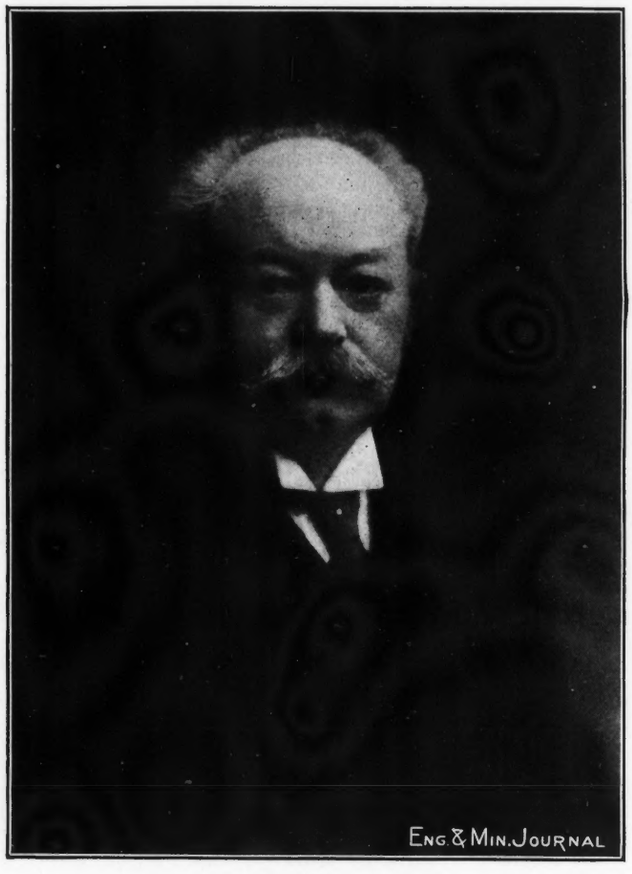
His wide knowledge of the metal business, coupled with his active experience both in German and English metal houses, gave him a grasp of the essentials of the industry, which soon placed his company among the leaders and led to his being recognized as one of the strongest and most conservative men in the metal field. He soon became connected with the firm of E. Balbach & Son (now the Balbach Smelting & Refining Co.), which was the first company to introduce into the United States the electrolytic process for refining copper, and through his foreign connections he was able to give that concern the benefit of many new and valuable discoveries in smelting processes which had been made in Germany.

Later Mr. Langeloth became engaged in the importation of ores from Mexico, and after a visit there he became interested in several Mexican mines from which copper and lead were shipped to New York. These Mexican interests he maintained up to the time of his death, and he always had the keenest sympathy for the Washington government in its efforts to cement friendly relations with that troubled country.

During recent years, Mr. Langeloth became interested in the zinc industry, and entered upon it with the same thoroughness and zeal which had characterized his efforts in connection with copper. It seemed that he kept constantly before his eyes a mental picture of the whole metal world and that his mind instantly grasped the significance of every change in supply and demand, together with its effect on economic conditions. It was this penetrating vision which distinguished him and gave him his exceptional standing as a foreign merchant and financier among the leading Americans in the metal industry.

Personally, Mr. Langeloth was noted for his exquisite consideration for the feelings of others, for his "live and let live" policy; and throughout the entire organization in which he has been for more than a quarter of a century such a potent force, there are abundant evidences of the simple and genuine manner in which he practiced these precepts. He was always interested in the personnel of the various companies with which his organization was associated, and at the time of his death he was engaged in preparing plans for a new city to be built at Burgettstown, Penn., renamed Langeloth. This is the site of the new plant of the American Zinc & Chemical Co., which is just nearing completion, and it was Mr. Langeloth's purpose to lay out a village for employees in accordance with the most modern sociological ideas. He has provided in his will for the creation of a fund to be used by his trustees in carrying out not only this project, but also another and much greater one, which will still further demonstrate his deep and abiding interest in those whose lot in life has not been so fortunate as his own.

The diversity of Mr. Langeloth's business interests can best be judged from the following list of companies in



JACOB LANGELOTH

which he was either an officer or a member of the directorate: The American Metal Co., Ltd.; Corn Exchange Bank; Balbach Smelting & Refining Co.; Miami Copper Co.; Metallurgical Co. of America; Mexican Bank of Commerce & Industry; Compañia de Minerales y Metales; Bartlesville Zinc Co.; American Zinc & Chemical Co.; Wetherill Separating Co.; Compañia Minera de Peñoles.

About two years ago he resigned the presidency of the American Metal Co., accepting instead the office of chairman of the executive committee of the board of directors, with the idea of gradually retiring from active participation in business, to live quietly at the beautiful home he had just built at Riverside, Conn., on Long Island Sound. But the constant attention to detail had become

so much a matter of habit to him that there was no appreciable moderation in his work up to the day of his death.

In 1903, Mr. Langeloth married Miss Valeria Knapp, who alone survives him. To her and to his immediate associates a host of sorrowing friends extend their sympathy over the loss of a broad-visioned, high-minded merchant and a warm-hearted, generous gentleman. Among a host of friends in financial and mining circles, who knew his sterling worth, his loyalty and integrity, and his courtly character, his untimely demise is regarded as a personal loss.

Lake Superior Mining Institute

SPECIAL CORRESPONDENCE

On Tuesday, Sept. 1, a special train left Marquette, Mich., at 6 a.m., with the 140 members and guests of the Lake Superior Mining Institute who had elected to take the trip to Detroit. The S. S. City of Detroit II left St. Ignace with this party at 11 a.m. of the same day and arrived at Detroit the following morning at 7:30. On board the boat, en route to Detroit, two business meetings of the Institute were held in the forward cabin.

The afternoon meeting was called to order by Pres. W. H. Johnson, who delivered the opening address. Among the guests were 10 members of the American Association of State Geologists, who had recently visited the Michigan copper country. In a brief address, Mr. Emmons, geologist from Minnesota, said he had been particularly impressed with the stability of the mining industry in the Lake Superior ranges, and the regularity of the deposits, as compared with those in the West, with which he is more familiar. He believes that a great responsibility rests on the members of the Institute because the low point of the great synclinal deposits of Lake Superior is being approached, and more attention must be paid to mining and treating low-grade deposits. Mr. Wolfe, State Geologist of Illinois, brought out the important features of the Curran-Foster bill, pending in Congress. He explained that the bill provides for 15 additional Bureau of Mines cars and 10 additional experiment stations, to be distributed over the country and to aid in the various mining districts. The bill carries with it an appropriation of $15,000 per car per year and $25,000 for each of the stations. It is intended that these cars and stations shall coöperate with mining schools, safety stations, and similar institutions in their vicinity. It is not expected that the bill will pass this session of Congress, but the Association of State Geologists hopes to see it passed next session, and to further this, has appointed a committeee of five to coöperate with the Bureau of Mines. Mr. Wolfe asked the Lake Superior Mining Institute to deliberate and act on the proposed bill.

William Kelly, Vulcan, Mich., replied to Mr. Wolfe and said that while the Institute takes great interest in first-aid work and heartily approves of extending the Government work broadly through the country, nevertheless, it is outside the function of the Institute to indorse the movement; that its constitution is similar to that of the American Institute of Mining Engineers, and no means are provided to take the consensus of opinion in such a case; but that every individual effort possible will be taken. Following this the reading of papers was commenced.

The first paper, "Use of Electricity at the Penn and Republic Iron Mines, Michigan," by William Kelly and F. H. Armstrong, Vulcan, Mich., was read by title only. Mr. Kelly stated that the paper was of such a nature that it should be read in leisure time at home. Lucien Eaton, Ishpeming, Mich., did not read his paper, "Methods of Stocking Ore on the Marquette Range," but emphasized a few points he had made. He stated that he had tried to determine, with a stop watch, the efficiency and reliability of different systems and had paid no attention to costs. He described the two systems in general use as one with hand-dump cars and short-length trestles, and the other with mechanical power cars from permanent or temporary trestles. In comparing the two, he remarked that the hand-tram system is good only for a small production, while the power tram is reliable and good for any capacity. Personally, he said, he had tried to eliminate car-riding, as a safety measure, as there is abundant evidence that it has been responsible for many accidents.

As Joseph Park Hodgson, Bisbee, Ariz., was absent, his paper, "General Outline of Mining Methods Used in the Copper Queen Mine, Bisbee, Ariz.," was read by title. The paper on "The Sinking of a Vertical Shaft at the Palms Mine of the Newport Mining Co., at Bessemer, Mich.," by Frank Blackwell, Ironwood, Mich., was read by title only, but was followed by some discussion. Mr. Blackwell stated that the universal practice on the Gogebic iron range is to sink inclined shafts in the foot wall, and that this is the first vertical shaft in the foot wall. He added that by the use of the blasting box, described in the paper, the speed of sinking had been increased 55%, with a saving also in fuse. The box has been used successfully in high raises. In reply to a question by Mr. Eaton as to whether the studdles are heavy enough, Mr. Blackwell stated that the shaft is concreted; that the concrete takes all the weight and the studdles act as reinforcements. The paper on "Mining Methods on the Marquette Range," contributed by a committee consisting of H. T. Hulst, G. R. Jackson and W. A. Siebenthal, was read by Secretary Yungbluth. The shrinkage stope system, in use at the Lloyd mine of the Cleveland-Cliffs Iron Co., was described first and led to some discussion, in the course of which it was brought out that all the ore in that mine of one grade, a low-grade bessemer, and does not require sorting for phosphorus. Prof. F. W. Sperr, of the Michigan College of Mines, suggested that a definition of "shrinkage stoping" should be given, and the following was brought out: In this method, the stope becomes larger in dimensions as the work progresses, but it fills more with loose material which must be pulled or "shrunk" to enable the men to go back to work after blasting.

In the discussion of the stoping system at the Hartford mine of the Republic Iron & Steel Co., Professor Sperr defined it as a modified block-caving system. The last method described in the paper is the one used at the Republic mine, Republic, Mich. In commenting on this paper, which described four mining methods, Professor Sperr said they are the best papers he had ever seen on mining methods. In referring to the method used at Sec. 21 mine of the Oliver Iron Mining Co., he said he did not understand how the dirt comes off the foot wall after

the last slice. C. A. Barabe, Ishpeming, who is familiar with that mine and the method, stated that the dirt must be shoveled off the foot wall after the last slice, if the foot wall is especially flat, and that some remains anyway. It was stated by one of the mining captains present that the loss due to this cause is estimated at not more than 5%, and that what is left from one level is drawn down to the next. Mr. Kelly added that the Republic orebodies are of various sizes, and that the method must be varied and modified accordingly.

A paper on "Steel Stocking Trestle at No. 3 Shaft, Negaunee Mine," by Stuart R. Elliott, Negaunee, Mich., was read by title and was thoroughly discussed. It was brought out that the use of this type of trestle entails no additional handling of the ore near the columns or elsewhere, that no trouble has been experienced with the ore freezing around the columns, and that it does not stick. It has been found possible to blast near the columns without injuring them. Mr. Kelly pointed out that this type of trestle eliminated the danger to life involved in drawing trestle legs, necessary with the usual type of trestles. P. S. Williams, Ironwood, Mich., was interested in knowing why an endless-rope system had been used on this trestle rather than motors, and if the cost had governed the decision. Mr. Elliott explained that motors would have been cheaper but more dangerous, and that this was the principal objection. Mr. Kelly added that there was a saving in power by the use of trolleys, but that the labor cost was higher. With an endless rope, one man at the shaft runs out the rope and tends the bells. Mr. Elliott remarked that the use of motors would increase the cost of the trestle, as they would increase the moving load, and this would require heavier construction. Mr. Williams said that this experience would tend to show that the endless-rope system is cheaper for the work than electric motors. Lucien Eaton, Ishpeming, Mich., stated that according to his experience, a 40-hp. corliss engine and rope will handle two loaded cars and two empties, whereas a 50-hp. motor has hard work with one. The final verdict seemed to be that for trestle work, of the nature being discussed, the endless rope is less expensive than electric motors.

"Ventilation in the Iron Mines of the Lake Superior District," by Edwin Higgins, of the Bureau of Mines, was not read. Mr. Higgins, however, gave a short résumé of the paper and stated that its object was to set forth the conditions of ventilation in the Lake Superior iron mines, and that he had tried to observe the effect of hot air on miners and on the cost of mining. Doctor McNair inquired for some specific suggestion as to any method of lessening the production of carbon dioxide from decaying timbers. Doctor McNair wished to know also if treatment of timber to prevent vitiation of air would also preserve the timber and so reduce the cost of treatment by the mining companies. Mr. Higgins, in reply, stated that any such treatment would simultaneously prevent vitiation of air, the rotting of timber and would reduce the heat. An interesting example was cited by one of the Institute's guests, who said that a coal mine, near Peoria, Ill., had used treated timbers for six years in an entry mouth, where untreated timbers had lasted only 18 months to two years. The preservative used had a creosote base, and tests on the treated timber showed increased strength after a few years' use. In reply to a question by Mr. Eaton as to the practicability of using artificial pressure to keep back the carbon dioxide, as in the Cripple Creek district, Mr. Higgins said he believed this method could be used to some extent in the Lake Superior iron mines, that it would keep back the gases, but would not reduce the heat.

At this point, Professor Sperr remarked that a new era in Lake Superior mining has come; that 20 years ago the caving or top-slicing method was just coming in and that it is now passing out. New methods must be found for the greater depths of the present and future. Also, a method must be found whereby less timber and less shoveling of ore are necessary. In this development, he stated that the use of "yielding supports" must come. It is his opinion that steel and concrete supports will be tried and will fail; that their use will be found to be a mistake. Mr. Williams inquired if it would be proper to use a concrete shaft through a dike at 2000-ft. depth in order to keep air away from the dike rock which disintegrates on contact with air. Professor Sperr was of the opinion that this plan would work temporarily but that the dike rock would yield when pressure comes, and would injure the shaft.

Evening Session

The paper on "Follow-Up System and Method of Recording Injuries in Compliance with the Workmen's Compensation Law," by Herbert J. Fisher, Iron River, Mich., was read by title at the evening session. F. C. Stanford's paper on the "Electrification of the Mines of the Cleveland-Cliffs Iron Co." was not read, but led to some interesting discussion. Mr. Stanford remarked that only within the last few years have hoisting and underground pumping been undertaken by the electric drive, and that contrary to the general impression among operators, the Cleveland-Cliffs company has had no trouble with electric hoisting, and it has been found reliable.

Mr. Kelly gave a very interesting talk on the use of electricity at mines. He said that the major uses are for pumping, hoisting and compressing.

Dwight E. Woodbridge's paper on "Titaniferous Ores in the Blast Furnaces—a Recent Experiment" was read by title. Mr. Yungbluth read Mr. Channing's paper on the caving system, and subsequent discussion brought out a variety of dates and places where this method of mining was supposed to have been used first on the iron ranges. There seems to be evidence that the method was used in the north of England as early as 1877; that it was introduced at places in the Cleveland hematite mine, Michigan, from 1882-87.

On Wednesday morning, the steamer, while yet some distance from Detroit, was met by a launch containing members of the Detroit Board of Commerce, who entertained the Institute for the following two days. They had made all arrangements for showing the visitors the points of interest they wished to see. Luncheon was served at the Board of Commerce dining room on Wednesday and a chartered steamer took the party to the Detroit Copper & Brass Rolling mills and Semet-Solvay Co.'s coke ovens in the afternoon. Tickets were provided for the theater in the evening. Thursday was spent in visiting the Ford Motor Co.'s factory in the morning and the Chalmers Motor Co. in the afternoon. The visitors were guests of the Detroit Boat Club at luncheon on Thursday. Those of the party who went north, returned by steamer in the evening.

Correspondence and Discussion

A Comparison of the Huntington-Heberlein and Dwight Lloyd Roasting Processess*

W. W. Norton's interesting paper in the August Bulletin of the A. I. M. E. (abstracted later in the ENGINEERING AND MINING JOURNAL of Aug. 15, 1914, p. 297), comparing the H. & H. and D. & L. processes, no doubt reflects with a high degree of accuracy the behavior of these two roasting methods, as he has found it at the Murray plant, in Salt Lake Valley, Utah.

Up in Montana, however, we are working with somewhat different conditions, and as we have been a little more favorably impressed with the relative merit of the Dwight-Lloyd sintered product, it may be of interest at this time to describe the behavior of these two processes at the East Helena lead plant of the American Smelting & Refining Co.

The reason for a difference in performance of these roasting processes at Helena and at Salt Lake undoubtedly lies in the rather unique roasting and smelting practice at the former plant, where all operations are on charges carrying an abnormally high lead and zinc content. Helena mixture beds contain approximately 80% Cœur d'Alene lead sulphides and average 160 to 180 lb. per cu.ft. The local significance of this high percentage of heavy leady material can readily be seen when it is remembered that the processes under discussion involve the blast-roasting principle. This density, together with the ready fusibility of such a lead-bearing charge, presents a set of conditions at East Helena that gives rise to peculiar problems at both roasters and blast furnaces.

Certain it is that with both the H.-H. and Dwight-Lloyd products in excellent physical condition, our East Helena blast furnaces run at higher speeds and with distinctly lower coke when dominated by the Dwight-Lloyd sinter. All those daily observations, recorded and unrecorded, that the metallurgist makes as he guides his blast furnaces through their various ailments and difficulties, have for several years past confirmed us at East Helena in the feeling that the more Dwight-Lloyd material we can get on our furnaces in place of H.-H. product, the lower is the percentage of coke required and the faster do the blast furnaces run. That we have dealt with extremes as well as averages in these matters, may be seen from the fact that the East Helena furnaces have carried upward of 90% roast on charge for long periods, with smelting tonnages of 475 to 575 tons per 100 sq.ft. tuyere area. An average of 249 tons per furnace day, maintained during the month of March, 1913, figures 549 tons per 100 sq.ft. tuyere area.

In December, 1912, one of our blast furnaces was run for seven days on a charge containing H.-H. roasted product and no Dwight-Lloyd; a furnace alongside of it running on Dwight-Lloyd product with no H.-H., the idea being to note the tendencies of the two roasted products as to speed and reduction. The composition of the two charges used is shown in the following:

	H.-H. Charge Lb.	Dwight-Lloyd Charge Lb.
Siliceous bed ore	1580	176
H.-H. roast	5264	....
Dwight sinter	....	7040
Limerock	1076	322
Scrap iron	80	80
Golden Curry iron ore	....	382
	8000	8000

The results of the week's test are shown in the following tabulation:

		Huntington-Heberlein												
December 1912				Tons	Slag			% Pb.			% S	%		
Date	Furnace	% Coke	% F.C.	Wet Chge.	% Zn	Oz. Ag	Wet Pb	on Ch.	% Roast		on Ch.	Matte Fall	Matte Pb	Matte Cu
5, 6, 7, 8, 9	1	13.75	10.9	210	5.0	0.29	1.99	30.1	66.2		4.2	18.3	24.6	9.9
3, 4	2	12.50	9.8	208	4.9	0.26	1.47	30.4	67.9		4.2	16.8	18.8	10.9
Av'ge		13.39	10.6	209	5.0	0.28	1.84	30.2	66.7		4.2	17.9	22.9	10.2
		Dwight-Lloyd												
3, 4	1	11.57	9.0	216	5.1	0.21	0.72	30.6	88.8		3.7	15.4	9.8	8.1
5, 6, 7, 8, 9	2	11.39	9.0	224	5.1	0.25	1.48	30.2	87.6		3.8	15.9	17.8	9.4
Av'ge		11.52	9.0	218	5.1	0.22	0.94	30.5	88.4		3.7	15.6	12.1	8.5

This tabulation indicates that 2% less coke-on-charge, better reduction, and higher speed attended the use of Dwight-machine product. It is to be noted that the Dwight-machine charge was run part of the time on one furnace and part of the time on the other, in order to make a fair comparison of the Dwight-Lloyd and H.-H. products regardless of local furnace conditions. In every instance except one, the Dwight-Lloyd product gave a more favorable showing than the H.-H.

It was found, in fact, that with furnace No. 2 doing poor work on the H.-H. charge, it was possible to straighten out both the tonnage and assays by switching to the Dwight charge. In all cases we had good crucibles, bright tuyeres, and cool tops, but it was found necessary repeatedly to take off considerable amounts of coke on the Dwight furnace, on account of persistent over-reduction.

It was found in general that our mechanical feeding arrangements were more favorably adapted to the proper distribution of the Dwight-machine product. As fast as they were indicated, however, changes were made in the distribution of both charges, and it was felt that each one of the changes made was in the nature of an improvement at the time. The test was too short, however, to permit these changes in feeding arrangement to proceed to a point at which the H.-H. product was distributed to absolutely the best advantage. In fact, had we been able to prolong the test, we could undoubtedly have made a more favorable showing for the H.-H. by further changes in feed-floor arrangement. It is true, however, that the over-reduction on the Dwight furnace prevented the large tonnages that were clearly indicated for the Dwight charge under proper conditions.

It should be noted that in these tests both charges involved larger percentages of roasted product than were

*Discussion of W. W. Norton's paper before the Salt Lake meeting of the A. I. M. E.

used in the Murray trials—65.8% and 88% as against 37.5% and 60%.

In Mr. Norton's recapitulation, five items are set down, two in favor of H.-H., two in favor of Dwight-Lloyd, and one with honors even. These same five items viewed in the light of East Helena operations, compare as follows:

(1) *Cost of Installation*: Regardless of location, this is, of course, in favor of the Dwight-Lloyd apparatus.

(2) *Cost of Roasting*: During the year 1913, the Dwight-Lloyd plant at East Helena accomplished a sulphur elimination of from 10.9% to 4.6%, while the H.-H. converter pots during the same period reduced from 10% to 5.1% sulphur. In this narrow range of sulphurs is seen the deterrent effect of the heavy dense lead charge at East Helena on both methods of blast roasting. The roasted material at present turned out in the H.-H. department averages 38% lead, while the Dwight-Lloyd sinter carries 43% lead. The H.-H. process is also favored to the extent of receiving the coarser Cœur d'Alene products while the Dwight-Lloyd beds take care of the slimes and fine concentrates. The average figures for the 12 months of 1913 show a cost per unit of sulphur eliminated, the same within a fraction of a per cent. for both processes. Three hundred tons per day are handled in the H.-H. plant, and about 400 at the Dwight machines.

(3) *Adaptability of Charge*: As at Murray, we recognize as greater leeway on the Dwight-Lloyd process in the physical and chemical variations possible in the charge.

(4) *Metal Losses*: Repeated tests on East Helena flues indicate, as at Murray, that lead losses are practically the same on both processes.

(5) *Physical Condition of Product*: An abundance of experience and testimony concerning the important part in reduction played by ascending blast-furnace gases makes it seem entirely logical and proper to us at East Helena to attribute the beneficial effect of Dwight-Lloyd product on our smelting procedure to its peculiarly cellular structure, allowing the reducing action of the gases to proceed over a maximum area of contact from the moment the charge begins its downward journey from the furnace top.

The dangers from the fusing of such predigested material (either Dwight-Lloyd or H.-H.) at too low a temperature in the furnace, should be and is offset, at East Helena, at least, by the faster descent of the charges containing these roasted products. Although 85% to 90% of our smelting stock is made up of roasting product (50% Dwight-Lloyd, 35% H.-H.), hot tops are practically unknown.

Recent years have found us gradually and steadily increasing the amount, and improving the character, of the roasted product on charge at East Helena, and with each step in the process, better blast-furnace results have been noted. In short, it is to the roasters and not the blast furnaces that we are inclined to give credit for accomplishing a notable improvement in smelting speed and general metallurgy during the last few years all over the country, and the Dwight-Lloyd process has played such an important part in this at East Helena that we are glad to add our word to the approval expressed by Mr. Norton. In going a little further in our appreciation and acknowledging a distinct superiority of Dwight-Lloyd over H.-H. product, we fully realize that the handling of 35% to 40% lead charges may present a rather extreme smelting proceedure, and that these opinions as to the relative merits of Dwight-Lloyd and H.-H. roasted products may simply reflect local Montana conditions.

A summary of Murray and East Helena experience with these two roasting processes would appear, then, as follows:

	Advantage in Favor of (At Murray)	(At East Helena)
Cost of installation	D-L	D-L
Cost of roasting	H.-H.	Even
Adaptability of charge	D-L	D-L
Metal losses	Even	Even
Physical condition of product	H.-H.	D-L

G. C. RIDDELL,
Superintendent, East Helena Smeltery.

East Helena, Mont., Aug. 27, 1914.

Mine Taxation

Mr. Steele in the JOURNAL, of Aug. 29, sets forth some interesting views on mine taxation. I shall not quarrel here with his general conclusions, but if they are based on conceptions no more accurate than some of his incidental ideas, I consider them untrustworthy. Have we not had enough of this thoughtless coupling of mining and agriculture, "the two basic industries?" In the first place, mining is not basic; in the second place, if it were, other industries than agriculture should be classed with it. Man can exist without mining. I have no doubt some Esquimaux do it today. Nor can he exist by mining alone. Therefore, mining is not basic. Agriculture or fishing or the chase are basic industries, because at least one of them is necessary for existence and any one is sufficient. Mining is a great aid to these other basic industries; so is transportation, with which it is most logically coupled; and so is lumbering which it closely resembles in its essential operations.

If we do adopt Mr. Steele's implied definition of a basic industry as one that creates new wealth, by what process of reasoning can we exclude lumbering, fisheries, the fur trade, many chemical industries such as nitrogen fixation, and a great number of minor lines of human activity?

I have no mind to decry the too-little recognized importance of mining, but let us not try to bolster it with statements that are wholly incorrect.

ROBERT OLDS.

New York, Sept. 7, 1914.

Pyritic Smelting

Referring to the excellent article on pyrite smelting in the JOURNAL of May 2, it seems to me that the moisture contained in the charge, which must escape in the form of vapor, should account for some of the heat. The fumes, too, contain CO and SO_3 as well as the other gases mentioned. I have known sulphur to volatilize at a high temperature in the presence of free oxygen, so that quite possibly more than 10% would be driven off in that form. It is questionable, too, whether the smelter fumes passing through a flue are of uniform composition; I think the gas near the center will be found to vary from that near the outside.

W. H. MAWDSLEY.

Rockhampton, Queensland, June 29, 1914.

Editorials

The Labor Trouble at Butte

The labor war in Butte resembles the great war in Europe in that each was so long expected that fears had been allayed in the idea that neither would ever really happen. In both cases the wolf finally appeared at the door.

As for Butte, the explosion could hardly have happened at a more opportune time or with more auspicious circumstances. If the miners do not want to work it makes no great difference to the Anaconda company, which will be entirely satisfied if it can during the present period of distress keep its thousands of men from starving even if it makes no money itself.

The present trouble at Butte is not like the ordinary labor dispute which is between the employer and the employee. There are here none of the elements of self-interest that there were in the Lake Superior strike. At Butte it is primarily a fight between two labor unions, one of which does not want to let the other one work. Incidentally one has dynamited property of the other and there has been some murdering, not of "scabs" but of members of a labor union in good standing.

In the meanwhile, the company has stood aloof except for some concern lest the combatants should destroy some of its property, the remarks of one labor leader to the effect that he was going to run the mines and things in Butte generally being of threatening nature.

However, since martial law was declared and troops appeared on the scene, insuring the safety of the property of the mining companies and other citizens, there has been a feeling of relief and a willingness to see tested the principle of the right to work and whether that right belongs alone to members, not merely of a union but of one particular union. Thus is there a prospect of a great labor question being fought out without any participation by the employer and without any interest in making political capital on the part of the cheap politicians.

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Potash Supply

The JOURNAL has, upon sereval occasions, during the last two or three years published reports of potash discoveries in Spain. It now appears upon no less authority than the American Agricultural Chemical Co., that some of these deposits are of unmistakable promise and that it is now engaged in their exploration. They are said in the last report of that company to be similar in character to the German deposits, but richer in quality and probably more easily worked. It is hoped that these will be a commercial source of potash in the near future. In the meanwhile the company owning the deposits in southern California is aetively pushing its operations, but it hardly expeets to be a producer this year. The potash developments are encouraging, offering a distinet promise of relief from the German monopoly which has been oppressed for many years. However, it will take time to develop the new mines and pending the war potash is likely to be a scarce commodity.

Paying Wages in Mining Camps

A strong effort is being made in Arizona and southern California, emanating especially from Los Angeles, to abolish the payment of wages by checks on local banks. This is a good move. It is more convenient for an employer to pay by check, but manifestly it is less convenient for the employee. The upshot of the practice is that such checks are to a large extent cashed by the saloons, and the result is too often like this graphie narrative of the *Los Angeles Express:*

> Supposing, for example, a man goes into a saloon and gets someone to identify him so he can cash his check. The bartender hands out the money and looks inquiringly at the man he has "accommodated." What does the man do? Does he walk out and go home? Well, if he does he will never get another check cashed in that saloon, you may be certain of that. No; he says to his friend who has introduced him or vouched for him:
>
> "What'll you have?"
>
> And to the bartender and possibly others he says:
>
> "What'll you have, boys?"
>
> And then and there the trouble starts. Possibly he will leave immediately after one round of drinks, in which case he has only spent 30c., we will say, but even 30c. every Saturday night means $15.60 a year.
>
> How many, though, stop at one drink? And when they do, if the bartender is "onto his job," they are invited to take another at the expense of the house. This opens the way for other drinks—delays things, you might say—until one or more of the other boys drop in, and then the check-cashing is repeated and the drinking goes on.

In the big mining and smelting towns of southern Arizona there are hundreds of saloons, many of which derive a large part of their revenue from the eashing of checks and what naturally follows. Nobody supposes that the saloon man posts the notiee "Checks eashed here" out of any altruistie motive.

True, the local banks keep open for the eashing of such checks, but the loeal bank, with perhaps a single paying teller, is not equipped to pay off promptly a large number of men, and the latter do not like to have to stand tediously in line. Nobody does. Nor is it right to compel the workman to incur inconvenienee in order to get his money. Many of the largest employers of labor in the United States, including the Steel Corporation, the biggest of all, pay cash. All ought to. There was a time when the transportation of eurreney in the mining regions was attended with some risk. Every mine manager of 45 or 50 recolleets earrying the monthly pay roll out to his mine with a guard, or with fear and trepidation, but those days passed long ago.

Anyway, the saloon is the curse of the mining camp, and of the mining company most of all. The saloons of Dublin Gulch, in Butte, are a parasitic pest upon the mining industry of that great center. Equally pestiferous are the saloons of Bingham and Bisbee. When a population of 1000 workingmen undertakes to support 10 saloons, with 30 to 50 barkeepers and their families, they put on their shoulders a heavy load. They would be better off if they supported the same number of idlers who neither toiled nor spun, since then the resultant

mischief of the saloon would be cut out. The saloon everywhere works against thrift. Whatever works against thrift is contrary to the interest of the employer. The companies may not be able to vote their towns dry, but at least they can abolish the practice of paying wages by check and thus cease from playing into the hands of the saloon men.

Attend to Making Improvements

The producers of copper and silver who are now operating on a reduced scale but are maintaining their technical staffs, abiding the time when conditions may become normal, may well make use of the opportunity to try out new ideas that may reduce the cost of production or improve metallurgical extraction. Every works has its enthusiasts among its staff who have some pet scheme they would like to experiment with, but when things are going full blast the general manager is likely to frown upon diversions from the regular routine involved in maintaining production. The condition is now different. So let the boys have a chance to work in the laboratory or in a corner of the works and let them have a little money even if the general policy be retrenchment. Similarly, let the young mining engineers have an opportunity to make some desirable changes in the mines. All hands can profitably spend their leisure time in studying out new systems of economy. Attend to making the mines safe and reduce the cost of accidents. In general, do all those things that ought to be done before the rush begins again.

American Sheet Zinc

The shortage in the supply of sheet zinc is likely to be felt even more keenly than the shortage in spelter, a singularly large proportion of this supply having heretofore come from the Belgian and Silesian mills. In this form of metal, America can be less helpful than in spelter, our own rolling capacity being relatively small, probably not more than 35,000 tons per annum. Previous to Aug. 1, even that small capacity was only partially in use, business in sheet zinc having been very poor. We have no doubt that this situation has been totally changed of late. Anyway, the manufacturers have withdrawn their regular price lists and now quote only in a private way. In the early part of the year there were some importations of sheet zinc from Germany, which alarmed Lasalle and Peru considerably. That dread has, of course, now disappeared.

Mr. Casey's Bill

The bill to transfer the safety work of the Bureau of Mines to a proposed new bureau in the Department of Labor appears to have died a natural death; but now a certain Mr. Casey has come forward with a bill (H. R., 18,500, introduced Aug. 24) to transfer the Bureau of Mines *in toto*. This is a bold conception; so bold, indeed, as to be humorous. However, it will not do to assume that this bill is a joke which will be killed in committee. No stone should be left unturned to defeat it overwhelmingly and decisively. Let imagination picture the fate of the Bureau of Mines under the direction of Brother Wilson.

No Check to New Metallurgical Construction

Most of the big new metallurgical constructions are going on uninterruptedly. These are especially the Inspiration, Chuquicamata and Juneau plants. None of them is yet a producer, except Inspiration in a very small way, all of them are financed and there is, of course, no reason why construction should be checked in their cases. With a producer that is engaged in new construction the situation is quite different. A producer is apt to have a large part of its surplus in the form of unsold metal. When conditions arise, as they did in August, which prevent the normal sale of such metal, the management has to think about the conditions of carrying it and ordinary prudence decrees the suspension of outlay on new construction until the sky becomes clearer. This is one of the ways in which the war has seriously affected the mining industry.

Paying Wages for Keeping the Working Place Safe

The Calumet & Hecla Mining Co., according to the testimony of its manager, Mr. MacNaughton, before the Congressional Committee investigating the recent mine strike, insists that each miner, whether on contract or not, keep his working place safe by barring off the loose hanging, and puts no limit whatever on the time thus occupied. If the miner is on contract, and has to do an unusual amount of barring down, such as to detract from the time of his contract to an appreciable extent, say half a day or three-quarters of a day, he is allowed company time for this. If the work is such that it is impossible for one man to do it, he has the right to call in a neighboring miner or a timberman to help him, and if such a one should be on contract, he is also recompensed by the company. The company considers it cheaper to allow unlimited time for this work rather than to run the risk of injury to an employee. As Mr. MacNaughton put it, the company pays in one case wages for a shift or two and in the other compensation for an injured or killed employee, one being a matter of from $3 to $10 and the other several hundred dollars This point of view, perhaps, is not strictly correct, since the one case is a certainty and the other at most a possibility Nevertheless, the cost of time spent in cleaning off a back is cheap insurance against the risk of accident by a fall of ground

James MacNaughton, manager of the Calumet & Hecla, was questioned before the Congressional Committee investigating the recent strike, in regard to the appointment and competency of hoisting engineers. Mr. MacNaughton recalled the fact that the only hoisting engineer of whom complaints had been made was a socialist. When asked whether the men had thought that his belief might jeopardize them while being hoisted or lowered, Mr. MacNaughton replied that he did not think they objected to his being a socialist so much as to his being prone to preach socialism instead of attending to hoisting. We can easily conceive that miners would prefer to be hoisted by men with their attention fixed on the signals and the levers rather than on means of promoting a more equitable distribution of this world's wealth.

Trade Posibilities with Brazil

By Henry C. Carr*

The general war in Europe, with the subsequent stoppage of export, should prove the golden opportunity for American manufacturers. In the past the manufacturer in the United States has seemed content to let business come to him or to be perfectly satisfied with having a representative, who also represented a great many others in Rio Janeiro. Perhaps he did not realize the fact that Brazil is larger than the United States and that Para is 11 days away from Rio Janeiro by the fastest boat. At any rate, the business, or at least the greater part of it, is in the hands of the Germans and English. This hardly seems a fair proportion when the United States takes at least 75% of both the rubber from the North and coffee from the South.

Personally, I think that there are two reasons: First, that both the Germans and English have direct steamboat lines running to Brazil, and secondly, the Germans especially go after the business. A German is a born linguist and it is safe to say that every one of them that goes to Brazil, talks the language fluently before his arrival. The fact of being able to talk the language is one of the greatest assets one can have, as no matter how good a line of goods a man may have, still he will find that the preference is given always to the man who can speak the language. Again, German firms keep representatives on the ground, that is, in each city of any size, the Brazilian can order direct from a German representative. Now that this war is proceeding, it is certainly the chance for American manufacturers, especially for iron and steel products, lead, zinc, paint, etc. The American is supreme in only three things in Brazil, flour, shoes and Collins hardware. He may get a small part of the other things but it would be small. For instance, the government is building a railroad from Maranor to Baxias, 468 kilometers. There are an immense number of bridges required on this road, from 10 m. up to 40 m. in length, as many in fact as 14 in 40 km. in one section. They are all ordered in Belgium, but I do not see any chance of either manufacture or delivery, and there is a golden opportunity. The same way with rails, railroad equipment, locomotives, portable railways, pipe and all the lead and zinc products, and paint. Now is the time to go and get this business and keep it. The same way with coal. All the gas plants, river steamboats on the Amazon, the Lloyd Brazileiro running all around the coast to Rio, the Madeira Marmoré R.R., all burn Cardiff coal when Norfolk, Va., is almost as good and is directly in line.

The German, when he gets an order from Brazil, is punctilious about his shipment. He has it put into boxes that the damp will not affect, as everything gets moldy in a week in the north of Brazil. He is careful about his weights and measurements. I do not think in the United States we pay enough attention to these matters.

In concluding, I want to draw attention to payments. Generally payments are made by 60- or 90-day drafts against the bill of lading. The merchant will accept and, being honest at heart, will pay if he possibly can, still as there are few banks in the North, it will be found hard to discount these accepted drafts. In the South it is different, as the population is greater and there is a regular banking system. The Brazilians like the Americans and regard us as their very best friends. Now is the time to go and get business which really belongs to us.

*71 Broadway, N. Y.

Legal Aspects of Mining Claims

The following principles of mining law were recently reannounced by the United States Circuit Court of Appeals for the Ninth Circuit, in the case of Mason vs. Washington-Butte Mining Co., 214 *Federal Reporter* 32:

A patent to a placer claim conveys to the grantee all mineral within the claim, including veins or lodes not known to exist at the time of the application for the patent.

"Discovery" means the acquirement of knowledge that a vein or lode exists within the limits of a claim. Although it is not necessary that pay ore be found, in order to make a valid discovery, it is essential that the indications be of such character that miners in the district would follow them in the expectation of finding such ore as would justify them in working the claim.

Before it can be held that veins or lodes are excluded from the grant of land included in a placer patent, it is not sufficient to show that the land does in fact contain valuable minerals, but it must be shown that, at the time of the application for the patent, more has been discovered than the indications of mineral which would ordinarily sustain a lode location, and that it was at that time known to the applicant for the placer patent, or known to the community generally, or else disclosed by workings and obvious to anyone making a reasonable and fair inspection of the premises, for the purpose of obtaining title from the government, that there was rock in place bearing minerals of such extent and value as would justify expenditures for the purpose of extracting them.

Bureau of Mines Rescue Car No. 5

It is expected that the U. S. Bureau of Mines Car No. 5 will visit California mining districts from Sept. 9 to Oct. 31, the attendants giving training in mine-rescue and first-aid work in some of the mining districts. The itinerary, which will probably be adhered to fairly closely, follows: Sept. 9-19, Colfax; Sept. 20-27, Jackson; Sept. 28-Oct. 5, Angels Camp; Oct. 6-13, Melones; Oct. 13-20, Jamestown; Oct. 22-31, Kennett.

Prospective Open Shop in Butte

The Journal is in receipt of a telegram from Butte, Mont., dated Sept. 8, to the effect that 13 of the mining companies operating there unite in declaring for an open shop because of the acts of the new miners' union and the helplessness of the remnant of the old union with which the companies had working contracts. The statement issued by the companies declares that hereafter nobody will be permitted to visit the mines for the purpose of inspecting working cards. The only company not subscribing to the statement is the Davis-Daly, which was not represented at the meeting.

PERSONALS

C. F. Rand, president of the Spanish American Iron Co., is in Cuba on business.

H. D. McCackey, U. S. Geological Survey, left San Francisco recently for Salt Lake and Denver on professional business.

Frederick D. S. Robertson, mining engineer, of Toronto, Ont., has gone to the war in Europe with the 48th Highlanders in the British Army.

Edward E. Free, late of San Francisco, will after Oct. 1, be with the Department of Plant Physiology, Johns Hopkins University, Baltimore, Maryland.

R. G. McConnell, of the Canadian Geological Survey has been appointed to the position of Canadian Deputy Minister of Mines in place of Prof. R. W. Brock, who recently resigned.

J. B. Tyrrell, of Toronto has been making an examination of the lower portion of the Valley of the Fraser River in British Columbia with the object of determining the probability of the occurrence of oil in paying quantities.

H. W. Hardinge has just returned to New York from an extended western trip which took him up as far as Dawson. Mr. Hardinge has now gone on a trip to Porcupine and will return to New York about the middle of September.

Thomas H. Leggett, who has been in charge of the mining interests of the American Smelting & Refining Co., has severed his connection with that company and has resumed practice as consulting engineer, with offices in the Singer Building, New York.

Samuel Mather, senior member of the firm of Pickands, Mather & Co.; William G. Mather, president the Cleveland-Cliffs Iron Co., and E. W. Oglebay, senior member of the firm of Oglebay, Norton & Co., all of Cleveland, Ohio, have returned from Europe.

P. R. Conlin, superintendent of Dover furnace of M. A. Hanna & Co., Cleveland, at Canal Dover, O., has been appointed general superintendent of the United Iron & Steel Co., Cleveland, to succeed B. J. Mullen, resigned. Mr. Conlin will have charge of Cherry Valley furnace at Leetonia, O., and Fannie furnace at West Middlesex, Penn.

Gould, Free & Ash, chemical engineers, announce that on Aug. 31, Edward E. Free retired from the firm. The business will be continued by Ralph A. Gould and Charles S. Ash under the firm name of Gould & Aash with offices as formerly in the Monadnock Building, San Francisco.

E. Harms, general superintendent of the Cia. Metalurgical de Torreon, Torreon, Mexico, had the misfortune to be in a railroad accident near Chicuahua, while enroute from Torreon to El Paso with his wife. Mrs. Harms was killed and he sustained severe injuries. He is now recovering. The plant will soon start operations after a shut-down of more than a year.

R. A. Kinzie, Superintendent for 14 years; E. P. Kennedy, assistant superintendent for eight years; W. P. Lass, superintendent of the cyanide plant for seven years, all of the Alaska Treadwell Gold Mining Co., and G. C. Jones superintendent of the Alaska Juneau Gold Mines Co. for five years, resigned to take effect Sept. 1. Their resignations were accepted. Mr. Kenzie will go to California with his family, Mr. Lass and Mr. Kennedy will open offices in Juneau in connection with the Speel river electric-power project, and Mr. Jones will live in the states. No successors have been named but it is generally understood that Philip Bradley will be in charge of the Alaska Juneau operations.

OBITUARY

John Armstrong Rollins, member of the firm of Naylor & Co., New York iron and steel merchants, and vice-president and director of the American Grondal Co., died at the Nassau Hospital, Mineola, N. Y., Aug. 27, from injuries sustained in playing polo. Mr. Rollins was a native of London, and was 43 years old.

James M. Frink, for 32 years president of the Washington Iron Works Co., Seattle, died at his home Aug. 31, of heart failure. Mr. Frink was prominently identified with the iron and steel industry on the Pacific coast. He has been affiliated with the United Metal Trades Association of the Pacific Coast in various official capacities for many years, and it was through his efforts that the Washington Iron Works Co. grew from small beginnings to one of the largest manufacturers of logging equipment in the northwest. Mr. Frink is survived by his two sons, Gerald and Francis G. Frink, who will continue actively in charge of the business of the Washington Iron Works.

SOCIETIES

American Society of Mechanical Engineers—As heretofore announced the preliminary work of the Committee to Formulate Standard Specifications for the Construction of Steam Boilers and Other Pressure Vessels and for the Care of Same in Service, was completed last February and placed in the form of a tentative report of limited edition for critical study and improvement. It is now to be submitted to public hearing for further suggestions and improvement. A hearing is to be held Sept. 15 in the rooms of the Society, No. 29 West 39th Street, New York.

American Association of State Geologists—The summer meeting of this association convened at Houghton, Mich., on Aug. 27, with 18 members in attendance. On the afternoon of that day, an hour was spent in inspecting the Michigan College of Mines, after which some geological formations in the vicinity of the Isle Royale mine were examined. The latter inspection was made under the guidance of Dr. L. L. Hubbard, former state geologist, and W. E. Hopper, assistant professor in geology at the Michigan College of Mines.

A business m eting, held on the evening of that day, at the Houghton Club, was devoted to the relation of the geological surveys of the various states and the Federal Government. Dr. Allen, state geologist for Michigan, explained the method by which the Government appropriates money to the various states, in proportion to the money appropriated by the state itself, this money to be used in preparing a topographical map by states. The discussion at the evening meeting was in connection with the proposal that Federal aid should be based on area and population, rather than on the amount that each state appropriates. The matter has a direct bearing on the State of Michigan, which at present has only completed about 11% of its map, while other states have completed as much as 43%. The proposed change would enable Michigan to obtain more money to prosecute the work, and is especially desirable because of Michigan's importance as a mineral state. It is hoped the discussion will result in some congressional action being taken on the matter.

On Aug. 28, part of the morning was spent at Eagle River, in Keweenaw County. This is at the north end of Keweenaw Point, north of the Calumet district. Some of the interesting geological features of the vicinity were viewed by the visitors, and the balance of the morning was spent in examining some of the surface plants of the Calumet & Hecla Mining Co. After luncheon the outcrops in the Houghton Douglas ravine were examined, and from there the party continued to the Calumet & Hecla regrinding plant at Lake Linden and the smelters at Hubbell. The party expected to leave Aug. 28 for the Marquette iron range, where the meeting will be continued. No election of officers took place as that is done at the winter meeting of the association, usually held in the East.

Iron & Steel Institute—A circular from the secretary's office in London says: "In consequence of the war, the Comité des Forges de France has been obliged to cancel all arrangements for an autumn meeting of the Institute in France this year. Under the circumstances, the Council has decided that it would be advisable to postpone for the present the organization of any alternative arrangements for an autumn meeting for the reading and discussion of papers. A number of papers have been submitted with a view to their presentation at the meeting which was to have been held at Paris, and the Council proposes to print in the usual way advance copies of those papers approved for publication and to invite discussion thereon by correspondence. It is expected that the copies will be ready for issue about the second week in September."

The following is the list of papers that have been submitted:

1. E. D. Campbell, "Note on the Theory of Hardening and on the Constitution of Steel.
2. G. S. Cooper, "By-product Coking Industry and Its Relation to the Manufacture of Iron and Steel."

3. L. Dufty, "Determination of Cobalt in High-speed Steels."

4. L. Guillet, "Electrolytic Iron, Its Manufacture, Properties and Uses."

5. G. Hailstone, "Transverse Testing of Cast-iron."

6. W. L. Johnson, "Utilization of Heat Contained in Slags."

7. N. G. Kapp, "Mechanical Charging of Blast-furnaces."

8. P. Nicou, "Iron Ore Deposits of Lorraine and the West of France."

9. H. de Nolly and M. Veyret, "The Transformations of Steels."

10. J. A. Pickard and F. M. Potter, "Oxygen Content of Openhearth Steel."

11. A. M. Portevin, "Decarburisation of the Steels in Salt Hardening Baths."

12. A. M. Portevin and V. Bernard, "Influence of Coalescence on Mechanical Properties of Steels and Alloys."

13. A. Sahlin, "Use of Liquid Ferromanganese in the Steel Processes."

14. A. Spannagel, "New Process for Heating Blast-furnace Stoves."

El Paso School of Mines—Faculty for school, which is a branch of the University of Texas, has been selected. First semester commences Wednesday, Sept. 23, with encouraging enrollment for the new institution. The installation of an ore testing plant is proposed. S. H. Worrell is dean of the school.

INDUSTRIAL NEWS

The International Steam Pump Co. went into receivership on Aug. 27. The business of the subsidiary companies will not be affected.

Luitwieler Pumping Engine Co., Rochester, N. Y., Catalog; The Luitwieler System of Non-Pulsating Triplex Pumps, 32 pp., Illus., 9x6 inches.

The appointment of A. H. Whiteside as vice-president and general sales manager of the Goulds Manufacturing Co., of Seneca Falls, New York, manufacturers of hand, triplex and centrifugal pumps, has just been announced.

The Bell Development Co., Duluth, Minn., has contracted with the Mesaba Boiler & Manufacturing Co., of that city, for a furnace designed to treat the manganiferous ores of the Cuyuna range. The company adds that it will manufacture spiegeleisen and ferromanganese and that it expects to have the furnace in operation about Sept. 15, with a capacity of 50 tons a day, says the "Iron Age." This seems rather an early date to set.

Two 1250-hp. (sea-level) Carels-type Diesel engines have been built for Phelps, Dodge & Co., for the central power plant of the Burro Mountain Copper Co., Tyrone, N. M. The plant is situated at an elevation of 6700 ft., at which height the normal power developer will be 1000 hp. Each engine is direct connected to an 815-kw.-a. G. E. 60-cycle, three-phase alternator. One engine is now ready for operation, the other practically erected in the power plant. They are two-cycle engines, with five power cylinders, and a scavenging air cylinder, driven directly from the main crankshaft. These engines were built by Usines Carels Freres, of Ghent, Belgium. As already noted in these columns, the Usines Carels Freres have concluded exclusive arrangements with the Nordberg Co., of Milwaukee, Wis., to build the Carels-type Diesel engines in this country.

TRADE CATALOGS

The Ruby Manufacturing Co., Jackson, Mich., Bulletin. Fuby All-Steel Sectional Buildings 12 pp. Illus. 9x6 inches.

Western Electric Co., New York, N. Y. Catalog. Magneto Telephones and Supplies. 40 pp., illustrated, 10½x8 in.

The American Rolling Mill Co., Middletown, Ohio. Pamphlet. Iron Roofs That Resist Rust. 18 pp., illustrated, 6x9 in.

National Tube Co., Frick Bldg., Pittsburgh, Penn. "National" Bulletin No. 7D. 5th Edition. N. T. C. Regrinding Valves. 8 pp., 1 Illus., 8½x11 inches.

Alberger Pump & Condenser Co., 140 Cedar St., New York. Catalog E. Alberger centrifugal pumps, Alberger-Curtis steam turbines. 56 pp., illustrated, 6x9 in.

NEW PATENTS

United States patent specifications may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

ALLOY-STEEL SCRAP—Method of Treating. Paul P. Reese and Emory L. Diehl, Munhall, Penn. (U. S. No. 1,108,235; Aug. 25, 1914.)

ALLOYS—An Improvement in the Production of Metal Alloys. L. Goldmerstein, New York. (Brit. No. 7103 of 1913.)

BIN. Wilbur E. Sanders, Sonora, Calif., assignor of one-half to Annette J. Chamberlain, Berkeley, Calif. (U. S. No. 1,107,846; Aug. 18, 1914.)

CONCENTRATION—Belt Concentrating or Vanning Machine for Separating Pulverized Ores and Similar Material. Orrin H. King, Chicago, Ill., assignor to United States Concentrating Co. (U. S. No. 1,108,186; Aug. 25, 1914.)

CRUSHING MACHINE. Thomas Leggett Sturtevant, Quincy, and Thomas Joseph Sturtevant, Wellesley, Mass., assignors to Sturtevant Mill Co. (U. S. No. 1,105,713; Aug. 4, 1914.)

CRUSHING MILL. Thomas Joseph Sturtevant, Wellesley, Mass., assignor to Sturtevant Mill Co. (U. S. Nos. 1,105,712; Aug. 4, 1914; and 1,107,373; Aug. 18, 1914.)

DRILL—Fluid-Operated Drill and Handle Therefor. Caid H. Peck, Athens, Penn., assignor to Ingersoll-Rand Co., New York, N. Y. (U. S. No. 1,105,998; Aug. 4, 1914.)

DRILL—Rock-Drill. George J. Beaudin, Flat River, Mo. (U. S. No. 1,106,537; Aug. 11, 1914.)

ELECTRIC FURNACE. George Hillard Benjamin, New York, N. Y. (U. S. No. 1,106,486; Aug. 11, 1914.)

ELECTRODE for Furnaces. Carl Hering, Philadelphia, Penn. (U. S. No. 1,106,381; Aug. 11, 1914.)

FLOTATION—Separation of Zinc Blende and Other Metalliferous Constituents from Ore Concentrates and Slimes by Flotation or Granulation. Edward James Horwood, Broken Hill, N. S. W. (U. S. No. 1,108,440; Aug. 25, 1914.)

FURNACE WALLS AND TUYERES—Improvements in and Relating to the Walls and Tuyeres of Furnaces. W. Piernay, Stettin, Germany. (Brit. No. 7206 of 1914.)

GALVANIZING MACHINE. Miles W. Trout, Youngwood, Penn. (U. S. No. 1,107,464; Aug. 18, 1914.)

HARDENING FURNACES—Apparatus for Automatically Charging Hardening and the Like Furnaces. Robert Röntgen, Remscheid, Germany. (U. S. No. 1,107,449; Aug. 18, 1914.)

HOISTING—Controlling Apparatus for Hoisting Engines. Clarence R. Welch, Scranton, Penn. (U. S. No. 1,108,044; Aug. 18, 1914.)

INGOTS—Method of Treating Ingots. Herbert C. Ryding, Birmingham, Ala. (U. S. No. 1,108,243; Aug. 25, 1914.)

INGOTS—Method of Treating Ingots. George C. Crawford, Birmingham, Ala. (U. S. No. 1,108,862; Aug. 25, 1914.)

IRON ALLOYS—Process of Manufacturing Iron Alloys. George M. Colvocoresses, New York, N. Y. (U. S. Nos. 1,106,785 and 1,106,786; Aug. 11, 1914.)

JIG PLUNGER. Guy H. Elmore, Swarthmore, and Horatio V. Croll, Philadelphia, Penn. (U. S. No. 1,108,558; Aug. 25, 1914.)

LEACHING—Agitator and Filter for Treating Ores. John D. Fields, Maxville, Mont. (U. S. No. 1,107,922; Aug. 18, 1914.)

OPEN HEARTH FURNACES—Charging Apparatus for Open-Hearth Furnaces and the Like. John Albert Swindell, Pittsburgh, Penn. (U. S. No. 1,106,988; Aug. 11, 1914.)

ORE-CONCENTRATING MACHINE. George W. Burnhardt, Ward, Colo., and Albert Krieg, Kansas City, Mo. (U. S. No. 1,106,923; Aug. 11, 1914.)

ORE TREATMENT—Metallurgical Process for Ores Containing Arsenic and Nickel or Cobalt, Especially those of the Temiskaming District. W. McA. Johnson, Hartford, Conn. (U. S. No. 1,107,310; Aug. 18, 1914.)

POTASH—Process of Extracting Potassium Compounds from Siliceous Minerals. Thomas B. Stillman, Hoboken, N. J. (U. S. No. 1,106,984; Aug. 11, 1914.)

RESCUE APPARATUS—Smoke Mask for Respiration Apparatus. Alexander Bernhard Dräger, Lubeck, Germany, assignor to Drägerwerk Heinr. und Bernh. Dräger, Lubeck, Germany. (U. S. No. 1,105,127; July 28, 1914.)

RIFFLEBOX. Karl F. Nelson, Kellogg, Idaho. (U. S. No. 1,104,919; July 28, 1914.)

ROASTING FURNACE. Albert Zavelberg, Hohenlohehütte, Germany. (U. S. No. 1,107,006; Aug. 11, 1914.)

SEPARATOR. John M. Allen, Anaconda, Mont. (U. S. No. 1,107,472; Aug. 18, 1914.)

TIN—Process of Manufacturing Stannic Chloride from Materials Containing Oxide of Tin. Hans Goldschmidt, Essen-on-the-Ruhr, Germany. (U. S. No. 1,105,902; Aug. 4, 1914.)

TUNNELING—Process for Moving Material. William Cooper, Denver, Colo. (U. S. No. 1,106,863; Aug. 11, 1914.)

URANIUM—Incandescent Body for Electric Lamps. William G. Hughes, Pittsburgh, Penn. (U. S. No. 1,106,384; Aug. 11, 1914.)

VANADIUM—Process for Extracting Vanadium from Vanadium Ores. Harold Boericke, Newmire, Coro. (U. S. Nos. 1,105,244 and 1,105,245; July 28, 1914.)

VANADIUM ALLOY—Alloy of Vanadium and Precious Metals. Felix Freiherr von Oefele, New York, N. Y., assignor of one-half to Heinrich Schweitzer, New York, N. Y. (U. S. No. 1,107,180; Aug. 11, 1914.)

ZINC—Process for the Extraction of Zinc from Zinc-Bearing Refuse. Ralph R. Parish, Waterbury, Conn., assignor to Chase Rolling Mill Co., Waterbury, Conn. (U. S. No. 1,104,922; July 28, 1914.)

Editorial Correspondence

SAN FRANCISCO—Aug. 27

The U. S. Bureau of Mines has arranged for a first aid field meet at Jackson, Amador County, on Labor Day, Sept. 7. Mr. Krogdahl will be in charge. Fifteen first-aid teams from the Mother Lode region will enter the contest. Prizes are to be awarded winning teams by the American Mine Safety Association and operators and owners along the Mother Lode. As a result of Mr. Krogdahl's work in coöperation with the California Industrial Accident Commission a great deal of interest has been aroused in first-aid practice in the mining district of the state. The meet at Jackson should, and no doubt will, create a greater interest and result in permanent good.

Closing Down of the Balaklala Mine at Coram, Shasta County, is reported. Four men remain at the mine and four at the smelting plant. The buckets have been removed from the aërial tramline, the ore cars and locomotives housed and the mine placed in order for indefinite shut down or for immediate resumption, as may be decided upon. The mine was shipping 250 tons of ore per day, part to the Mammoth plant at Kennett and part to Yerington, Nev. The Hall process plant, built for experimental purposes, had not been in recent operation, and the resumption of smelting was awaiting the results of this experiment or some other method of neutralizing the fumes. Prior to the outbreak of the European war the Balaklala was in fine shape for resumption of complete operation of mine and plant, and the partial operation of the mine was on a profitable basis, even though all the ore extracted was shipped. But the continued operation of the mine on a further reduced scale would evidently have been unwarranted.

The New Orebody Recently Disclosed in the Belcher on the Comstock is stated by Whitman Symmes to have the appearance of being the greatest strike made on the Comstock in the past 30 years, because of the probability that it will develop into an extraordinarily large body of good grade. The ore is on the foot wall, and on the 1500-ft. level appears to be 60 ft. wide, averaging probably $8 per ton. Values improve on the 1600-ft. level, car samples going as high as $15 per ton from a raise being driven. Even before stoping has begun the Belcher is making expenses out of the ore extracted in development. When direct connection is made with the shaft the ore can be mined and milled for less than $5 per ton. Similar ore was mined above the Sutro tunnel level several years ago, which averaged $20 per ton, and was known as "the gold rock," differing in appearance from the silver ores. Stocks of the Gold Hill group of mines furnished the leading features of trading at the short sessions of the San Francisco Mining Exchange on the strength of the report of Symmes and the further report that those properties have become self-supporting.

The Situation at the Zeila Mine in Amador County indicates the probable resumption of operation within the next year. Dismantling of the worn-out surface and removal of equipment from the old underground workings have been completed, leaving the hoisting machinery, boilers and compressor intact. The property is in fine condition for renewed development of the orebodies disclosed in the north end of the mine by the latest operation of the owners and further proved by the extensive examination made by Robert E. Cranston for Breitung & Co. The ore is low-grade, probably under $4 per ton, and the situation of the orebodies will necessitate sinking a new shaft to a depth of 1500 ft. in order to bring the cost of development and extraction within a figure that will admit of profitable operation. This condition is largely responsible for failure to sell the mine to prospective purchasers who have made examinations within the past two years. The question of terms may have been partially responsible. Large investors in new and old mines in California have repeatedly declined to make any cash payments. Large bodies of low-grade ores may unquestionably be mined and treated at a profit, even in the Mother Lode region where the ores are not generally amenable to cyanidation. But where the ore is wholly low-grade and the initial cost of entire new equipment must be added to the purchase price of the mine, and the sinking of 1500 ft. of new shaft must be added to the cost of mining, the condition does not lend encouragement to the prospective purchaser, particularly in the absence of liberal terms of purchase. That a more liberal management may succeed the present is not at all probable. Rather, the present management is more likely to gain complete control. It is this probability that lends color to the belief that the Zelia will resume operation without being sold to a new company. The purchase of sufficient stock to entitle the management to undisputed control and to enjoyment of the largest share of the profits of operation would require a much smaller investment than the purchase of the entire property outright; and there is no reasonable doubt that it would be a safe investment.

BUTTE—Sept. 4

Butte Business Men Asked to Aid Prospectors—The Butte Chamber of Commerce being in receipt of numerous requests from all parts of the state asking the organization to take up the matter of the present laws governing location and working of mining claims with a view to securing an extension of time and a lessening of the amount of development work now required of the prospector. The Butte men are urged to coöperate with other commercial bodies in the state in asking members of congress to support a bill providing for a suspension of the requirement of $100 worth of work each year on each claim held. Secretary Austin of the Butte Chamber of Commerce announced that the importance of the mining industry and its relation to other industries is realized by Butte business men and that the matter of proposed legislation to aid the prospector will therefore be taken up at once by the Butte chamber.

Mine Workers Union—The proposal was submitted that all miners employed in the Butte mines should be forced to become members of the new union and wear its button. This was first carried into effect at the Anaconda mine on the morning of Aug. 26. On that day a committee of 20 representing the new union called at the Anaconda shaft and notified the miners employed there that they would be expected to secure, and wear the union's button, thereby indicating membership, or they would not be permitted to go underground. The men were given 24 hr. in which to join the union and secure the button. At 5 p.m., after a special meeting of the union, a parade consisting of about 300 men marched up to the Anaconda mine to inform the night-shift men of the demands made to the day shift. On the following morning the jurisdiction committee assisted by members of the new union took from their work at the Anaconda mine, 34 miners who had failed to obey the order, and led by President Muckie McDonald marched them as prisoners to the union hall and thence to a vacant lot, and there tried them in informal fashion on the charge of being enemies to the new union. By a vote of the miners assembled, 31 of the prisoners were given until seven o'clock in the evening to join the union; the other three were expelled from Butte. Suspcted of being gunmen and friends of Moyer and the old union, they were escorted to a point beyond the city limits and ordered to keep going and never to come back to Butte. It is reported that they returned to town under the protection of Sheriff Driscoll.

As this act of the union reduced the crew of men employed at the Anaconda mine below the required number, the mine was shut down for the time being. Five members of the old Butte Miners Union No. 1 thereupon called upon Mayor Duncan, demanding protection for the miners who were forcibly taken away from their work and from their homes by members of the rival union. One member of the committee stated that the Mayor on that occasion remarked that he was "absolutely powerless" to do anything.

On the morning of Aug. 28 the committee charged with the work of enforcing the exclusive jurisdiction of the Butte Mine Workers' Union in all mines of the camp, repaired to the St. Lawrence mine where the same demand was made of the miners as was made at the Anaconda mine on the preceding morning. It was also announced that the committee would visit one mine after another for the same purpose. This caused a great number of miners, anxious to keep their jobs, to join the new union and secure the required buttons.

On the morning of Aug. 29 one miner who refused to join the new union was taken from the St. Lawrence mine

by the jurisdiction committee and marched out of town to the west of the city limits and told not to come back. In the evening of the same day members of the new union held an open-air meeting in front of the Auditorium at which President McDonald declared that the new union would not submit to the arrest of its officers or members on account of their forcing miners into the union and deporting those who refused to join. He also emphasized the fact that "the union is running things in this city"; denied that the union had broken any law; promised that it intended to be peaceable but if molested would resist with force.

Numerous placards bearing the names of the executive committee were posted at all mines. The placard says:

This is to notify you that your union has made arrangements with the companies whereby these conditions will be corrected at the earliest possible moment. And you are hereby notified that after this date there will be no more blasting at dinner hour or during the shift, and an infraction of this order must be promptly reported to the union. A water system will be installed as quickly as possible for dampening the rock before putting in the chute and the workings where needed, and fans installed where most needed. You are requested to report to the union any places which you consider wholly unfit to work, and the union will see to it that such condition is corrected. You are further notified that wherever water is now available to be sure, in interest of your own health as well as that of the rest of your fellow workers, to use it. Careless or indifferent workers failing to do this should be promptly reported to the union or your grievance committee on the job. The workers are admonished in the interest of health, sanitation and common decency to use toilet tanks wherever provided, and where there are none report that fact immediately to the union.

Report to your grievance committee on the job any grievance which may arise and, in case you are unable to settle it, fail not to bring it before your union. Treat the boss in the mine upon that reciprocal basis and relation upon which should most justly rest the traffic between individuals and all mankind. Upon no other. Treat him as every man, who is a man, should treat every other man. Stand up in full dignity of real manhood and do not under any circumstances tolerate in the future, as in the past, from any boss, any bulldozing, brow-beating, bamboozling, or abuse of any kind, and if you receive any such treatment, do not be slow in letting it be known to the grievance committee or the union. If you feel you have been unjustly discharged without warrant or sufficient cause, do not be slow in letting it be known.

And let us all pull and coöperate to build a union, for, by and in the interest of all workers.

The company's rules are that miners will blast two minutes before going off shift, which gives the mine time to clear of smoke before next shift goes to work.

At 1:30 o'clock on the morning of Aug. 30, the employment office of the Anaconda company, located at the Parrot mine, was dynamited and wrecked by unknown parties. This office was established some time ago by the company to carry on the hiring of men in a more efficient manner than had been the practice heretofore; any man who wishes to ask for employment at any of the company's mines must be provided with a "rustling card" which is secured at the employment office, where he has to give his name and a brief account of his previous employment and his fitness for the job applied for. The establishment of this office met with a good deal of objection on the part of the miners and efforts were made at various times to induce the companies to discontinue it. The dynamiting put the office out of commission for the time being. The Anaconda offered $10,000 reward for information leading to arrest and conviction of perpetrators.

Following this event, President McDonald issued a statement denying all rumors that members of the union had a hand in the outrage. He admitted, however, that it was the intention of the union to bring about a cessation of the rustling card system but not "in that way." The act of violence was attributed by the members of the new union of that union. No one was hurt by the explosion.

On the morning of Aug. 30, the jurisdiction committee of the Butte Mine Workers' Union appeared at the Tramway mine, a property of the Anaconda company and warned the day shift before going underground that they should strictly observe the new working rules recently promulgated by the organization. One of the delegates, pointing to the placard said to the men gathered at the top of the shaft: "You are expected to live up to these rules. There is to be no blasting between shifts. Any violation of these rules is to be reported." Thereupon the men were lowered into the mine and work was resumed without interruption or incident.

In view of the possibilities of further disturbances due to the labor situation, 300 citizens organized under military rules and secured the necessary permits to carry arms to protect the homes and business interests in the city of Butte. The organization is entirely separate from the mines and the forces of the mining companies and from Sheriff Driscoll's force of 200 deputies. The cause for the formation of the organization was the reports from authentic sources of the threats being made in certain quarters. Men who were supposed to be I. W. W. agitators speaking on street corners, were reported as urging the looting of stores. Other threats of direct action, of dynamiting and of all kinds of violence emanating from men supposed to be leaders among the miners, added to the feeling that citizens should take measures to protect the city.

The water company and the Montana Power company both made arrangements to protect their properties from any attack that might result in the city being without water or light.

Governor Stewart, in order to be prepared for emergencies assembled at Helena 10 companies of the National Guard of Montana 600 strong, ready to move at any moment to Butte. He also asked President Wilson for Federal troops.

On Aug. 31 the Butte Mine Workers' Union held two meetings at which it was announced that they would proceed with their original program according to which all miners must join the new union and abide by the rules promulgated by that union. A communication was sent to Sheriff Driscoll asking him to deputize 250 members of the union. It was promised and guaranteed that these deputies would preserve order at all times and in all parts of the city. At these meetings many suggestions were made as to what should be done to prevent troops from coming to Butte and what action should be followed if they did come. Business men were asked to sign a petition asking the governor not to send the militia. It is said that 160 signatures were secured. During the meeting President Muckie McDonald predicted that "there will be something doing" if troops came to Butte.

As previously reported in the Journal, martial law was declared the night of Sept. 1 and the National Guard was called to Butte. The establishment of martial law was attacked by union attorneys by means of a petition filed in the U. S. District Court. Attempts to find McDonald and other union officers were unsuccessful according to latest reports available. It is further reported that the militia taking its cue from Europe established a censorship on news.

SALT LAKE CITY—Sept. 3

The Salt Lake Stock & Mining Exchange has continued business in spite of the war, and is said to be the only exchange in the country which has done so. During August, a total of 192,715 shares was traded in, for which there was a market value of $54,930. During July there were 217,254 shares sold, having a market price of $64,188.

TORONTO—Sept. 3

A Novel Plan to Relieve the Unemployed has been adopted by the business men of Edmonton, Alta. The banks and sand-bars of the Saskatchewan River, which runs through Edmonton, contain small amounts of fine gold. Experienced men are showing the uninitiated how to wash out the gold, It is stated that they will be able to make from $1.75 to $2.50 a day and that there is a sufficient area over which gold can be obtained to take care of several thousand men.

The International Nickel Co. has made a big reduction in its output. Crane Hill, Nos. 2 and 3 mines have been closed down completely, while at the Creighton, the big producer, only one shift is being worked and the production is being cut from 40,000 tons per month to less than 30,000. At the smelting plant there are only two furnaces in operation instead of six as formerly and the reverberatory plant has been closed down completely. The company is, however, in a strong position, as the annual report issued a few months ago shows over $3,500,000 cash on hand together with large stocks of supplies and a large amount of matte in transit. The Mond Nickel Co. which has its largest market in England, has not effected any reduction. The International Nickel Co., however, sends a large part of its output to France, Germany and Italy where the market has been almost completely cut off.

The Improved Position of the Silver Market and the willingness of the smelters to accept shipments of high-grade ore together with the action of the banks in advancing cash on bullion, has resulted in much greater activity in the Cobalt district. The Seneca Superior and the Kerr Lake are being reopened and production will be maintained at normal. It is also understood that the Buffalo will shortly resume operations and it is possible that one or two of the other smaller properties such as the Beaver and Temiskaming will again start producing. Final arrangements have not as yet been concluded with the Dominion Government to guarantee the banks in view of their accepting bullion as collateral, but it is believed that this step will shortly be taken. The American Smelting & Refining Company which handles a considerable proportion of the output of the district, is paying in full on the official New York quotations established by Handy & Harmon. A short time ago a large number of men were out of employment in Cobalt, but these have been leaving the camp for other parts and at the present time, there is only a comparatively small labor surplus.

The Mining News

ALASKA

RECENT RECEIPTS at Seattle assay office include $150,000 from Nome and $500,000 from Seward, Valdez, Port Wells, Fairbanks, and other inland points.

SHUSHANNA GOLD FIELDS said to be living up to expectations of early days of discovery. First cleanup this year was made by Fletcher Hamshaw at mouth of Eldorado. From 2700 ft. along bed rock he took out 272 oz. gold with value about $4300. Since discovery estimated there has been practically $180,000 taken from district and prospects for this season are for cleanups totaling $100,000 on Hamshaw claims and fully that much again on Range and Chisholm group of claims. Lack of water this season has been relieved somewhat and camp is running full pressure now and will probably do so for balance of season. District is widening out, reports coming to camp for some time of fairly good prospects in section to north. All creeks in immediate vicinity are being worked. There are good prospects on Dry Gulch and Alder, with a little pay on Big Eldorado, where they are now shoveling in. There is also pay on Nos. 7 and 8 and Nos. 7 and 8 fractions on Bonanza. Carl Whitham has five men working No. 2 Eldorado and expects to take out good pay. Nothing much discovered on Snow Gulch or Coarse Money Creeks. There was small stampede over to Canadian side and some work done on Bryan and Donjek Rivers without any results.

TREADWELL GROUP (Juneau)—Alaska Treadwell milled 81,340 tons in July, producing $115,543 worth of free gold and $111,565 worth of concentrates; Alaska Mexican milled 19,803 tons, producing $17,537 worth of free gold and $20,784 worth of concentrates; Alaska United milled 37,954 tons, producing $40,960 worth of free gold and $34,796 worth of concentrates.

ARIZONA

Pima County

SUIT HAS BEEN FILED in United States District Court at Tucson by John B. Wright of Tucson and James F. Mack of New York, attorneys for James B. Riley and J. Edward Michel, stockholders in Copper Bell Mining Co. of Cochise County against Shannon Copper Co., Leonard Copper Co., Copper Bell Mining Co. and N. L. Amster. Bill in equity alleged that defendants conspired to deprive minority stockholders of interests, and petitions court to be allowed to redeem property under foreclosure of mortgage held by Martin Costello; that Amster and Leonard Copper Co. be required to render accounting of all ores extracted from mines; and that defendants be required to convey their interests in property back to Copper Bell Mining Co.

Pinal County

KELVIN-SULTANA (Kelvin)—On 500-ft. level, No. 1 vein reached at point 135 ft. from station. Drifting begun to west. Last consignment of heavy equipment for mill received but considerable difficulty being experienced in getting it across Gila River which has been high for past month.

Santa Cruz County

MOWRY (Patagonia)—Fire recently destroyed concentrator at old Mowry property and endangered smelting plant near by. Fire caused by lightning; loss, $100,000. Property not in operation for about six years.

Yavapai County

RICH HILL PLACER (Stanton)—Stebbins dry concentrator having capacity of 12 tons per hour installed and 20 men at work under Shumate and Anderson. Gravels from test pits to be tested beginning at point about a mile and a half southwest of Stanton and working towards Weaver Gulch and Octave. Camp established near Stanton.

CALIFORNIA

Amador County

ARGONAUT (Jackson)—Work of erection of new 50-stamp mill expected to begin shortly.

PACIFIC (Plymouth)—First clean-up following 12-day run said to have shown good returns. Company expects to devote attention to milling reserves for present. Large screens used permit larger tonnage of ore to be handled in mill.

HARDENBERG (Jackson)—Survey being made of underground workings. Mine kept pumped out pending further developments. Present ore reserves not sufficient to keep mill running steadily and owners will not prosecute development at present.

KEYSTONE (Amador City)—Development on 2600-ft. level proves encouraging as orebodies appear extensive and good grade. Previous workings extended to 1200-ft. level. Present operators have deepened shaft 1000 ft., installed new machinery and are operating 20 stamps.

ORIGINAL AMADOR (Amador City)—Company has instituted suit to quiet title to valuable property in Amador mining district. Properties involved are Eclipse, Eclipse Extension and Last Chance, covering 18½ acres. Company is in active operation developing these properties.

Butte County

PACIFIC DREDGE on Butte Creek near Chico expected to go into commission in November. Pit completed and hull being constructed.

Calaveras County

ROYAL CONSOLIDATED (Copperopolis)—This mine near Hodson has been sampled by new owners and arrangements made for extensive development. Stamp mill being overhauled and new equipment will be added.

LOCKWOOD (West Point)—Development work past two years shows encouraging results. Shaft deepened to 400 ft. Lane mill installed, gasoline engine furnishes power for mill and hoisting. Expected that cyanide plant will later be added.

Eldorado County

FARMERS along Cosumnes River have lodged protests that gold dredgers at Michigan Bar are making water muddy. Anti-Débris Association will investigate.

RYMAL (Pilot Hill)—Bert Rymal and Will Young, owners, contemplate erection of mill.

LUKENS (Pilot Hill)—Reported that operations will be resumed shortly.

HUNT (Pilot Hill)—Test run of ore will be made to determine advisability of erecting mill.

RUBY CONSOLIDATED (Georgetown)—Work has been resumed following shut-down on account of litigation.

Inyo County

SKIDOO (Skidoo)—Dividend was declared on July 25. Ten-stamp mill in active operation.

CASHIER (Ballarat)—Five-stamp mill being erected.

Kern County

GOOD HOPE (Randsburg)—Reported electric hoist will be installed.

AMERICAN TRONA CORPORATION (Searles)—Reported to Department of the Interior in Washington, D. C., that initial output of potash will be only five tons but plant under construction will probably have capacity of 120 tons per day.

Mendocino County

MANGANESE DEPOSITS near Potter Valley being developed following high prices for ferro-manganese. Several shipments made to Heroult. Deposits reported to be extensive.

Nevada County

ACTION BEGUN by Anti-Débris Association against George Wright, E. F. Banning, the You Bet Mining Co. and others operating in Rough and Ready district, to restrain them from conducting hydraulic mining and dumping tailings in Greenhorn and Steep Hollow Creeks.

BRUNSWICK (Grass Valley)—Reported another dividend will be declared. Development work below 1250 level is encouraging.

UNION HILL (Grass Valley)—Work to be resumed by new owners. Mine kept pumped out during shut-down. Property well equipped with 20-stamp mill and modern hoist and pumps.

COLUMBIA CONSOLIDATED (Nevada City)—Company doing large amount of work developing Meister claims. Has installed 100-hp. Giant air compressor, and has built ¼ mile of flume for water power. Expected 200-ton mill will be completed Nov. 1. It is C. O. Bartlett Co. type, crushing to 20-mesh with outside amalgamation; plate room has 14 sets plates 5x12 ft. Mine opened by adit giving 1200 ft. of backs.

Placer County

PROSPECTING of land along Bear River being carried on by Nevada capitalists who expect to erect gold dredge if conditions warrant.

MAGNESITE CLAIMS of Johnson and Sullivan near Towle being examined by New York interests with view to their purchase. Claims are extensive.

BANNER (Auburn)—Property being examined with view of resuming operations in near future.

CARDELLA DREDGE (Newcastle)—Materials for new dredge to be erected in Gold Hill district, are arriving. Machinery will be taken from dismantled boat at Oroville.

PLUMAS BONANZA (Quincy)—Fifteen stamps are to be added to present mill. Development work being pushed on new shaft.

ARCADIA (Greenville)—Property has been bonded by English syndicate which will begin active operations. New shaft will be sunk.

SENECA CONSOLIDATED (Seneca)—Milling operations expected to commence shortly. Property has been in litigation, recently settled by compromise. Twenty-five men are now employed.

San Bernardino County

GOLD MOUNTAIN (Victorville)—Cyanide process being used with good results.

GALLAGHER (Johannesburg)—Placer machine being installed by A. B. Call and W. R. Flint.

Shasta County

LAST CHANCE (Ingot)—Arrastre being erected by George Gilmer to treat large dump.

AMERICAN (French Guich)—Property bonded by James and Harvey Sallee who are installing equipment to begin development work.

NOBLE ELECTRIC STEEL CO. (Heroult)—Reported company will start up two furnaces to handle manganese ore. Prevailing high prices for ferro-manganese should make it profitable venture.

MIDAS (Knob)—Operations resumed by new owners. Mine has been closed since underground fire in April. Tramway has been built to connect Midas workings with mill on Victor property. Treatment of impounded tailings by cyanide process will continue.

Sierra County

BALD MOUNTAIN (Forest City)—Vertical shaft will be sunk by new owners to tap gravel deposits formeriy worked from tunnel.

TIGHTNER (Allegheny)—Reports that property had been closed down owing to European war, entirely erroneous. Large force employed and vigorous policy of development being prosecuted. Contracts made for 60,000 running feet round timbers for underground work. Mill running full time.

Trinity County

HEADLIGHT (Carrville)—Development work continues large tonnage ore being blocked out. Expected mill will be remodeled. Company attempting to develop process to treat ores so as not to conflict with Forest Service regulations.

GLOBE CONSOLIDATED (Junction City)—Twenty-stamp mill treating 120 tons daily with good extraction. New tunnel to tap orebodies 600 ft. below present workings, being pushed. New development shows orebodies to be extensive.

Tulare County

TULARE MINING CO. (Porterville)—Shipments of magnesite resumed following increased demand due to European war. Machinery being installed to produce epsom salts from material previously thrown away. Sixty-five men are employed.

Tuolumne County

MOHICAN (Jamestown)—Reported 3-ft. vein of good milling ore discovered.

TULLOCH (Columbia)—Mine is being reopened, reported milling will be resumed.

SANTA YSABEL (Sonora)—Mine being pumped out preliminary to an examination.

FOREST FIRES near Sonora burned bunk house and blacksmith shop at Vaiparaiso mine and house and blacksmith shop at Lawson mine. Hard fight saved surface improvements at Horse Shoe Bend mine. Crew from Springfield mine rendered valuable assistance in fighting flames.

COLORADO

Clear Creek County

ARGO MILL (Idaho Springs)—Having laid in good supply of cyanide, mill will not be in danger of shutdown from effects of European war and has assured supply of ore to keep going at rate of 65 tons per day indefinitely.

BIG FIVE TUNNEL (Idaho Springs)—Company is driving toward old shaft of Dove's Nest mine on Seaton Mountain which was big producer of galena-silver ore 25 years ago and closed down because of litigation with Comstock mine over convergence of two veins. Crosscut has 2500 ft. still to go. Klein and Williams, lessees, are shipping three carloads per week of $25 ore from newly developed ground in the East Bellman vein above the tunnel. Slate & Co. are sinking winze to work same oreshoot from lower level. Edgar that was formerly large producer as individual shaft mine is under new lease to Al Friedman, et al. who have opened shoot of good ore. Ranson, Thurston & Quaintance lease is taking ore from Lake vein.

Lake County

ROCKEFELLER TUNNEL (Leadville)—Work in this Evans Gulch property is going ahead. About 200 ft. more crosscutting will reach objective vein.

LOUISVILLE (Leadville)—Manager Ed. A. Hanafen utilized recent shutdown to make repairs to pumps and compressor; mine has resumed its normal activity and will so continue if silver maintains present prices.

DAMASCUS MILL (Leadville)—William J. Candlish has acquired this old mill in lower end of city and remodeled it to treat custom ores by a scheme of his own that is automatic in handling materials from the crude to finished products. Flow-sheet includes: Receiving bins; fine grizzlies; oversize to crusher and rolls; all to cyiindrical drier; air-chamber, blast sizing, oversize going to fine crusher and Kent mill. Dry pulverized ore is next drawn through pipes by suction into air-tight box with four lower compartments or bins into which minerals of differing specific gravities will separate, finest siliceous dust being partially exhausted and delivered to waste in this step. Bottom of each bin delivers into pipe that conveys the air-separated products to new type dry jig. Jig products are carried by pipes to storage bins for shipment, while waste is taken on belt conveyor to dump. Mill is intended to handle 100 tons complex suiphides per day.

Routt County

ROYAL FLUSH (Columbine)—Large party of Wisconsin officers and stockholders of Hahn's Peak G. M. & M. Co. attended recent annual meeting. Management reported that development and construction has continued without interruption the past year and that good shoot has been developed. After few minor changes in mill, it will be put into service.

San Juan County

PRIDE OF THE WEST (Silverton)—John Giono, et al., have pushed their lease until they are now shipping rich ore to smelting piant.

SILVER LEDGE (Silverton)—Lessees Matties and Bonavida have finally unwatered and cleaned up this old mine at Chattanooga and are extracting ore. Expect to run continuously through coming winter.

San Miguel County

MOUNTAIN FLOWER (Telluride)—J. E. Souter has taken contract to push Delta adit and has installed gasoline rock drill. Small water-driven motor will provide fan ventilation.

MINNESOTA

NEW YORK STEEL CO.—At Duluth, Aug. 20, Federal court entered decree of foreclosure on all Minnesota assets of this company. Company formerly leased Roberts, Kellogg, Larkin and Knox mines, on Mesabi range; these allowed to revert to fee owners through nonpayment of annual minimum royalties for several years past. Company's assets consist mainiy of mining machinery and equipment, together with some reaity holdings in Mesabi range towns. New York properties of this company were soid for $770,000.

Cuyuna Range

CUYUNA RANGE POWER CO. (Brainerd)—Company, which supplies power to practically all mining operations on Cuyuna range, will add another unit to power plant, at dam on Crow Wing River near Brainerd, increasing capacity from 2000 to 3000 hp.

E. J. LONGYEAR CO. (Brainerd)—Explorations on Crow Wing County poor-farm have met with but fair results. Five holes have been drilled of the nine required by option agreement. Depth of surface of 240 ft. at this point would necessitate substantial showing of merchantable iron ore, and unless subsequent holes show great improvement property will no doubt be dropped, and Crow Wing County will be without county-owned iron mine so widely advertised.

Mesabi Range

HIBBING—Assessed valuation of this village (population 8832) fixed at approximately $80,000,000. Of this amount $79,000,000 is represented by unmined iron ore within village limits.

ADAMS (Eveleth)—Blasting in this openpit caused considerable damage to neighboring residences. Oliver company plans to remove nine such dwellings off property to Leonidas location.

INTERSTATE IRON CO. (Grand Rapids)—Dredge stripping operations started here last season discontinued, having been found not feasibie for several reasons. Dredge dismantled.

GRAHAM (Aurora)—This property of Oliver company closed for season. Much development work was done this season underground; it is planned later to operate by openpit methods as well as underground.

SHIRAS (Hibbing)—This new property of Oliver company is hoisting first ore, and will ship probably 5000 tons this season. Was formerly known as Wanless No. 2, located in the Buhl district, an underground mine. Fee is owned by State of Minnesota.

LENOX (Calumet)—Actual stripping operations start d by A. E. Guthrie Contracting Co. on this work, which is one of largest stripping contracts ever let on the Mesabi range, requiring upwards of two years to complete. Marion shovel in use is largest on range.

DUNWOODY (Chisholm)—G. N. Ry. completing trackage for this new pit of Arthur Iron Mining Co. Winston-Dear Co., stripping contractors, have been at work on job since June, 1912, and will finish before next year. Pit is 90 ft. deep. When completed will be one of big producers of the Mesabi range. Numerous buildings, inciuding 18 dwellings, in course of erection.

Vermilion Range

SIBLEY (Ely)—New dry house, just completed, is one of most modern on iron ranges, containing 80 shower baths, four drinking fountains, toilets, laundry tubs, all of most approved type.

MONTANA

Silver Bow County

MOONLIGHT MINE—This Anaconda property shut down morning Aug. 27, when shaft of main engine broke, putting it out of commission. Repairs started at once but no prediction as to how much time work will require and how soon mine will resume. About 300 men are employed.

NEVADA

Esmeralda County

SANDSTORM-KENDALL (Goldfield)—An 18-in. shoot of ore, said to assay $32, struck on 350-ft. level. Shoot is downward extension of that on 200-ft. level.

Humboldt County

NEVADA SHORT LINE R.R. (Rochester)—Grading completed to mill site at lower Rochester and track laying will commence at once. Mill will be connected with mines by two-mile aërial tramway.

CODD LEASE (Rochester)—Development work being done on new vein opened by crosscut on 350-ft. level, and oreshoot of shipping grade opened. Large tonnage of milling-grade ore is also developed.

Lincoln County

DAY-BRISTOL (Pioche)—Application for hearing to show cause why there should not be receiver's sale made by one of principal creditors of company. Debts total $90,000, it is stated. Sept. 9 set for preliminary hearing. Hoped that mines may be operated again.

Lyon County

NEVADA-DOUGLAS (Ludwig)—Some machinery for new leaching plant is arriving. Railroad spur finished and grading for ore bins started.

Mineral County

CONDITIONS AT RAWHIDE are good. Nevada New Mines Co. is operating 10-stamp mill steadily. Mine developed to 600-ft. level and good-grade ore being stoped on this level. Black Eagle Co. is also operating. Stated that 500 men are employed in district.

THE WAGNER-AZURITE (Luning)—Leaching plant completed. Trial runs proved success of process on Luning ores. Company experienced delays and trouble by breaking of filters, pumps, etc., which interfered with steady operations. These defects being remedied and plant will be running at full capacity soon.

Nye County

VICTOR (Tonopah)—North Merger vein was drilled into on 1550-ft. level, causing tremendous flow of water which flooded shaft; water rising 380 ft. All pumps and bailers are at work and 400,000 gal. water per day being lifted. Work in Merger mine had to be suspended and also in Midway, which buys air from Merger. No loss of life suffered.

White Pine County

GOLD STRIKE IN BULL CAÑON, north of Blain reported. Narrow shoot shows free gold.

NEW MEXICO

Dona Ana County

MORMAN MINE AND MILL (Organ)—Property under lease and bond to L. B. Bentley who contemplates sinking shaft 200-ft. deeper. If development work shows good value ore, mill will be repaired and operated. C. M. Lerchen has lease and bond on Sunol group, same vein with Morman mine.

TURGITE MINING CO. (Las Cruces)—Judgment was rendered defendant in civil suit of Robert Railey vs. The Turgite Mining Co., involving title to iron mines situated in Picacho Mountains owned by El Paso, Tex. men. Title contested by plaintiff on grounds that property had been located as placer ground instead of as lode claim. Evidence showed deposits of iron consisted of surface deposition, marine origin, lying horizontally in form and character similar to Lake Superior regions. Ore is principally hematite containing various hydrous oxides. Over 1,000,000 tons high-grade ore said to be exposed. Sulphur and prosphorus low; 480 acres in group.

Grant County

SILVER CELL MINE (Pinos Altos)—Stoping in drift from 135-ft. level of main shaft disclosed silver ore of high value on Sept. 5. Believed main orebody, lost years ago through fault, has been encountered.

CARLISLE MINES (Steeple Rock, via Duncan, Ariz.)—Jim Crow shaft has retimbered and unwatering is now under way. G. H. Utter purchased large consignment of machinery for all mines of group. Over 25 men employed in preparation for extensive work.

SILVER HILL MINE (Pinos Altos)—Property taken over by G. St. Clair Douglas and associates. Property is extension of Langston lode and is promising. Ore contains zinc, lead, gold and silver. Operators plan to install harz concentrators and construct aerial tramway to railroad at Silver City, nine miles distant.

CHINO COPPER CO. (Santa Rita)—No variation in production which was reduced to 50% usual out-put. Some employees discharged when reduction was effected given employment by government at Elephant Butte Dam; on Santa Fe railroad construction work, and in sugar beet fields in Colorado.

MOUNTAIN HOME GROUP (Hanover)—Shipment of silver-lead ore made from newly discovered deposit. Development work continues. Property under consideration of purchase by large syndicate. Thousands of tons, low-grade carbonate zinc ore blocked out in mine. Claims developed by adits and stopes.

Socorro County

ERNESTINE MINING CO. (Mogollon)—Maude S. mill destroyed Sunday, Aug. 23, when tailings dump of Little Fannie mine gave way and slid upon mill. Undermining of recent floods said to have been cause. Watchman killed.

SOUTH DAKOTA

Lawrence County

MONARCH (Deadwood)—P. N. Hanson and associates, who leased block of this ground on Two Bit Creek, are meeting with gratifying results. Two feet of ore is being mined from which shipping grade of $50 per ton is expected to be maintained. Ore shows some free gold, which is rare in shales.

HEIDELBERG (Deadwood)—Shaft work instituted in main adit indicates existence of additional strata of ore below present workings. At depth of 5 ft. a 3-ft. body was encountered, said to assay $30 per ton.

ORO HONDO (Deadwood)—Shaft work resumed, after installation of auxiliary hoist on 1000-ft. level. Hoisting engine on surface will handle rock excavated in shaft and raised to 1000-ft. point by this auxiliary. Pumps will not be used except in emergency, as Manager Talbert will use skips to hoist water from 1000-ft. level. Below this point little water encountered in shaft.

BRANCH MINT (Galena)—By placing on court calendar of number of suits in which J. D. Hardin is plaintiff, and affecting title to this property, legal controversy which delayed operations for some years, is resumed. Hardin, among other claims, protests he has prior lien against property for over $500,000, and seeks to be given title. In former litigation courts decided this lien was secondary to other claims against property.

HOMESTAKE (Lead)—With gathering of audience said to be largest ever attending dramatic performance in Lead, Homestake opera house, in "Recreation" building was opened to public Aug. 31. Before opening of evening performance Superintendent Grier made brief address in which he said it gave him pleasure, on behalf of Homestake company, to turn over to employees of company that splendid building which was to be theirs to use for amusement and recreation, free with exception of theater portion. He said invitation to use building was extended, not only to good people of Lead, not employees of Homestake company, but to people of Lawrence County. Maximum scale of prices for theatrical attractions has been fixed at $1, 75c., 50c. and 25c. On nights when not otherwise used moving pictures will be shown, for which price of admission will be 5c. Theater seats 1000 people, and is fully equipped in every particular, with an especially good ventilating system. Management of theater and building has been put in charge of M. C. Kellogg.

UTAH

Juab County

KNIGHT-CHRISTENSEN MILL (Silver City)—Ore from Dragon Consolidated and Iron Blossom is being treated.

LOWER MAMMOTH (Mammoth)—Five sets of lessees are working on zinc ore between 1500- and 1800-ft. levels. Work on company account being done on 1000-ft. level.

CHIEF CONSOLIDATED (Eureka)—Grade is nearly finished for side track or spur to property. Zinc ore recently opened,—occurring as casing, or below silver-lead ore.

UNCLE SAM (Eureka)—Lessees are working hand jigging plants, treating silver-lead ore. Two cars of ore and jig concentrates were shipped week ended Aug. 28.

EAGLE & BLUE BELL (Eureka)—Preparations made for sinking shaft from 1550 to 1700-ft. level. Work on this will soon be started. Fifteen cars of ore were shipped the week ended Aug. 28.

DRAGON CONSOLIDATED (Silver City)—Flow of water of 60-80 gal. per min. encountered on 1000 level, where development is being done. This will not interfere with output. Two cars of ore were shipped week ended Aug. 28.

MAY DAY (Eureka)—Shipments from silver-lead orebody above tunnel level have been resumed. Work started on 300-, 400-, and 500-ft. levels, on zinc ore, which can be mined at profit at present price of spelter. This material as shipped runs about 35% zinc. Lessees also working on zinc ore at some points, and may install jigs. There is much ore exposed, which carries about 18 to 20% zinc, and effort may be made to raise zinc content by jigging.

Summit County

SNAKE CREEK TUNNEL (Park City)—Twelve to sixteen feet daily being made in driving. Face is under Bonanza Flat, and ground is dry, rock breaking easily.

Park City Mills (Park City)—Company which is remodeling old Grasselli zinc mill for chloridizing process, is installing roaster of Christensen type, similar to that used at Knight-Christensen mill in Tintic.

MINES OPERATING (Park City)—Another shipment of bullion made, containing 14,000 to 15,000 oz. silver. This is result of cleanup from operations early in August. Last previous shipment made Jul. 15. Company treating low-grade ores and stope filling from Ontario.

DALY-JUDGE (Park City)—Mill machinery being overhauled and repairs made in timbering shaft from collar to 200 level. Flotation process for mill being considered. Development being done in mine in number of places. Shipments will probably be resumed in near future. Under normal conditions 250 men are employed in mine and mill at present.

SILVER KING CONSOLIDATED (Park City)—Extensive development recently done in ore between 1500- and 1700-ft. levels. Steady shipments being made from material taken out in devlopment. A cable received from General Manager Solon Spiro said he had reached London, and would catch first available steamer for home. Mr. and Mrs. Spiro were travelling in Germany at time of outbreak of war. Net smelter returns on 200 tons shipped recently better than $40 per ton.

WASHINGTON

Okanogan County

PEACOCK MOUNTAIN (Conconully)—Contract awarded for the construction of dam, ditch and flume at this mine. Three-drill compressor will also be installed.

CANADA

Ontario

LA BINE CLAIMS in Sesekinika near Kirkland Lake, optioned to Hamilton-Erlich & Co. of London.

KERN LAKE (Cobalt)—Operations will be resumed Sept. 17, with a force sufficient to maintain production at old level.

VIPOND (Schumacher)—Remodeled mill with cyanide plant addition with capacity of 150 tons per day started up Aug. 31.

SENECA SUPERIOR (Cobalt)—Mine has begun working operations on more extensive scale keeping about 70 men employed on double shifts.

DOME LAKE (Porcupine)—Development work at 180- and 300-ft. level said to show satisfactory results and mill being overhauled in preparation for starting operations in October.

BUFFALO (Cobalt)—July report states underground mining will be continued for present and reclaiming of mercury from residues will be done at high-grade plant, concentrating mill being closed down until conditions improve.

FOSTER (Cobalt)—At this mine now being worked under lease by Glen Lake Co., drifting is being undertaken on 200-ft. level with intention of getting under lake where there is a deep conglomerate formation.

TOUGH OAKES (Kirkland Lake)—Mine making effort to produce as much high-grade ore as possible. In addition to favorable prices being paid for this ore, it is believed that company needs money to carry on operations, as funds in England are not at present available.

The Market Report

METAL MARKETS

NEW YORK—Sept. 9

All of the markets have been dull during the last week.

Copper, Tin, Lead and Zinc

Copper—The situation remains unchanged. Some copper continues to go abroad on old contracts and on consignment. No demand, except for relatively trifling quantities, has yet developed from domestic manufacturers.

Base price of sheet c pper has been reduced ½c. and is now 17½c. per lb. for hot rolled and 18½c. for cold rolled. The change dates from Sept. 1. The usual extras are charged, and higher prices for small quantities.

In a recent interview, Dr. W. H. Nichols, of the Nichols Copper Co., said with regard to the copper market, "that the situation was quite remarkable, and that the producers had for the first time in their history been unanimous in showing a large amount of common sense. All copper mines had reduced production by 50% or even more, and the refineries had, of course, followed suit, the Nichols Copper Co.'s plant being run at present at about 50% of its capacity. As approximately one-half of the copper produced has heretofore gone abroad, this curtailment should make it possible to provide for all of the local requir ments, so that when the war is over the metal should be in a good and strong position."

Tin—There have been more arrivals and supplies have consequently become more liberal, but the market has been very quiet and quotations are nominal.

Visible stocks f tin, Aug. 31, are reported as follows, including tin afloat: London, Straits and Australia, 3835; other kinds, 3188; afloat, 3460; London, total, 10,483; Holland, 167; United Stat s, excluding Pacific ports, 3802; total, 14,452 long tons, an increas. of 285 tons during August.

Messrs. Rob rts n & Bense report receipts of tin ore and concentrates at Hamburg, Germany, in July at 2058 tons from Bolivia and 10 tons from German Southwest Afri a; 2068 tons in all.

Lead—This market has been uninteresting, but weaker in view of some renewed pressure to sell, all faith in an advance on account of the war having been lost. However, th re have been some sales for export. The Cœur d'Alene mines are maintaining their production and supplies from all q art rs s m to be large. The A. S. & R. Co. maintains its previous price of 3.90c., New York, but there have been sellers at 3.85c. and less than that has been accepted.

Spelter—Demand has petered out almost entirely. Indeed, there has b n no domestic demand of consequence since early in August, while during the last fortnight the demand from abroad has been absent. Pr ducers' sales during the last week have been very light and quotations are based chiefly on the offers they have made to consumers. These have been at reduced prices from day to day, without there being, however, any pressure to sell.

By a clerical error the August spelter average was given last week as 5.412c., St. Louis, instead of 5.418c.

Other Metals

Bismuth—On Aug. 17, the International Bismuth Syndicate raised the price of bismuth from 7s. 6d. per lb. to 10s. The American price is now $2.85@3.

Antimony—It is difficult to quote this market, as there is practically no busin ss b ing done. Dealers are asking 12½c. for Cooksons, 12c. for Halletts, and 10½c. for outside brands.

Aluminum—The market is still quiet, with prices at 20@20½c. per lb.

Quicksilver—The market has not changed materially since last week. Quotations are still $75@85 per 75-lb. flask, New York.

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

Gold, Silver and Platinum

Gold output of Rhodesia, seven months ended July 31, was $8,158,966 in 1913, and $9,890,678 in 1914; increase, $1,731,712, or 21.2%, this year.

Imports of gold into France five months ended May 31 were 286,551,000 fr.; exports, 47,013,000 fr.; net imports, 239,538,000 fr., being 109,638,000 fr. morethan last year.

Platinum—There is no changes in prices. We quote $50 for refined, and $57.50 per oz. for hard metal.

Silver—Although there is still no business in silver between the Far East and London, prices advanced during the last week. The shipments going forward from the United States to London are being absorbed, presumably for Continental coinage. There is still difficulty in doing business between New York and London, because of delays in cables, of cancelled sailings, and the uncertainties of foreign exchange. Nevertheless, insurance rates have dropped markedly, and the situation has cleared up somewhat.

London prices are Sept. 3, 24d.; Sept. 4, 24d.; Sept. 5, 24¼d.; Sept. 7, 24¼d.; Sept. 8, 24⅛d.; Sept. 9, 24⅛d.

Shipments of silver from London to the East, Jan. 1 to Aug. 27, as reported by Messrs. Pixley & Abell:

	1913	1914	Changes
India	£4,705,500	£4,464,500	D. £241,000
China	562,000	42,000	D. 520,000
Total	£5,267,500	£4,506,500	D. £761,000

Exports to India have been very light, as for two or three weeks past.

Imports of silver into France five months ended May 31 were 82,989,000 fr.; exports, 112,773,000 fr.; excess of exports, 29,784,000 fr., an increase of 15,481,000 fr. over last year.

Zinc and Lead Ore Markets

JOPLIN, MO.—Sept. 5

Lead, high, $47.60; base, $46 per ton of 80% metal contents; average all grades, $44.40 per ton. Sellers readily accepted the decline and ore was on the market in midweek;

Blende prices declined from $1 to $2 per ton, high price $51; assay base, $46@48; metal base, $44@46 per ton, 60% zinc; calamine base, $25@27 per ton, 40% zinc; average all grades zinc, $44.22 per ton.

DAILY PRICES OF METALS

NEW YORK

Aug. Sept.	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc	
			Electrolytic, Cts. per Lb.	Cts. per Lb.	New York, Cts. per Lb.	St. Louis Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.
3	*	53½	*	†36½	3.85 @3.90	3.70 @3.75	5.75 @5.85	5.60 @5.70
4	*	53½	*	†36	3.80 @3.90	3.65 @3.75	5.70 @5.80	5.55 @5.65
5	*	53½	*	†35½	3.80 @3.90	3.65 @3.75	5.70 @5.80	5.55 @5.65
7	.....	...		...	.....	.....	.....	.....
8	*	54¼	*	†34	3.80 @3.90	3.65 @3.75	5.70 @5.75	5.55 @5.60
9	*	54¼	*	†33½	3.80 @3.90	3.65 @3.75	5.65 @5.70	5.50 @5.55

*No quotations. †Nominal.

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.

Some current freight rates on metals per 100 lb., are: St. Louis-New York, 15½c.; St. Louis-Chicago, 6c.; St. Louis-Pittsburgh, 12½c.; Chicago-Baltimore, 10½c.; Chicago-New York, 13½c.

COPPER SMELTERS' REPORT

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.

	March	April	May	June	July
Alaska shipments.	2,069,960	1,279,537	585,387	1,114,758	2,879,396
Anaconda.....	23,800,000	22,900,000	23,500,000	23,800,000	.....
Arizona, Ltd.....	3,286,000	3,570,000	3,092,000	3,742,000	3,300,000
Copper Queen....	7,637,042	7,562,723	8,388,203	7,613,719	7,817,318
Calumet & Ariz..	5,875,000	5,450,000	5,495,000	4,630,000	5,940,000
Chino.....	5,399,814	5,926,591	5,496,875	5,486,419	.....
Detroit.....	1,973,725	1,790,926	2,105,034	2,129,100	1,966,526
East Butte.....	1,546,180	1,178,000	1,179,762	1,215,323	.....
Giroux.....	287,980	45,948	429,553	425,000	.....
Mason Valley....	1,250,000	862,000	916,000	950.000	.....
Mammoth.....	1,800,000	1,850,000	1,750,000	1,725,000	1,950,000
Nevada Con.....	5,218,257	4,880,043	4,959,589	4,483,175	.....
Ohio.....	597,520	610,518	625,000	605,000	.....
Old Dominion....	2,997,000	2,779,000	3,302,000	2,937,000	2,962,000
Ray.....	6,036,908	6,089,362	6,300,847	5,941,567	.....
Shannon.....	1,082,000	1,012,000	1,056,000	1,049,227	1,084,000
South Utah.....	406,381	247,641	55,394	62,990	.....
Tennessee.....	1,262,184	1,370,800	1,336,950	.....	.....
United Verde*...	3,100,000	3,000,000	3,100,000	2,900,000	.....
Utah Copper Co.	12,323,493	12,739,757	13,208,483	12,870,063	.....
Lake Superior*....	11,000,000	13,000,000	12,500,000	16,000,000	.....
Non-rep. mines*..	8,200,000	8,000,000	8,200,000	8,000,000	.....
Scrap, etc.....	2,500,000	2,500,000	2,500,000	2,500,000	.....
Total prod.....	109,649,444	108,644,846	110,082,077	.....	.....
Imp., bars, etc...	22,676,605	17,043,191	19,081,487	23,885,521	.....
Total blister...	132,326,049	125,688,037	129,163,564	.....	.....
Imp. ore & matte.	7,029,646	10,400,122	10,586,506	9,157,540	.....
Total Amer....	139,355,695	136,088,159	139,750,070	.....	.....
Arrivals–Europe†	17,572,800	17,299,520	13,558,720	19,040,000	.....

† Does not include the arrivals from the United States.

there was no attempt to hold for week-end prices, as buyers, tormented the past two weeks with late sales, had announced that the price would be made on Thursday and no later price would be made. In support of this stand, few buyers bought any ore after Thursday.

SHIPMENTS WEEK ENDED SEPT. 5

	Blende	Calamine	Lead	Value
Totals this week.	8,586,560	708,920	1,600,640	$242,070
Totals this year..	363,715,330	27,242,380	61,941,390	9,176,160

Blende value, the week, $195,990; 36 weeks, $7,089,740.
Calamine value, the week, $9570; 36 weeks, $314,700.
Lead value, the week, $36,510; 36 weeks, $1,471,520.

IRON TRADE REVIEW

NEW YORK—Sept. 9

The promised activity in the iron trade has not yet materialized, and it seems doubtful whether over 60% of the steel-making capacity of the country is employed. Unfortunately the outlook is for a still further shrinkage during the current month. Fears of ferromanganese shortage are no longer entertained, as it is understood several cargoes intended for Germany have been diverted to American ports.

The Carnegie Steel Co.'s new schedule, dated Aug. 5, gives prices per ton of 2240 lb. for domestic manganese ore delivered at Pittsburgh or Etna, Penn., or at South Chicago, Ill., as follows: 49% metallic manganese, 26c. per unit; 46 to 49%, 25c.; 43 to 46%, 24c.; 40 to 43% manganese, 23c. per unit. This is an advance of 1c. per unit over the old list.

Assessments

Company	Delinq.	Sale	Amt.
Alameda, Ida.....	Sept. 5	Sept. 29	$0.005
Alta, Nev.....	Sept. 10	Sept. 28	0.03
Andes, Nev. (post.).....	Aug. 28	Sept. 18	0.03
Aurora-Sampson, Ida. (post).....	July 18	Sept. 18	0.002
Best & Belcher, Nev.....	Sept. 15	Oct. 6	0.05
Big Elk, Ida.....	Aug. 25	Sept. 25	0.001
Black Bear, Ida.....	Sept. 1	Oct. 1	0.01
Blue Star, Ida.....	July 28	Sept. 25	0.03
Cedar Creek, Ida.....	Sept. 10	Oct. 10	0.003
Cons. Imperial, Nev. (post.).....	Aug. 27	Sept. 18	0.01
Con. Virginia, Nev.....	Sept. 3	Sept. 24	0.10
Columbine, Colo.....	Sept. 15	Oct. 20	0.02
Eagle Mountain, Ida.....	Aug. 22	Sept. 22	0.001
Davis-Daly, Mont.....	Oct. 15	.....	0.25
Emerald, Utah.....	Sept. 15	Oct. 10	0.0033
Great Western, Nev. (post).....	Aug. 25	Sept. 15	0.01
Huron, Mich. (Iron).....	.....	.....	3%
Hypotheek, Ida.....	Aug. 17	Sept. 15	0.01
Idaho & Los Angeles, Ida.....	Sept. 7	Sept. 25	0.005
Idaho-Nevada, Ida.....	Sept. 7	Oct. 1	0.001
Lehi Tintic Utah.....	Aug. 12	Sept. 17	0.0025
Lucky Calumet, Ida.....	Aug. 21	Sept. 21	0.005
Monarch-Pittsburgh, Nev. (post.).....	Sept. 14	Sept. 21	0.01
North Star, Ida.....	Aug. 8	Sept. 10	0.0015
Ophir, Nev. (post.).....	Aug. 31	Sept. 24	0.10
Oreano, Ida. (post.).....	July 24	Sept. 25	0.002
Plutus, Utah.....	Aug. 28	Sept. 15	0.002
Royal Copper, Ida.....	Sept. 3	Oct. 3	0.001
Sierra Nevada, Nev. (post.).....	Aug. 28	Sept. 18	0.10
Utah Metal, Utah.....	.....	Oct. 1	0.05

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	58.175	28.038	27.825	26.704
June.....	61.290	58.990	56.471	28.215	27.199	25.948
July.....	60.654	58.721	54.678	27.919	27.074	25.219
August....	61.606	59.293	54.344	28.375	27.335	25.979
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			
	Electrolytic		Standard		Best Selected	
	1913	1914	1913	1914	1913	1914
January...	16.488	14.223	71.741	64.304	77.750	69.488
February..	14.971	14.491	65.519	65.259	71.575	70.188
March.....	14.713	14.131	65.329	64.276	70.658	69.170
April.....	15.291	14.211	68.111	64.747	74.273	69.313
May.....	15.436	13.996	68.807	63.182	74.774	67.786
June.....	14.672	13.603	67.140	61.336	70.821	66.274
July.....	14.190	13.223	64.166	60.540	69.446	64.955
August....	15.400	.....	69.200	.....	74.313	.....
September	16.328	.....	73.125	.....	78.614	.....
October...	16.337	.....	73.383	.....	79.250	.....
November.	15.182	.....	68.275	.....	73.825	.....
December .	14.224	.....	65.223	.....	69.583	.....
Year....	15.269	.....	68.335	.....	73.740	.....

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

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	33.360	224.143	150.702
June.....	44.820	30.577	207.208	138.321
July.....	40.260	31.707	183.511	142.517
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	3.900	4.226	3.808	18.923	18.503
June.....	4.325	3.900	4.190	3.810	20.226	19.411
July.....	4.353	3.891	4.223	3.738	20.038	19.051
August....	4.624	3.875	4.550	3.715	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	5.074	5.256	4.924	24.583	21.393
June.....	5.124	5.000	4.974	4.850	22.143	21.345
July.....	5.278	4.920	5.128	4.770	20.592	21.568
August....	5.658	5.568	5.508	5.418	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	$13.23	$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	14.90	15.80	13.90	15.40	14.23
June.....	17.14	14.90	15.40	13.90	15.10	13.97
July.....	16.31	14.90	15.13	13.90	14.74	13.96
August....	16.63	14.90	15.00	13.90	14.88	14.09
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	.....